annual report
2009/10

CSIR

our future through science

contents

chairman's overview

I am pleased to report that the CSIR has exceeded most of its targets despite the global economic crisis and has achieved a solid overall performance.

An international review endorsed the organisation's demonstrated commitment to human capital development, the strengthening of the science base and its good business practices. It, however, called for more attention to be given to planning for impact and the subsequent communication thereof. Discussions centred on the impact made on industry and broader society as well as how the complexity of a multidisciplinary organisation might be portrayed in a more focused manner with more clearly defined boundaries.

In response to the review, efforts towards a renewed focus on national areas of impact have seen six research impact areas – health, natural environment, energy, the built environment, defence and security, and industry – identified with a number of supporting technologies.

It is for this reason that I am particularly satisfied with the streamlined research focus of the CSIR. Closer alignment of its expertise to issues of current and future national importance bodes well for the country as a whole.

The CSIR's multidisciplinary nature enables it to develop creative solutions by drawing from the diverse skills needed to meet these challenges and effect the impact it seeks, and which is embedded within its mandate: to make a difference in the economy, environment, society and the quality of life of people through the implementation and exploitation of knowledge and solutions resulting from R&D activity.

The organisation is a major contributor to the country's knowledge economy, it contributes know-how to the development and implementation of national strategies and policies; transfers technologies and knowledge to industry and society; and responds to national priorities – areas that directly affect the wellbeing of our people. In this regard, the CSIR will need to communicate its contribution more clearly to all stakeholders, but particularly to the public at large.

Scientific and technological development aimed at serving South Africans cannot happen in a vacuum. The organisation works locally and internationally with a number of government departments, higher education institutions and science councils; as well as with private sector stakeholders. I look forward to seeing the CSIR's improved research focus and better defined boundaries finding expression in the organisation's collaborations, thereby increasing its impact.

A key collaborator, and also main stakeholder, is the Department of Science and Technology. On behalf of the Board and the CSIR, I would like to thank the Minister of Science and Technology, Mrs Naledi Pandor, and her department for their continued support.

An exemplary and uncompromising governance system is the key to an effective and credible organisation. I congratulate the CSIR's management on its performance in this regard. Continuous pursuit of excellence aligned with ethical values and regulatory requirements will stand the CSIR in good stead far into the future.

In the near future, the CSIR looks forward to working with the relatively new innovation enabler, the Technology Innovation Agency, especially on strategic projects that address social needs in health, energy, and ICT, but also other priorities such as industry development. It is with anticipation that we await a new entry in the South African science and technology arena: the South African National Space Agency. The CSIR is actively involved in the establishment of the agency.

I wish to congratulate the CSIR on its solid performance and its proven high standards in corporate governance. I thank the members of the Board for their valuable contributions. A special word of thanks to the management and staff of the CSIR for their commitment to make this organisation one that counts.

Professor Francis Petersen

ceo's introduction

As the following pages will show, the CSIR has again demonstrated its agility and determination to respond to the country's needs – and a changing economic climate – without losing sight of its mandate: making a positive difference in people's lives through industrial and scientific development.

During an international review in 2009, the institutional panel complimented us on the progress made since the organisational reconfiguration in 2005, particularly in terms of strengthening our science base, while maintaining good business practices and high-quality management processes.

The review also recommended that we improve our research focus and be clearer on the impact of our good work.

Improved research focus

Impact is at the core of our mandate. In improving our research focus and ensuring that it achieves maximum impact in industry and society, the organisation has identified six research impact areas:

- Health, with the aim of the improving health care delivery and addressing the burden of disease
- Natural environment, with an emphasis on protecting our environment and natural resources
- Energy, with the focus on alternative and renewable energy
- Built environment, with a focus on improved infrastructure, creating sustainable human settlements and improved quality of household life
- Defence and security, contributing to national efforts to build a safer country
- Industry, in support of an efficient, competitive and responsive economic infrastructure.

These areas facilitate CSIR-wide portfolio management and allow a clear articulation of our identity. Research and development (R&D) in these impact areas is supported by a

number of technologies, such as biotechnology, photonics, materials science, nanotechnology, robotics and information and communications technology. We have embarked on an extensive process to identify, define, measure and communicate the impact of our research.

We also reorganised our mining research and launched the Centre for Mining Innovation, based in Johannesburg. The centre intends to meet current and projected future needs of the mining industry by focusing on research into real-time risk management, novel mining methods and human factors.

Initiatives to support service delivery

Effective planning and delivery of socio-economic development and basic services to communities as captured in the Local Government Turnaround Strategy remain a government priority. While we are not mandated to play a service-delivery role, we can certainly, through relevant and innovative R&D, enable and assist the appropriate service-delivery agents with their task. We strongly promote science and technology as enablers for improvement in our society and economy.

Guided by our mandate, we have started a special initiative that focuses on the transfer of CSIR-developed technologies and solutions to improve service delivery, with implementation ensuing through the appropriate government line departments.

The initiative intends to offer integrated systemic interventions and solutions such as integrated monitoring and evaluation systems, as well as infrastructure solutions to enhance a complete local government system. In this regard, we have established an institutional relationship with Cooperative Governance and Traditional Affairs (COGTA).

An excellent year on all fronts

In addition to streamlining our strategic and operational thinking over the past year, we have also achieved excellent results in our organisational priorities. These focus on highly-skilled people (building and transforming human capital); world-class and pertinent R&D (strengthening the science, engineering and technology [SET] base and performing relevant R&D); and ensuring that the expertise and skills generated and honed at the CSIR add value to South Africa (transferring technology and skilled human capital). These priorities are underscored by financial sustainability and good corporate governance.

Some highlights of this period include:

- The SET base comprises 64.8% of total staff – up from 59% in 2005/06 – and includes 757 Master's and PhDs, up from 550 in 2005/06.
- Publication equivalents achieved are up by 11.2% from 2008/09. The value of collaborative R&D activities with a value exceeding R1.5m amounts to R268.8m.
- The value of royalty income (R10.5m earned in 2009/10) is about 1% of turnover, above the comparative performances by similar organisations of 0.5%. Thirteen new international national patents were granted and 38 inventions disclosed.
- Financially, we exceeded our targets for total turnover, net margin and the value of contract R&D during the past year. We have also maintained an unqualified audit.

Such exceptional performance bears testimony to the dedication and hard work of our high-calibre people. It is their commitment that spurred the CSIR on to a very good year in the midst of a global recession, and while continuing to augment our positive impact on society through our science.

Dr Sibusiso Sibisi

built environment

A sound and effective built environment is critical for socio-economic development and economic growth in the country. Expanding and improving infrastructure such as roads, rail networks, bridges, ports, airports, buildings and other facilities is a national priority and must be achieved without forfeiting environmental sustainability. In addition, the effective operation of the infrastructure, through effective management of these components, is crucial for economic welfare.

The provision of infrastructure and associated operations is not only an enabler of economic growth, but also stimulates growth by increasing the productive capacity of the economy. Social development, which is fundamental for any country, can take place only with the proper provision of basic amenities such as hospitals, schools and housing together with infrastructure for electricity supply, water and sanitation.

The CSIR conducts relevant research and development to find key solutions to facilitate socio-economic development and improve the quality of life of South Africans. Specific focus areas over the past year include:

- Energy-efficient buildings;
- Updating the national human settlements atlas to facilitate the establishment of sustainable human settlements;
- Designing appropriate tuberculosis (TB) facilities to assist in combating cross-patient drug-resistant TB;
- Publication of the 6th State of Logistics™ survey to quantify and provide trends of important logistics indicators
- Physical modelling of an off-shore loading wharf to facilitate construction of ports for the safe movement of ships;
- Progress on the interdisciplinary research platform to investigate models of sustainable and integrated municipal service delivery.

The CSIR has implemented and successfully transferred technology for the built environment in the highlighted areas and in other instances. Many of these technologies are used extensively locally and in a number of specific cases internationally.

The CSIR's demonstration unit for improved government-subsidised low-income housing.

Houses under construction in Kleinmond, using many CSIR-developed features.

CSIR technology for improved, more durable low-income housing

Communities who depend on subsidised, low-income houses in South Africa could benefit greatly from technology developed and tested by the CSIR. The Department of Science and Technology (DST) commissioned the CSIR to investigate technology possibilities for improved low-income housing.

Having determined the shortcomings of a default 40 m^2 low-income house scientifically, researchers developed a demonstration house that would be more comfortable, durable, faster to build, easily extendible and less dependent on municipal services.

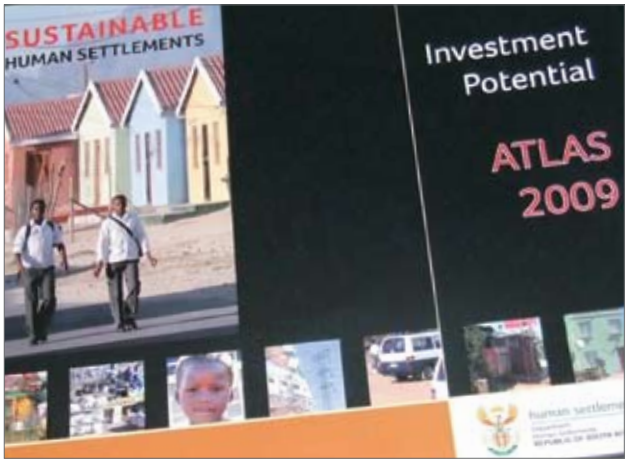
An added advantage is that the amount of concrete used during construction is reduced by an estimate of one ton per house due to the innovative technology used for the single foundation slab. This results in a reduction of CO_2 emissions – estimated at almost one ton per house.

Incorporating many features of the CSIR-developed low-income demonstration house, 441 pilot units are being built in Kleinmond, Western Cape. Local municipal authorities are collaborating with the CSIR and the DST in this pilot study within the local community. It is expected that the first houses will be ready for occupation by December 2010, with the last houses set for completion by March 2011.

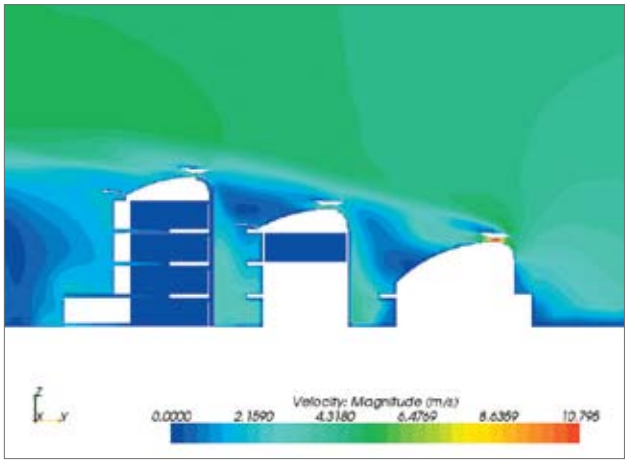
The DST has commissioned the CSIR to monitor and evaluate the pilot houses at Kleinmond after one year's occupation to determine the performance improvements achieved.

Improvements

- Same size (40 m^2), but optimal design of bathroom and kitchen spaces
- Modular, design-to-fit, like Lego set
- Can be extended easily by home owner
- Continuous foundation slab based on ultra-thin concrete road technology
- Roof assembly – reinforced roof ring beam further reduces cracking
- Prefabricated plumbing – waste outlet manifold installed on site
- Improved thermal performance – insulation material doubles up as ceiling
- Additions: solar geyser, photo voltaic panel for LED lights inside, rainwater harvesting tank.



CSIR research results were used for updating the Human Settlements Atlas 2009 published this year by the Department of Human Settlements.



Modelled air flow in and around buildings.

Human settlement research enables well-informed decision-making

Limited resources are available for South Africa's housing needs, while housing development pressures emerge in diverse locations. To make well-informed and justifiable investment choices that will promote the development of sustainable human settlements, the Department of Human Settlements (DHS) commissioned the CSIR to update research contained in the 2009 Human Settlements Atlas.

The overall aim of the atlas, which has been published by the DHS, is to provide a spatial interpretation of current policies regarding the establishment of sustainable human settlements, specifically settlement locality. The main spatial challenge in South Africa continues to be the spatial exclusion of the poor from the main socio-economic facilities of cities and regions. Locations close to employment areas, opportunities and services are not accessible to all people because of issues such as high land costs, limits to planning instruments and subsidies, and limited bulk infrastructure in appropriate places.

The atlas can be used to:

- Give a spatial dimension to national housing policy
- Give input to integrated settlement planning on a national scale
- Put provincial and district settlement planning in a national spatial context.

CSIR-produced policy guidelines for use in the design of energy-efficient buildings

The CSIR and the City of Joburg collaborated on a project to produce a set of policy guidelines for the City to use in the design of new energy-efficient buildings. The document, which was completed early 2009, provides practical guidelines that have been developed through international studies and local research.

The CSIR looked at a range of building types, from offices to residential buildings. Researchers concentrated on passive environmental control, day lighting and renewable energy, such as solar, power rather than mechanical systems such as air conditioning.

Buildings consume energy throughout their lifespan, from construction to operation and demolition. Legislation in South Africa will in future require buildings to be more energy efficient, with new standards on energy efficiency being developed by the South African Bureau of Standards. Municipalities such as the City of Joburg and the City of Tshwane are looking at by-laws and incentive schemes to reduce energy consumption in buildings.

The guidelines are a proactive step by the City of Joburg and the CSIR to build awareness and knowledge in industry. This is to ensure that the required capacity is developed so that increasingly stringent energy-efficient measures and legislation can be implemented.

Dedicated wards for drug-resistant TB patients constructed at seven hospitals

The CSIR is assisting seven provincial health departments with the roll-out of new accommodation for M(X)DR TB patients at existing TB hospitals. Construction at the first hospital site, the Manguzi Hospital in KwaZulu-Natal, has been completed.

Other locations for new or improved TB wards, in various stages of development, include the Catherine Booth Hospital in KwaZulu-Natal, the Modimolle Hospital in Limpopo, the Bongani Hospital in Mpumalanga, the West End Hospital in the Northern Cape, the Tshepong Hospital in North West and the Jose Pearson Hospital in the Eastern Cape.

The lack of appropriate hospital infrastructure to prevent cross-patient infection is a key constraint in the effective treatment and rehabilitation of patients.

The research focus is on creating a physical environment that will minimise the risk for patient-to-patient and patient-to-staff airborne infection transmission, while fully supporting nursing and healthcare delivery. As treatment is long term – usually over six months – the units need to allow for patient support and dignity. The designs – which promote single rooms – must also be environmentally friendly and economical in both initial capital outlay and ongoing operating costs.

Computational fluid dynamics modelling of the designs has shown that with appropriate design and administrative management of the unit, natural ventilation can provide an acceptable level of air changes all year round in most areas in South Africa. This is critical for reducing cross-infection opportunities. However, in some situations mixed mode ventilation – including a measure of forced ventilation – is required. Performance of all units will be validated once completed and in operation.

On location at the construction site of Catherine Booth Hospital in KwaZulu-Natal.

R92 million+

INTERNATIONAL DONOR FUNDING SOURCED FROM THE GLOBAL FUND FOR THIS PROJECT

R115 million+

ADDITIONAL FUNDING COMMITMENT FROM PROVINCES WHERE SUCH FACILITIES ARE BEING CONSTRUCTED

R207 million+

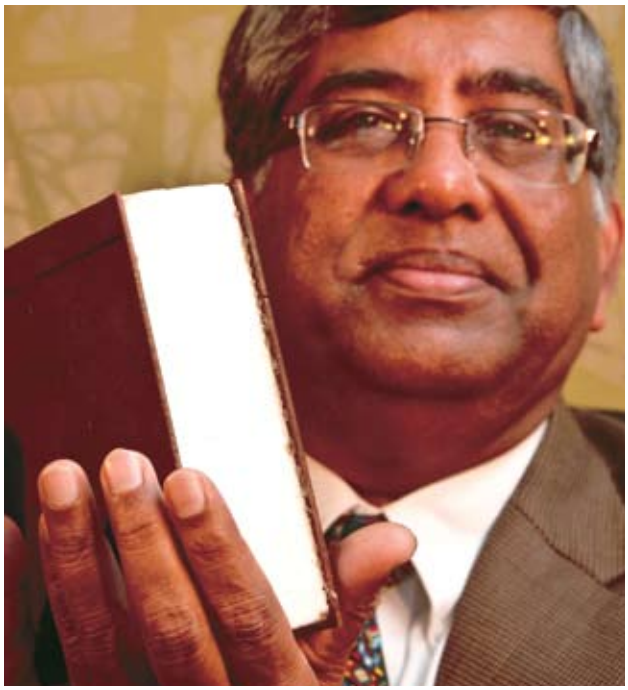
TOTAL PROJECT CAPITAL INVESTMENT

Biobased ceiling panel developed for greener buildings

The worldwide drive towards green buildings has prompted the CSIR to focus some of its research energies on developing biobased building materials. As a result, CSIR researchers have developed a prototype natural fibre-based, insulated sandwiched panel that can be used as a roof panel in construction.

This is essentially a ceiling panel with flax-reinforced phenolic resin skin; the materials meet all required standards for construction use. Flax is a natural fibre and completely renewable. These materials reduce the environmental impact (carbon footprint) of the construction industry. They have the potential to create new rural industries and thereby jobs and assist with economic development. Furthermore, they have a lower weight and cost, and provide inherent insulation compared to traditional roofing products.

This panel is one of the first CSIR-developed biobased building materials aimed at assisting the South African construction industry to apply green-building principles.



A sample of the biobased ceiling panel, one of the first biobased building materials from the CSIR's Fibres and Textiles Industry Support Centre in Port Elizabeth.

Freight is still transported, primarily by road, with rail not being used optimally.

6th State of Logistics™ survey made available

The annual State of Logistics™ survey (now a registered CSIR trade mark) has become one of the premier references for logistics in South Africa.

The CSIR and its associates – Stellenbosch University and IMPERIAL Logistics – believe the survey opens the way for further discussions, interactions and dialogue on various logistics and supply – chain management issues. They inform decision makers in the public and private sectors how to manage the costs of logistics better.

The theme of the latest survey is 'Logistics value and costs – driving macro- and micro-economic change towards global competitiveness and sustainability'. The survey highlights the importance of the critical area of logistics and supply-chain management in the world marketplace and emphasises the value that can be derived from logistics.

Freight is still predominately by road and there seems to be little chance of this changing in the near future. A number of new issues are raised and elaborated on in this survey, for example, the effect of bad roads on the costs of logistics and humanitarian logistics.

Logistics costs relative to GDP were at their lowest level since the inception of the survey at R339 billion or 14,7% of GDP in 2008, with this percentage being 15,9% in 2007.

Transport cost increases were also lower than in any of the previous surveys (transport costs increased by 2,4%, but still account for 50,4% of total logistics costs). Inventory carrying costs were once again much higher in 2008 and increased by 21,2% from the previous year, constituting 18,6% of total logistics costs.

The new South African road pavement design method will protect the investment in the transport infrastructure through improved design and quality of roads.

R1,047 trillion
VALUE OF SA'S ROAD NETWORK

R100 billion
SA ROAD MAINTENANCE BACKLOG

R32 billion
ANNUAL ROAD MAINTENANCE NEED

R9,2 billion
CURRENT MAINTENANCE EXPENDITURE

Multimillion-rand research to improve design and quality of roads

The South African National Road Agency Ltd (SANRAL) has commissioned the CSIR to conduct a comprehensive study to evaluate and update the current South African road pavement design method.

In view of increased premature road failures and associated traffic congestion, the research, development and implementation will require a substantial financial investment, with the road agency committing more than R50 million and the CSIR providing more than R10 million.

The outdated models for calculating materials strength and responses due to loading in the current road pavement design method have rendered important parts of the method obsolete and in dire need of serious revision and updating.

Guideline documents, test protocols and equipment for new design and rehabilitation investigation will be modified in light of new information generated by this project.

The new South African road pavement design method will protect the multibillion-rand investment in the South African transport infrastructure through improved road pavement design by the local road industry. It will facilitate the analysis of the current road network condition and the maintenance process. Roads approaching the end of their design lives will be identified timeously, allowing early light rehabilitation instead of total (and more costly) reconstruction.

The new method will be made available as a web-based software application, available to the industry through membership registration. It will be managed by SANRAL, with technical support from the CSIR. It will cater for different levels of expertise and design complexity, covering a broad spectrum of roads ranging from national roads to light structures for rural access and urban mobility.

CSIR develops large, precision-built model of off-shore iron-ore loading wharf

The CSIR's coastal engineering and port infrastructure team in Stellenbosch recently completed a large, intricate 1:100 scale model of an international port. The new digital imaging technology resulted in a new South African capability to measure waves in a physical model. The modelling will ensure that the harbour being constructed will provide for the safe and easy movement of large ships.

The large size of the CSIR's modelling hall and the fact that ship motion can be included in the equation make the CSIR one of the few laboratories worldwide able to achieve a precision-built modelling scale. Here the effects of waves on ships can be measured to an accuracy of less than half a millimetre in the model hall.

A model of an off-shore iron-ore loading wharf at Port Hedland in Australia was precision built in the vessel-response wave basin in the CSIR's hydraulics laboratory. A number of custom-made model bulk carrier ships were also built for the study. The team conducted moored and moving ship motion tests and wave propagation tests for the project, making it one of the largest and most precision-built projects the CSIR has ever worked on.

The CSIR conducted physical and numerical modelling studies of the effect of long waves on the movements of the moored bulk carriers under different conditions and different port designs. Researchers had to imitate the effect of long waves and measure the effect of these on the horizontal movement of various sizes of bulk carriers. Long waves influence the surge and sway movements of carriers, affecting the way the carriers are loaded.

Accuracy of less than half a millimetre was obtained.

Custom-made model bulk carrier ships were also built for the study.

Immovable asset register developed to improve service delivery

The CSIR was contracted by the Department of Arts and Culture to support its efforts for enhanced service delivery through better facilities planning and more effective estate management of its museums, libraries, playhouses, archives, burial grounds, historical sites and office buildings.

As part of this project, the CSIR undertook a condition assessment of all the department's buildings and supporting infrastructure – as well as those of the public entities that fall under its auspices. A verified Immovable Asset Register was developed based on consolidated fieldwork data, and a User Asset Management Plan drafted in line with the requirements of the Government Immovable Asset Management Act (No. 19 of 2007). The department was also assisted with an Immovable Asset Management Policy, which ensures ongoing compliance with the prevailing legislative prescripts.

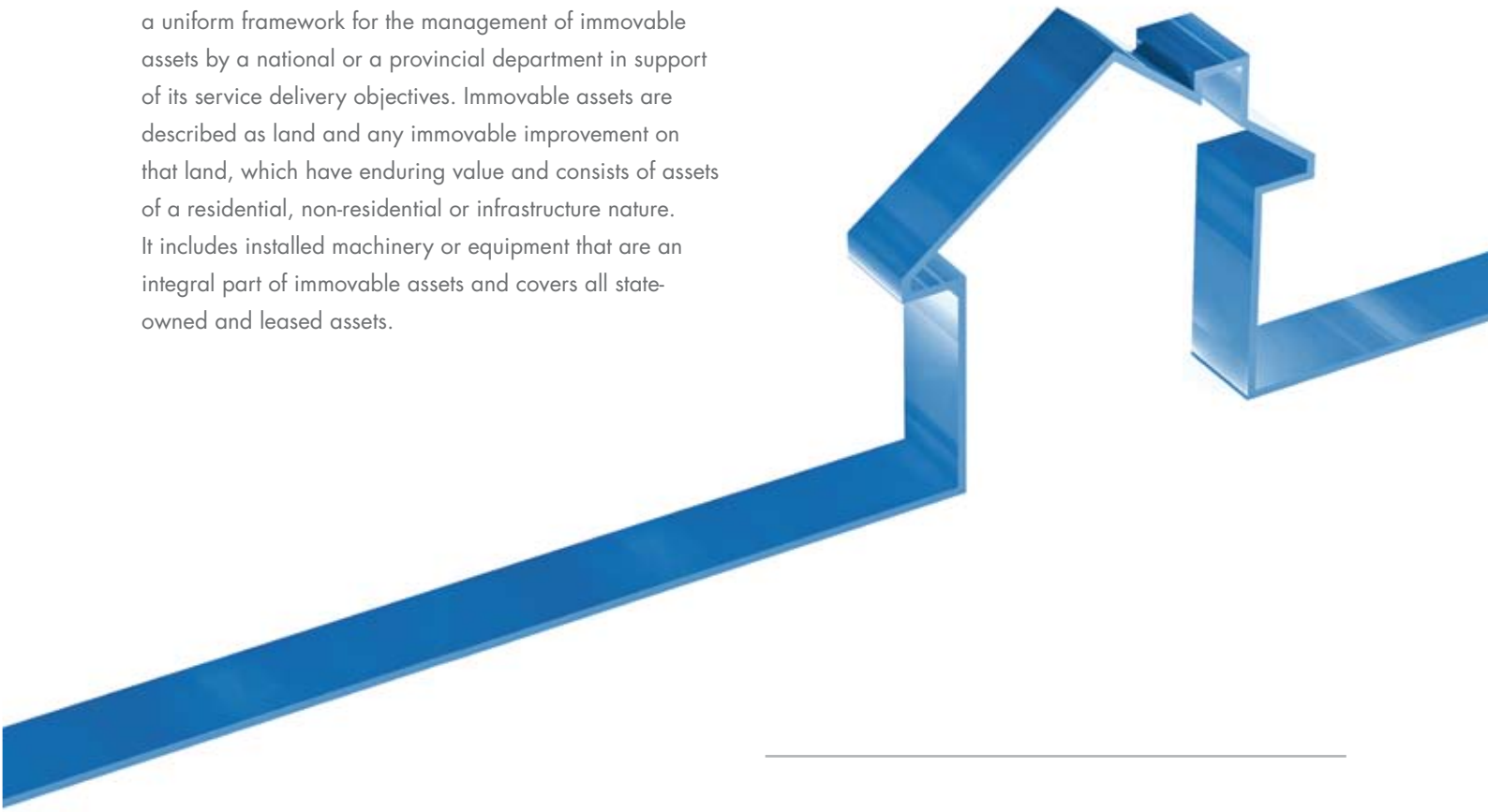
The legislative environment for the management of the government estate has changed dramatically since the introduction of the Act. The object of this Act is to ensure a uniform framework for the management of immovable assets by a national or a provincial department in support of its service delivery objectives. Immovable assets are described as land and any immovable improvement on that land, which have enduring value and consists of assets of a residential, non-residential or infrastructure nature. It includes installed machinery or equipment that are an integral part of immovable assets and covers all state-owned and leased assets.

Helping the public sector comply with immovable asset management legislation

In response to the introduction of the Government Immovable Asset Management Act in 2007, the Free State Department of Public Works and Rural Development appointed the CSIR to assist with the establishment of processes within the department to ensure full compliance to the legislation.

The objects of the project were manifold: the Professional Real Estate Management Information System (PREMIS) had to be re-activated, the asset register updated, staff trained in the use of PREMIS and a Provincial Immovable Asset Management Policy compiled.

Further work included a scoping exercise in preparation for a complete rental portfolio, determination of preliminary values for all properties reflected in the asset register and a scoping exercise in preparation for a Custodian Asset Management Plan and a User Asset Management Plan. The first phase of the project was completed successfully at the end of the 2009/2010 financial year.

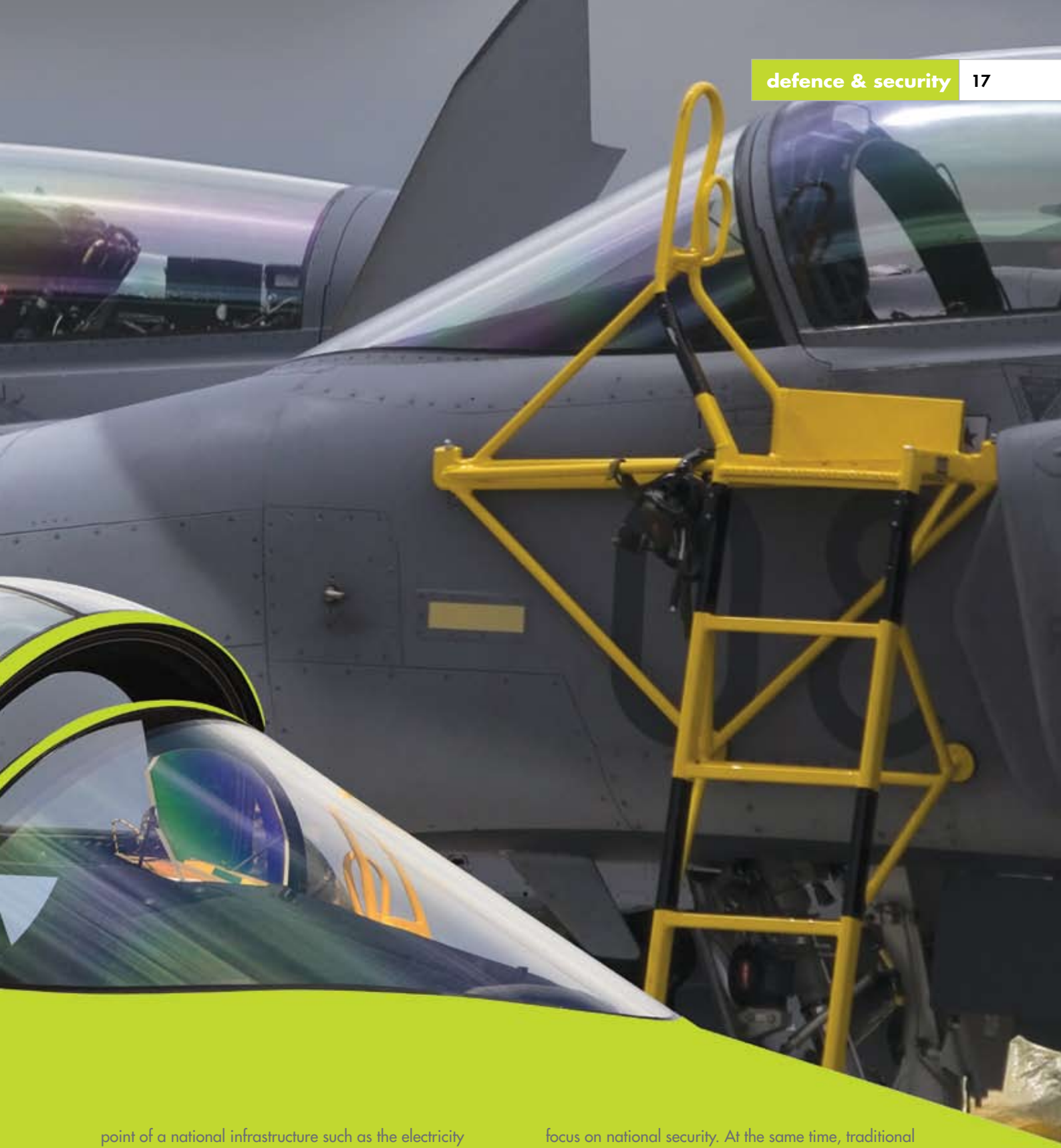


defence and security

Perceptions about national security impact on many spheres, including economics, politics, tourism and sport, as was clear in the build up to and during the recent 2010 FIFA World Cup soccer tournament. As a nation, South Africa had to provide a safe and secure environment for the event. This in turn necessitated close cooperation between all agencies involved in crisis and disaster response.

The CSIR rose to this challenge by developing ICT tools and solutions for interoperability and cooperation between military and civilian policing – considerably enhancing the national crisis and disaster management capability, and gained valuable experience relevant to the changing security environment.

Globally, conflict driven by non-state actors such as ethnic or radical groups is increasing. Terms such as asymmetric warfare (where the opponents have completely different capabilities, for example, a traditional military force opposing a force using suicide attacks and improvised explosive devices) and systems warfare (where a dissident group causes widespread disruption by destroying a nodal



point of a national infrastructure such as the electricity distribution system or the telecommunications system) are being used more and more frequently. Africa is not isolated from these trends; improvised explosives and suicide attacks are increasing. The possibility of the South African National Defence Force encountering such threats in Africa during peace support operations is growing.

This changing security environment poses significant challenges to research and development. Internationally, new programmes are being formulated with a stronger focus on national security. At the same time, traditional military capabilities are being revolutionised with major technological advances in areas such as communications, computing and miniaturisation.

Some of the highlights on the following pages reflect the CSIR's support of the Department of Defence and other national security agencies to respond to these trends and our readiness to enter into partnerships with relevant role players globally.

Many of the lessons learnt during the interoperability exercise to ensure a safe World Cup will be employed for the South African Army's borderline protection task.

Supporting a safe FIFA World Cup through interoperability of defence systems

In preparing for the 2010 World Cup, FIFA required that an appropriate emergency response capability be in place to support all World Cup matches. Such an emergency response capability meant that all the relevant agencies should be able to work together in a coordinated and time-critical manner. The agencies included the South African Police Service, the South African National Defence Force, ambulance services, medical facilities and fire brigades.

Each of the agencies uses its own communications and operational systems and these had to be integrated. Integration started in preparation for the Confederations Cup in 2009. The CSIR acted as an independent technical advisor, supported the process for establishing systems requirements, identified interoperability problems and developed specialist software as part of the preparations. It also made some of its research and development infrastructure available to support of the operational activities. The bulk of the CSIR's effort was towards supporting the situation awareness element of the emergency response capability.

Scientists developed common standards and data systems to integrate into pre-existing situation awareness models. They had to determine whether the situation awareness models were compatible with the existing systems and processes, and whether personnel felt comfortable operating these. Communication between all arms of service – land, naval and air – was necessary as well as an understanding of common procedures and organisational structures to ensure interoperable processes, technology and user interface. Additional situation awareness and communications tools were added to the existing tools of the defence force to support shared understanding and perception.

Many lessons were learnt by the different agencies and it was decided to keep the core capability active as a national competence. Many of the lessons learnt will also be taken forward in support of the borderline protection task, for which the South African Army is preparing.

32 nations

THE NUMBER OF COUNTRIES THAT PARTICIPATED IN THE 2010 FIFA WORLD CUP

A smartcard and card reader are some of the innovative security technologies for fingerprinting and smartcards.

THE CSIR AIMS TO BUILD A LOCAL CAPABILITY TO DEVELOP SMARTCARD AND BIOMETRICS-BASED TECHNOLOGIES AND TO SECURE THESE

Identity authentication research coming to fruition

The key to information security is a strong capability to verify the identities of those who are authorised to access the information. For the past two years, the CSIR has been developing local identity authentication technologies, namely biometrics (for example, fingerprint recognition) and smartcards.

Most of the biometric and smartcard-based technologies that are currently used in South Africa to control access to critical information and facilities, are imported. This poses a national security risk since many countries from where these technologies are sourced, place restrictions on the security safeguards, such as encryption software, on exported technologies. The CSIR is looking to close that gap by building indigenous capability, not only to develop smartcard and biometrics-based technologies locally, but also to secure these. The research largely focuses on the core of these technologies where security vulnerabilities exist.

In biometrics research during the financial year, the focus was on the development of a fingerprint-based access control system. A technology demonstrator of the system was successfully developed and the CSIR is currently working on developing a commercial prototype.

In terms of smartcard technology, the key components are currently undergoing functional testing. The plan is to prepare the smartcard technology for the development of commercial applications in the new financial year.

Radar technology touted as best worldwide

Currently, the largest defence acquisition programme for the South African National Defence Force is the Ground Based Air Defence System. A key element of this system is its radar.

ARMSCOR has the option to import radar or to use radar developed and manufactured in South Africa. It was decided that a local radar will only be considered if it is internationally competitive, in terms of both price and performance.

In response to this, the second phase of what was probably the largest collaborative radar technology development project ever undertaken in South Africa, the DBR-XL Radar Technology Development Programme, has been successfully concluded.

It has been described by defence stakeholders as superior to all international offerings and suitable as a missile fire control radar for the current, and future model of the Umkhonto missile.

The CSIR provided an independent evaluation of the technical concepts based on previous radar experience and detailed radar and algorithm level modelling and simulation; developed optimised signal processing algorithms; participated in missile fire control system level performance analysis workshops and provided specialist input based on its advanced radar signal processor design and development experience.

Collaborators included the CSIR, Armscor, the universities of Cape Town and Stellenbosch, industry stakeholders such as Reutech Radar Systems, Denel Dynamics and Denel Integrated Systems Solutions, and the Ground Based Air Defence System Programme Office.

This is expected to lead to further developments in the local radar industry, as well as export opportunities.

Cash-in-transit heists stemmed by PUDU

Since the installation of the CSIR's polyurethane dispensing units (PUDU), no further heists have been attempted on the 300 armoured cash-in-transit vehicles that have the technology installed. The technology has also been bought by international companies.

PUDU is a 'sense-and-explode' technology developed at the CSIR, which protects cash being transported in armoured vehicles, from being robbed.

The technology has made it possible for polyurethane foam to be dispensed inside the vault area of the vehicle when the system is activated by a security guard or if the vehicle tilts at a certain angle. The polyurethane expands and hardens immediately into a solid block, which makes it impossible for the attackers to get to the cash.

PUDU devices are installed in cash-in-transit vehicles to deter criminals from attempting heists. Shown here is a hardened form of the polyurethane foam. PUDU is an international success.

Simulation environment for electronic warfare sharpens decision-making

The CSIR's sensors and electronic warfare engagement simulation (SEWES) is used by defence research institutes for evaluating the effectiveness of electronic warfare, developing doctrine and training.

SEWES is a 'few-on-few' simulation environment which allows any number of platforms, populated with various sensors and systems, to engage each other.

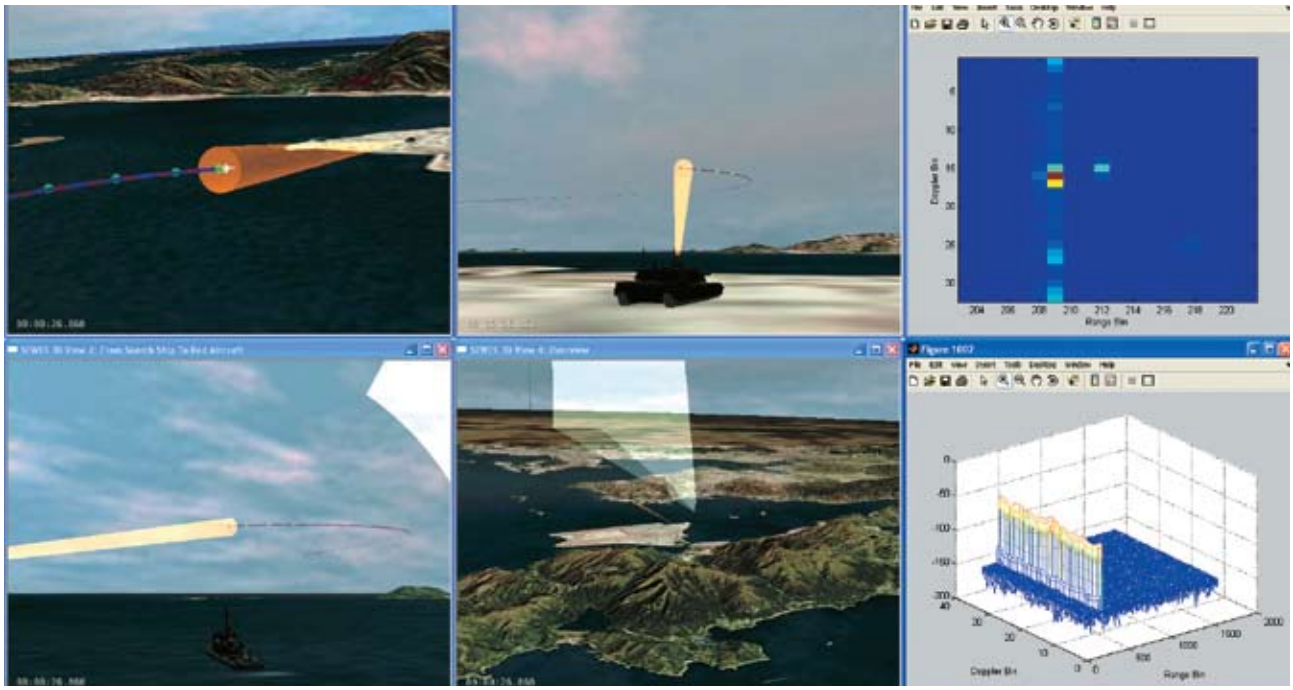
During the financial year, the CSIR expanded its SEWES modelling and simulation capability by adding airborne sensor and electronic warfare system models to assist in the evaluation of the effect of electronic warfare on the Gripen fighter aircraft. Closer integration between hardware systems, such as the DRFMs and MECORT have resulted in a mixed real/virtual test bench for radars.

Decision-makers typically use SEWES to simulate 'what if' questions. To maximise platform survivability, the use of sensors and electronic warfare systems can be optimised given a threat scenario. These vary from algorithm-level questions such as the range at which the signal intercept system will be effective, to doctrine-type questions such as how the countermeasure system could be utilised to optimally protect a platform.

A typical tactical engagement investigation would be to evaluate the sensor and electronic warfare system coverage of a fighter aircraft, given that the coverage would be limited due to system performance, the terrain, and the flight path of the aircraft.

At a more detailed level, the performance of these systems can be predicted using the dynamic nature of the engagement and the effects of the natural terrain. At this level a typical question would be to investigate the range at which a small target, such as an inflatable boat, could be detected in a piracy scenario.

The parameter level simulation of the systems and interactions are modelled at the level required by the research question. All required system parameters in the simulation are stored and visualised in a realistic 3D world.



A simulated engagement between an aircraft, a ship and a vehicle is shown. The four views on the left show the respective platforms in the simulation, while the two views on the right show representations of the signal processing performed in the tracking radar.

Supporting the SAAF in optimal handling of its Gripen fleet

The modernisation of the fleet of the South African Air Force (SAAF) resulted in the acquisition of 26 new Gripen advanced, light fighters. These are by far the most sophisticated and technologically superior combat aircraft ever operated by the SAAF. The CSIR has played, and continues to play, an instrumental role in ensuring that South Africa becomes a 'smart buyer' and also a 'smart user' by developing expertise and systems to extract the most from the fourth-generation technologies of the Gripen fleet. Typical examples of CSIR support included:

Acquisition of radar system

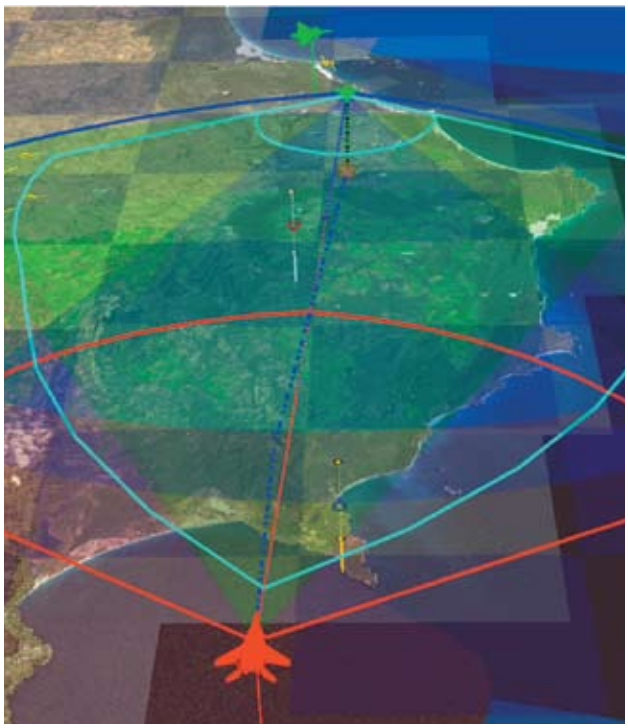
Radar engineers provided initial support in the acquisition of the radar system, developing the SAAF User Requirements and developing design reviews and acceptance tests. As the radar system of the modern fighter acts as the eyes and ears of the aircraft and can contribute as much as 25% of its total costs, it is prudent to ensure that such equipment meets the requirements of the SAAF.

Support of fly-by-wire technology

Aeronautics engineers at the CSIR contributed by ensuring optimal handling of the combat aircraft. The CSIR was requested to establish the knowledge base required to understand and support the new fly-by-wire technology to enable 'carefree handling', thereby allowing pilots to focus on the tactical situation. The project entailed creating baseline flying qualities and system specifications to characterise handling qualities to promote safe and effective air operations. This involved not only researching modern fly-by-wire systems, but also validating research through actual flight testing.

Development of a desktop simulation tool

While the Gripen brings with it advanced capabilities, it also calls for new tactics and standard operational procedures to be revised. CSIR aeronautical engineers



A fighter aircraft approaches a pair of Gripens on patrol in this simulation.

The Cobra helmet, as used in the SAAF's Gripens, can display critical data onto the visor and tracks where the pilot is looking. *Images copyright Gripen International.*

assisted in this regard by developing a desktop simulation tool that serves as a mission simulator. It can be downloaded to a laptop for enhanced access to a planning tool in a cost-effective way. Known as the Gripen doctrine and tactics development tool, it supplements the Gripen Mission Support System based at the Air Force Base Makhado in the Limpopo province.

Improvement of helmet-mounted displays

Other aspects of technological enhancements in respect of the Gripens included exploring the use of fifth-generation 'all-aspect' missile firing, in conjunction with helmet-mounted displays, which allow the pilot to merely look at the target and fire the missile. To meet the demands of modern air defence, the Gripen is equipped with Denel's A-Darter missile coupled to helmet-mounted displays.

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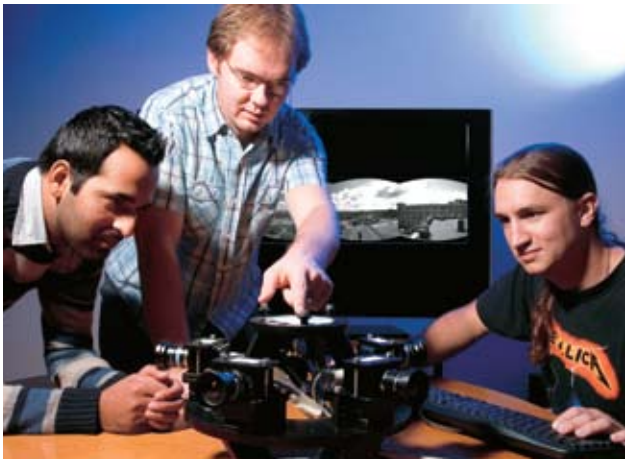
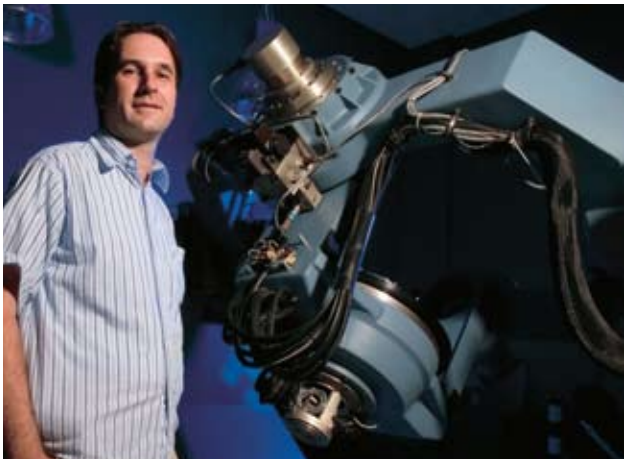
NEW GRIPENS ACQUIRED BY THE SAAF AND SUPPORTED BY THE CSIR'S TECHNOLOGICAL EXPERTISE

The CSIR helped to evaluate the complex digital flight control system used in the Gripen.

Images copyright Gripen International.



WASP comprises five high-resolution cameras. The images of the cameras are stitched together in real-time to result in a high-quality image.



CSIR skills rooted in optics, electronics and mechanics ensure that the observation abilities of the armed forces are optimal.

Surveillance of Navy ship surroundings increased to full 360° view

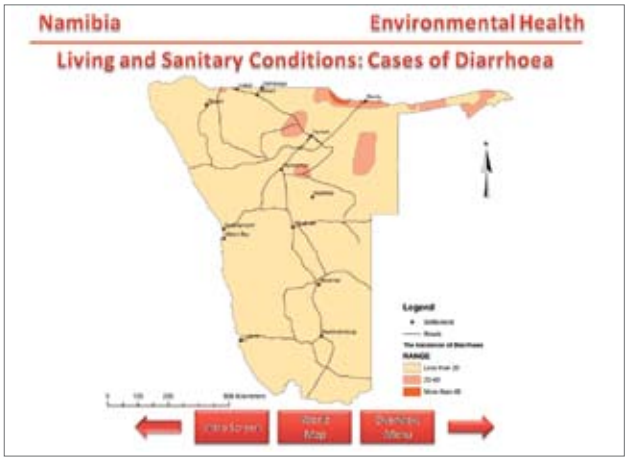
When the South African Navy operates in hostile littoral environments, the protection of the ship is of the utmost importance. Potential threats include small arms fire, rockets and improvised explosive devices. Countering these threats requires extensive surveillance of the ship's surroundings. During the past year, the CSIR's wide area surveillance project (WASP) sensor has been further developed to deliver a 360° view (from an initial 60°) – offering unparalleled situation awareness. WASP comprises five high-resolution cameras. The images from the cameras are stitched together in real-time to result in a high-quality image of the surrounding environment.

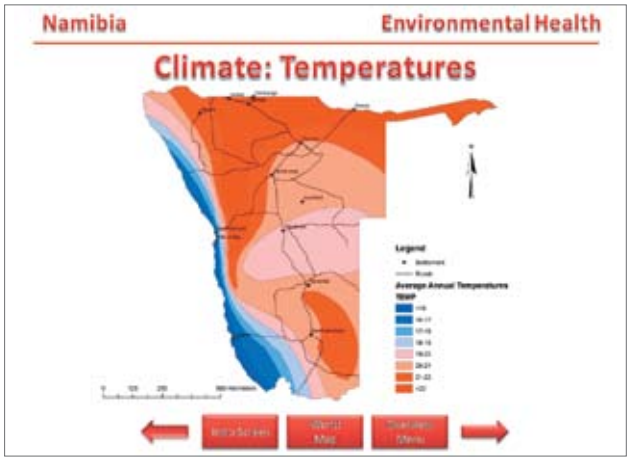
Stable surveillance images made possible in rough seas

CSIR researchers have developed a way to stabilise surveillance systems on ships in rough seas without costly inertial measurement equipment. This bodes well for ubiquitous situation awareness on board Navy ships as these rely on the accuracy of images received from surveillance systems for decisions regarding potential threats.

The movement involved on a ship at sea includes the continuous movement of the ocean and clouds, temporarily obscuring targets. Thus, a ship on which the surveillance camera system is mounted, moves up and down with the swell, which may cause the horizon to move in and out of the field of view. Ideally, a ship with a mounted camera should be able to provide stabilised images.

In the CSIR experiment, ship motion was simulated using a three-axis rate table and the camera position was controlled using a pan-and-tilt unit mounted on the rate table to counteract the effect of the sea motion on the images. Researchers focused on mechanical stabilisation and worked only with data obtained from the image itself – literally working with the 'absolute error' in the image. This 'deviation' was fed back to the pan-and-tilt unit, which delivered positive results.





These are the first sample pages from the medical atlas that will greatly benefit the armed forces when completed.

Military health services to benefit from CSIR geospatial medical atlas

The CSIR is using geographic information systems (GIS) to create medical atlas software, the Geospatial Atlas of Disease Intelligence and Countermeasures. The atlas will be housed by the South African Military Health Services Mobile Military Health Formation for use by medics.

The primary mission of military healthcare providers is military readiness, which means being able to respond effectively in times of conflict. Missions may also involve military operations other than war, such as humanitarian assistance and peacekeeping operations.

The medical atlas will provide military health professionals with instant and easy access to a wide range of medical reference data for situation awareness. Medics will be enabled to review environmental risks and conditions in their areas of responsibility.

Medical geography can also be used to support the readiness of soldiers by keeping them fit to fight before, during and after deployment.

GIS is an aid to decision-makers in overcoming spatial issues of a medical nature as factors such as environmental health, diseases and climate can be researched. Troops and medics are able to prepare further by researching topography, population, water supply, living and sanitary conditions, pollution and threats from animals and plants in areas of deployment.

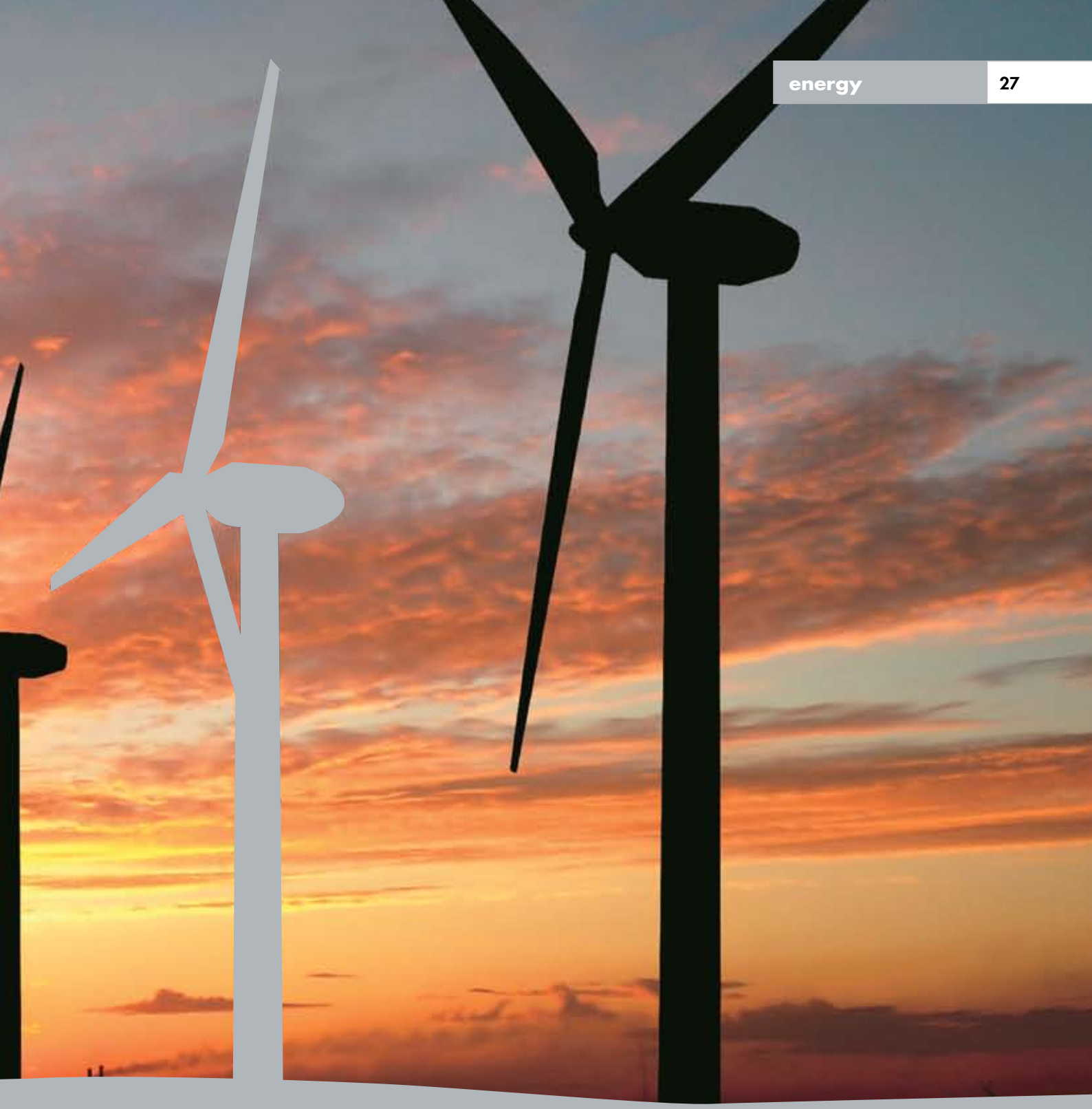
The atlas can also be developed into an intelligence tool as it contains additional information for other arms of service. For instance, a ballistic weather module is useful for the artillery because certain atmospheric conditions directly affect the accuracy of artillery fire.

THE GEOSPATIAL ATLAS OF DISEASE INTELLIGENCE AND COUNTERMEASURES WILL PROVIDE MILITARY HEALTH PROFESSIONALS WITH INSTANT AND EASY ACCESS TO A WIDE RANGE OF MEDICAL REFERENCE DATA FOR SITUATION AWARENESS

energy

South Africa's energy challenges relate to access – 27% of the population has no access to electricity; security of energy – only a low electricity generation reserve margin is available and infrastructure is aging; and emissions – South Africa is the 30th largest economy, but the 15th largest CO_2 emitter. In response to these challenges, the CSIR is investigating ways to improve energy security, reduce our carbon footprint and water consumption through renewable and alternative energy technologies, and lower energy demand through energy-efficient interventions.

The strategy for the CSIR's energy research impact area focuses organisation-wide attention on energy technology and policy. On the supply side, the CSIR will focus on low-carbon sources using waterless technologies and on storage technologies for the three energy carriers: electricity, heat and hydrogen. Demand-side management involves energy efficiency in buildings and processes, and reducing demand through switching from electricity and fuel as carriers to solar and waste heat streams.



The strategy also includes decision support, which entails resource mapping of renewable energy resources, modelling and simulation of scenarios and processes, and the development of policy, business models and other decision-support tools.

Research highlighted in the following pages describes the integrated research infrastructure platform project, which constitutes obtaining electricity from solar and sewage biogas; the algae-to-biodiesel process; the development of a South African wind atlas, which will support decisions in wind farm placement; and the spectrally selective absorber coating, which will allow more efficient solar energy capture for water heaters and other applications to reduce energy demand.

The CSIR platform is looking at devising alternative solutions to municipal service delivery problems, such as energy, water and sanitation.

Integrated models to aid small-town municipal service delivery

The CSIR is one step closer to the establishment of an integrated research infrastructure platform on its campus, having completed a feasibility study. The goal of this platform is to devise alternative solutions to municipal service-delivery problems (energy, water and sanitation), which mitigate climate change and contribute to food, energy and water security using a systems approach.

The platform aims to design and develop an integrated system of technologies that turn sunshine and sewage into energy and valuable commodities and create opportunities for local economic development and job creation through food and fuel production.

Providing municipal services such as electricity and waste-water treatment is a major challenge for small towns that often lack the institutional capacity to manage and maintain the necessary infrastructure. High levels of poverty in these towns also present cost-recovery challenges. The platform is a CSIR interdisciplinary response to assist rural municipalities.

Research platforms in varying stages of development include municipal service delivery processes such as the provision of energy, clean water and the collection and treatment of wastewater and solid waste. It will also investigate and refine anaerobic digestion, aquaculture (including algal culture), concentrated solar power and membrane bioreactor-based wastewater treatment.

THE NEW PLATFORM IS A CSIR INTERDISCIPLINARY RESPONSE TO ASSIST RURAL MUNICIPALITIES

A pilot scale photobioreactor at the CSIR Modderfontein campus containing an algal species that has demonstrated good potential as a biodiesel producer.

Algal biodiesel research accentuates potential socio-economic benefits

Ongoing research into microalgae for biodiesel shows that this technology offers one of the best natural solution to current energy and environmental challenges.

CSIR researchers are currently focusing on bioprospecting microalgae that produce lipids from all South African environments and have propagated the samples in a controlled environment that resulted in some 300 algal isolates of which about 80 produce lipids. Processes are being developed that will ultimately see some of these isolates implemented in industry to produce bio-oils.

Looking further ahead, the implementation of algal biofuel also has other benefits for developing communities such as skills development, job creation and socio-economic improvement.

In another project, researchers are developing an integrated process for the production of algal biodiesel, which includes the use of waste substrates (CO_2 wastewater). The research will eventually be scaled up to growing algae in small-scale ponds, which will lead to a pilot project of a plant of one hectare where various technology adoption models will be investigated.

Breakthroughs in this area could contribute to the country's commitment to reduce its carbon emissions. It is expected that this technology will revolutionise energy delivery to small communities, thus boosting the subsistence sector of the economy by enabling value-added activities in agriculture and aquaculture.

It is envisaged that the CSIR will be the hub for algal research and will play a key role in facilitating the wider roll-out of this technology into Africa and internationally.

Research to convert waste plant material to biofuel shows progress

The CSIR is part of a consortium funded by the Department of Science and Technology and the Technology Innovation Agency to find new biological catalysts to enhance the conversion of waste plant material to biofuel.

Using cutting-edge genetic techniques and robotic equipment, thousands of bacteria are screened for novel enzymes that can degrade woody materials, making them easier to ferment into alcohols for second-generation biofuels. So far, a number of new enzymes have been discovered and will be evaluated in laboratory trials. It is anticipated that these and related discoveries could reduce the cost of ethanol biofuels to the point where they become commercially attractive as replacements for fossil fuel.

The benefit of this type of technology is that the fuel can be generated using non-food crops and agricultural waste. The technology can also generate chemicals for use by industry to replace oil-based feed stocks. This, in turn, could form the basis for a renewable and environmentally-friendly bio-based economy that would reduce the imports of fuels and create local businesses. The consortium includes the University of the Western Cape and Stellenbosch University. The Tshwane University of Technology and the University of Limpopo also collaborate on the project.

The conversion of waste plant material to biofuel could reduce the cost of ethanol biofuels to the point where they become commercially attractive as replacements for fossil fuel.

Wind atlas to help identify viable locations for wind farms

Denmark and South Africa have entered into an agreement for capacity development and research cooperation through the development of wind-resource mapping for the Western Cape and areas of the Northern and Eastern Cape.

Research will obtain data on wind speeds and frequency along the South African coastal and escarpment regions to update South Africa's current wind resources map. Partners in the project include the Danish Technical University, the South African National Energy Research Institute, the CSIR, the University of Cape Town and the South African Weather Service.

Denmark will provide South Africa with expertise to do wind measurement and to develop a Numerical Wind Atlas for South Africa that may lead to viable, 'bankable' wind-farm projects.

Of the 10 sites identified for wind-measurement stations, the CSIR has already erected masts with instrumentation at six of the stations in the Northern Cape and the Western Cape. Data from these six masts are being captured at the CSIR's Stellenbosch office. As soon as data for one year from all 10 masts become available, researchers in Pretoria will start with micro-scale modelling of the data to Danish standards.

Looking down one of the wind masts erected in Denmark.

Battery Research Centre gearing for action

A Battery Research Centre is being established at the CSIR as part of a worldwide drive to research low-cost, safe, long-lasting batteries specifically for the automotive market.

New sets of equipment for making battery coin cells have been acquired, including eight-channel battery analysers for establishing the capacity of batteries, an automatic coating device for attaching materials onto the positive and negative plates of batteries, and an electrochemical Potentiostat/Galvanostat, which is used for the testing and characterisation of cells. This particular piece of equipment can test any device that supplies electricity including fuel cells, solar cells, batteries and capacitors.

Another newly acquired and installed instrument is an Atomic Force Microscope (AFM). The AFM is a high-resolution scanning probe microscope. The battery researchers use it to take atomic-scale (smaller than nano-size) photographs of surfaces of printed electrodes. These images allow the researchers to see the surface morphology of the device they are testing, revealing conglomeration of particles that might have an influence on its conductivity.

CSIR researchers are attempting to improve the efficiency and stability of batteries by changing its cathode chemistry.

Coin cells are basic battery cells that researchers use to test changes made to its cathode chemistry.

Internationally recognised expert appointed as director of Hydrogen South Africa Infrastructure Centre of Competence

The Hydrogen South Africa Infrastructure Centre of Competence has as its director an internationally-recognised expert in the field of hydrogen and fuel-cell technology, Dr Dmitri Bessarabov.

The CSIR and North-West University (NWU) jointly host the Hydrogen South Africa Infrastructure Centre of Competence, one of three such centres that fall under the Department of Science and Technology's (DST) hydrogen strategy.

Appointing an expert such as Dr Bessarabov was one of the key requirements by the DST for the establishment of the centre. It will be his task to coordinate the research and development within the centre and, by working closely with the centre directors of the other two centres of competence, to ensure that the national programme delivers on the DST's vision. This vision is to supply 25% of the future global fuel cell market with novel, locally-developed and fabricated platinum-group metal catalysts by 2020 and to develop innovative hydrogen production, storage and distribution technologies.

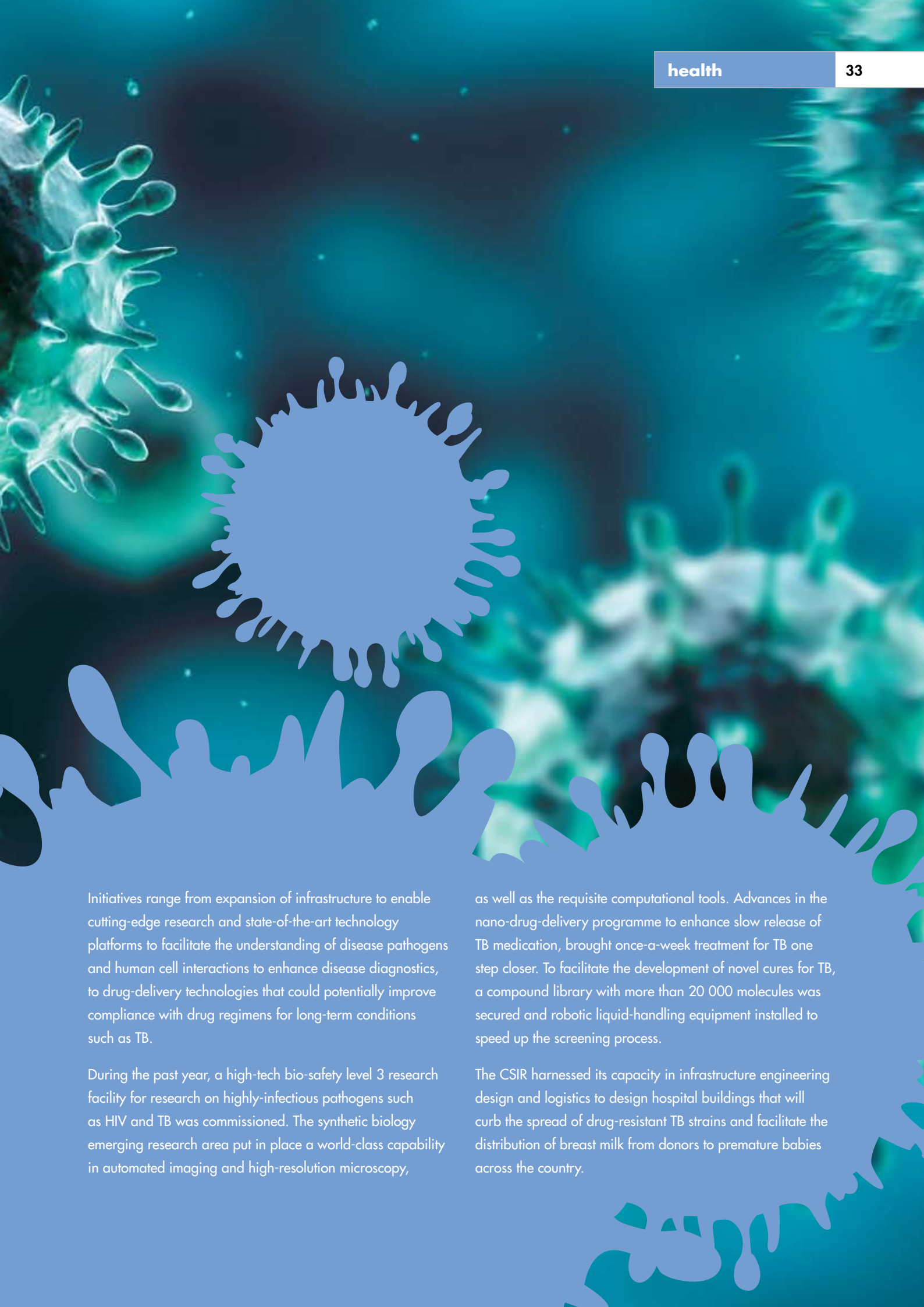
A Canadian citizen, Dr Bessarabov started his career in Russia, at MV Lomonosov Moscow State University. He moved to South Africa in 1994, where he obtained his PhD in polymer science at Stellenbosch University. In 2007, he returned to Canada, where he worked for the Automotive Fuel Cell Corporation as a senior scientist. He relocated to South Africa in April this year to take up the challenge of leading the centre of competence.

Dr Bessarabov has offices at both the NWU and the CSIR. His first challenge was to formulate a business plan acceptable to the DST. He will now give effect to that plan through the appointment of researchers and establishing the necessary infrastructure.

health

The health sector in South Africa faces challenges not only in terms of bottlenecks in the healthcare delivery system (pertaining to information systems and logistics in service delivery), but also in terms of the burden of disease: We have the fourth highest HIV infection rate in the world, the highest rate of tuberculosis (TB) infection (with HIV co-infection), and malaria is still endemic in South Africa and the region.

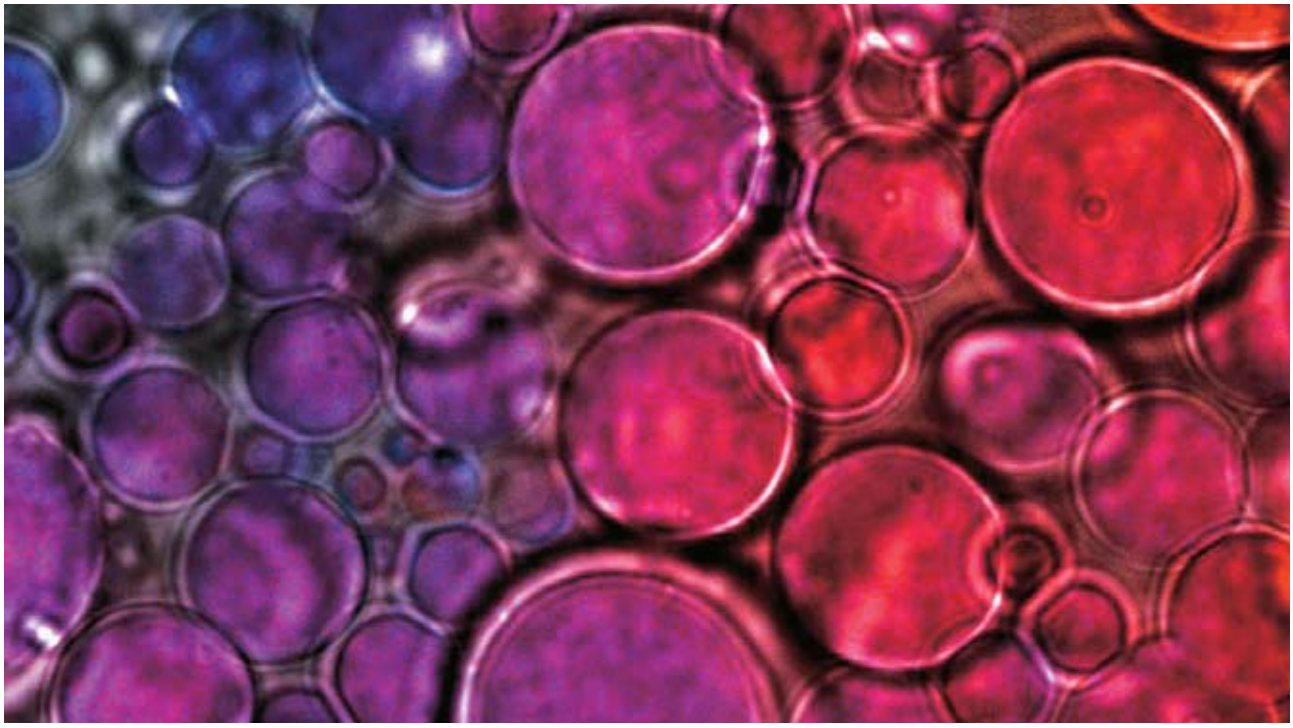
The CSIR's health interventions target some of the most pressing health issues in South Africa currently, with the aim of reducing the impact of the burden of disease on the nation. These interventions are conducted by drawing on the numerous, multidisciplinary science, engineering and technology competences housed in the various research groups of the organisation.



Initiatives range from expansion of infrastructure to enable cutting-edge research and state-of-the-art technology platforms to facilitate the understanding of disease pathogens and human cell interactions to enhance disease diagnostics, to drug-delivery technologies that could potentially improve compliance with drug regimens for long-term conditions such as TB.

During the past year, a high-tech bio-safety level 3 research facility for research on highly-infectious pathogens such as HIV and TB was commissioned. The synthetic biology emerging research area put in place a world-class capability in automated imaging and high-resolution microscopy, as well as the requisite computational tools. Advances in the nano-drug-delivery programme to enhance slow release of TB medication, brought once-a-week treatment for TB one step closer. To facilitate the development of novel cures for TB, a compound library with more than 20 000 molecules was secured and robotic liquid-handling equipment installed to speed up the screening process.

The CSIR harnessed its capacity in infrastructure engineering design and logistics to design hospital buildings that will curb the spread of drug-resistant TB strains and facilitate the distribution of breast milk from donors to premature babies across the country.



Microscopic image of polymer particles, a proprietary technology underpinning the development of improved diagnostic technologies.

CSIR develops diagnostic tools using proprietary technologies

Low-cost, easy-to-use diagnostic technologies have been identified globally as a priority to enable more equitable healthcare provision and to reduce the burden of disease by reducing mortality and healthcare expenditure. Of particular interest are point-of-care diagnostic technologies, including lateral flow (test strip), and devices capable of diagnosing multiple diseases.

Diagnostic test-strips are considered true point-of-care diagnostic tools as these require little human intervention and are inexpensive and rapid.

The CSIR's synthetic biology emerging research area has embarked on a project to improve the sensitivity of the technology used in diagnostic test strips. The development of this technology can lead to earlier diagnosis, which can significantly reduce disease mortality and assist in disease management in impoverished countries. The project will first focus on developing diagnostic tests for the malaria parasites to prove the concept.

The CSIR has further partnered with the University of Cambridge to develop a technology for the quantitative diagnosis of multiple diseases at the point-of-care. The device is aimed at addressing the stringent requirements for application in resource-constrained environments.

If successful, the technology will allow for simple, rapid and reliable diagnosis of multiple diseases at low cost; with low energy requirements. The device requires the successful integration of proprietary technologies from the CSIR/Cambridge collaborative partnership.

DEVELOPMENT OF THE TECHNOLOGY CAN LEAD TO EARLIER DIAGNOSIS, WHICH CAN SIGNIFICANTLY REDUCE DISEASE MORTALITY AND ASSIST IN DISEASE MANAGEMENT IN IMPOVERISHED COUNTRIES

The nanoscopy platform is able to perform routine super-resolution of single biological molecules.

Nano-drug-delivery researchers measuring the size of nanoparticles.

World-class, super-resolution microscopy systems developed

CSIR bioscientists have developed sophisticated microscopy systems of an international standard. These systems have tremendous potential for understanding cellular biology and will enable researchers to study and better understand the fundamental processes that occur when a cell becomes infected.

Understanding the cell biology will lead to the development of novel and improved methods for fighting diseases.

With the emergence of routine nanoscopy techniques, it has become possible to study cells at a detailed level with high resolution. For the first time individual viral particles or bacterial structures, which are very small in size, can be seen. Nanoscopy also offers new possibilities such as single molecule detection in areas such as molecular diagnostics.

One step closer to once-a-week TB treatment

Significant breakthroughs have been made in the CSIR's tuberculosis (TB) nano-drug-delivery programme. Pre-clinical trials have confirmed that the scientists are on the right track to provide TB patients with a once-a-week drug regime instead of their current once-a-day dose. The study demonstrated that TB drugs given once a week over a four-week period were just as effective as daily doses of the drug over the same period. Four different types of TB drugs are encapsulated in nano-sized polymeric particles. The drugs are taken orally and the particles end up in systemic circulation in the body for a longer period. This enables a sustained release into the body over longer periods with a gradual uptake of the antibiotics into the cells.

CSIR researchers hope to prove that the nano-drug-delivery method will use less medicine over a shorter period of time and with lower frequency. This should reduce drug side effects, make drugs more effective and therefore encourage patient compliance.

Medicinal plants and essential oils – opportunities from nature

During the 2009/10 financial year, the CSIR was directly involved in approximately 12 essential-oil and medicinal-plant projects. These projects are at various stages of development – piloting, incubation or establishment. The typical technologies involved relate to cultivation, irrigation, harvesting, distillation, drying, production and business management.

Although South Africa has rich flora assets, the essential-oil and medicinal-plant sector is poorly developed due to farmers' insufficient access to technology and services to compete in the agro-processing market. Funding from the Department of Science and Technology for a 'Farmer-to-Pharma' project has enabled the CSIR to assist in this field. Some examples are:

Improving drying equipment for medicinal plants

Herb-drying methods in the food-processing industry are not suited to the techniques required for treating indigenous medicinal plants. Research into cost-effective drying techniques was commissioned based on solar energy which will retain the physical and chemical properties of harvested medicinal plants. The outcome is set to improve drying equipment on a number of community farms.

Establishing a cultivation process

A cultivation process for the scarce indigenous medicinal plant, *Pelargonium sidoides*, was successfully established in the Eastern Cape.

Medicinal products based on *Pelargonium sidoides* have a long tradition of use in countries in the European Union for treatment of bronchitis and, in particular, respiratory tract infections. Medicines appropriate to African diseases are being investigated. The new methodology includes pollination of the flowers by hand and germination in nurseries before plant cultivation continues in open fields.

The project, overall, is extremely labour intensive and subsequently offers good employment opportunities. The novelty of the process has provided scope for learning for young horticulturists, chemical analysts and natural product chemists.

Investigating propagation methods

The CSIR has successfully investigated and proved propagation methods for three indigenous medicinal plants with scientifically-proven medicinal properties. These plant species are the subject of ongoing bioprospecting research at the CSIR. Successful development of these species, which are endemic to the arid zones of the country, promises to create new opportunities for economic stimulation in remote areas of the country where few job opportunities exist.

The essential-oil and medicinal-plant sector is poorly developed due to farmers' insufficient access to technology and services to compete in the agro-processing market.

A new CSIR methodology for cultivation of medicinal plants includes pollination of flowers by hand and germination in nurseries before plant cultivation continues in open fields.

Crab shell nanofibres assist in wound healing

Chitosan, a derivative of crab shells, is being researched by the CSIR for use in bandages and to develop low-cost, high-performance, nanofibre-based wound dressings.

Researchers have found that chitosan nanofibres have favourable antibacterial activity against *S.aureus* and *E.coli* bacteria, commonly associated with wounds.

The nanofibres are produced from a polymer solution by introducing electrostatic fields into the solution through a process known as electrospinning.

Combinations of electrospun chitosan nanofibres with traditional textile wound dressings may improve the functionality of these dressings, while providing a lower-cost alternative to advanced dressings.

The fibres can also be used in tissue engineering and food and filtration applications, among other uses.

Electrospun chitosan nanofibres that have been found to have certain antibacterial properties.

Study shows danger of DDT when combating malaria

In a study funded by the Water Research Commission, researchers from the CSIR and the University of Pretoria have found disturbingly high levels of DDT and one of its byproducts, DDE, in the water, sediment, soil, vegetables, chicken and fish meat of the Vhembe District Municipality in Limpopo, bordering Zimbabwe and Mozambique. According to the Limpopo Malaria Control Programme, this area has been sprayed with DDT annually since 1966.

The health risk assessment indicates that the potential for serious health effects exists if people are exposed to affected water and selected food from the test areas, as well as part of the control areas. These possible health effects include neurological, reproductive and developmental effects.

The CSIR study reinforces the findings of a group of international researchers who reviewed 494 studies that investigated human exposure to DDT and DDE. They found that DDT may pose a risk to human health and recommended that the World Health Organization reconsiders its recommendation for allowing DDT in certain cases.

In South Africa the use of the powerful insecticide DDT is allowed for malaria control in high-risk areas such as KwaZulu-Natal and Limpopo.

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STUDIES ON HUMAN EXPOSURE TO DDT AND DDE INVESTIGATED BY INTERNATIONAL RESEARCHERS

Breastmilk from donors has been distributed to micro-premature babies.

A milk bank or corner established at one of the participating hospitals.

Supply-chain skills to assist in getting breast milk to micro-premature babies

A CSIR project is supporting the expansion of the South African Breastmilk Reserve network through research aimed at facilitating the successful transportation of breast milk from donors to participating hospitals.

A premature baby, younger than 14 days and weighing less than 1,8 kg, is highly susceptible to a number of possibly fatal infections. Healthy donor breast milk strengthens the immune system of the baby, effectively helping the infant survive the first two weeks of life.

The reserve facilitates the collection, pasteurisation and distribution of healthy donor breast milk to micro-premature babies. The main stumbling block to the reserve's expansion strategy was the transportation of breast milk from donors to participating hospitals at the appropriate temperature.

In the first research phase, scientists used business-process engineering and supply-chain design to develop a successful expansion strategy into all the provinces. Four alternative transportation models were also recommended.

During the next research phase, each alternative solution will be developed in detail and economic and strategic analyses performed to determine which is the best and most sustainable.

This CSIR research is one of five sub-projects included in the Department of Science and Technology's humanitarian logistics and humanitarian operations research project.

IN THE FIRST PHASE, SCIENTISTS DEVELOPED A SUCCESSFUL EXPANSION STRATEGY INTO ALL THE PROVINCES AND MADE RECOMMENDATIONS ON FOUR ALTERNATIVE TRANSPORTATION MODELS

Voluntary healthcare workers collect data on the five vital signs of patients and send the information to clinics using their cellphones.

Improving healthcare for patients in rural areas through ICT

The CSIR piloted research to assist a rural community with improved healthcare through an intervention using information and communications technology (ICT). Volunteer healthcare workers provide basic medical assistance to rural patients, visiting them at home on a daily to weekly basis.

Healthcare workers in the Leroro area in Mpumalanga are the direct link between patients and medical staff. Medical staff and institutions require data on the five vital signs – blood pressure, pulse, temperature, blood sugar and weight – for effective patient monitoring and early diagnosis. The challenge was to transfer the captured information to the nearest medical institution.

The system that was designed is a robust and affordable ICT system. It enables communication between 12 caregivers and medical staff at the two local clinics participating in the pilot. As volunteer healthcare workers interact with patients, they use their existing, familiar cell phones to send the vital-sign information *via* an ICT-enabled system with a preset menu that guides them through the process.

The benefit derived by the community is evident in a transcript of an interview with a caregiver in Moremela village in March 2010, "Since I started using this system I am able to see a lot of patients. Today I already managed to see 14 patients, which is the highest number for me yet. Previously, I had to walk to the centre and the clinic to submit reports, but now I can spend the entire day with patients."

HEALTHCARE WORKERS CAN NOW SEND PATIENTS' VITAL-SIGN INFORMATION TO THE NEAREST MEDICAL CENTRE *VIA* AN ICT-ENABLED SYSTEM

industry

Advanced manufacturing

CSIR research in support of strengthening the country's industrial competitiveness focuses on advanced manufacturing and mining.

Manufacturing is the second largest contributor to GDP in South Africa. The sector contributes some 18%, more than 50% of exports and employs about 1,7 million people. Declines were evident in all manufacturing sectors in 2009 due to the global recession.

There is a broad realisation that South Africa's economic growth will not be sustainable on the back of raw material-driven exports only, and that it is imperative to continue to develop a diversified, export-orientated manufacturing base. The continuing emergence of low-cost manufacturing locations in Asia leaves little choice but to move into higher value-added activities such as product R&D, design, high-end manufacturing and product integration. There has already been a marked increase in the introduction of high-end manufacturing and product tooling equipment in South Africa.

The CSIR made significant contributions in 2009/10 to improving industry competitiveness through strengthening its R&D competences and developing and transferring technologies to improve the competitiveness and sustainability of the South African manufacturing industry. R&D competences that continue to be strengthened and which serve as platforms for developing and transferring solutions to industry include robotics and mechatronics, advanced machine design, micro-manufacturing, bioprocess development, laser-based manufacturing, processing of light metals and clean production technologies.

New materials provide opportunities for industry development and for the creation of entirely new manufacturing industries. The CSIR continues to strengthen its R&D capability in advanced materials, with a focus on smart materials, nano-structured materials, light metal alloys and fibre-based composites. A key element of the advanced materials strategy of the organisation is to add value to local raw materials with the aim of developing new or improved products (and associated changes in manufacturing technology) that offer opportunities for industry development and the establishment of new industries.

Mining

In 1994, the democratic government started to deliver on the desire expressed in the Freedom Charter that the people of South Africa should own its mineral resources. The Minerals and Petroleum Resources Development Act put in place the legislative framework and now all mineral resources in South Africa belong to its people.

The task of the CSIR's mining research impact area is to increase the wealth that the nation receives from its mineral resources, while lowering the cost to individual miners in terms of health and safety. This is achieved through:

- Research that improves the working environment in mines and could halt the progress of silicosis and noise-induced hearing loss with their related suffering;
- Research into the causes and prevention of accidents, particularly accidents unique to our mining environments, such as rockbursts and rockfalls (which kill or maim many miners each year);
- Development of tools and techniques that can assist the industry to mine more cost effectively, extending the life of mines, allowing them to continue providing jobs and contributing to the economy.

The following highlights reflect the CSIR's efforts to understand the culture in mines, to encourage safe behaviour; understand the causes of rockfalls and provide tools that can warn of impending danger from rockfalls; and to lower the costs of pumping slurry through innovative instrumentation. The CSIR also contributes to the debate on the 'use it or lose it' principle enshrined in the Minerals and Petroleum Resources Development Act.

Progress made to develop competitive titanium industry

A hub of the Titanium Centre of Competence is being established at the CSIR to support the long-term goal of establishing a competitive titanium industry in South Africa. This will span the entire value chain, from primary production to the manufacture of final components.

To date, the Department of Science and Technology and the CSIR have invested in research and development (R&D) under the Light Metals Development Network of the Advanced Metals Initiative to develop a range of competencies in support of South Africa's entry into this lucrative and growing industry. This has resulted in the development of breakthrough technological capability in the area of primary titanium metal production, which must be developed to become an attractive commercial opportunity.

These R&D initiatives, as well as component manufacturing technologies under the Light Metals Development Network have now been consolidated in the Titanium Centre of Competence. The intention is to have a fully institutionalised centre from 2010 onwards and to establish a 500 ton semi-commercial titanium metal powder-production facility by 2013/14 that can attract private-sector interest in establishing a 20 000 ton full-scale plant by 2018/20.

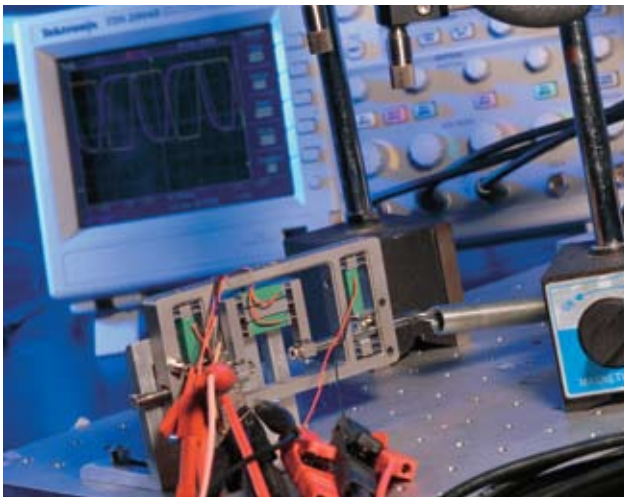
These tiny model train wheels made from titanium are examples of parts with intricate shape, size and design that can be manufactured through metal injection moulding, a powder metallurgy technology.

Smart UAS wing automatically controls wing profile during flight

CSIR researchers are building an unmanned airborne system (UAS) wing demonstrator that will be tested in the CSIR wind tunnel when completed. This demonstrator is being built from smart materials that actively control the aileron position, or wing profile, of the UAS during different phases of flight. It makes use of the piezoelectric effect, which enables a smart material to convert a mechanical energy into an electrical energy and the other way around.

As this technology reduces the number of parts needed on a UAS, it makes the system lighter and more fuel efficient. Use of the smart actuation system furthermore requires less energy to operate, which is a particular advantage for UASs as this improves flight time.

The CSIR is a leader in South Africa in UAS R&D for civilian applications. Its use in, for instance, long-range border surveillance, persistent monitoring of maritime traffic, airborne fire detection and communication relay functions can drastically improve the safety of our country's people and natural resources.



The UAS wing demonstrator makes use of the piezoelectric effect, enabling a smart material to convert mechanical energy into electrical energy an *vice versa*.

Fire-resistant, better flowing paints and coatings

Researchers at the CSIR-hosted National Centre for Nanostructured Materials have shown that the inclusion of only 2% of nanoclay particles (equal to about one teaspoon of sugar to a cup of coffee) dramatically changes the inherent properties of polymer-based composites – including paints and coatings.

The addition of these particles makes the paint and coatings become both UV and fire resistant, as well as improving its rheological behaviour (making it flow better).

Nanoclays can act as flame-retardant fillers by moving to the surface of the polymer and forming a coating that acts as a heat shield. In addition, chemically-modified nanoclays may act as a binder (compatibaliser) between otherwise unmixable polymers.

The centre, which is one of the Department of Science and Technology's innovation centres, is currently jointly developing this technology with a local paint producer and is negotiating the transfer of the technology.

To assist efforts in developing nanomaterials for industry use, the centre has acquired a piece of equipment, called a batch extruder, that can produce 30 kg per hour of the required composite material.

This will allow the upscale of laboratory-produced nanocomposites by producing small batches that can be tested in extruders and injection-moulding processes in industry.

The first product to follow this route will be nanoclay/polypropylene-advanced composite materials. Polypropylene can be sourced from plastic waste.

0,000 000 001 m

THE SIZE OF ONE NANOMETRE

Nanotechnology experts have shown that adding 2% (in weight) of nanoclay particles changes the inherent properties of polymer-based composites, such as paint.

A demonstration of a world-first laser cladding system that offers a permanent solution to sealing leaks and repairing cracks at power stations.

A CSIR researcher aligns a laser as part of a laser-based heating system for diamonds.

Laser welding seals large water vessel leaks *in situ*

The CSIR has developed a patented laser weld overlay process that enables the sealing of cracks in large water-filled vessels *in situ*. In addition, researchers have demonstrated this technology as a mobile laser system capable of scaling vertical walls with a height of up to 20 m. This technology and system were developed in partnership with Eskom's Research and Innovation Division.

The ability to seal leaking cracks *in situ* poses a major advantage over other repair processes, which typically require that water-filled vessels are drained before repairs can be effected. This imposes downtime on processes of which the leaking vessels form a part. Conventional arc-welding repair procedures cannot be applied on wet surfaces since the presence of moisture will result in arc instability and induce porosity in the weld metal. Neither do arc-welding processes offer the same level of control as a laser-based cladding process.

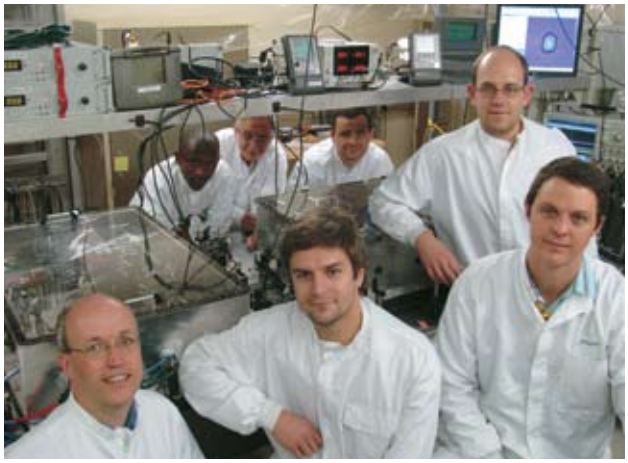
A patent application was filed for the technology and the research team has received a positive report from the International Search Authority. Implementation and transfer of the technology to Eskom is expected in 2010.

CSIR develops a laser-based diamond heating system

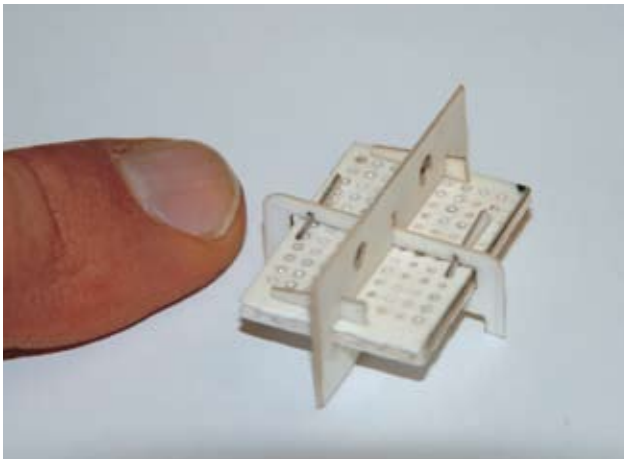
Industrial diamonds have found wide commercial acceptance in the drilling industry since their introduction more than three decades ago. Drill bits equipped with industrial diamonds now account for a significant portion of the total footage drilled, due to the effectiveness in drilling soft to medium formations at relativity high penetration rates.

Element 6, a global leader in supermaterials, approached the CSIR with a request to develop a laser-based heating system that can be used to study the thermal stresses that occur in industrial diamond-based cutters during rock drilling.

Researchers at the CSIR have demonstrated an accurate laser-heating system for diamonds. The technique enables the accurate determination of uniform temperature and gradient temperature profiles across diamond surfaces by optical means using grey body emissions from the target. Knowledge of the mechanism of temperature-induced damage in diamond tools is critical to improve tool performance for applications in harsh natural environments.



A high-energy laser will enable engineers to develop new manufacturing technologies for materials processing.



Holding device developed by the CSIR for holding 500 µm spheres for processing and heat treatment up to 2 000 °C.

World record-breaking laser developed at CSIR

CSIR laser researchers have demonstrated a new architecture to produce high-energy laser pulses in the mid infra-red spectral region. The architecture is based on existing laser sources, which have never been used together, to produce high-energy laser pulses in this spectral region.

This invention will enable engineers to develop new manufacturing technologies for materials processing using this laser. Examples of application possibilities include more efficient cutting and welding of plastics, cutting of ceramics, and utilisation in many other laser-based processing techniques.

The Tm:YLF slab laser was used to pump a high-energy Ho:YLF slab amplifier. This was seeded by the previously reported single-frequency Ho:YLF ring laser operating at 2064, 12 nm, locked to a molecular absorption line, which in itself was also a world-leading result. This system produced in excess of 200 mJ per pulse, which is a new world record for a pulsed mid-infrared laser with this geometry. The combination of these technologies for the amplifier system has demonstrated a high-energy 2 µm laser suitable for a number of applications in defence, monitoring of the natural environment and as an advanced technology that can be used in the health and material processing sectors.

CSIR develops technology for micro processing and sealing of ceramic materials

Micromachining of brittle ceramic materials remains a challenge. At the CSIR, laser researchers completed a development project for the PBMR (Pebble Bed Modular Reactor) on a novel drilling and sealing technology for ceramic materials using lasers. This technology enabled the PBMR to develop not only an analytical technique to study diffusion at elevated temperatures, but also the gas-tight sealing of ceramic material at temperatures above 1 000 °C. Sealing by using laser-manufactured plugs was one of the sealing processes considered.

The research team used Nd:YAG technology to develop a process to machine cylindrical cavities with diameters of 0.25 mm. Laser-manufactured conical plugs with dimensions 0.25 mm diameter and 0.25 mm length were machined in a grid container configuration to subsequently seal the holes. Several hundred of the machined ceramic micro-plugs were processed. The knowledge gained through this project again confirmed that laser technology can be used to treat and process brittle materials such as ceramics, which is very difficult to process using conventional manufacturing technologies. This technology supported the PBMR's fuel optimisation process.

CSIR develops robot for search-and-rescue mission support

CSIR researchers are working on an autonomous mule project aimed at developing a platform to carry heavy loads for personnel on foot.

The platform can be taught to follow various targets, either a person or possibly another vehicle. The autonomous mule will also have the ability to return to previously visited locations. This allows a human operator to train the mule to navigate safely in complex environments.

Applications of the mule range from military usage, such as border patrol and troop support to civilian applications, such as search-and-rescue missions or transportation.

The rover is being used as the base platform in the Mule project. CSIR researchers have integrated cameras, laser scanners and GPS modules to enable it to perceive its environment.

Helical sewing machine transferred to backfill company

A CSIR-developed and patented helical sewing machine has been given to a backfill bag company, Quickstitch, in Fochville as part of a technology-transfer initiative. Backfill bags are used in the mining industry to dispose of silt and other waste products, after which these are used as support structures in mining operations.

The machine sews backfill bags in a helical fashion. It remains stationary while the sewing head runs across the width of the fabric during sewing. This mechanism results in a quick and productive method of linking fabrics together and provides a bag with a higher strength than conventionally manufactured backfill bags. Recent tests revealed that it provides a probable 30% higher seam strength.

This technology-transfer initiative is one of the first completed by the newly-established CSIR Fibres and Textiles Industry Support Centre in Port Elizabeth.

The CSIR, as part of a technology-transfer initiative, developed and patented a helical sewing machine that was given to a backfill bag company.

Boosting small business in the Western Cape

The CSIR is involved in approximately eight enterprise-development projects, in various stages of implementation across five regions in the province. These projects are funded by the Provincial Government of the Western Cape through its Rural Economic Assistance Fund (REAF) programme. Estimated annual turnover from these projects is expected to grow to R14 million in 2010/11. The average historically disadvantaged individual ownership of REAF projects is 85%, of which 42% are women. Currently 207 beneficiaries are supported in the businesses outlined below.

Subsistence fishermen's earnings improved

The Doornbaai rock lobster holding facility has improved the earnings of small subsistence fishermen and was recently hailed by the Minister of Economic Development, Mr Ebrahim Patel, as exemplary in the small business development domain. A new holding facility incorporating fibre-glass tanks and an international packing room has been established. Ten co-operatives with a total of 105 subsistence fishermen now own a company that processes and packs their products before marketing these to the retail sector. This will considerably increase their income as well as the sustainability of their operations.

Jam supplier's facilities expanded

Intaba Jam became a fully-fledged supplier to Woolworths of its own product range. The CSIR assisted with the expansion of the facilities and the introduction of food-quality measures into the production processes. In addition to its traditional markets, Intaba supplies jam to the value of R2 million per annum to Woolworths and plans are in place to increase volumes.

Environmentally-friendly charcoal generates economic returns

New sources of energy are high on agendas around the world. Overberg Charcoal, near Bredasdorp in the Western Cape, is an example of achieving a positive environmental impact while generating economic returns. The project is undertaken in conjunction with the Agulhas Biodiversity Initiative. Alien vegetation is removed in terms of the government's Working for Water programme. Waste from the local sawmill is used to produce charcoal in a low-emission process. The end product is a chemical-free, long-burning, low-ash and low-smoke charcoal for local and international markets. The majority shareholding in the company is reserved for B-BBEE partners and a local NGO, Flower Valley Conservation Trust. There is considerable scope to replicate this business in other areas of the country.

Improved facilities and production cycle benefit local fish company

Dried and smoked fish company, Smokey Fish Traders, had a fresh start through assistance from the CSIR. The company now operates a computer-controlled smoke house in a Hazard Analyses and Critical Control Points-compliant factory. REAF project funding was used to relocate the business to an industrial park and to set up a modern, hygienic production facility. The production cycle has been reduced from the previous two days to approximately two hours. The business is formally registered and runs as a self-sustaining operation offering quality products, improved working conditions and reduced environmental impact. Staff have a 40% shareholding *via* an employee's trust that is being formed.

Other projects

Other projects in the Western Cape include mussel farming, pomegranate farming, hydroponics and essential oil production. New sectors and technology packages are constantly being investigated for entrepreneurial possibilities and opportunities in areas of low economic status. These include natural fibres, clean drinking water, aloe cultivation and processing, renewable energy, fruit processing, medicinal plants and cosmetics.

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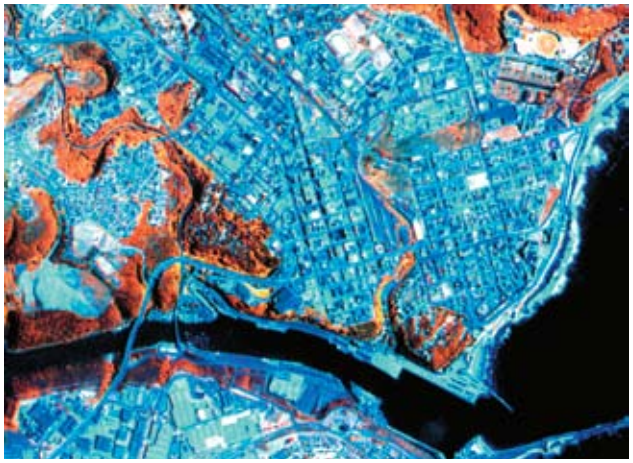
BENEFICIARIES SUPPORTED BY ENTERPRISE DEVELOPMENT PROJECTS



SumbandilaSAT, South African owned and manufactured earth observation satellite, launched in 2009, has an optical instrument that consist of six multi-spectral bands with a spatial resolution of 6,25 m each. The image was taken over the East London area on 3 February with an area coverage of 40 x 40 km.

The CSIR's satellite expertise is increasingly in demand as shown by the record number of launch reports during 2009.

CSIR takes over mission control of SumbandilaSat

The mission control of South Africa's second satellite, SumbandilaSat, has been transferred to the CSIR. Responsibilities include carrying out the operation and control, as well as image download by tracking the satellite using a large dish antenna.

The CSIR also downloads telemetry (remote measurement and reporting of information), processes the data and schedules all activities. This is followed by data analyses and the distribution of results.

The 81 kg microsatellite, which is about 1 m x 0,5 m in size, lifted off into space on 17 September 2009 from the Baikonur space base after it was integrated into the Russian Soyuz rocket. The satellite development programme was commissioned by the Department of Science and Technology in 2005 and carried out by Stellenbosch University's Engineering Faculty.

SumbandilaSat will provide South Africa with valuable information that will assist in the effective management of disasters (floods and fires), food security (crop-yield estimation), health (prediction of disease outbreaks), safety and security, water resources and energy security. The satellite orbits about 500 km to 600 km above the Earth.

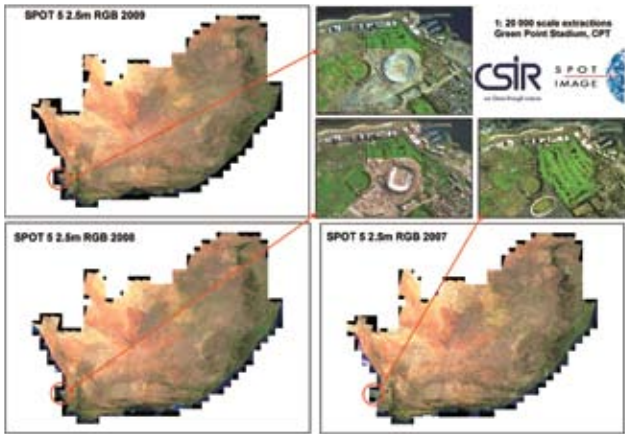
CSIR sets new record for launch supports in 2009

The CSIR set itself a new benchmark when it notched up over 20 launch supports for satellites in 2009.

The launch supports undertaken by the tracking, telemetry and command group started in February 2009 and ended on 29 December 2009. The last two months of the year proved to be the busiest with eight scheduled launches.

The satellites that the CSIR helped to put into orbit have many different uses, for example telecommunications, satellite radio broadcasts, television broadcasting and earth observation. The centre also helped put missions such as the Kepler mission and the Wide-Field Infrared Survey Explorer into space.

The launch team's experience and expertise stood it in good stead for the highlights of the year – the tandem support of NSS-12 and THOR-6 in October as well as W7 and IS-14 in November. In both cases, the satellites were acquired on time after injection and separation from the launch vehicle.



Users of satellite imagery typically employ these for critical planning purposes.

A very high resolution image of the CSIR and surroundings taken by the World View 2 USA satellite (0,5 m spatial colour resolution).

Fourth high-resolution colour mosaic over South Africa released

The CSIR has produced its fourth annual SPOT 5 2,5 m natural colour spatial resolution mosaic over South Africa. The imagery is distributed under a multi-government licence to CSIR stakeholders, government departments, academia and research institutions.

These users typically employ the imagery for critical planning purposes across various sectors such as public health, disaster management, land and water management, national security, agriculture and forestry, housing development, as well as postgraduate research addressing application development, general cartography, change detection and environmental monitoring.

To produce this mosaic implies complex, time-consuming and data-storage challenges. Various processes need to be followed in order to produce a final quality product. During the past financial year, 1 444 images were validated according to quality specifications and 3 966 images were rejected due to clouds or high-noise levels.

The Department of Science and Technology, the Department of Water Affairs and the Department of Environmental Affairs assisted in the funding of the 2009 mosaic. In another positive development, the contract between the CSIR and Spot Image, France, was renewed for another three-year operational term. The 2010 and 2011 coverages can thus be expected in the near future.

1 444

SATELLITE IMAGES VALIDATED

USERS EMPLOY SATELLITE IMAGERY TO PLAN IN AREAS SUCH AS PUBLIC HEALTH, DISASTER MANAGEMENT, LAND AND WATER MANAGEMENT, NATIONAL SECURITY, AGRICULTURE AND FORESTRY, HOUSING DEVELOPMENT

Working towards safer mining

The CSIR is contributing to safer mining through a major rockfall risk management project undertaken for the Mine Health and Safety Council. The project has resulted in a complete in-stope measurement system being deployed at Driefontein gold mine. The system uses the CSIR's AziSA architecture for underground sensing and communications and includes a number of sensors to monitor the condition of the roof:

- Closure meters monitor the closure of the working area under the pressure of the rock above – unusual closure is often a harbinger of rockfalls;
- A seismic sensor measures local seismic activity, which may be an immediate precursor to rockfalls; and
- Mobile sensors are used by miners to examine the roof, including electronic sounding devices and thermal imagers, which have their position tied into the sensor network by ultrasonic beacons.

The system has started to return data, which will now be used to determine which parameters are key to estimating the risk of rockfall and should therefore be used routinely in mines.

The mobile sensors can also be deployed independently, to assist individual miners or crews in ensuring that the roof of their working place is safe. The electronic sounding device has proven its worth in a trial of more than 500 test cases and is being considered by two mining companies for operational deployment.

Another major project to facilitate safer mining through better understanding the process underlying earthquakes has been initiated by the Japan Science and Technology Agency and the Japan International Collaboration Agency. The project is being undertaken by a consortium of Japanese universities, the Council for Geoscience and the CSIR. The CSIR's specific focus is to understand the effect of seismic events on mining excavations. The CSIR is currently preparing to install instrumentation on active faults in four mines: Driefontein, Mponeng, Moab Khotsong and Ezulwini, in an attempt to record the occurrence of an earthquake.

Rockfalls are a life-threatening reality in mines. An in-stope measurement system for underground sensing and communication, which also includes a number of sensors to gauge the condition of the roof, was developed by the CSIR.

CSIR autonomous vehicle to assess safety of mines

Researchers from different domains at the CSIR are collaborating on a mining safety platform project.

The objective of the project is to create an autonomous vehicle capable of assessing the safety of a mine after blasting and during the period when toxic fumes make access for humans dangerous.

Researchers believe that use of the platform could enhance safety for miners and that the system may contribute to increased productivity of mines.

The autonomous vehicle is required to navigate different terrains in the mine.

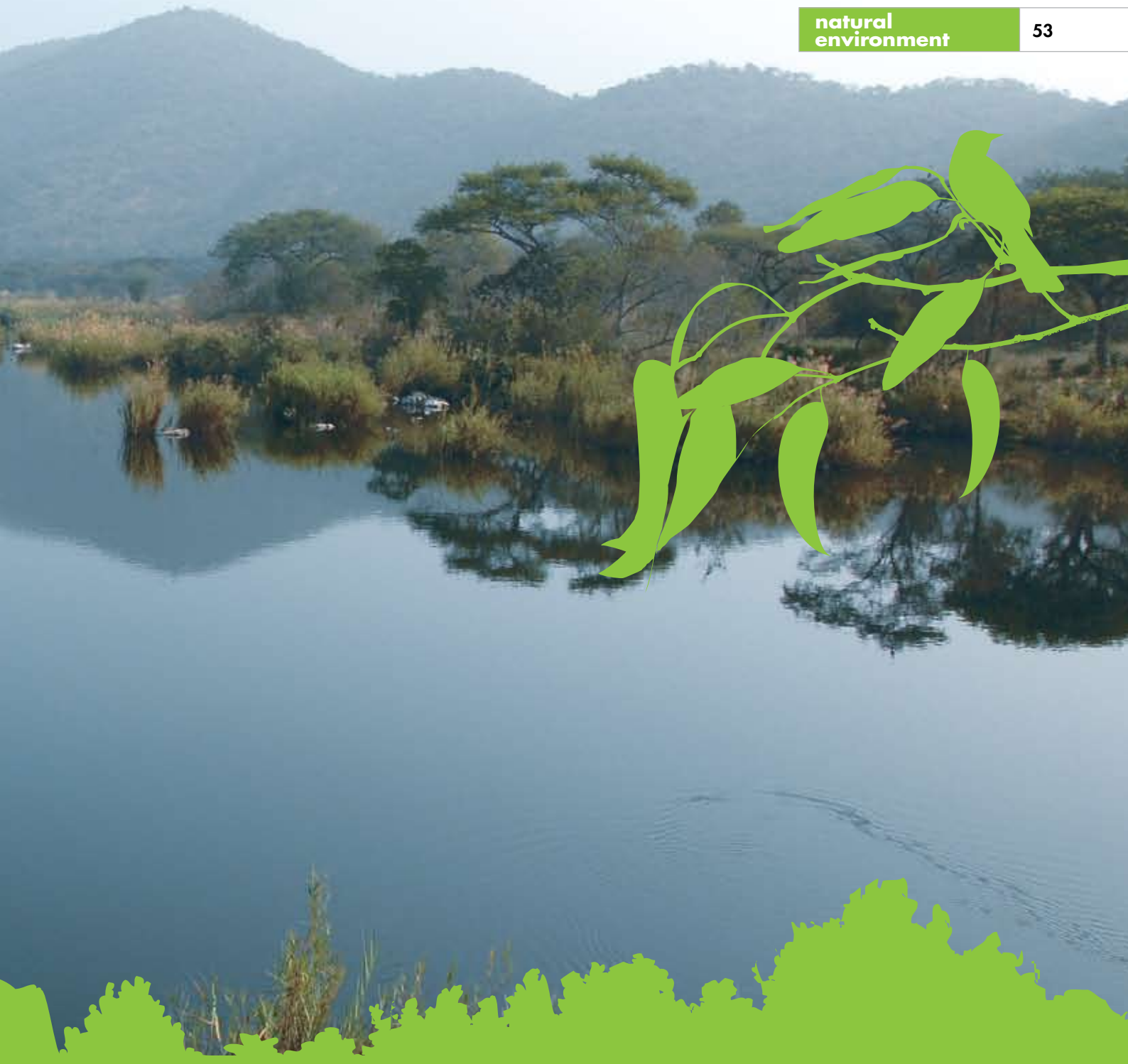
Mponeng Gold Mine is one of the mines earmarked for receiving technology assistance from the CSIR (see article opposite page). The CSIR's mining research, such as the automonous rover, aims to improve the safety of miners in South African mines. *Photo courtesy of AngloGold Ashanti.*

natural environment

Sustainable development is a worldwide conceptual framework for development which recognises the interdependence between economic growth, social equity and environmental integrity. In this framework, social, economic and ecosystem factors are integrated and underpinned by systems of governance.

South Africa faces substantial developmental challenges. Poverty, unemployment and inequality persist at serious levels and the country has limited natural resources to support development.

Sustainable development strategies and spatial configurations across the many sectors of South African society require coherent projections of population, resource consumption, service demand and impact for 10 to 50 years into the future. The policy environment is one of the key drivers for planning these scenarios, but the lack of a formal, sustained structure for evaluating integrated future strategies and the associated long-term consequences lead to uncoordinated development between sectors. This is neither efficient nor accurate, as simultaneous demands are being placed on finite resources that fail to include feedback effects from one sector to another.



The CSIR's natural environment research and development strategy aims to develop a CSIR capability to engage in strategic (core national) dialogues on resource-based development. This will build on the established CSIR track record of solving problems and supporting policy in many aspects of resource management.

The projects highlighted in this section reflect some of the research conducted within the research impact area to ensure the wise use of and a safe future for our natural resources. In many instances, particularly in the water sector, our work provides guidelines and international best-practice to enable informed decision- and policy-making. Additional work in the water sector includes assessments of water quality in, among others, the Olifants River; determining the ecological status of the Waterberg prior to the operation of new power plants in the area; water conservation guidelines in buildings; a proposed framework on how to test for endocrine-disrupting chemicals in water; research into freshwater ecologies; and methodologies for managing shared (transboundary) freshwater resources.

Water quality problems in the Loskopdam in Mpumalanga holds far-reaching consequences for irrigation farmers downstream producing fruit and vegetables for export and large retailers in the area.

Aquatic invertebrates from the Upper Olifants River catchment are caught to test for the bioaccumulation of heavy metals in the CSIR's laboratory in Stellenbosch.

Understanding a catchment to save a river – the case of the Upper Olifants River

The CSIR is leading a multidisciplinary group of 30 researchers in a three-year research project to assess the eutrophication and chemical pollution of one of the hardest-working – and also most polluted – rivers in South Africa, the Olifants River.

Funded by the Olifants River Forum, the research team is looking at aspects such as river health, fish and insects, biodiversity, riparian vegetation, atmospheric deposits, water bacteria, water quality, bioaccumulation of heavy metals, nanomaterials, isotope analysis and ecotoxicology to assess the ecological status and health of the river ecosystem.

Since November 2009, different research teams have been sampling 16 different sites in the Upper Olifants River catchment and another five sites in Loskop Dam every six to eight weeks.

The problems facing the research teams are complex and preliminary results show high levels of pollution from mining, agriculture and industry, as well as nutrients and microbiological contamination originating from poor sewage treatment and feedlots.

The catchment of the Olifants River rises in the Highveld grasslands and covers some 54 570 km². It provides water to more than 200 dams, most of which are used to irrigate about 110 000 hectares. The study includes Loskop Dam as it provides water to the second-largest irrigation scheme in the country and water quality problems hold far-reaching consequences for farmers producing fruit and vegetables for export and large retailers.

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SITES IN THE UPPER OLIFANTS RIVER CATCHMENT SAMPLED EVERY SIX TO EIGHT WEEKS

54 570 km²

AREA COVERED BY OLIFANTS RIVER CATCHMENT

200

DAMS RECEIVING WATER FROM THE OLIFANTS RIVER

110 000 ha

IRRIGATED BY WATER FROM THE 200 DAMS

View of the defunct West Wits opencast mine workings outside Krugersdorp showing erosion gullies.

Pristine dolomitic landscape in the John Nash Nature Reserve in the Cradle of Humankind.

Monitoring the impact of acid mine water on the Cradle of Humankind

The South African mining sector is a critical pillar and driver of the South African economy. However, mining activities are also associated with environmental contamination such as acid mine drainage.

Acid mine drainage is highly acidic water, usually containing high concentrations of metals, sulphides and salts as a consequence of mining activity. Drainage from abandoned underground mine shafts into surface water systems (decant) may occur as the mine shafts fill with water. Although the chemistry of acid mine drainage generation is straightforward, the final product is a function of the geology of the mining region, presence of micro-organisms, temperature and also of the availability of water and oxygen. These factors are highly variable from one region to another, and, for this reason, the prediction, prevention, containment and treatment of acid mine drainage must be considered carefully and with great specificity.

In one project, CSIR geohydrologists are keeping a close eye on the impact of acid mine drainage on surface water and groundwater resources in the Cradle of Humankind World Heritage Site.

The Western Basin outside Krugersdorp started decanting in late January this year. Partly-treated and raw mine water discharges into the Tweelopie Spruit, which then flows through the reserve and beyond, where it enters the dolomitic Zwartkrans Compartment and the southern portion of the Cradle of Humankind. Apart from mine water, the area is also impacted by municipal wastewater effluent.

Tasked by the Cradle's management authority, the CSIR leads a joint venture to establish a comprehensive surface and groundwater monitoring programme for the area. The study includes the development of a sound conceptual model of the groundwater regime in terms of flow directions, boundary conditions and water quality aspects based on historical information, long-term monitored data and new data and information. It is also developing a better understanding of the close relationship and interaction between groundwater and surface waters in the largely dolomitic environment. This is crucial for the implementation of a relevant and effective water resource monitoring programme. The study is also assessing the risk posed to the numerous UNESCO-inscribed fossil sites, such as Sterkfontein and Zwartkrans, by changes in the quality of surface water and groundwater.

The Cradle of Humankind is one of seven World Heritage Sites in South Africa and the only one in Gauteng.

Revamping SA's marine water-quality guidelines for recreation

South Africa is revising its recreational water-quality guidelines for coastal marine waters and the then Department of Environmental Affairs has commissioned the CSIR to assist in this process.

The aim is to bring the management of beaches along the country's 3 000 km coastline in line with international best practice while at the same time taking the unique geographic position and demographics into account.

The proposed new guidelines recognise that 'single' target values for microbiological indicators to classify recreational waters as either 'safe' or 'unsafe' are no longer appropriate.

Rather, applying target ranges linked to different risk levels is proposed, supporting the principle of informed personal choice and allowing authorities to set achievable improvement targets for high-risk areas.

In other words, recreational waters may be classified from 'fair' to 'excellent', leaving the user to then make a choice.

An important consideration of specific relevance to the South African situation will be the relatively large proportion of its population that is immuno-compromised and therefore potentially more susceptible to infection.

The interim guidelines will be subjected to an intensive stakeholder consultation process and pilot testing over the next two to three years.

3 000 km

SOUTH AFRICA'S COASTLINE

In terms of the new marine water quality guidelines for recreation proposed to the then Department of Environmental Affairs, users may be given the option of choosing between 'fair' to 'excellent' beaches, thereby taking the country's unique geographic position and demographics into account.

National estuarine management protocol developed for South Africa

As part of a Water Research Commission project on cooperative governance, the CSIR, with contributions from various leading authorities, initiated the development of a national estuarine management protocol (NEMP). This is a flexible, but legally defensible, protocol providing guidance to estuarine managers at all levels.

South Africa's estuaries have a diversity of management requirements, often unique to individual systems, and are governed by a variety of national and local authorities.

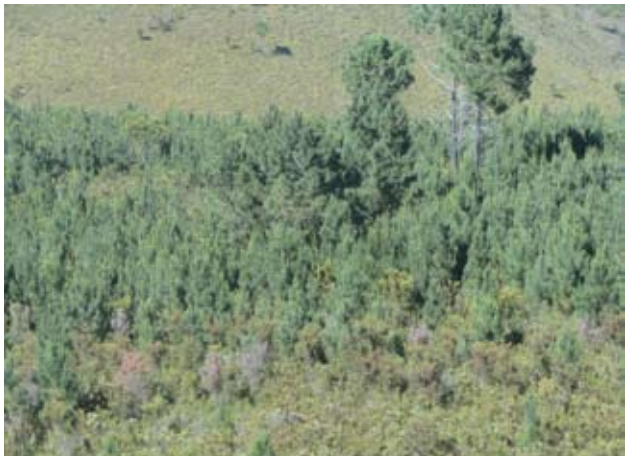
In addition, estuaries constitute one of the most utilised and productive zones on our planet. Estuarine management is a complex task, for it deals with the use and care of the interface between the land, rivers and the sea.

The NEMP framework follows an adaptive management approach, which requires the setting of a vision and resource objectives, the development of strategies, implementation, monitoring and an assessment of the results. The integrated approach will lead to better coordination of policy-making and management across sectors and geographically, facilitating a more rational use of resources and more effective environmental protection.

THE NATIONAL ESTUARINE MANAGEMENT PROTOCOL WILL PROVIDE GUIDANCE TO ESTUARINE MANAGERS AT ALL LEVELS

Managing estuaries is a complex task, as managers have to deal with the use and care of the interface between the land, rivers and the sea. *Photo courtesy of Roxanne Klein.*

An integrated approach to estuarine management will lead to better coordination of policy-making and management across sectors and geographically. *Photo courtesy of Roxanne Klein.*



Invasive alien pine trees are a large and rapidly growing threat to biodiversity and water generation in fynbos and grassland ecosystems in South Africa.

R152 billion

ANNUAL VALUE OF ECOSYSTEM SERVICES

R6,5 billion+

LOST ANNUALLY DUE TO THE EFFECT OF INVADING ALIEN PLANTS

Working for Water programme is showing success

The government's Working for Water programme is having a significant impact on the availability of water resources, especially in those provinces with aggressive invaders such as Black wattle, Eucalypt, Port Jackson, Pine, Lantana and Solanum.

Results from a CSIR study in the Western Cape and KwaZulu-Natal showed an annual decrease in water use of 13% and 6%, respectively, following the clearing of invasive alien plants in terms of the programme.

Combining remote sensing data with the Surface Energy Balance Algorithm for Land (SEBAL) model, CSIR researchers, in conjunction with Water Watch in the Netherlands, were able to estimate the water use of invasive alien plants spatially for three climatically different years in the provinces.

This is the first study to demonstrate the impact the Working for Water programme has on scarce water resources, using remote sensing and SEBAL technology.

The Working for Water programme was initiated in 1995 as a joint project between the then Department of Water Affairs and Forestry and the CSIR. It currently spends R600 million each year on providing over 20 000 jobs aimed at clearing invasive alien plants. It has received international acclaim as one of the world's biggest programmes on invasive species.

Biological control of invasive aliens saves SA billions annually

CSIR researchers for the first time provided a programme-level economic evaluation of the relative contribution of biological control to the overall control of invasive alien plants in South Africa. Biological control, as opposed to chemical or manual control, is (if executed properly) a safe and sustainable form of control that relies on insects and plant pathogens.

Ecosystem services based on water, grazing and biodiversity products are worth an estimated R152 billion per year. Roughly R6,5 billion of this amount was lost every year due to the effect of invasive alien plants. However, this loss would have been greater by approximately R41,7 billion, had no control been carried out.

The greatest measure of protection was achieved through biological control. The benefit:cost ratios associated with biological control ranged from 50:1 for invasive sub-tropical shrubs to 3 726:1 for invasive Australian trees. Currently, spending on biological control is far lower than that spent on other forms of control, despite the significantly higher returns on investment from biological control. The CSIR assessment suggests that higher levels of spending on biological control research would generate very attractive returns on investment.

The *South African Risk and Vulnerability Atlas* is now available in hard copy and online.

South African Risk and Vulnerability Atlas to inform global change solutions

The *South African Risk and Vulnerability Atlas*, a project initiated and funded by the Department of Science and Technology, is now available in hard copy and online.

The project is managed by the CSIR, with key content, intellectual and technological inputs from South African institutions and research groups. The atlas captures and links to data relating to key aspects such as groundwater, surface water, forests, biodiversity, human health, crops, demographics, economics and social dimensions.

It provides a vivid visual portrayal of South Africa and its changing environment. Images, photographs, as well as case studies and other narratives are included to inform global change adaptation responses and planning. The atlas is an important storehouse of information about global change that will contribute to the knowledge and understanding essential for adaptation and mitigation.

The atlas is expected to be of immense value to policy-makers and decision-makers at all levels of government, as well as consultants, researchers, students, and everyone else who would like to know more about global change and its impact on South Africa. It will also help to support national initiatives such as the National Disaster Management Framework.

The project will have a human capital development component by training current and potential users in the supporting technology and the application thereof.

Predicting weather patterns better with multiple models

The CSIR can now produce operational forecasts and simulations for days or decades in support of the national forecast product and contributes to the simulation of multi-decadal projections over the region.

It runs the conformal-cubic atmospheric weather-forecasting model to produce high-resolution weather forecasts daily for the next seven days.

These forecasts are then combined with forecasts produced by the South African Weather Service (SAWS) to produce a probabilistic assessment of weather extremes for the following few days.

CSIR modellers have also joined forces with their counterparts at the SAWS, the University of Cape Town, the International Research Institute for Climate and Society, and the United Kingdom Met Office.

They will develop seasonal forecast systems that can predict rainfall and temperature extremes over southern Africa at a 50-km resolution up to five months ahead.

Some of these models are complex, fully-coupled land-ocean-atmosphere systems that can also predict the likely occurrence of the El Niño and La Niña events.

EL NIÑO OR LA NIÑA IS A CLIMATE PATTERN THAT OCCURS ACROSS THE TROPICAL PACIFIC OCEAN ON AVERAGE EVERY FIVE YEARS, BUT OVER A PERIOD VARYING FROM THREE TO SEVEN YEARS. IT IS CHARACTERISED BY TEMPERATURE VARIATIONS – WARMING (EL NIÑO) OR COOLING (LA NIÑA)

Photo courtesy of Roxanne Klein.

CSIR paving the way for Plant Breeders' Rights for eucalypt clones

The CSIR has applied for Plant Breeders' Rights for a eucalypt clone. If the application is successful, it will be the first time in the South African forestry industry that intellectual property (IP) rights are granted to the breeder of a new variety of eucalypt tree.

In South Africa legal rights are acquired in terms of the 1976 Plant Breeders' Rights Act in order for the breeder to legally protect the IP of the new variety.

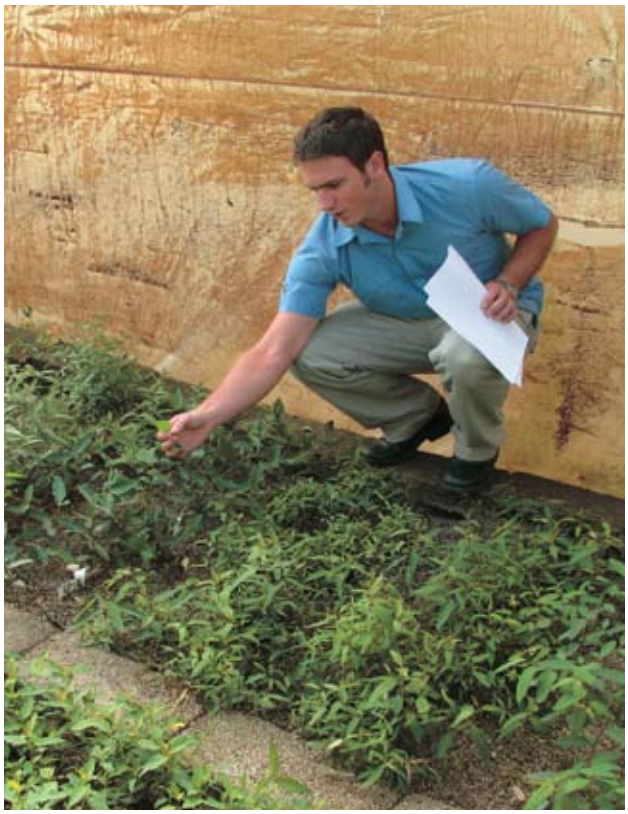
While genetic plant material is protected by licensing, Plant Breeders' Rights are legally more defensible and governed by international protection laws.

CSIR tree geneticists have had to establish the distinctness, uniformity and stability of the new *Eucalyptus* germplasm by describing it in terms of primarily bark, leaf and floral morphology.

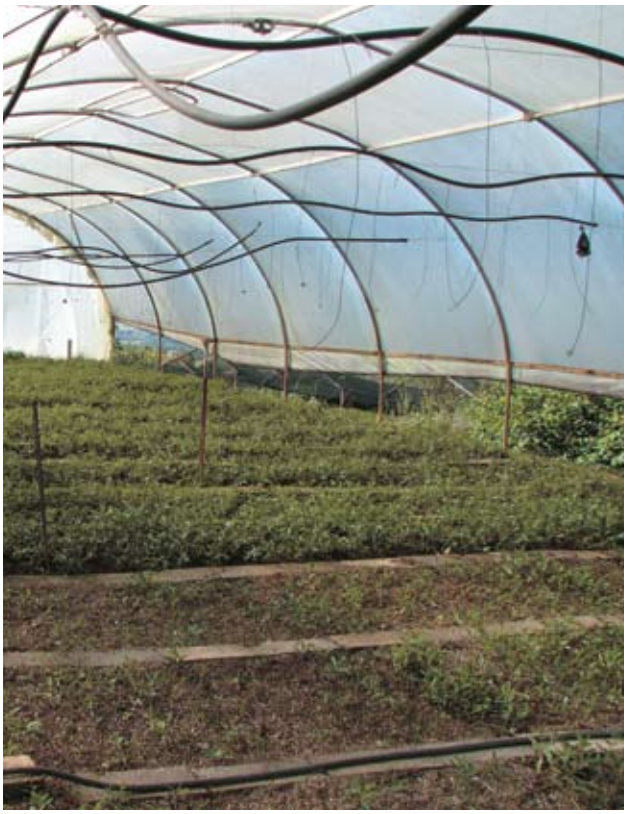
With funding from the Innovation Fund under the auspices of Project Pulp (co-funded by NCT), they found that sufficient distinctness exists for a new clone of *Eucalyptus grandis X E. nitens* (as compared to the parent species), bred as part of Project Pulp, to allow for the application of Plant Breeders' Rights.

For the first time, IP in the form of the germplasm will be legally protected in this manner.

When the trees reach reproductive maturity, the researchers will look for more traits by which to characterise the CSIR clone and reinforce the principles of distinctness, uniformity and stability.



Inspection of the bulking up of the *E. grandis x E. nitens* hybrid CSIR GxN2107 at Sunshine Seedling Services nursery in KwaZulu-Natal. The CSIR submitted an application for Plant Breeders' Rights for this hybrid in 2010.



The CSIR has licensed a number of private nurseries to supply tree farmers with genetically improved material.

ict for society

The contribution that information and communications technology (ICT) makes to socio-economic development is now well established. The proliferation of ICT through society and the economy has given rise to the concept of 'information society', which is seen as the successor to the industrial society established after the industrial revolution. Just as the industrial revolution is associated with important technological breakthroughs, such as the invention of the steam engine, the move towards an information society is associated with important technology inventions such as the personal computer, the internet, World Wide Web and mobile telephony.

In 2003 in Tunis, world leaders signed the World Summit on the Information Society Declaration of Principles in which they declared their "common desire and commitment to build a people-centred, inclusive and development-oriented information society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life".

For South Africa to benefit fully from the potential that ICT and the information society represent, we need to do research and development (R&D) that addresses barriers to access and enable us to be part of this revolution that is still unfolding.

The CSIR's ICT research is focused on contributing to South Africa's development towards an advanced information society by addressing key issues with broad societal impact, namely:

- Enabling ICT readiness by focusing on both extending infrastructure and access through researching, developing, demonstrating and building broadband infrastructure and ensuring inclusive access by addressing barriers of literacy, disability, language or financial means;
- Promoting ICT use through research, development and innovation (R,D&I) which increase ICT intensity in society in areas such as scientific computing and geo-spatial applications, and address societal challenges such as health, education and other service delivery needs;

- Contributing to ICT capabilities and skills by enabling advanced human capital development as part of our research activities and building critical mass in R,D&I capacity in selected ICT fields, in collaboration with higher education institutions.

The CSIR's work in ICT R&D ranges from addressing the needs of the most rural communities of South Africa through technologies such as the Digital Doorway, wireless mesh networking and speech technology, to implementing advanced cyberinfrastructure such as the Centre for High Performance Computing and the South African National Research Network. It is important that both ends of this spectrum are addressed to ensure that the information society that we build is inclusive – something from which everyone can benefit.

Through South Africa's competitive edge in advanced cyberinfrastructure, we can harness the collaborative potential of our scientists to understand and solve problems in areas such as healthcare and climate change, enabling new forms of scientific and industrial development. The following articles reflect a small sample of the CSIR's work in ICT.

Access to ICT: Putting broadband into the hands of rural communities

Broadband connectivity is viewed as a critical enabler of socio-economic development. Conventional approaches to deploying broadband technology are generally not viable in rural areas due to the high cost of these approaches.

The CSIR has been researching wireless mesh networks as a technology to enable sustainable deployment of broadband networks in rural areas. The multi-year project, Broadband for All, is building on the results of this research to provide Internet access to rural schools and other government centres, such as clinics, Thusong Centres, community libraries and tribal offices in the vicinity of Dinaledi schools. The project is funded by the Department of Science and Technology through the Sector Budget Support of the European Union.

The project has achieved significant milestones in the Nkangala district of Mpumalanga through the installation of wireless equipment at 180 sites, which has connected schools and other government institutions in the Dr J S Moroka and Thembisile Hani local municipalities for service delivery. Preparatory work has started on replicating the project in the Sekhukhune district in Limpopo and in the J T Gaetsewe district of the Northern Cape.

To ensure sustainable business models and maximum benefit for local communities, 19 young local entrepreneurs have been trained in business and marketing as well as in information technology and the installation of hardware. Businesses envisaged by these entrepreneurs range from computer training to providing communities with multimedia services.

They are participating in the installation phase and are being prepared to take over maintenance and support of the project beyond the pilot phase. An additional two entrepreneurs are involved in fulltime mentoring and support of the young entrepreneurs.

180

SITES IN MPUMALANGA WHERE WIRELESS EQUIPMENT HAS BEEN INSTALLED, CONNECTING SCHOOLS AND GOVERNMENT INSTITUTIONS

A visit to the CSIR by young entrepreneurs in training who will be using broadband connectivity for their businesses, with DST and CSIR staff.

Access to ICT: Solar-powered Digital Doorways™ for remote rural areas

Digital activity for people in remote rural areas without access to electricity is becoming a reality through the deployment of solar-powered container Digital Doorways™. Two are now in operation: one at the Seidet Centre in Siyabuswa, Mpumalanga and the second at the Nophungwe primary school in Vumbu, KwaZulu-Natal.

The Digital Doorway™ initiative is funded by the Department of Science and Technology. It is a rugged computer system used to promote self-learning of computer and information skills in remote areas.

As a self-contained unit, the container Digital Doorway™ can operate in deep rural areas with no access to the electricity grid. It has identical functionality to that of other traditional three-terminal Digital Doorways™ of which over two hundred have now been deployed across South Africa.

The systems operate off 12 Vdc (Volts of continuous current). Roughly 3x3 m, the container stands 3.8 m at its highest point and has seven 'stick-on' 68 Watt solar panels on its sloping roof. The solar panels charge 10 110 Ah deep-cycle marine batteries within the container, which supply power to the Digital Doorway™ systems. The system operates 14 hours a day and has a zero-sun capacity of approximately five days.

Meanwhile, the Digital Doorway™ initiative is expanding internationally. In partnership with the United Nations Children's Fund (UNICEF), the CSIR has embarked on a three-year plan to supply three-seater Digital Doorways™ to UNICEF and assist in developing a capability to produce these in Uganda.

Digital Doorways™ have been installed in Ethiopia, the Solomon Islands, Lesotho and Australia.

Digital inclusion for people in remote rural areas without access to electricity is becoming a reality through the deployment of solar-powered container Digital Doorways™.

The polar-powered container Digital Doorway™ can be found in rural Mpumalanga and KwaZulu-Natal.

Using Dr Math, learners with a cellphone have access to mathematics tutoring wherever they are.

ICT for education: Mathematics made easy *via* mobile

A novel mathematics tutoring system is helping South African learners to take up the challenge of science, engineering and technology. Dr Math is a mobile mathematics tutoring system that runs on MXit, a popular instant-messaging service available *via* cell phones. Six thousand learners subscribed to the service since its inception, with approximately 3 000 active users.

Dr Math aims to assist learners to improve their mathematical understanding and skills. As mathematics or mathematics literacy have become compulsory secondary school subjects, learners can be helped to improve their understanding and to pass these subjects in their final examinations. A longer-term benefit would be better prepared first-year students at tertiary level, with a better chance of success in courses where mathematics is a compulsory subject.

Tutors have been drawn from the University of Pretoria, the African Institute for Mathematical Sciences and the CSIR to assist learners free of charge by logging on remotely to Dr Math. Queries are channelled to available tutors *via* a flow management model. The system offers real-time mathematics support at a fraction of the cost of an SMS. The learner sends in a query *via* MXit and receives a response on MXit.

The project has received support from the Department of Education and will ultimately benefit more than 25 000 schools throughout South Africa. New developments include drill-and-practice competitions and text-based mathematics adventure games.

3 000

ACTIVE USERS OF DR MATH

Through South Africa's national cyberinfrastructure, scientists can achieve results faster and are able to collaborate more effectively.

ICT for research: High bandwidth boosts South Africa's science

The soon-to-be-completed first phase of the South African National Research Network (SANReN) will connect 85 South African research and higher education sites to global networks. Researchers have started reaping the benefits of access to a world-class network for national and international collaboration. The project, funded by the Department of Science and Technology, is part of its cyberinfrastructure initiative and is being implemented by the CSIR.

The national backbone interconnects the metros of Tshwane, Johannesburg, Mangaung, Cape Town, Nelson Mandela Bay and eThekwini on a 10 gigabit-per-second fibre-optic ring network. The Tertiary Education Network has acquired international bandwidth connectivity from Seacom, which can now be distributed *via* the SANReN national backbone network. SANReN is the communications system of the national cyberinfrastructure; enhancing complementary projects such as the Very Large Database facility and the Centre for High Performance Computing.

It has substantially enhanced South Africa's ability to tackle data and bandwidth-hungry projects such as the bid for the Square Kilometre Array and other projects of national importance in space science and technology.

International video-conferencing, large-scale data transfer, virtual research organisations and fast web-browsing are some of the advantages SANReN brings to individual researchers at universities to support their endeavours in research and development. As SANReN unfolds, it will offer additional advanced services.

Research is becoming increasingly data driven—in fact, data volumes are becoming unmanageable. High-speed research networks and large data repository and analysis capacity are essential to conducting world-class competitive research. It will result in a new cadre of young researchers with access to unparalleled bandwidth, which will change the face of research and development in South Africa.

85

INSTITUTIONS SOON TO BE CONNECTED THROUGH SANREN

ICT for service delivery: Making a digital difference through mobile phones

Increased mobile penetration is well correlated with economic development. The benefits that these now almost ubiquitous devices have for improved quality of life are becoming clearer by the day. In Africa, mobile phones are being used in unexpected and surprising ways as more channels, products and services are created.

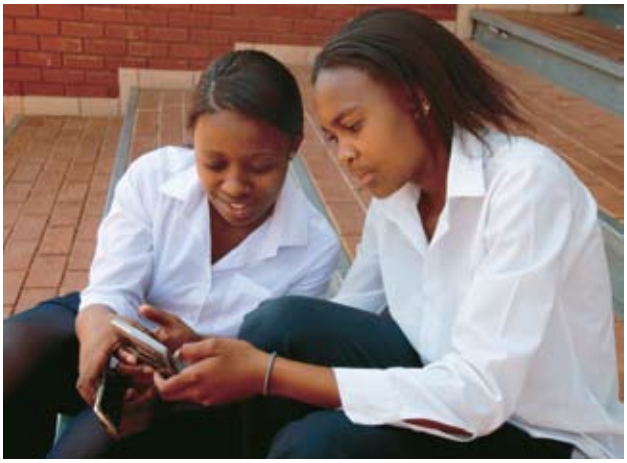
The CSIR's mobile for development (Mobi4D) platform aims to stimulate the development of even more applications and services by making it easier to develop such applications and services.

Mobi4D provides an easy-to-use, cost-effective and extendible mobile service-delivery platform. Examples include cell phone 'top-up' payments through unstructured supplementary service data (USSD) or using cell phones for banking. The generic Mobi4D platform will make more valued-added mobile services available to users of feature and smart phones, as well as low-end phones.

Worldwide, 470 million people use cell phones to communicate and share information. In South Africa there are approximately 42 million cell phones. As a ubiquitous device, the cell phone has great potential for extending existing channels, products and services, and creating new ones.

The Mobi4D platform adapts expertise developed over the past years, such as short message service, USSD and extensible messaging and presence protocol used in instant messaging to design, develop and deploy a mobile service delivery platform. This platform is based on standards and can be expanded, with the added advantage of allowing people to switch from one network to the next in the mobile environment.

To date, resource adaptors for existing services and an authentication, authorisation and administration module have been developed. Value-added services can, consequently, be developed and deployed by various developers independently of networks.



In Africa mobile phones can be used in unexpected ways as more channels, products and services become available.

ICT for service delivery: Using your own language to find government information

Information about government services to communities in an official language of choice is becoming a reality as benefits of the CSIR's work in human language technology are deployed. By using a telephone and selecting a language, South African citizens can access information with ease, even if they do not own a computer and without the need for travel or other costly endeavours.

The Lwazi information system – funded by the Department of Arts and Culture – provides South Africans with the opportunity to access government information and services in any of South Africa's 11 official languages free of charge, using either landline or mobile telephones.

The Lwazi information system is underpinned by scientific and technical innovations, notably robust automatic speech recognition (ASR) and text-to-speech (TTS) systems for all 11 official languages of South Africa. The integration of these language technologies into a telephony platform allows individuals to interact with the system by voice over a standard telephone line. Lwazi was successfully piloted at six locations around the country, both urban and rural, which covered testing of the resources developed for all the official languages.

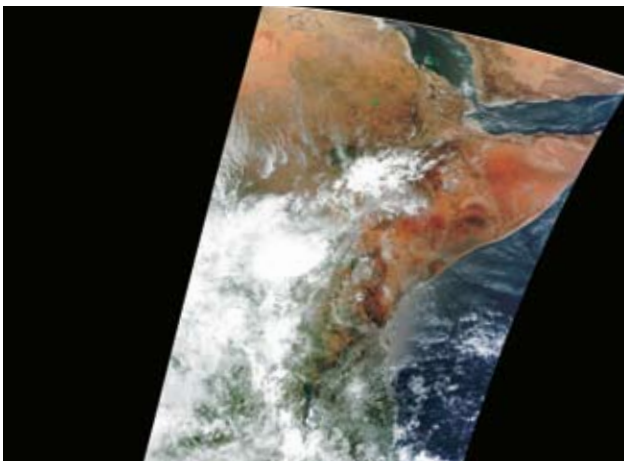
South Africans can access information on government services *via* mobile or landline, thanks to the Lwazi information system.

ICT for service delivery: Fire warnings expanded to cover two-thirds of Africa

Veld and fynbos fires in Africa during the dry seasons account for costly damage annually to human life and settlements, infrastructure, land cover, stock and game. Technical collaboration with researchers at the Malindi satellite reception station in Kenya is now making it possible for the CSIR's Advanced Fire Information System (AFIS) to pinpoint fires in near-real time over southern, eastern and central Africa.

AFIS, developed jointly with the University of Maryland and Eskom and with funding from the former Department of Agriculture, relies on earth observation satellites from NASA and Europe to detect possible hotspots on the ground. A sophisticated processing system developed in-house ingests raw satellite data and within minutes of the satellite overpass produces the location of fires.

Fires as small as 50 m^2 can be detected by the satellites, based on the radiance emitted by the fire. Following the installation of the AFIS processing server at Malindi, satellite-based fire information can now be produced for two-thirds of Africa. The archive of fire information at the CSIR is also regularly being fed with data from the processing server in Kenya, making it a repository of fire information for Africa all the way from Sudan.

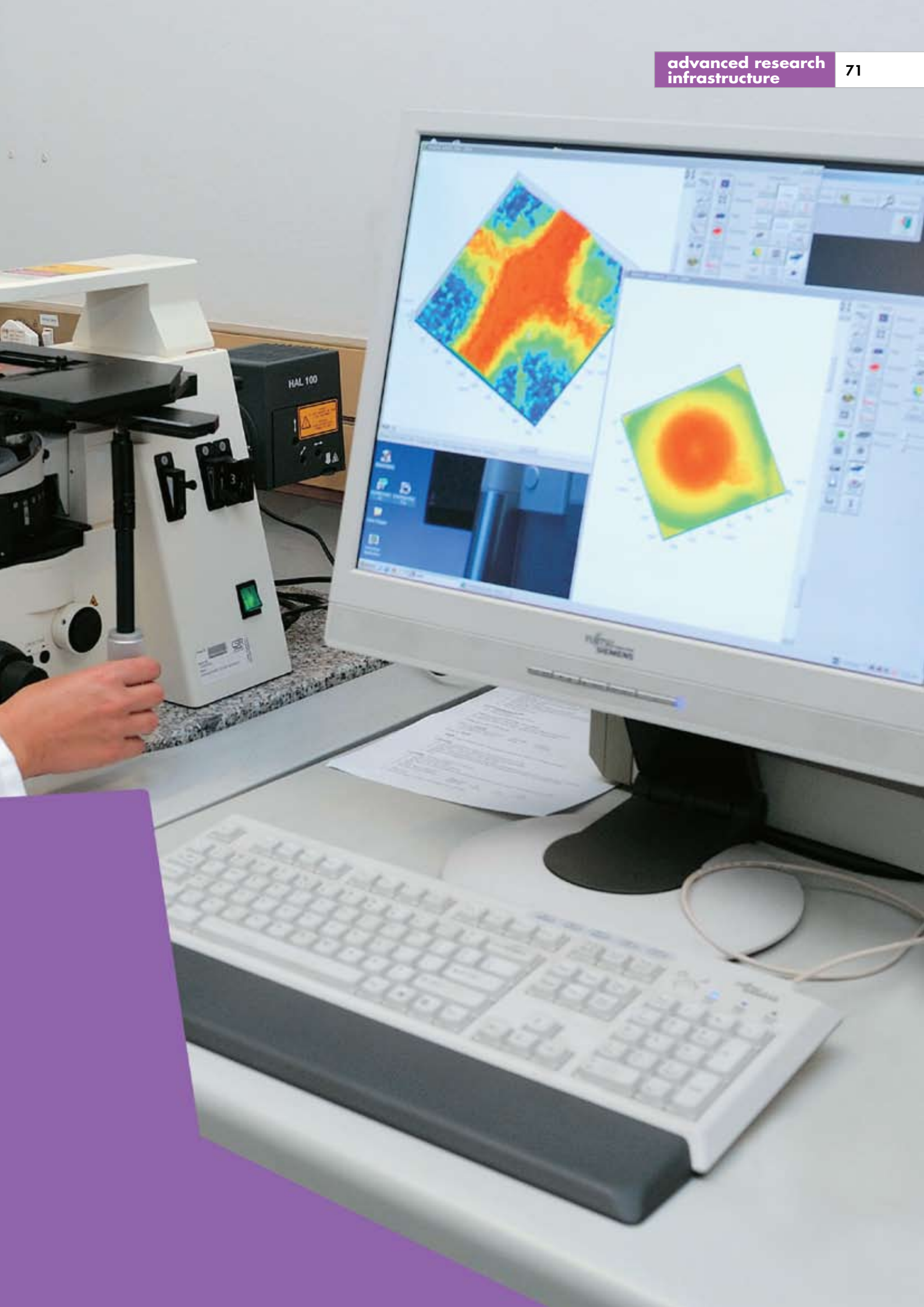


Satellite-based fire information is now available all the way from Sudan to South Africa.

advanced research infrastructure

A sound research infrastructure is a vital contributor in delivering research and development outcomes of the highest standard. Supporting this commitment to an environment and facilities conducive to world-class research and development, the Department of Science and Technology deserves reference for its continued investments in research infrastructure at the CSIR, also for use by the wider research community.

Examples of continued investment in research infrastructure in numerous domains, and work resulting as a direct outcome of the infrastructure, are outlined over the next few pages.


HAL 100

Biosafety level-3 containment facilities for HIV and TB research opened

The CSIR launched an HIV and tuberculosis (TB) laboratory during the year, with state-of-the art equipment housed in adjacent, yet independent, containment level-3 research suites.

The facility epitomises world-class research infrastructure in South Africa and significantly increases the capacity to discover, test and develop new drugs and diagnostics against HIV and TB. This is a controlled-access laboratory for all experiments involving HIV/Aids and TB pathogens.

The establishment of this facility was realised through a Department of Science and Technology infrastructure grant of R15 million to the CSIR. This is an indication of its commitment to address the national health priorities by equipping key research institutions and scientists to undertake ground-breaking research. Activities will include the testing of novel agents capable of inhibiting HIV entry in target cells and the culture of *Mycobacterium tuberculosis*, as well as the handling of clinical samples from TB patients to support the development of novel diagnostic kits and the testing of candidate anti-TB drugs.

The facility will be accessible to national and international collaborators, and will be used to train postgraduate students and postdoctoral researchers in the fields of HIV and TB biomedical research. This will contribute to the knowledge economy and the national system of innovation with significant human capital development in science and technology. The laboratory will also enable affordable, yet effective therapeutics and non-invasive point-of-care diagnostics for HIV/Aids and TB.

R15 million

THE DEPARTMENT OF SCIENCE AND TECHNOLOGY INFRASTRUCTURE GRANT TO THE CSIR, WHICH BUILT THE HIV AND TB LABORATORY

Mycobacterium tuberculosis culture being grown into a culture plate for diagnostic proof of principle.

An HIV-1 neutralisation assay being performed under the sterilised bio-safety cabinet.

High-throughput biology laboratory enables research in infectious chronic diseases

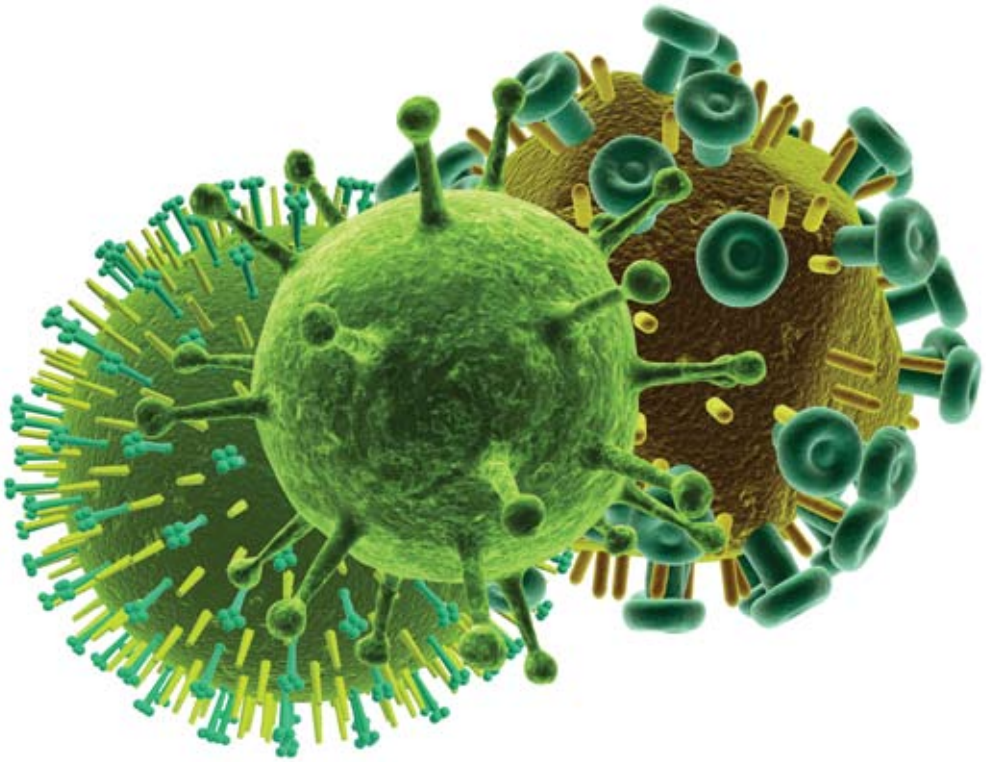
The CSIR's high-throughput biology laboratory innovates technology to meet challenges in our understanding of biology. The laboratory is one of only 40 in the world, of which only three are similar in scale to the CSIR laboratory.

The research exploits synthetic chemical surfaces created by a high-precision surface-patterning system. It enables automated, standardised and rapid screening to identify key human host dependency factors in disease through systematic genome scale RNA interference.

The technology couples speed and ease of use to enable genome-wide screening at a pace and scale matched by only a handful of other laboratories. The high-throughput biology laboratory has identified 48 HIV drug targets, around 20 for the trypanosomal Chagas disease and more than 25 for cystic fibrosis. During 2009, the CSIR synthetic biology emerging research area acquired an siRNA genome-wide library that enables the ability to screen the entire human genome for genes implicated in HIV infection.

Current research goals are to extend the reach of the synthetic surfaces that scientists produce to encompass recalcitrant disease models (primary cells) and reach from the single genome to single molecule-scaled detection. The current disease focus is on the molecular basis of both analgesic tolerance and the human host factors coupled to HIV strains problematic in South Africa.

THE CURRENT DISEASE FOCUS IS ON THE MOLECULAR BASIS OF BOTH ANALGESIC TOLERANCE AND THE HUMAN HOST FACTORS COUPLED TO HIV STRAINS PROBLEMATIC IN SOUTH AFRICA



CSIR researchers dressed in protective overcoats, gloves, shoes and caps inside the foyer to the clean room. Protective gear is worn to limit all particles of dust, hair and other micro-sized pollutants that are inevitably found on human bodies and clothes.

Clean room facility opens up new micromanufacturing avenues

The CSIR has established a clean room facility for the manufacturing of soft lithography moulds for microfluidic research. The facility is used in the manufacture of various microsystem and microfluidic components such as those used for microchips, valves and actuators. A clean room is an environment that has a low, controlled level of environmental pollutants such as dust, airborne microbes, aerosol particles and chemical vapours.

Micromanufacturing is all about making things smaller in order to unlock the advantages of working in the micro world. Typical feature sizes range from 1 um to <1 mm. In modern science and technology everything seems to revolve around the ability to generate small structures. Downsizing existing structures or making new types of small structures may unlock an entire new world of opportunities. Here, 'smaller' means better, less expensive, more components per chip, faster operation, higher performance and lower power consumption.

As an example, microfluidic systems are being developed to assist with the diagnoses of the so-called developing-world illnesses, TB and HIV/Aids. These systems will be inexpensive and will not require the intervention of an experienced operator, while providing accurate and reliable measurement. This is in contrast to conventional, expensive diagnostic methods that require clean and controlled environments and skilled operators. This field of research promises high levels of impact in the near future.

The importance of micromanufacturing was highlighted in 2007, with the launch of the Advanced Manufacturing Technology Strategy Micro-Manufacturing Strategy for South Africa. Applications of research in this field facilitate new innovations in healthcare and the life sciences.

From left: Naledi Pandor, Minister of Science and Technology, launches the Sun Microsystems hybrid supercomputer in September 2009, with Dr Sibusiso Sibisi (CSIR President and CEO) and Dr Philemon Mjwara, Director-General of the DST.

South Africa takes its place among the HPC world leaders

The commissioning of a Sun Microsystems hybrid supercomputer at the Centre for High Performance Computing (CHPC) has taken South African high-performance capabilities into the top 500 in the world – and the leader in Africa.

It has been said that being able to out-compute is a prerequisite for a country to out-compete in the global arena. High performance computing (HPC) lies in the specialist domain where cutting-edge computing equipment and software – predominantly open source – push the boundaries of what can be achieved in processing, storage and visualisation.

The world-class facilities at the CHPC are increasingly utilised by researchers at local universities and science councils on flagship projects and smaller computational tasks. Examples include a novel application of HPC that models cardio-vascular systems, in collaboration with the Medical Research Council and the University of Cape Town's training hospital, Groote Schuur.

In another example, a better understanding of how CO_2 and oxygen are changing in the thermocline waters of the South East Atlantic and Southern Oceans, helps to shed light on global warming. Researchers are using the CHPC facilities to do just this.

Increased interest by industry has resulted in the signing of agreements with SASOL. Of note is the role played by CHPC in providing facilities for battery research on South Africa's own electric car, Joule. Besides next generation aircraft, HPC is being used to design the optimal shape for Pringles (a potato crisp snack in a tube), infant diapers and brain imaging research.

In line with trends worldwide, South Africa's first 3D animated film by Character Matters, to be released in 2010, was rendered at the CHPC. It is the only facility in South Africa with the capacity to store and work with 480 terabytes of information – the capacity necessary for such an undertaking.

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REGISTERED CHPC USERS AT LOCAL UNIVERSITIES AND SCIENCE COUNCILS

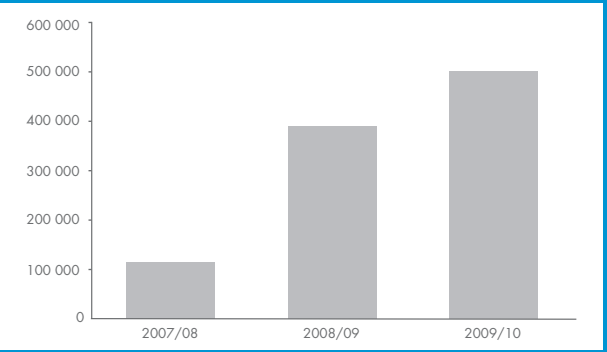
CSIR knowledge dissemination

Knowledge dissemination and transferring technology remained important components of the CSIR output and fundamental to the organisation fulfilling its mandate.

Published research output is a good measure of knowledge disseminated and is reflected, where copyright allows, in the open-access institutional repository Research Space launched in August 2007. Ranked number 171 in the January 2010 world ranking of repositories – ahead of the majority of South African universities – the repository has become a trusted source of research information for the broader international research community and remains the only open-access, online repository by a South African research council.

The number of items downloaded from Research Space increased from 382 232 in 2008/09 to 498 964 in 2009/10 – an average of just more than 40 000 articles per month. The annual comparable usage pattern for the repository since June 2007 is reflected in the figure below.

Full text downloaded



The CSIR Research Space is accessible at http://researchspace.csir.co.za/dspace

The CSIR's publication equivalents in journals also increased from previous years and during the past year increased by 24% from 215 in 2008/09 to 266 in 2009/10. Total publication equivalents increased from 451 in 2008/09 to 502 in 2009/10. See figure below.

Transferring technology highlights included the implementation of a technology transfer fund; the KSS TechTracS information management system aimed at improving access to intellectual property and technology transfer information, which went live; and the signing of a Memorandum of Understanding between the CSIR and the Industrial Development Corporation, to collaborate in the commercialisation of CSIR technologies. Royalty and licence revenue accruing to the CSIR amounted to R10.2 million. The output of the CSIR intellectual property portfolio reflects an impressive performance.

The following pages list research published in the past financial year and intellectual property performance.

Year	External publications for which publication equivalents were assigned				Other external publications			Total publication equivalents
	Articles in accredited journals	Conference papers (Peer reviewed)	Books	Book chapters	Journal articles (Other)	Conference papers and presentations (Other)	Books	
2006/07	129	115	2	27	43	250	0	220.0
2007/08	180	202	12	50	31	136	0	343.0
2008/09	208	393	9	38	69	228	5	451.5
2009/10	266	334	14	48	46	149	1	502.0

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Barrier Technology - Australia - Patent No: 2004228459

Barrier Technology - Italy - Patent No: MI2004A000725

Dirfinder - USA - Patent No: 7,637,198

Dirfinder - New Zealand - Patent No: 553814

Encapsulation Method - Japan - Patent No: 4313196

Encapsulation Method - USA - Patent No: 7,641,917

Method & Apparatus for testing the installation quality in a grouted anchor system - Australia - Patent No: 2004202923

Processing of Semi Solid Metal Alloys - Australia - Patent No: 2004209884

Processing of Semi Solid Metal Alloys - India - Patent No: 224728

Safe Eggs - China - Patent No: ZL2005-80012676.1

Spherezymes - USA - Patent No: 7,700,335

Track/Wheel Protection - Australia - Patent No: 2004243664

Warning of Impending Collapse of Unstable Geotechnical Structure - Australia - Patent No: 2002301535

Invention disclosures

Novel HIV treatment derived from a natural product

Novel anticancer drugs derived from a natural product

Yarrowia lipolytica fermentation strategy for the production of heterologous proteins

Antifolate antimalaria drug

Debaryomyces abalone probiotic

Detection reagents for point-of-care diagnostics

Improved sensitivity detection reagents for ELISA diagnostics

Multidrug-resistant TB hits

Vibrio mideae abalone probiotic

Agribinder

Aircraft warning device for lattice mast

Anaerobic digester

Automated dynamic cone penetrator

Keofloat highly accurate wave measurement system

Low cost road roughness integrator (LORRI)

Pressurised emulsion sprayer

360° wide area surveillance project (WASP)

Aileron actuation mechanism to eliminate control reversal

Blast impulse reduction protection measure

Low collateral high efficiency reactive armour

Rotating partial entry nozzle guide vane system

Sensors and electronic warfare engagement simulation (SEWES)

Synthetic ground clutter simulator

High performance computing node

Ability based technology interventions

C4 cloud platform C4

Crime prevention toolkit

Dr Math information and communications technology system

Iota of text accumulator (IOTA)

Mobile for development (Mobi4d) platform

Gas carriers for mineral beneficiation

Microfluidics valves

Mobile autonomous printer

Reconfigurable parallel kinematic machine tool

Titanium magnesium alloys

Production of titanium powder in a continuous process

Real time dust monitoring

Santrac process – Sulphate and acidic neutralisation through rumen and cellulose

Technology packages

Biocontrol agents

Fish feed

Edible film

Hoodia cell culture

Road maintenance kit

Stress in motion Mk V

Low income house design

Low cost road roughness integrator (LORRI)

Geospacial analysis platform 2

Geospacial analysis platform 2

Regional socio-economic profiling software (The Presidency Territorial Review System)

CSIR space planner

Portable aircraft landing lights

First responder cyber forensics training course

Houwteq radiometric test and calibration facility

Development of new training module for Joint Aerospace Reconnaissance Intelligence Centre (JARIC): tactical reconnaissance

South African educational telescope

Mobile service robot

Multi-spectral imaging (MSI) camera

Chemical milling of titanium for investment casting

Umbiflow ultrasonic unit for ante-natal health care

Afrimesh wireless network

Open phone telephony-based information system

High perfomance node

Video processing library

Speech software framework for text to speech systems

Ubuntu SCI mathematics, geosciences, computer sciences

Lwazi community development workers application

Laser resonator with phase correcting elements

Working for Water alien plant removal

corporate governance

Framework

Corporate governance is formally concerned with the organisational arrangements that have been put in place to provide an appropriate set of checks and balances within which the stewards of the organisation operate. The objective is to ensure that those to whom the stakeholders entrust the direction and success of the organisation act in the best interest of these stakeholders. It is about leadership with integrity, responsibility and transparency.

The CSIR is committed to principles and practices that will provide our stakeholders with the assurance that the organisation is managed soundly and ethically. We have established a management model that governs and provides guidance for the way that all employees interact with our various stakeholder groups.

The underpinning principles of the Group's corporate governance rest on the three cornerstones of an effective and efficient organisation, namely day-to-day management processes, a long-term strategic planning process and effective change processes. These processes are supported by systems that are used to plan, execute, monitor and control the strategic and operational domains of the organisation.

The supporting infrastructure and its evolution are documented in our management model, which is reviewed and updated regularly.

In accordance with the Scientific Research Council Act, Act 46 of 1988, as amended by Act 71 of 1990, the appointment of the CSIR Board is by the Executive Authority. The Board provides strategic direction and leadership, determines goals and objectives of the CSIR, and approves key policies, including investment and risk management and reviews. It also approves financial objectives, plans, goals and strategies. The Board has adopted formal terms of reference that are in line with the Scientific Research Council Act and the Public Finance Management Act (PFMA), Act 1 of 1999, as amended by Act 29 of 1999.

The CSIR Board and the CSIR Executive Management Committee believe that the organisation has in all material respects applied and complied with the principles incorporated in the Code of Corporate Practices and Conduct, as set out in the King Report.

Shareholder's Compact

In terms of the treasury regulations issued in accordance with the PFMA, the CSIR must, in consultation with the Executive Authority, annually agree on its key performance objectives, measures and indicators.

This is annexed in the shareholders performance agreement (Shareholder's Compact) concluded between the CSIR Board and the Executive Authority.

The compact promotes good governance practices in the CSIR by helping to clarify the roles and responsibilities of the Board and the Executive Authority and ensuring agreement on the CSIR's mandate and key objectives.

The chairperson of the Board and the Executive Management Committee hold bilateral meetings with the Executive Authority.

Financial statements

The CSIR Board and the CSIR Executive Management Committee confirm that they are responsible for preparing financial statements that fairly present the state of affairs of the Group as at the end of the financial year and the results and cash flows for that period. The financial statements are prepared in accordance with South African Statements of Generally Accepted Accounting Practice. In addition, the CSIR Board is satisfied that adequate accounting records have been maintained.

The external auditor is the Auditor-General, who is responsible for independently auditing and reporting on whether the financial statements are fairly presented in conformity with South African Statements of Generally Accepted Accounting Practice. The Auditor-General's terms of reference do not allow for any non-audit work to be performed.

Risk management

The CSIR Board is accountable for the process of risk management which is reviewed regularly for effectiveness. Appropriate risk and control policies are established and communicated throughout the organisation. The CSIR Board retains control through the final review of key risk matters affecting the organisation and is satisfied that the risk management process is effective.

Risk management in the CSIR is an ongoing process, focused on identifying, assessing, managing and monitoring all known forms of significant risks across all operations and Group companies. This has been in place for the year under review and up to the date of approval of the Annual Financial Statements.

A structured process of risk management has been put in place to ensure that the growth and development of human capital, strengthening of the science, engineering and technology (SET) base, operational excellence and financial sustainability will be achieved and maintained.

CSIR systems have been put in place to review aspects of economy, efficiency and effectiveness. Management is involved in a continuous process of improving procedures to ensure effective mechanisms for identifying, managing and monitoring risks in the following major broad risk management areas: research; business; fraud; safety, occupational health and environmental management; operating and financial management.

Documented and tested processes are in place, which will allow the CSIR to continue its critical business process in the event of a disastrous incident impacting on its activities, and to ensure complete, timely and relevant reporting by management.

Research risk management

The Group recognises that research has to be conducted in compliance with the existing legal framework, aligned to CSIR strategies and in accordance with the standards and practices that would ensure outputs that support the CSIR's mandate.

In order to mitigate research-related risks, the CSIR has an established *Good Research Guide*, research ethics and institutional governance structures such as the Research and Development (R&D) core management function, the Strategic Research Panel (SRP) and the Research Advisory Panels (RAPs).

The CSIR has established a Research Ethics Committee which is accountable to the Strategic Review Committee of the Board. The Committee reviews all projects which require evaluation from a research ethics perspective.

Business risk management

The organisation has effective mechanisms in place for identifying and monitoring risks that impact on the CSIR Group. The procedures for implementing the Group's business risk management process include a focus on areas such as human capital assessment and development, technological development and business continuity.

Fraud risk management

The objective is to manage the fraud risk and to raise the level of fraud awareness amongst the CSIR's internal and external stakeholders. The CSIR's fraud prevention plan intends to reduce the risk of fraud and provide contingency plans that will protect the interests of the organisation. The proactive approach consists of the responsibility for, prevention, detection, reporting and, communication of, and reaction to fraud.

Safety, occupational health and environmental management

The CSIR is committed to the promotion of environmental, health and safety principles and practices to create a safe and healthy environment for all and to meet the requirements of all relevant environments and health and safety legislation as a minimum standard. This commitment is depicted in two ways: in the manner it serves business as a supplier of environmental management-related products and in the way it demonstrates sound environmental practices at all CSIR sites.

Operating risk management

The CSIR endeavours to minimise operating risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout the Group. Key practices employed in managing operating risk include segregation of duties, transaction approval frameworks, financial and management reporting and monitoring of metrics, which are designed to highlight positive or negative performance across a broad range of key results areas (KRAs). The Operations Committee, which comprises members of the CSIR Executive, operating unit and centre executive directors and group managers, oversees all operational matters.

Financial risk management

Financial risks are managed within predetermined procedures and constraints as identified and detailed in the various policies and the setting of annual goals and objectives. Controls are designed to give assurance that assets are safeguarded and that liabilities and working capital are managed effectively. Organisational policies, procedures, structures and an approval framework provide for segregation of duties and contain self-monitoring mechanisms. Compliance is measured through regular reporting against the business goals, internal audit checks and external audit verification. The requisite skills and qualifications are in place for the management of the finance function.

Going concern

The CSIR Board has reviewed the Group's financial budgets for the period 1 April 2010 to 31 March 2011 and is satisfied that adequate resources exist to continue as a going concern for the foreseeable future. The CSIR Board confirms that it has assessed key sustainability risks and there is no reason to believe the business will not be a going concern in the year ahead.

Internal control

The CSIR Board has ultimate responsibility for the system of internal controls. The key controls required to ensure the integrity and reliability of financial statements have been identified in conjunction with the internal and external auditors. Close cooperation between the internal and external auditors ensures adequate and efficient audit reviews of the proper functioning of these key controls.

The annual audit plan is based on the key financial risks to the organisation and the results of the risk management process. The work programme that gives effect to the plan is reviewed by the Audit and Risk Committee and approved or modified as required.

Internal financial controls have been assessed as effective to mitigate related risks.

Approval framework and policies

The CSIR Board has adopted an approval framework that governs the authorisation processes in the CSIR. It deals with, among others, the construction of strategic plans, development of operational plans and budgets, appointment of staff, approval of salaries and acquisition and disposal of assets. It also defines authority levels in relation to organisational positions.

Appropriate controls are in place to ensure compliance with the above framework. A comprehensive set of procedures exists to provide the necessary checks and balances for the economical, efficient and effective use of resources. The essence of this framework is that it is comprehensive, clear and unambiguous, and easy to assimilate and understand.

Each subsidiary company's board of directors has adopted an approval framework, which mirrors that of the CSIR. All subsidiary companies are under the control of the CSIR Board and CSIR Executive Management Committee.

Employee participation

The CSIR strongly encourages effective and modern workplace practices and relationships to foster employee participation and work process involvement as a key practice at all levels in the organisation. Employee participation happens, for example, through self-directed quarterly staff sessions, formal induction programmes, roadshows, technical and strategic focus groups and task teams.

Code of ethics and organisational values

The CSIR Board and CSIR Executive Management Committee have approved and adopted a code of ethics, which reflects their commitment to a policy of fair dealing and integrity in conducting its operations. The code links closely to the CSIR's set of values and requires all employees to maintain the highest ethical standards, ensuring that business practices are conducted in a manner which, in all reasonable circumstances, is beyond reproach. Monitoring ethical behaviour is devolved to unit level and transgressions are addressed by means of procedures detailed in the CSIR's Conditions of Service and the PFMA.

governance structure

CSIR Board

The responsibilities of the Board are governed by the Scientific Research Council Act and the Public Finance Management Act.

The Board approves the strategy, goals, operating policies and priorities for the organisation and monitors compliance with policies and achievement against objectives.

With the exception of the CEO of the CSIR, all members of the CSIR Board are non-executive. CSIR Board members are actively involved in and bring independent judgement to bear on Board deliberations and decisions.

The CSIR Board, of which the current number of members adheres to the statutory minimum requirements, meets quarterly. For the year under review, the Board met on 30 June 2009, 06 August 2009, 16 September 2009, 17 September 2009 and 23 February 2010. The Annual Financial Statements for the 2009/10 financial year were approved on 30 June 2010.

The CSIR Board has the following sub-committees: the Human Resources and Remuneration Committee, the Audit and Risk Committee and the Strategic Review Committee (see page 101 to 102). These committees are selected according to the skills sets required for the committees to fulfil their functions. For the 2009/10 year, the committees complied with their respective terms of reference.

The CSIR Board has adopted formal terms of reference, which are annexed in the Shareholder's Compact.

Schedule of attendance at CSIR Board and CSIR Board Committee meetings (1 April 2009 – 31 March 2010)

Board member	Board meetings (5)	Audit and Risk Committee (2)	Human Resources and Remuneration Committee (3)	Strategic Review Committee (2)
Petersen	5			2
Behrens	4	0*		1
Hall	5			
Knott-Craig	5		3	
Sibanda	5	2	3	
Silinga	2	2		
Thoka	4		3	
Wingfield	1			2
Sibisi	5	2		2

*Appointed to the Audit & Risk Committee with effect 23 February 2010 and replaces Dr Sibisi as a member.

Executive Management Committee

The Executive Management Committee has executive responsibility for the CSIR and consists of the following Executive Members:

- Chief Executive Officer: Dr Sibusiso Sibisi
- Group Executive, Operations: Dr Hoffie Maree
- Group Executive, R&D Outcomes and Strategic Human Capital Development: Khungeka Njobe
- Group Executive, Research and Development: Dr Thulani Dlamini
- Chief Financial Officer: Chris Sturdy
- Executive Director, Services: Raynold Zondo.

All Executives are employed on a five-year contract basis. The required period of notice for termination of service is three months.

CSIR Executive team back row from left: Khungeka Njobe, Group Executive: R&D Outcomes and Strategic Human Capital Development; Raynold Zondo, Executive Director: Services; Chris Sturdy, Chief Financial Officer; and Dr Sibusiso Sibisi, CSIR President and CEO

Front row from left: Dr Hoffie Maree, Group Executive: Operations; and Dr Thulani Dlamini, Group Executive: R&D

CSIR leadership team

The CSIR management is responsible for strategy implementation and managing the day-to-day affairs of the CSIR and its operating units in accordance with the policies and objectives approved by the CSIR Board. This leadership team comprises the members of the CSIR Executive Management Committee and operating unit executive directors and centre managers.

Other internal structures that contribute to governance at the CSIR include the Executive, Operations and Service Committees, the Strategic Research and Contract Research and Development Forums, and the Research Advisory Panels.

Board of directors of Group companies

The CSIR Executive has control over the boards of the various subsidiary companies.

Board and Executive Management remuneration

Details of the CSIR Board are set out on page 100 of the Corporate Governance Report. The membership and terms of reference of each Board Committee are further described on page 101 to 102. Remuneration to Board Members and the Executive Management is set out in Note 19 to the Annual Financial Statements.

Remuneration of Executive Management is in accordance with the remuneration policy which has been approved by the CSIR Board.

General

The CSIR acknowledges that systems of corporate governance should be reviewed continuously to ensure that these are sound and consistent with world-class standards relevant to the operations of the Group and the evolution thereof.

We shall continue to comply with all major recommendations of the Code of Corporate Practices and Conduct as set out in the King Report on Corporate Governance.

Public Finance Management Act

The PFMA came into effect on 1 April 2000 and has had an impact on governance matters in terms of the regulation of financial management in the public sector. The Group complies, in all material aspects, with the Act.

Materiality framework

The materiality framework for reporting losses through criminal conduct and irregular, fruitless and wasteful expenditure, as well as for significant transactions envisaged per section 54(2) of the PFMA, has been finalised and incorporated into the Shareholder's Compact. No material losses through criminal conduct and irregular, fruitless and wasteful expenditure were identified as having been incurred during the year.

CSIR board members

(1 April 2009 – 31 March 2010)

The Board and all its Committees were appointed on 1 January 2009. There was no change to the Board during the year under review.

Professor Francis Petersen (Chair), Dean: Faculty of Engineering and the Built Environment, University of Cape Town

Professor Denis Hall, Professor of Photonics, Director of SMI, Heriot-Watt University

Mr Pepi Silinga, Chief Executive Officer: COEGA Development Corporation

Mr Norbert Behrens, Group General Manager: Strategy and Planning, Sasol Limited

Professor Mike Wingfield, Director Forestry and Agricultural Biotechnology Institute: University of Pretoria

Mr Mclean Sibanda, Head of Innovation Fund IP Management Office

Ms Khomotso Thoka, Managing Executive: The Talent Hub

Mr Alan Knott-Craig, Director of Companies

Dr Sibusiso Sibisi, CSIR CEO and President

CSIR board committees

2009/2010

Audit and Risk Committee

Chairperson Mr P Silinga

Members Mr M Sibanda
Dr S Sibisi
Mr N Behrens

Meetings: 03 August 2009
10 February 2010

Purpose: Deals with all matters prescribed by the regulations issued in terms of the PFMA. Controls the final review of the key risk matters affecting the organisation. Agrees on the scope and reviews the annual external audit plan and the work of the CSIR internal auditors (including the internal audit charter). Acts in an unfettered way to understand the dynamics and performance of the organisation without restrictions. The Audit and Risk Committee has adopted formal terms of reference and is satisfied that it has complied with its responsibilities as set out in the terms of reference.

Human Resources and Remuneration Committee

Chairperson Mr A Knott-Craig

Members Ms K Thoka
Mr M Sibanda

Meetings: 27 May 2009
06 August 2009
16 September 2009

Purpose: Provides the vehicle for the CSIR Board to influence and control human resources and remuneration in the organisation. Determines human resources policy and strategy. Approves remuneration changes and bonus payments. In addition, it reviews the remuneration and expenses of the Executive Management.

The Human Resources and Remuneration Committee has adopted formal terms of reference in line with the King Report on Corporate Governance.

CSIR board committees (continued)

2009/2010

Strategic Review Committee

Chairperson	Professor F Petersen
Members	Professor M Wingfield Mr N Behrens
Meetings:	22 October 2009 08 March 2010
Purpose:	Provides guidance and advice on the long-term trajectory and composition of the CSIR's science and technology portfolio in the context of the needs of the country. Ensures that key innovation and research processes are conducted effectively and benchmarked against international best practice, and that research outputs, organisational climate and credibility remain congruent with the role and objectives of the institution.

report of the audit & risk committee

Report of the Audit and Risk Committee as required by Treasury Regulations 27.1.7 and 27.1.10 and Section (51) (1)(a) of the Public Finance Management Act, Act I of 1999, as amended by Act 29 of 1999.

The Committee is pleased to present its report for the financial year ended 31 March 2010.

The Committee members and attendance

The Committee consists of the members as stated on page 101 of the Corporate Governance report. The Committee meets twice per annum as per its approved terms of reference. Schedule of attendance is shown on page 97 of the Corporate Governance report.

The Committee's responsibility

The Committee has adopted formal terms of reference in its charter in line with the requirements of Section 51(1) (a) of the PFMA and Treasury Regulations 27.1.7 and 27.1.10 and has discharged all its responsibilities for the year, in compliance with the charter.

The effectiveness of internal control

Through the review of the internal audit activity, the Committee is satisfied that an adequate system of internal control is in place to reduce significant risks faced by the organisation to an acceptable level and that these controls have been effective during the period under review. The system is designed to manage, rather than eliminate, the risk of failure and to maximise opportunities to achieve business objectives. This can provide only reasonable but not absolute assurance.

Internal audit

The Committee has evaluated the internal control environment and based on the information provided has assessed the internal financial controls as effective to mitigate related risks.

Risk management

The Committee is satisfied that the CSIR has an ongoing risk management process, focused on identifying, assessing, managing and monitoring all known forms of significant risks across all operations and Group companies. This has been in place for the year under review and up to the date of approval of the Annual Financial Statements.

Evaluation of Financial Statements

The Committee has evaluated the Annual Financial Statements of the CSIR Group for the year ended 31 March 2010, and based on the information provided to the Audit and Risk Committee considers that it complies, in all material respects, with the requirements of the various acts governing disclosure and reporting on the Annual Financial Statements. The Committee therefore recommends the adoption of the Annual Financial Statements and the associated reports by the Board of the CSIR.

Pepi Silinga
Chairperson of the Audit Committee
30 June 2010

report of the auditor-general

Report of the Auditor-General to Parliament on the Financial Statements of the Council for Scientific and Industrial Research for the year ended 31 March 2010

Report on the Consolidated Financial Statements

Introduction

I have audited the accompanying consolidated financial statements and financial statements of the Council for Scientific and Industrial Research, which comprise the consolidated and separate statement of financial position as at 31 March 2010, and the consolidated and separate statement of financial performance, statement of changes in equity and statement of cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information, as set out on page 121 to 165.

Accounting authority's responsibility for the consolidated financial statements

The accounting authority is responsible for the preparation and fair presentation of these financial statements in accordance with South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP) and in the manner required by the Public Finance Management Act No. 1 of 1999. This responsibility includes: designing, implementing and maintaining internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error; selecting and applying appropriate accounting policies; and making accounting estimates that are reasonable in the circumstances.

Auditor-General's responsibility

As required by section 188 of the Constitution of South Africa and section 4 of the Public Audit Act (PAA) of South Africa and section 14 (1) of the Scientific Research Council Act No. 46 of 1988, my responsibility is to express an opinion on these financial statements based on my audit.

I conducted my audit in accordance with International Standards on Auditing and *General Notice 1570 of 2009* issued in *Government Gazette 32758 of 27 November 2009*. Those standards require that I comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my audit opinion.

Opinion

In my opinion, these financial statements present fairly, in all material respects, the consolidated and separate financial position of the Council for Scientific and Industrial Research as at 31 March 2010, and its consolidated and separate financial performance and its consolidated and separate cash flows for the year then ended in accordance with South African Statements of Generally Accepted Accounting Practice (SA Statements of GAAP) described in note 1 to the financial statements and in the manner required by the Public Finance Management Act No. 1 of 1999.

Report on other legal and regulatory requirements

In terms of the PAA of South Africa and *General notice 1570 of 2009*, issued in *Government Gazette No. 32758 of 27 November 2009*, I include below my findings on the report on predetermined objectives, compliance with the Public Finance Management Act and financial management.

Predetermined objectives

No matters to report.

Compliance with laws and regulations

No matters to report.

Internal control

I considered internal control relevant to my audit of the financial statements and the report on predetermined objectives and compliance with the Public Finance Management Act and the Scientific Research Council Act, but not for the purposes of expressing an opinion on the effectiveness of internal control. The matters reported below are limited to the deficiencies identified during the audit.

No matters to report.

Other reports

Engagements to perform agreed-upon procedures

During the year, several reports were issued on agreed-upon procedure engagements. Twelve reports were finalised for the Commission of European Communities, four for national departments and three for national public entities.

Auditor-General

Pretoria
9 July 2010

AUDITOR-GENERAL SOUTH AFRICA

Auditing to build public confidence

executive report

Introduction

On behalf of the CSIR Board, we take pleasure in submitting to Parliament, through the Minister of Science and Technology, this report and the audited Annual Financial Statements of the CSIR Group for the financial year ended 31 March 2010.

In the opinion of the CSIR Board, which fulfils the role of directors as envisaged by the Companies Act, Act 61 of 1973, the Financial Statements fairly reflect the financial position of the CSIR Group as at 31 March 2010 and the results of its operations for the year then ended.

Statutory basis

As a statutory research council established by government, the CSIR is governed by the Scientific Research Council Act, Act 46 of 1988, as amended by Act 71 of 1990. The organisation is listed as a Public Business Enterprise in terms of the Public Finance Management Act, Act 1 of 1999, as amended by Act 29 of 1999.

The CSIR mandate

The CSIR's mandate is as stipulated in the Scientific Research Council Act, Act 46 of 1988, as amended by Act 71 of 1990, section 3:

"The objects of the CSIR are, through directed and particularly multidisciplinary research and technological innovation, to foster, in the national interest and in fields which in its opinion should receive preference, industrial and scientific development, either by itself or in co-operation with principals from the private or public sectors, and thereby to contribute to the improvement of the quality of life of the people of the Republic, and to perform any other functions that may be assigned to the CSIR by or under this Act."

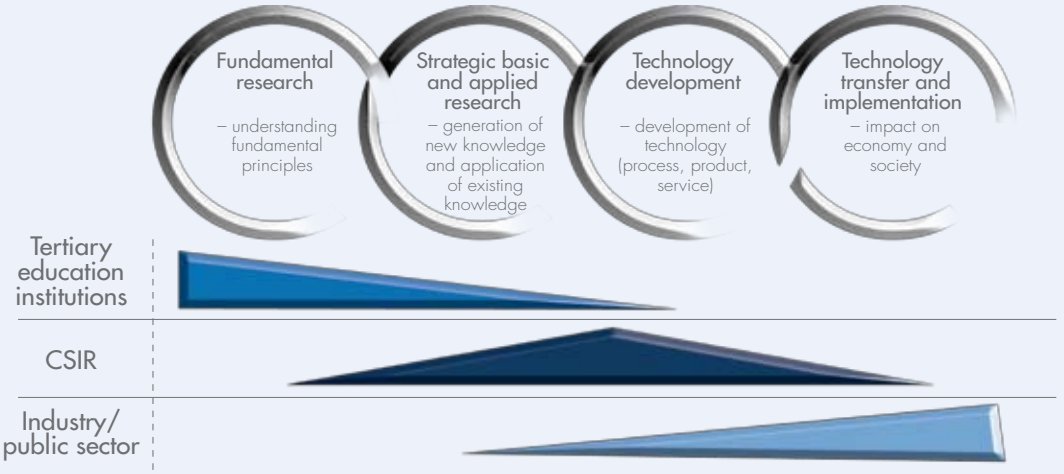
The organisation's objectives and plans are reviewed on a rolling three-year basis. The institutional planning cycle for the CSIR results in a three-year strategic plan, as well as a detailed one-year operational plan. The plan provides the organisation's medium-term objectives and priorities, within the context created by the external and internal environments.

Income sources

The CSIR derives income from baseline and ring-fenced grants from the Department of Science and Technology (DST), contract research and development (R&D) income from local and international public and private sectors, and income from intellectual property exploits or technology transfer efforts.

Grant funding is spent on research programmes and research infrastructure as well as R&D skills development. Processes, policies and guidelines underpin the effective utilisation of grant funding. A portfolio approach is used to manage the funding and is structured to align with the mandate of the CSIR, priority areas in national strategy and the needs of key stakeholders.

Figure 1: The CSIR's role within the National System of Innovation (NSI)



Role in the National System of Innovation (NSI)

The CSIR conducts research across the R&D value chain, a role that distinguishes it from tertiary education institutions (TEIs) or public and private sector R&D players (see Figure 1). The CSIR conducts a degree of basic research, but focuses mainly on directed research, development and technology or knowledge transfer for commercial or social benefit.

CSIR Strategic Review 2009

A strategic (five-year) institutional review of the CSIR was conducted by an international panel during 2009. The review panel complimented the CSIR on the progress made since the implementation of its renewal process "Beyond 60" strategy of five years ago, particularly in terms of strengthening the science base, while maintaining good business practices and high-quality management processes. The review also recommended an improvement in research focus and more clarity on the impact of the CSIR programmes of work. Significant progress was recently made on the definition of the CSIR research impact areas. In future, these will help to achieve more focus. The CSIR has embarked on an extensive process to identify, define, measure and communicate the impact of research. This highly complex matter will receive more attention in the future.

Responding to national imperatives

The CSIR's research agenda is influenced by the National R&D Strategy, the DST's Ten Year Innovation Plan, other key government strategies and the national development agenda. A particular focus is on human capital development (HCD) and the national availability of science, engineering and technology (SET) skills.

The CSIR's role at national level is performed through its research outputs that contribute to achieving goals in national economic and social systems (health, transport, human settlement, defence and security). Specific contributions range from knowledge for decision-making by government and industry, policy development at various levels of government, to transfer of knowledge and technologies that stimulate economic development or enable service delivery and policy implementation.

The CSIR is directly involved in supporting a number of national imperatives and strategies such as those on employment and sustainable livelihoods, rural development, combating crime and corruption, improving health standards and responsible use of resources. Table 1 links the CSIR focus with the government's priorities as summarised in the Medium Term Strategic Framework (MTSF).

Table 1: CSIR research impact areas in support of government's national priorities

MTSF national priorities	CSIR focus
Ensuring more inclusive economic growth, decent work and sustainable livelihoods	Industry support covering advanced manufacturing, defence, forestry and mining issues.
Economic and social infrastructure	Transport and human settlements, health facilities, water supply, climate change, pollution and waste, water quality, atmospheric and marine issues.
Rural development, food security and land reform	Transport and human settlements, health facilities, water supply, climate change, pollution and waste, water quality, nutrition, atmospheric and marine issues.
Access to quality education	ICT, transport and planning of human settlements.
Improved healthcare	Novel drug development, nutrition, materials science and health facilities.
Fighting crime and corruption	Crime mapping, community safety and general defence capability.
Cohesive and sustainable communities	Renewable and alternative energy, transport and human settlements, water quality, water supply, pollution, waste and health issues.
Creation of a better Africa and a better world	Renewable and alternative energy, novel drug development, nutrition, climate change, pollution and waste, water, atmospheric and marine issues, transport and human settlements, ICT and industry support.
Sustainable resource management and use	Forestry and mining issues, pollution and waste, water, atmospheric and marine issues, and renewable energy.
A developmental state including improvement of public services	Renewable and alternative energy, health issues, water, climate change, pollution and waste issues, planning of transport and human settlements, ICT and industry support.

Initiatives to support service delivery

Effective planning and delivery of socio-economic development and basic services to communities as captured in the Local Government Turnaround Strategy (LGTAS) are of priority. Guided by the CSIR mandate, the CSIR has:

- focused on the transfer of CSIR-developed technologies and solutions to improve service delivery (science with social benefit), with implementation happening through the appropriate government line departments;
- strongly promoted science and technology as enablers for improvement in our society and economy.

Setting of KPIs and performance reporting

As an entity within the NSI, the CSIR annually formally reflects its contribution to national priorities through the Science, Engineering and Technology Institution (SETI) scorecard set by the DST, with very specific key performance indicators (KPIs). The CSIR has consistently met or exceeded targets over the past few years.

The CSIR's KPIs are structured to address its organisational priorities: building and transforming human capital; strengthening the SET base and performing relevant R&D; transferring technology and skilled human capital; maintaining financial sustainability and good corporate governance.

As far as possible, the CSIR has set international benchmarks. The process of identifying similarly-structured organisations as benchmarks, is complex. Significant differences exist in funding models as well as the developmental state of the respective countries. Efforts to improve benchmarking are ongoing.

Overview of 2009/10 performance

In 2009/10, the CSIR performed positively against objectives set in its annual Strategic and Operational Plan – evidence of achieving a balance between high standards of science and high standards of corporate governance.

The CSIR has once again achieved an unqualified audit report. Despite global economic hurdles, the CSIR has delivered outstanding financial results in terms of total turnover compared to the previous year. The value of contract R&D and contract R&D income supporting national strategies exceeded target. The target for net margin was also exceeded. The CSIR maintained a customer satisfaction index of 80%.

The HCD pipeline has grown significantly in terms of the number of studentships, interns and bursars supported. Strategic research alliances also increased. The value of capital investment in scientific equipment and facilities exceeded the target. Outputs in terms of publication equivalents increased considerably over the past five years.

In terms of energy saving, the CSIR energy utilisation reduction for the 2009/10 year was 8,36% (measured in kWhr), The CSIR reduction in electricity demand was 9,65% against a target of 10% reduction per year (measured in kVa).

Broad-based black economic empowerment

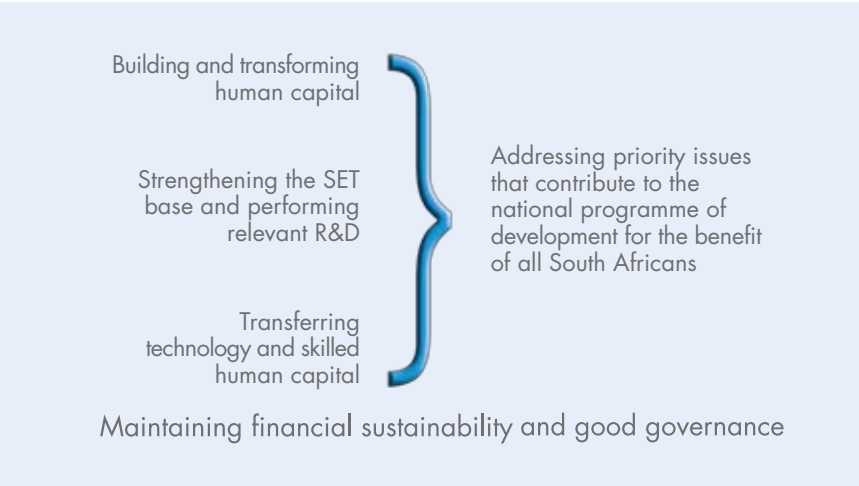
During March 2010, the CSIR was awarded the status of "Finalist" in the Metropolitan Oliver Empowerment Awards. The CSIR was recognised for its "outstanding achievement as a leading black empowered company in its sector/category (Government agency/parastatal) for outstanding contribution to the growth and sustainability of the South African Economy".

Organisational priorities

The CSIR's strategy is translated into organisational priorities. Performance is measured both qualitatively and quantitatively, most notably through the KPIs of the DST's scorecard, as mentioned earlier. Organisational priorities have remained consistent over the past few years and have allowed for cumulative performance and entrenchment of strategy. The organisational priorities are reflected in Figure 2 below. Portfolio offices exist to coordinate and support strategic priorities such as those of the Human Capital Development group, the Intellectual Property Management and Technology Transfer support unit, the Contract R&D office and the Strategic Initiatives and Implementation group.

Organisational support units form part of a CSIR Shared Services grouping and render transactional or specialist strategic support and administrative services to the rest of the organisation.

Figure 2: Organisational priorities



Priority area: building and transforming human capital

To achieve more localised R&D to be funded and performed in South Africa, as called for by the National R&D Strategy, the national shortage of highly-qualified science and engineering postgraduates is cause for concern. The CSIR has subsequently put in place a formal Human Capital Development (HCD) strategy and associated programmes to address this concern, see Table 2 below.

This strategy entered its third year of implementation in 2009/10. The emphasis was on advancing professional development, increasing the numbers of student researchers, black employees and women across all SET levels and promoting the upward mobility of SET personnel.

Table 2: Building and transforming human capital

Priority Area		Main KPIs	2009/10 Target	2009/10 Actual
Human capital development	Quantity: number of full-time students supported financially	Number of permanent CSIR staff studying towards Master's or PhD degrees	225	209 *
		Number of studentships supported	175	232
		Number of interns supported	102	141
		Number of bursars appointed	116	192
Human resource management	Quality of CSIR human resource environment	Total size of SET base (Number, %)	1 550 (65%)	1 547 ** (64,8%)
		% of SET base who are black	53,5%	52,2%***
		% of SET base who are female	32,0%	32,9%
		Number of staff with PhD-level qualifications	282	283

* The CSIR has embarked on a strategy of employing more staff already at Master's level, hence the deviation from target in permanent staff studying towards Master's or PHD degrees.

** The total size of the SET base is for all practical purposes on target.

*** This is a result of a combination of a number of factors including challenges in the retention and attraction of highly-qualified black SET staff.

Pipeline development

In terms of pipeline development, the CSIR supports the following programmes: the Maths & Science Improvement Programme, the Bursary Programme, the Internship Programme and the Studentship Programme.

The Maths and Science Improvement Programme

Part of a memorandum of understanding (MoU) with the Denel Centre for Learning and Development, this tuition programme helped 40 learners to improve their science and mathematics results to access university education. The programme proved a great success: only one learner dropped out of the programme and of the 39 learners, all passed mathematics and 38 passed physical science. A total of eight learners achieved distinctions in mathematics and science. Most learners showed a marked improvement in mathematics (HG) and the same level of improvement in physical science (HG). Fifteen learners were awarded CSIR bursaries for 2010 in the fields of mathematical statistics, chemical engineering, electronic engineering and computer science.

The Bursary Programme

The CSIR Bursary Programme was launched in February 2009 to financially support full time BSc and BSc Honours students in obtaining qualifications in areas that are deemed a priority by the CSIR. The target of 116 bursars was exceeded with a total number of 192 bursars supported, compared to 67 bursars in 2008/09.

The Internship Programme

The Internship Programme supported 141 BSc and BSc Honours graduates to gain practical experience to augment their theoretical studies. A framework to strengthen the content offering of the internship programme was developed and adopted by the CSIR Operations Committee members. About 40% of interns were appointed at the CSIR after completion of the programme. The CSIR has also implemented the DST Innovation Internship to enable 17 interns who were unemployed science graduates to gain exposure in innovation, core research and professional skills at the CSIR. Of the 17 candidates, 11 have been appointed at the CSIR.

The Studentship Programme

The Studentship Programme is aimed at fulfilling the future human capital needs of the CSIR by providing fulltime Master's and PhD students with an opportunity to work on their research projects, under the guidance of CSIR experts. In 2009/10, a total of 232 Master's and PhD students formed part of the programme. The programme also positions the CSIR as a place of science, engineering and technology careers for the entry-level employment market. While most students are still studying, 28 have been appointed as permanent staff at the CSIR. A student professional development framework to strengthen the content offering of the Studentship Programme was developed and adopted by the CSIR.

Professional development initiatives

Research and Innovation Core Skills Programme (RICS)

The RICS targets young and emerging researchers as well as students based at the CSIR to strengthen the research and innovation skills of SET professionals. In 2009, RICS was offered in blocks of four to five sessions per week for three weeks.

Other SET professional development initiatives

Short courses complementing the RICS programme and serving SET staff currently studying for Master's and PhD qualifications were well attended. The Dissertation Writing course attracted 80 participants and the Refworks course, 55. The Access to Peer Reviewed Scientific Publications course attracted another 38 participants. These courses were additional to standard courses

offered by the CSIR Innovation Leadership and Learning Academy (CiLLA) and they were aimed at improving the skills of SET professionals to contribute to their career development.

Career-pathing

In 2006, the CSIR implemented a career-pathing framework (the career-ladder system) for its SET professionals. A total of 134 people were promoted in 2009. Of these, five were promoted to Chief Researcher-level – a researcher of international repute – increasing the number from ten to fifteen. Of significance was the promotion of three women and two black employees to Chief Researcher-level. This was a first for the CSIR and highlighted the quality of researchers at the CSIR.

Since its implementation, the CSIR has vigorously pursued the implementation of the career-ladder process. During the reporting year, as part of improvements to the process, training was provided to different stakeholders, including individuals submitting for assessment and their managers, as well as CSIR research unit panel members.

The revision of career ladders was undertaken to address challenges identified and will be implemented during the next assessment cycle.

Psychosocial support

Support is offered to promote the integration of new and young SET staff and ensure future career growth. The CSIR offers a comprehensive on-boarding process as well as active mentoring and coaching partnerships. A strong interface between bursars, interns and students has been instituted to bond students with the CSIR and the various research programmes through induction courses, visits to the CSIR research units and two university visits by the CSIR. The support provided has had a positive impact on the students' attitude to their studies and the CSIR.

Priority area: strengthening the SET base and performing relevant R&D

The strength of the CSIR SET base is determined by the calibre of its research staff, the quality of research infrastructure, the quality of research outputs and the extent to which research is shaping the national and international research agenda.

The CSIR research and development strategy is informed by national priorities and is focused on creating an impact in selected research areas. In keeping with the CSIR mandate, research impact areas allow for multidisciplinary and integrative research across the organisation, which harnesses the collective capability of the CSIR. Research programmes undertaken within these research impact areas cut across the innovation value chains in a coordinated manner for maximum impact in society, government and industry.

The CSIR achieved outstanding performance with regard to its objective of strengthening the SET base, when measured against targets set for its key performance indicators (see Table 3 opposite). Significant progress was made with both the quality and quantity of research outputs. Despite the unfavourable economic climate, the organisation made large investments in research infrastructure and leveraged various research partnerships to support the implementation of research strategy.

The organisation's investment in emerging research areas (ERAs) is bearing fruit. The ERAs have positioned the CSIR as a key player, both nationally and internationally, in cutting-edge R&D within the fields of nanotechnology, robotics and synthetic biology, with some of the research featured on the cover pages of top international scientific journals. The CSIR-developed technology in these areas is attracting interest from private-sector stakeholders. The ERAs have also made a significant contribution to human capital development.

CSIR research impact areas in support of our mandate

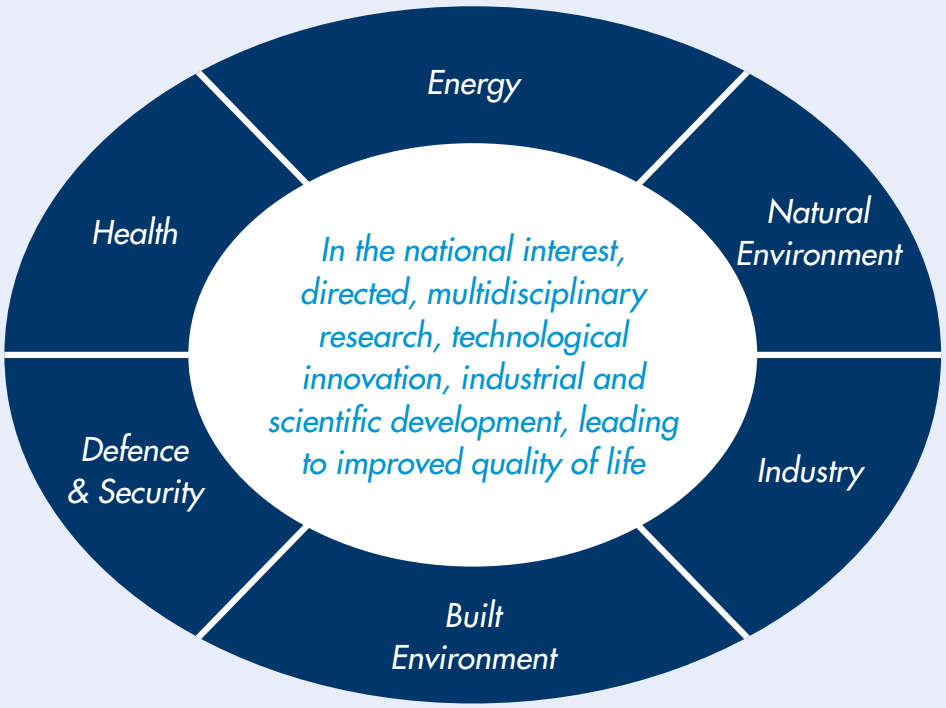


Table 3: Strengthening the SET base and performing relevant R&D

Priority Area		Main KPIs	2009/10 Target	2009/10 Actual
Research and development	SET resource allocation	Total PG excluding ring-fenced PG (% of total income)	R500,9m (33,6%)	R509,1m (30,3%)
		Value of capital investment (% of total income)	R146,6m (9,1%)	R179m (10,6%)
	R&D outputs	Publication equivalents	425	502
		New technology demonstrator equivalents	27	39
Strategic research alliances	Activity of research relationships	Value and number of collaborative R&D activities with a value exceeding R1,5m	R118,7m / 52	R268,8m / 66
		Value and number of collaborative research projects with TEIs	R72,8m / 80	R140,3m / 125

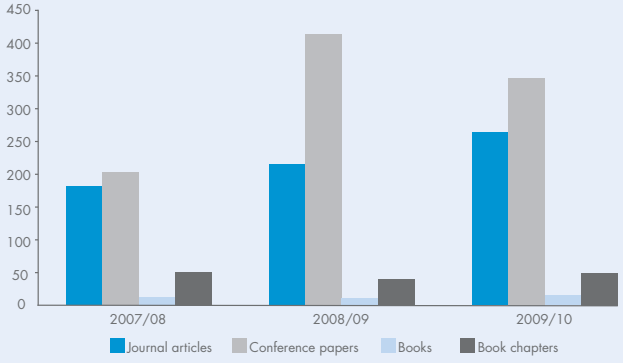
Research productivity

The total number of publication equivalents increased by 11,2% in 2009/10 when compared to the performance of 2008/09. Over the years, the organisation has placed significant emphasis on the quality and quantity of research outputs. It is generally accepted that articles published in scientific journals undergo a more rigorous peer-review process and as a result serve as a good proxy for research quality. Indeed, the number of publication equivalents emanating from journals has shown a steady increase over the years and in the last year increased by 24% – from 215 in 2008/09 to 266 in 2009/10.

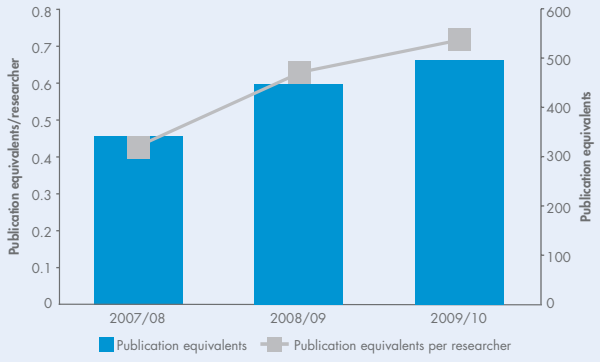
Similarly, articles published in ISI journals with an impact factor greater than 2, increased to 38,1%.

Based on a figure of 697 researchers in the organisation, which is lower than the number of researchers in 2008/09, the number of publication equivalents per researcher increased from 0,63 in 2008/09 to 0,72 in 2009/10. The number of publications per researcher has shown a steady increase over the years, indicating higher levels of researcher productivity.

CSIR publications continue to grow



Publication equivalents per researcher have increased



National research partnerships with TEIs

The CSIR considers its strategic partnerships with tertiary education institutes (TEIs) as a key component of its human capital development and R&D strategies. At the beginning of 2009/10, the CSIR had research collaboration memoranda of agreement in place with nine TEIs, namely the universities of Cape Town, Stellenbosch, Johannesburg, Pretoria, Witwatersrand, Western Cape, Fort Hare as well as the Tshwane University of Technology and the Walter Sisulu University. During the year, an additional two agreements were concluded with the University of Limpopo and the Nelson Mandela Metropolitan University.

Seventeen projects were implemented through seed funding from the CSIR Cooperation Fund. These projects produced peer-reviewed journal articles, conference papers and detailed project proposals for funding. Students participated in most of these projects.

Impact reports, based on previously-agreed indicators, were prepared for five universities. The reports reflected significant numbers of joint publications, joint projects, CSIR staff enrolled as students at these universities and various modalities for sharing human and other resources.

New research collaborations with international partners

Research collaborations continued with Global Research Alliance (GRA) and Regional Research Alliance (RRA) partners. The most significant work with respect to the GRA related to activities in ICT and health. The CSIR ICT team continued its work in collaboration with TNO (Netherlands) on wireless mesh networks in Zambia.

The CSIR, in collaboration with TNO and the TANGA Aids Working Group in Tanzania, continued its work on the validation of indigenous herbs for treating HIV/Aids. The research team also received funding for human capital development from the SABINA network in Malawi.

With respect to collaboration with international bilateral research partners, CSIR Built Environment, in cooperation with the Danish Technological Institute, is implementing a project on low-income housing.

The RRA continued activities within most of its domains – infrastructure, food security and water. Notably, the water team continued its collaboration, which began in the previous year, on the impact of mercury on water resources caused by small-scale mining in the SADEC region.

Priority area: transferring technology and skilled human capital

The CSIR undertakes a range of activities aimed at ensuring that maximum benefit is derived from scientific research conducted for private and public interest (see Table 4 below).

Table 4: Technology transfer and skilled human capital

Priority Area		Main KPIs	2009/10 Target	2009/10 Actual
R&D outcomes	A robust and attractive portfolio of IP and technologies	New international national patents granted	12	13
		Number of new technology packages available for transfer	25	26
	An increased rate of technology transfer for both commercial gain and social good	Royalty and licence revenue	R12,2m	R10,5m*
	Quality of contract R&D	Value of contract R&D formally recognised as supporting national strategies	R464,1m	R693,8m
		Customer satisfaction	80%	80%

* Royalty income is below the target of R12,2 million due largely to the recession in the USA where a sizeable portion of the royalties are earned.

Progress in this area includes:

- A Technology Transfer Fund was implemented to support projects ready for technology transfer by providing funding for value proposition and business case development, market research and development of a technology transfer plan, prototype development and licence negotiation costs.
- The KSS TechTracS information management system went live, improving access to IP and technology transfer information.
- A Memorandum of Understanding was signed between the CSIR and the Industrial Development Corporation (IDC), to collaborate in the commercialisation of CSIR technologies.
- Royalty and licence revenue for the past year amounted to R10,5 million.

CSIR IP portfolio performance in 2009/10

CSIR portfolio performance	Achieved
Invention disclosures	38
Number of new technology packages available for transfer	26
Number of new PCT applications	7
Number of new agreements signed for commercial/social gain	11

The CSIR has an obligation to ensure the knowledge it generates is disseminated and accessible to society. During 2009/10, CSIR Consulting and Analytical Services provided mine explosion awareness training to 3 000 people from all main mining industries. CSIR Enterprise Creation for Development assisted with ongoing implementation of 20 projects/enterprises providing employment to more than 550 people in the underdeveloped areas of the country.

Priority area: financial sustainability

Table 5: Financial sustainability

Priority Area		Main and supporting KPIs	2009/10 Target	2009/10 Actual
Financial sustainability	Operational sustainability	Total income (excluding royalty income)	R1 479,3m	R1 668,9m
		Value of contract R&D income	R963,8m	R1 159,7m
		Net margin	R30,1m	R52,4m
Corporate citizenship		B-BBEE rating	Level-2 contributor	Level-3 contributor*
		Energy efficiency	Achieve 1,2% reduction in energy consumption on previous year	Achieved 8,4% reduction in energy consumption on previous year
		Disabling injury frequency rate (DIFR)	<0,3 disabling injuries	0,4 disabling injuries **

* The new B-BBEE audit will take place in June 2010 and the results thereof are expected in July. The CSIR is currently a Level-3 contributor.

** Several minor incidents resulted in loss of work hours which pushed the DIFR to 0,4 against a target of 0,3.

Financial performance overview

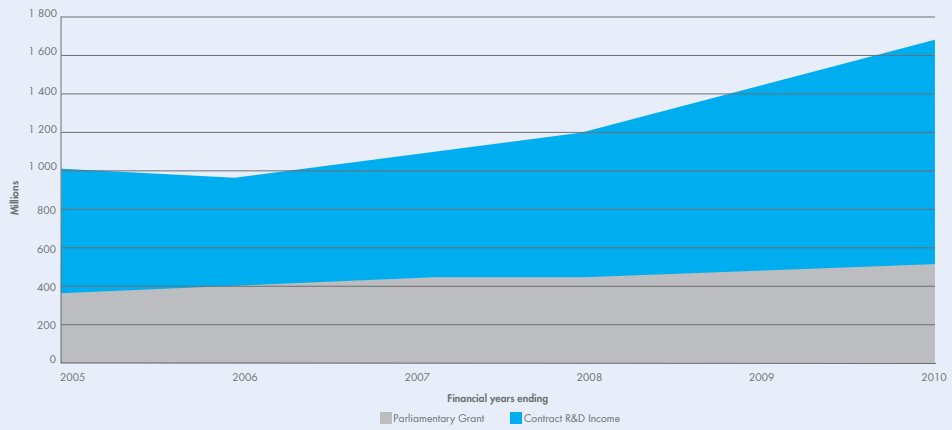
Income

The total operating income of the CSIR increased by 14,1% to an amount of R1 680 million (2008/09: R1 472,3 million). The CSIR Group's total operating income amounted to R1 697,5 million (2008/09: R1 492,7 million), an increase of 13,7%.

The Parliamentary Grant of R510,9 million allocated to the CSIR increased by 6,9% from the prior year amount of R477,8 million.

The total contract R&D income grew by 21,9% to R1 159,7 million (2008/09: R951,4 million). This includes R99,5 million (2008/09: R104,6 million) ring-fenced funding from the DST. The CSIR Group's total contract R&D income increased by 23,1% to an amount of R1 176,8 million.

CSIR Parliamentary Grant and contract R&D income



The CSIR's continued alignment with national strategic priorities resulted in the South African public sector contract R&D income increasing by 28% to an amount of R848,8 million. International sector contract R&D income increased by 12,4% to R159,6 million and South African private sector contract R&D income increased marginally to an amount of R151,3 million.

The continued investment in scientific infrastructure and equipment remains a priority to ensure that world-class facilities and equipment are acquired and maintained. Over the past two financial years R367,2 million has been invested in property, plant and equipment.

Five-year review of CSIR income and expense indicators

	2010 R'000	2009 R'000	2008 R'000	2007 R'000	2006 R'000
Total income	1 748 848	1 554 910	1 271 062	1 150 467	1 016 104
Parliamentary Grant recognised as income	509 122	480 320	429 013	428 055	391 077
Contract income, royalty income, other income and net finance income	1 239 726	1 074 590	842 049	722 412	625 027
Local private sector	151 339	147 752	137 683	134 647	146 765
Local public sector	848 846	661 682	508 779	435 391	370 892
International sector (including Africa)	159 610	142 002	119 584	106 027	82 254
Royalties and other income	11 168	40 516	22 908	17 321	3 412
Net finance income	68 763	82 638	53 095	29 026	21 704
Total operating expenditure	1 695 419	1 495 442	1 219 665	1 125 588	1 047 745
Employees' remuneration	873 445	763 867	619 529	579 035	624 202
Operating expenses	779 832	694 435	572 454	496 752	384 157
Depreciation	42 142	37 140	27 682	49 801	39 386

Net profit and cash-flow

The net profit of the CSIR was R52,4 million (2008/09: R59,2 million). The increase in contract R&D income, the CSIR's sound working capital and cash-flow management together with operational cost control enabled the CSIR to remain financially sustainable in a challenging macro-economic environment. The net profit for the CSIR Group was R57,6 million (2008/09: R58,3 million).

Cash flow generated from operating activities for the CSIR for the year under review was R25,9 million (2008/09: R285,5 million). The cash and cash equivalent holdings, including long-term fixed deposits of the CSIR decreased to R766,2 million (2008/09: R834,8 million).

Five-year ratio analysis

	2010 R'000	2009 R'000	2008 R'000	2007 R'000	2006 R'000
Operating expenses					
Remuneration as a percentage of total income (excluding finance income)	52,0%	51,9%	50,9%	51,6%	62,8%
Remuneration as a percentage of total operating expenditure	51,5%	51,1%	50,8%	51,2%	59,6%
Asset management					
Investment in property, plant and equipment (Rm)	179,0	188,3	85,9	79,2	119,2
Investment in property, plant and equipment as a percentage of revenue	10,7%	13,0%	7,1%	7,1%	12,0%
Net asset turn	3,4	3,4	3,2	3,2	2,9
Current ratio	1,1	1,0	1,2	0,9	1,0
Cash flow					
Net cash from operating activities	25 967	285 546	167 307	341 357	146 659
Cash and cash equivalents at end of year (including long-term fixed deposits)	766 278	834 830	673 309	557 529	289 070

Definitions

Net asset turn – Total revenue (including finance income) divided by net assets

Current ratio – Current assets divided by current liabilities

The post-retirement medical benefit expense and liability and the effects of the adoption of SA GAAP, AC133: Financial instruments – recognition and measurement have been excluded for the comparison of financial indicators.

The investment in property, plant and equipment in 2007 and 2006 included the DST building costs of R7,8 million and R87,2 million, respectively.

annual financial statements

Statements of comprehensive income

for the year ended 31 March 2010

	Notes	GROUP 2010 R'000	GROUP 2009 R'000	CSIR 2010 R'000	CSIR 2009 R'000
Revenue	2	**1 696 558**	1 472 161	**1 679 435**	1 452 774
Other income	3	**1 001**	20 490	**650**	19 498
Total operating income		**1 697 559**	1 492 651	**1 680 085**	1 472 272
Expenditure					
Employees' remuneration		**880 745**	771 977	**874 458**	764 134
Depreciation and amortisation	6 & 7	**42 787**	37 409	**42 142**	37 140
Operating expenses	3	**787 400**	705 645	**779 832**	694 435
Total operating expenditure		**1 710 932**	1 515 031	**1 696 432**	1 495 709
Finance income	4	**78 468**	95 669	**75 921**	92 725
Finance expense	4	**(7 152)**	(10 023)	**(7 152)**	(10 023)
Share of loss of joint ventures and associates	8	**(214)**	(3 503)		
Profit for the year before income tax		**57 729**	59 763	**52 422**	59 265
Income tax expense	5	**(122)**	(1 485)		
Profit for the year		**57 607**	58 278	**52 422**	59 265
Other comprehensive income					
Foreign currency translation differences for foreign operations		**50**	(1 515)		
Other comprehensive income for the year		**50**	(1 515)	**–**	–
Total comprehensive income for the year		**57 657**	56 763	**52 422**	59 265
Profit attributable to:					
Stakeholders of the parent		**57 607**	58 278	**52 422**	59 265
Total comprehensive income attributable to:					
Stakeholders of the parent		**57 657**	56 763	**52 422**	59 265

Statements of financial position

31 March 2010

	Notes	GROUP 2010 R'000	GROUP 2009 R'000	CSIR 2010 R'000	CSIR 2009 R'000
ASSETS					
Non-current assets		**351 994**	399 851	**378 211**	426 845
Property, plant and equipment	6	**350 203**	297 975	**349 183**	296 833
Intangible assets	7	**46**	10	**–**	–
Interest in joint ventures and associates	8	**1 487**	1 608	**1 499**	1 609
Interest in subsidiaries	9			**27 529**	28 403
Other investments	10	**–**	100 000	**–**	100 000
Deferred tax asset	13	**258**	258		
Current assets		**1 104 552**	1 095 481	**1 070 078**	1 070 658
Trade and other receivables	11	**128 752**	138 725	**130 086**	164 720
Inventory and contracts in progress	12	**80 928**	79 338	**78 824**	76 218
Cash and cash equivalents	24	**799 982**	782 528	**766 278**	734 830
Non-current asset held for sale	6.1	**94 890**	94 890	**94 890**	94 890
TOTAL ASSETS		**1 456 546**	1 495 332	**1 448 289**	1 497 503
EQUITY AND LIABILITIES					
Reserves		**507 152**	449 495	**498 710**	446 288
Retained earnings		**506 372**	438 015	**498 710**	435 538
Self-insurance reserve		**–**	10 750	**–**	10 750
Non-distributable reserve:					
Foreign currency translation reserve		**780**	730		
Non-current liabilities		**9 875**	8 862	**9 875**	8 862
Post-retirement medical benefits	18.4	**9 875**	8 862	**9 875**	8 862
Current liabilities		**939 519**	1 036 975	**939 704**	1 042 353
Advances received	14	**493 943**	571 734	**493 943**	571 734
Trade and other payables	15	**445 195**	463 814	**445 761**	470 619
Provisions	16	**381**	1 427	**–**	–
TOTAL EQUITY AND LIABILITIES		**1 456 546**	1 495 332	**1 448 289**	1 497 503

Statements of changes in equity

for the year ended 31 March 2010

	Retained earnings R'000	Self-insurance reserve R'000	Non-distributable reserve* R'000	Total R'000
GROUP				
Balance at 31 March 2008	379 737	10 750	2 245	**392 732**
Total comprehensive income	58 278	–	(1 515)	**56 763**
Profit for the year	58 278	–	–	**58 278**
Other comprehensive income for the year:				
Foreign currency translation differences for foreign operations	–	–	(1 515)	**(1 515)**
Balance at 31 March 2009	**438 015**	**10 750**	**730**	**449 495**
Total comprehensive income	57 607	–	50	**57 657**
Profit for the year	57 607	–	–	**57 607**
Other comprehensive income for the year:				
Foreign currency translation differences for foreign operations	–	–	50	**50**
Transfer of self-insurance reserve to retained earnings	10 750	(10 750)	–	**–**
Balance at 31 March 2010	**506 372**	**–**	**780**	**507 152**
CSIR				
Balance at 31 March 2008	376 273	10 750	–	**387 023**
Total comprehensive income	59 265	–	–	**59 265**
Profit for the year	59 265	–	–	**59 265**
Balance at 31 March 2009	**435 538**	**10 750**	**–**	**446 288**
Total comprehensive income	52 422	–	–	**52 422**
Profit for the year	52 422	–	–	**52 422**
Transfer of self-insurance reserve to retained earnings	10 750	(10 750)	–	**–**
Balance at 31 March 2010	**498 710**	**–**	**–**	**498 710**

* The non-distributable reserve consists of a foreign currency translation reserve. The foreign currency translation reserve comprises all foreign currency differences arising from the translation of the financial statements of foreign operations as well as from the translation of liabilities that hedge the Group's net investment in a foreign subsidiary, if applicable.

Statements of cash flows

for the year ended 31 March 2010

	Notes	GROUP 2010 R'000	GROUP 2009 R'000	CSIR 2010 R'000	CSIR 2009 R'000
Cash-flows from operating activities					
Cash receipts from external customers		**1 208 457**	998 768	**1 190 502**	976 484
Parliamentary Grant received		**510 951**	477 796	**510 951**	477 796
Cash paid to suppliers and employees		**(1 778 483)**	(1 253 492)	**(1 744 249)**	(1 251 372)
Cash (utilised)/generated from operating activities	23	**(59 075)**	223 072	**(42 796)**	202 908
Finance income	4	**78 468**	95 669	**75 921**	92 725
Finance expense	4	**(7 158)**	(10 087)	**(7 158)**	(10 087)
Income taxes paid		**(122)**	(1 743)	**–**	–
Net cash from operating activities		**12 113**	306 911	**25 967**	285 546
Cash-flows from investing activities					
Acquisition of property, plant and equipment	6	**(95 624)**	(114 717)	**(95 056)**	(113 605)
Proceeds on disposal of property, plant and equipment		**1 299**	1 129	**1 222**	1 129
Increase in subsidiary loans				**(685)**	(11 130)
Increase in interest in joint ventures and associates		**–**	(419)	**–**	(419)
Decrease/(increase) in investments		**100 000**	(100 000)	**100 000**	(100 000)
Acquisition of intangible assets	7	**(406)**	(375)	**–**	–
Net cash generated/(utilised) in investing activities		**5 269**	(214 382)	**5 481**	(224 025)
Net increase in cash and cash equivalents		**17 382**	92 529	**31 448**	61 521
Cash and cash equivalents at beginning of the year		**782 528**	691 476	**734 830**	673 309
Effect of foreign exchange rate changes		**72**	(1 477)	**–**	–
Cash and cash equivalents at end of the year	24	**799 982**	782 528	**766 278**	734 830

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES

The CSIR is a parastatal (enacted by The Scientific Research Council Act, Act 46 of 1988) domiciled in the Republic of South Africa. The address of the CSIR's principal place of business is Meiring Naudé Road, Brummeria, Pretoria.

The consolidated Annual Financial Statements are prepared on the historical cost basis except for financial instruments held for trading and financial instruments classified as available-for-sale, which are stated at fair value. The consolidated Annual Financial Statements have been prepared in accordance with statements of South African Generally Accepted Accounting Practice (SA GAAP) and the Public Finance Management Act, Act 1 of 1999 as amended by Act 29 of 1999. The following principal accounting policies have been consistently applied by group entities in all material respects.

The preparation of financial statements requires management to make judgements, estimates and assumptions that affect the application of policies and reported amounts of assets and liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances, the result of which forms the basis of making judgements about carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates.

Estimates and underlying assumptions are reviewed on an ongoing basis. Revisions to accounting estimates are recognised in the period in which the estimate is revised and in any future periods affected.

The consolidated Annual Financial Statements are presented in South African rand (R), which is the CSIR's functional currency, and are rounded off to the nearest thousand.

Changes in accounting policies

Presentation of financial statements

The Group applies revised IAS 1 Presentation of Financial Statements (2007), which became effective as of 1 January 2009. As a result, the Group presents in the consolidated statement of changes in equity all owner changes in equity, whereas all non-owner changes in equity are presented in the consolidated statement of comprehensive income. Comparative information has been re-presented so that it also is in conformity with the revised standard.

Basis of consolidation

Interest in subsidiaries

The consolidated Annual Financial Statements incorporate the Annual Financial Statements of the CSIR and the Annual Financial Statements of the entities under its control from the date that control commences until the date that control ceases. Control exists when the CSIR has the power to govern the financial and operating policies of an investee entity so as to obtain benefits from its activities. In assessing control, potential voting rights that are presently exercisable are taken into account.

On acquisition, the assets and liabilities of the relevant subsidiaries are measured at their fair values at the date of acquisition. The interest of minority shareholders is stated at the minority's proportion of the fair values of the assets and liabilities recognised. The operating results of subsidiaries acquired or disposed of during the reporting period are included in the consolidated statement of comprehensive income from the effective date of acquisition or up to the effective date of disposal. All significant intercompany balances between group entities have been eliminated on consolidation.

Where a group enterprise transacts with a subsidiary company, unrealised gains and losses are eliminated in preparing the consolidated financial statements

Any excess of net assets of a subsidiary over the cost of an acquisition is treated in terms of the Group's accounting policy on goodwill.

Interest in associates

An associate is an entity over which the Group is in a position to exercise significant influence, but not control, through participation in the financial and

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Interest in associates (continued)

operating policy decisions of the investee. The Group's share of the total recognised gains and losses of associates is incorporated in the consolidated financial statements, from the date that significant influence commences until the date that significant influence ceases, using the equity method of accounting. The carrying amount of such interests is reduced to recognise any impairment, other than a temporary impairment, in the value of individual investments.

Where a group enterprise transacts with an associate company, unrealised gains and losses are eliminated to the extent of the group's interest in the relevant associate company, except where unrealised losses provide evidence of an impairment of the asset transferred. When the Group's share of losses exceeds its interest in an investee, the carrying amount of that interest (including any long-term investments) is reduced to nil and the recognition of further losses is discontinued except to the extent that the Group has an obligation or has made payments on behalf of the investee.

Any excess of net assets of an associate over the cost of an acquisition is treated in terms of the Group's accounting policy on goodwill.

Interest in joint ventures

A joint venture is a contractual arrangement whereby the CSIR and other parties undertake economic activity, which is subject to joint control.

Interests in jointly-controlled entities are accounted for by means of the equity method from the date that joint control commences until the date that joint control ceases. The carrying amount of such interests is reduced to recognise any impairment, other than a temporary impairment, in the value of individual investments.

Where a group enterprise transacts with a joint venture, unrealised gains and losses are eliminated to the extent of the group's interest in the relevant joint venture, except where unrealised losses provide evidence of an impairment of the asset transferred.

Any excess of net assets of a joint venture over the cost of an acquisition is treated in terms of the Group's accounting policy on goodwill.

Foreign currencies

Foreign operations

All foreign subsidiaries of the CSIR are foreign operations.

The financial statements of foreign subsidiaries are translated into South African rand as follows:

- Assets and liabilities, including goodwill and fair value adjustments on consolidation, at rates of exchange ruling at the reporting entities' financial year-end
- Revenue, expenditure and cash-flow items at the average rates of exchange during the relevant financial year (the average rates approximate fair value).

Differences arising on translation are reflected as non-distributable reserves called a foreign currency translation reserve (FCTR). When a foreign operation is disposed of, in part or in full, the relevant amount in the FCTR is transferred to profit or loss.

Foreign exchange gains and losses arising from a monetary item receivable from or payable to a foreign operation, the settlement of which is neither planned nor likely in the foreseeable future, are considered to form part of a net investment in a foreign operation and are recognised directly in other comprehensive income in the FCTR.

Foreign currency transactions and balances

Transactions in foreign currencies are converted to South African rand at the rate of exchange ruling at the date of the transactions. Monetary assets and liabilities denominated in foreign currencies are stated in South African rand using the rates of exchange ruling at the reporting date. The resulting exchange differences are recognised in the statement of comprehensive income. Non-monetary assets and liabilities stated at fair value are translated at foreign exchange rates ruling at the date the fair value was determined.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Property, plant and equipment

Owned assets

Land is stated at cost less accumulated impairment losses. Buildings, plant, equipment and vehicles are stated at cost less accumulated depreciation and accumulated impairment losses. Cost includes expenditure directly attributable to acquisition.

The cost of self-constructed assets includes the cost of materials, direct labour, the initial estimate, where relevant, of the costs of dismantling and removing the items and restoring the site on which these are located and an appropriate proportion of production overheads.

Where parts of an item of property, plant and equipment have different useful lives, these are accounted for as separate items (major components) of property, plant and equipment.

Gains and losses on disposal of an item of property, plant and equipment are determined by comparing proceeds from disposal with the carrying amount of property, plant and equipment and are recognised in profit or loss.

Subsequent costs

The Group recognises in the carrying amount of an item of property, plant and equipment, the cost of replacing a part of such an item when that cost is incurred, if it is probable that the future economic benefits embodied in the item will flow to the Group and the cost of the item can be measured reliably. The carrying amount of the replaced part is derecognised. The costs of the day-to-day servicing of property, plant and equipment are recognised in profit or loss as incurred.

Depreciation

Depreciation is based on cost less residual value and is calculated on the straight-line method from the day the assets are available for use, at rates considered appropriate to write off carrying values over the estimated useful lives of the assets, except for assets specifically acquired for a contract, which are depreciated over the life of the contract.

The estimated lives of the main categories of property, plant and equipment are as follows:

- Buildings: 40 years
- Equipment: 3 to 10 years
- Vehicles: 10 years

Depreciation methods, useful lives and current residual values, if not insignificant, are reassessed annually.

Intangible assets

Research and development

Expenditure on research activities, undertaken with the prospect of gaining new scientific or technical knowledge and understanding, is recognised in profit or loss when incurred.

Development activities involve a plan or design for the production of new or substantially-improved products and processes. Development expenditure is capitalised only if development costs can be measured reliably, the product or process is technically and commercially feasible, future economic benefits are probable, and the Group intends to and has sufficient resources to complete development and to use or sell the asset. The expenditure capitalised includes the cost of materials, direct labour and overhead costs that are directly attributable to preparing the asset for its intended use. Other development expenditure is recognised in profit or loss when incurred.

Capitalised development expenditure is measured at cost less accumulated amortisation and accumulated impairment losses.

Goodwill

Goodwill arising on consolidation represents the excess of the cost of an acquisition over the fair value of the Group's interest in the net assets of the acquired subsidiary, associate or joint venture at the date of the acquisition (refer to basis of consolidation).

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Goodwill (continued)

All business combinations are accounted for by applying the purchase method.

Goodwill arising from the acquisition of a joint venture or an associated company is included within the carrying amount of the joint venture or associated company. Goodwill arising from a subsidiary is presented separately in the statement of financial position and tested annually for impairment and is stated at cost less accumulated impairment losses. Goodwill is allocated to cash-generating units. On disposal of a subsidiary, joint venture or associated company, the attributable amount of goodwill is included in the determination of the profit or loss on disposal.

When an excess arising on an acquisition is negative (negative goodwill), it is recognised directly in profit or loss.

Subsequent costs

Subsequent expenditure on capitalised intangible assets is capitalised only when it increases the future economic benefits embodied in the specific asset to which it relates. All other expenditure, including expenditure on internally generated goodwill and brands, is expensed as incurred.

Amortisation

Amortisation is based on cost and calculated on the straight-line method at rates considered appropriate to write off carrying values over the estimated useful lives of the intangible assets with definite useful lives. Intangible assets are amortised from the day they are available for use.

The estimated lives of intangible assets with definite useful lives are as follows:

- Investment in technology: 3 to 10 years
- Development expenditure and intellectual property: 1 to 3 years

Impairment

Financial assets

A financial asset is assessed at each reporting date to determine whether there is any objective evidence that it is impaired. A financial asset is considered to be impaired if objective evidence indicates that one or more events have had a negative effect on the estimated future cash-flows of that asset.

An impairment loss in respect of a financial asset measured at amortised cost is calculated as the difference between its carrying amount and the present value of the estimated future cash-flows discounted at the original effective interest rate. An impairment loss in respect of an available-for-sale financial asset is calculated by reference to its current fair value.

Individually-significant financial assets are tested for impairment on an individual basis. The remaining financial assets are assessed collectively in groups that share similar credit risk characteristics.

All impairment losses are recognised in profit or loss. Any cumulative loss in respect of an available-for-sale financial asset recognised previously in other comprehensive income is transferred to profit or loss.

An impairment loss is reversed if the reversal can be related objectively to an event occurring after the impairment loss was recognised. For financial assets measured at amortised cost and available-for-sale financial assets that are debt securities, the reversal is recognised in profit or loss. For available-for-sale financial assets that are equity securities, the reversal is recognised directly in other comprehensive income.

Non-financial assets

The carrying amounts of the Group's non-financial assets, other than inventories and deferred tax assets, are reviewed at each reporting date to determine whether there is any indication of impairment. If any such indication exists then the asset's recoverable amount is estimated. For goodwill arising from the

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Non-financial assets (continued)

acquisition of subsidiaries and intangible assets that have indefinite lives or that are not yet available for use, the recoverable amount is estimated at each reporting date.

An impairment loss is recognised if the carrying amount of an asset or its cash-generating unit exceeds its recoverable amount. A cash-generating unit is the smallest identifiable asset group that generates cash-flows that are largely independent from other assets and groups. Impairment losses are recognised in profit or loss. Impairment losses recognised in respect of cash-generating units are allocated first to reduce the carrying amount of any goodwill allocated to the units and then to reduce the carrying amount of the other assets in the unit (group of units) on a *pro rata* basis.

The recoverable amount of an asset or cash-generating unit is the greater of its value in use and its fair value less costs to sell. In assessing value in use, the estimated future cash-flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset.

An impairment loss in respect of goodwill is not reversed. In respect of other assets, impairment losses recognised in prior periods are assessed at each reporting date for any indications that the loss has decreased or no longer exists. An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount. An impairment loss is reversed only to the extent that the asset's carrying amount does not exceed the carrying amount that would have been determined, net of depreciation or amortisation, if no impairment loss had been recognised.

Non-current assets held for sale

Non-current assets (or disposal groups comprising assets and liabilities) that are expected to be recovered primarily through sale rather than through continuing use, are classified as held for sale. Immediately before classification as held for sale, the assets (or components of a disposal group) are remeasured in accordance with the Group's accounting policies. Thereafter, the assets (or disposal group) are generally measured at the lower of their carrying amount and fair value less cost to sell. Impairment losses on initial classification as held for sale and subsequent gains or losses on remeasurement are recognised in profit or loss. Gains are not recognised in excess of any cumulative impairment loss.

Retirement benefits

Pension fund

The Group operates a defined contribution plan, the assets of which are held in a separate trustee-administered fund. The benefits payable by the fund in the future, due to retirements and withdrawals from the fund, are contributions to the fund together with fund interest at a rate determined by the valuator with the consent of the trustees. The rate is so determined that the value of the total of the fund shall not exceed the value of the total assets of the fund. The Group's contribution to the plan is charged to the statement of comprehensive income when due.

Post-retirement benefits other than pensions

The Group provides post-retirement medical benefits to qualifying employees, which is deemed to be a defined benefit plan. The expected costs of these benefits are determined using the projected unit credit method, with actuarial valuations being carried out at each reporting date. Contributions are made to the relevant funds over the expected service lives of the employees entitled to those funds. The estimated cost of providing such benefits is charged to the statement of comprehensive income on a systematic basis over the employees' working lives within the Group.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Post-retirement benefits other than pensions (continued)

Actuarial gains and losses are recognised in full in the statement of comprehensive income in the year when actuarially determined. The amount recognised in the statement of financial position represents the present value of the post-retirement medical aid contribution reduced by the fair value of the plan assets. Any asset resulting from this calculation is limited to actuarial losses and the present value of available refunds and reductions in future contributions to the plan.

Inventory and contracts in progress

Raw materials and finished goods are stated at the lower of cost and net realisable value. Cost of inventory is determined by the weighted average method. Net realisable value represents the estimated selling price less all estimated costs to completion and costs to be incurred in selling.

Contracts in progress are stated as a percentage of the sales value of work completed, after provision for losses relating to the stage of completion and any foreseeable losses to completion of the contract, less progress billings.

Income tax

Income tax expense comprises current and deferred tax. The charge for taxation is based on the profit or loss for the year as adjusted for items that are non-taxable or disallowed. It is calculated using tax rates that have been enacted or substantially enacted at the reporting date. Income tax expense is recognised in profit or loss except to the extent that it relates to items recognised directly in other comprehensive income, in which case it is recognised in other comprehensive income.

Deferred tax is recognised in respect of temporary differences arising from differences between the carrying amounts of assets and liabilities in the financial statements and the corresponding tax basis used in the computation of the taxable profit.

Where the tax effects of temporary differences, including those arising from tax losses, give rise to a deferred tax asset, the asset is recognised only if it is probable that future taxable profits will be sufficient to allow the tax benefit of the loss to be realised. Deferred tax assets are reviewed at each reporting date and are reduced to the extent that it is no longer probable that the related tax benefit will be realised. Deferred tax is not recognised for the following temporary differences: the initial recognition of assets or liabilities in a transaction that is not a business combination and that affects neither profit or loss, and differences relating to investments in subsidiaries and jointly controlled entities to the extent that it is probable that they will not reverse in the foreseeable future.

Deferred tax assets and liabilities are offset when there is a legally enforceable right and when these relate to income taxes levied by the same taxation authority and the Group intends to settle its current tax assets and liabilities on a net basis.

The amount of deferred tax provided is based on the expected manner of realisation or settlement of the carrying amount of assets and liabilities using tax rates enacted or substantively enacted at the reporting date. Deferred tax is charged to the statement of comprehensive income except to the extent that it relates to a transaction that is recognised directly in equity. The effect on deferred tax of any changes in tax rates is recognised in the statement of comprehensive income except to the extent that it relates to items previously charged or credited directly to equity.

Provisions

Provisions are recognised when the Group has a present legal or constructive obligation as a result of past events, for which it is probable that an outflow of economic benefits will be required to settle the obligation, and a reliable estimate can be made of the amount of the obligation. Provisions are determined by discounting the expected future cash-flows at a pre-tax rate that reflects current market assessments of the time value of money and the risks specific to the liability.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Provisions (continued)

A provision for onerous contracts is recognised when the expected benefits to be derived by the Group from a contract are lower than the unavoidable cost of meeting its obligations under the contract. The provision is measured at the present value of the lower of the expected cost of terminating the contract and the expected net cost of continuing with the contract. Before a provision is established, the Group recognises any impairment loss on the assets associated with that contract.

Government grants

Government grants that compensate the Group for expenses incurred are recognised as income on a systematic basis over periods necessary to match the assistance with the related expenses it is intended to compensate.

Grants that compensate the Group for the cost of an asset are deducted in arriving at the carrying amount of the acquired asset.

Revenue recognition

Revenue from the sale of goods is measured at the fair value of the consideration received or receivable, net of returns and allowances, trade discounts and volume rebates. Revenue is recognised when the significant risks and rewards of ownership have been transferred to the buyer, recovery of the consideration is probable, the associated costs and possible return of goods can be estimated reliably and there is no continuing management involvement with the goods, and the amount of revenue can be measured reliably.

Revenue from services rendered is recognised in profit or loss in proportion to the stage of completion of the transaction at the reporting date. The stage of completion is assessed by reference to work performed as at the reporting date.

Contract revenue includes the initial amount agreed in the contract plus any variations in contract work, claims and incentive payments to the extent that it is probable that these will result in revenue and can be measured reliably. As soon as the outcome of a contract can be estimated reliably, contract revenue and expenses are recognised in profit or loss in proportion to the stage of completion of the contract.

The stage of completion is assessed by reference to work performed as at reporting date. When the outcome of a contract cannot be estimated reliably, contract revenue is recognised only to the extent of contract costs incurred that are likely to be recoverable. An expected loss on a contract is recognised immediately in profit or loss.

The annual Parliamentary Grant is adjusted for the grant received for projects started before year-end, but not completed as detailed above (refer to Government grants).

Royalties are accrued based on the stipulations of the applicable contracts.

Finance income/expense

Finance income/expense comprises interest receivable on funds invested, dividend income, fair value adjustments on investments and interest payable on borrowings. Interest income is recognised in the statement of comprehensive income as it accrues, using the effective interest rate method. Dividend income is recognised in the statement of comprehensive income on the date that the entity's right to receive payments is established (which is when the dividend is declared). Interest payable on borrowings is calculated using the effective interest method.

Expenses

Operating lease payments

Payments made under operating leases are recognised in the statement of comprehensive income on a straight-line basis over the term of the lease. Lease incentives received are recognised in the statement of comprehensive income as an integral part of the total lease expense, over the term of the lease.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Finance lease payments

Minimum lease payments are apportioned between the finance charge and the reduction of the outstanding liability. The finance charge is allocated to each period during the lease term so as to produce a constant periodic rate of interest on the remaining balance of the liability.

Financial instruments

Financial instruments are initially measured at fair value plus, for instruments not at fair value through profit or loss, any directly attributable transaction costs, when the Group has become a party to contractual provision of the instrument. Subsequent to initial recognition, these instruments are measured as set out below.

Trade and other receivables

Trade receivables are subsequently measured at amortised cost using the effective interest method less any impairment losses, which approximate the fair value of these due to the short-term nature thereof.

Receivables originated by the Group and not held for trading are measured at amortised cost using the effective interest method less any impairment losses if these have a fixed maturity.

Investments and loans

Investments, other than in subsidiaries, associates or joint ventures, are recognised at fair value. Dividends are accounted for on the last day of registration in respect of listed investments and when declared in respect of unlisted investments. On disposal of an investment, the difference between the net disposal proceeds and the carrying amount is charged or credited to the statement of comprehensive income.

Loans are measured at amortised cost using the effective interest method less any impairment losses if they have a fixed maturity, or at cost if there is no fixed maturity.

Cash and cash equivalents

Cash on hand is stated at amortised cost, which is its fair value. Cash and cash equivalents comprise bank balances, cash on deposit and cash on hand.

Forward exchange contracts

Forward exchange contracts are fair valued and gains and losses are recognised in the statement of comprehensive income. Hedge accounting is not applied.

Trade and other payables and advances received

Trade and other payables and advances received are stated at amortised cost, which approximates the fair value of these due to the short-term nature thereof.

De-recognition

Financial assets (or a portion thereof) are de-recognised when the Group realises the rights to the benefits specified in the contract, the rights expire or the Group surrenders or otherwise loses control and does not retain substantially all risks and rewards of the asset. On de-recognition, the difference between the carrying amount of the financial asset and proceeds receivable is included in the statement of comprehensive income.

Financial liabilities (or a portion thereof) are de-recognised when the obligation specified in the contract is discharged, cancelled or expires. On de-recognition, the difference between the carrying amount of the financial liability and the amount paid for it is included in the statement of comprehensive income.

Fair value methods and assumptions

The fair value of financial instruments traded in an organised financial market is measured at the applicable quoted prices necessary to realise the asset or settle the liability.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Fair value methods and assumptions (continued)

The fair value of financial instruments not traded in an organised financial market is determined using a variety of valuation methods and assumptions that are based on market conditions and risk existing at the reporting date, including independent appraisals and discounted cash-flow methods.

Related parties

The Group operates in an economic environment currently dominated by entities directly or indirectly owned by the South African government. As a result of the constitutional independence of all three spheres of government in South Africa, only parties within the national sphere of government will be considered to be related parties.

Key management is defined as being individuals with the authority and responsibility for planning, directing and controlling the activities of the entity. All individuals from the level of Group Executive up to the Board of Directors are regarded as key management.

Close family members of key management are considered to be those family members who may be expected to influence, or be influenced by key management individuals or other parties related to the entity.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Standards and interpretations issued, not yet effective

At the date of authorisation of the financial statements of the Group for the year ended 31 March 2010, the following standards and interpretations were in issue but not yet effective:

Standard/ Interpretation	Description	Effective Date
IFRS 1 (AC 138)	First time adoption of International Financial Reporting Standards. This revision did not result in a change to the technical content of the standard and will therefore not affect the Group's results.	Annual periods commencing on or after 1 July 2009
IFRS 3 (AC 140)	Business combinations. The revision is applicable prospectively and will not affect past business combinations.	Annual periods commencing on or after 1 July 2009
IFRS 5 (AC 142) amendment	Improvements to IFRSs – IFRS 5 Non-current assets held for sale and discontinued operations. The amendment is not expected to affect the Group's results.	Annual periods commencing on or after 1 July 2009
IFRIC 17 (AC 450)	Distributions of non-cash assets to owners. IFRIC 17 is not expected to have an impact on the Group's results.	Annual periods commencing on or after 1 July 2009
IAS 27 (AC 132) amendment	Consolidated and separate financial statements. The revision is applicable prospectively. The impact on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 July 2009
IAS 39 (AC 133) amendment	Eligible hedged items. The revision is not expected to affect the Group's results.	Annual periods commencing on or after 1 July 2009
Various	Improvements to IFRSs (SA GAAP) 2009: IFRS 2 (AC 139) Share-based payment; IAS 38 (AC 129) Intangible assets – additional consequential amendments arising from revised IFRS 3 (AC 140); IFRIC 9 (AC 442) Reassessment of embedded derivatives; IFRIC 16 (AC449) Hedges of a net investment in a foreign operation. The impact on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 July 2009

Notes to the Annual Financial Statements

for the year ended 31 March 2010

1 PRINCIPAL ACCOUNTING POLICIES (continued)

Standards and interpretations issued, not yet effective (continued)

Standard/ Interpretation	Description	Effective Date
IFRS 1 (AC 138) amendment	Additional exemptions for first-time adopters. The amendment will not affect the Group's results.	Annual periods commencing on or after 1 January 2010
IFRS 2 (AC 139) amendment	Group cash-settled share-based payment transactions (withdrawal of IFRIC 8 (AC 441) and IFRIC 11 (AC 444)). The amendment is not expected to affect the Group's results.	Annual periods commencing on or after 1 January 2010
Various	Improvements to IFRSs (SA GAAP) 2009: IFRS 2 (AC 139) Share-based payment; IAS 38 (AC 129) Intangible assets – additional consequential amendments arising from revised IFRS 3 (AC 140); IFRIC 9 (AC 442) Reassessment of embedded derivatives; IFRIC 16 (AC449) Hedges of a net investment in a foreign operation. The impact on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2010
IAS 32 (AC 125) amendment	Classification of rights issues. The amendment is not expected to affect the Group's results.	Annual periods commencing on or after 1 February 2010
IFRIC 19 (AC 452)	Extinguishing financial liabilities with equity instruments. IFRIC 19 is not expected to have an impact on the Group's results.	Annual periods commencing on or after 1 July 2010
Revised IAS 24 (AC 126)	Related party disclosures. The amendments will have an impact on the Group's disclosure for significant related party transactions.	Annual periods commencing on or after 1 January 2011
IFRIC 14 (AC 447) amendment	Prepayments of a minimum funding requirement. The impact of this amendment on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2011
IFRS 9 (AC 146)	Financial instruments. The impact of this amendment on the Group's results cannot be determined at this stage.	Annual periods commencing on or after 1 January 2013

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP				CSIR			
	2010 R'000	%	2009 R'000	%	2010 R'000	%	2009 R'000	%
2 REVENUE								
Parliamentary Grant	**509 122**	**29**	480 320	32	**509 122**	**29**	480 320	33
Parliamentary Grant received	**510 951**	**30**	477 796	32	**510 951**	**30**	477 796	33
Less:								
Grant received for projects started before year-end but not completed	**(42 417)**	**(3)**	(40 588)	(3)	**(42 417)**	**(3)**	(40 588)	(3)
Add:								
Grant received in prior year for projects completed in this year	**40 588**	**2**	43 112	3	**40 588**	**2**	43 112	3
Contract R&D income	**1 176 895**	**70**	955 721	66	**1 159 795**	**71**	951 436	67
Local private sector	**148 802**	**9**	138 368	9	**151 339**	**9**	147 752	10
Local public sector	**848 846**	**50**	661 682	46	**848 846**	**52**	661 682	47
International sector (including Africa)	**179 247**	**11**	155 671	11	**159 610**	**10**	142 002	10
Royalties	**10 541**	**1**	36 120	2	**10 518**	**–**	21 018	–
	1 696 558	**100**	1 472 161	100	**1 679 435**	**100**	1 452 774	100

Contract R&D income is disclosed after taking into account the effect of the time value of money (the value of discounting) in terms of SAICA's Circular 9 of 2006: Transactions giving rise to adjustments to revenue/purchases. The value is R13,324 million (2009: R16,137 million) and is included in finance income (note 4).

Included in public sector contract R&D income is R99,58 million (2009: R104,58 million) ring-fenced allocation from the Department of Science and Technology for specific initiatives managed through memorandums of agreement.

Estimates on Parliamentary Grant recognition are based on cost to completion, budgets and percentage of completion.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

3 OPERATING PROFIT

The net operating profit is arrived at after taking the following items into account:

Auditors' remuneration	**4 225**	3 637	**4 157**	3 465
Audit fees	**4 225**	3 637	**4 157**	3 465
Fees for services	**6 108**	6 429	**5 491**	5 687
Patent costs	**5 660**	5 645	**5 043**	4 903
Legal costs	**448**	784	**448**	784
Operating leases	**16 169**	14 400	**15 057**	13 507
Buildings	**8 944**	6 411	**7 832**	5 518
Equipment	**4 639**	5 364	**4 639**	5 364
Vehicles	**2 586**	2 625	**2 586**	2 625
Net realised foreign exchange loss/(gain)	**2 684**	(13 019)	**3 510**	(13 211)
Net unrealised foreign exchange loss/(gain)	**7 254**	(4 568)	**8 411**	(4 955)
Board members' and executive management's emoluments (note 19)	**17 995**	14 141	**15 898**	11 495
(Reversals of impairments)/impairments	**(6 944)**	2 422	**(7 252)**	4 113
Impairment on subsidiaries, joint ventures and associates	**464**	–	**461**	–
Reversal of impairment on subsidiaries, joint ventures and associates	**–**	(4 692)	**–**	(2 188)
(Reversal of impairment)/impairment on trade receivables	**(7 713)**	6 775	**(7 713)**	6 301
Impairment on intangible assets	**305**	339	**–**	–
Provision for warranty	**(1 046)**	1 427	–	–
Lost and/or stolen equipment and vehicles	**1 464**	1 429	**1 464**	1 429
Bad debt written off	**3 558**	1 645	**3 558**	1 645
Write-down of inventory to net realisable value	**–**	4	**–**	4
(Profit)/loss on disposal and write-off of property, plant and equipment	**(647)**	3 621	**(658)**	3 621
Loss on disposal and deregistration of interest in subsidiary	**–**	330	**–**	–
Profit on disposal of interests in joint ventures and associates	**(559)**	–	**–**	–

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

4 FINANCE INCOME/EXPENSE

Finance income	**78 468**	95 669	**75 921**	92 725
Interest on bank balances and investments	**65 144**	79 532	**62 597**	76 588
Adjustment on initial recognition of contract R&D income*	**13 324**	16 137	**13 324**	16 137
Finance expense	**(7 152)**	(10 023)	**(7 152)**	(10 023)
Fair value adjustment on trade and other receivables	**6**	64	**6**	64
Adjustment on initial recognition of operating expenses*	**(7 158)**	(10 087)	**(7 158)**	(10 087)
	71 316	85 646	**68 769**	82 702

*These adjustments are due to the effect of the time value of money (the value of discounting) in terms of SAICA's Circular 9 of 2006: Transactions giving rise to adjustments to revenue/purchases.

5 INCOME TAX EXPENSE

The CSIR is exempt from South African income tax.

South African normal taxation	**122**	1 477
Current taxation	**122**	1 735
Deferred taxation – temporary differences	**–**	(258)
Foreign taxation	**–**	8
Current taxation	**–**	8
	122	1 485
South African normal rate of taxation	**28%**	28%
Profit attributable to tax-exempt entities	**(25%)**	(27%)
Assessed loss	**(3%)**	1%
Current and deferred taxation – effective rate	**0%**	2%

Notes to the Annual Financial Statements

for the year ended 31 March 2010

6 PROPERTY, PLANT AND EQUIPMENT

	2010			2009		
	Cost	**Accumulated depreciation**	**Carrying value**	Cost	Accumulated depreciation	Carrying value
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Group						
Land	**5 549**	**–**	**5 549**	5 549	–	5 549
Buildings	**249 665**	**77 463**	**172 202**	214 457	77 260	137 197
Equipment	**608 025**	**438 645**	**169 380**	557 743	405 701	152 042
Vehicles	**7 154**	**4 082**	**3 072**	6 912	3 725	3 187
	870 393	**520 190**	**350 203**	784 661	486 686	297 975
CSIR						
Land	**5 549**	**–**	**5 549**	5 549	–	5 549
Buildings	**249 665**	**77 463**	**172 202**	214 457	77 260	137 197
Equipment	**605 351**	**436 991**	**168 360**	555 273	404 373	150 900
Vehicles	**7 154**	**4 082**	**3 072**	6 912	3 725	3 187
	867 719	**518 536**	**349 183**	782 191	485 358	296 833

Notes to the Annual Financial Statements

for the year ended 31 March 2010

6 PROPERTY, PLANT AND EQUIPMENT (continued)

	Land R'000	Buildings R'000	Equipment R'000	Vehicles R'000	Total R'000
Group					
Carrying value 31 March 2008	5 549	109 539	108 433	1 908	**225 429**
Additions	–	31 609	81 524	1 584	**114 717**
Disposals and write-offs	–	(3 749)	(1 000)	(1)	**(4 750)**
Depreciation	–	(202)	(36 877)	(304)	**(37 383)**
Exchange differences on translation of foreign operations	–	–	(38)	–	**(38)**
Carrying value 31 March 2009	5 549	137 197	152 042	3 187	**297 975**
Additions	–	35 207	60 132	285	**95 624**
Disposals and write-offs	–	–	(652)	–	**(652)**
Depreciation	–	(202)	(42 120)	(400)	**(42 722)**
Exchange differences on translation of foreign operations	–	–	(22)	–	**(22)**
Carrying value 31 March 2010	**5 549**	**172 202**	**169 380**	**3 072**	**350 203**
CSIR					
Carrying value 31 March 2008	5 549	109 539	108 122	1 908	**225 118**
Additions	–	31 609	80 412	1 584	**113 605**
Disposals and write-offs	–	(3 749)	(1 000)	(1)	**(4 750)**
Depreciation	–	(202)	(36 634)	(304)	**(37 140)**
Carrying value 31 March 2009	5 549	137 197	150 900	3 187	**296 833**
Additions	–	35 207	59 564	285	**95 056**
Disposals and write-offs	–	–	(564)	–	**(564)**
Depreciation	–	(202)	(41 540)	(400)	**(42 142)**
Carrying value 31 March 2010	**5 549**	**172 202**	**168 360**	**3 072**	**349 183**

Notes to the Annual Financial Statements

for the year ended 31 March 2010

6 PROPERTY, PLANT AND EQUIPMENT (continued)

Land and buildings are unencumbered and full details of the titles are available at the registered office of the CSIR.

A change in the depreciation estimate due to a change in the useful lives of equipment and vehicles resulted in a R3,4 million (2009: R709 746) and R nil (2009: R2 164) decrease in the respective depreciation amounts for the current financial year.

Included in property, plant and equipment are assets with a cost of R301,5 million (2009: R280,4 million) that are fully depreciated as the remaining useful life is incidental.

During the current financial year, assets to the value of R83,9 million (2009: R74,7 million) were purchased with Parliamentary Grant funds. At year-end the cumulative value of assets purchased with Parliamentary Grant funds and shown at a nil carrying value is R216,9 million (2009: R133,0 million).

6.1 Non-current asset held for sale

A building of R94,89 million is in the process of being transferred to the Department of Public Works.

The sale of the building is subject to the finalisation of all conveyancing documentation and registration of the transfer by the relevant authorities.

7 INTANGIBLE ASSETS

	2010			2009		
	Cost	**Accumulated amortisation & impairment**	**Carrying value**	Cost	Accumulated amortisation & impairment	Carrying value
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Group						
Investments in technology	**9 697**	**9 651**	**46**	9 290	9 280	10

	GROUP
	R'000
Carrying value 31 March 2008	–
Additions	375
Impairment	(339)
Amortisation	(26)
Carrying value 31 March 2009	10
Additions	406
Impairment	(305)
Amortisation	(65)
Carrying value 31 March 2010	**46**

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000
8 INTEREST IN JOINT VENTURES AND ASSOCIATES				
Cost of investments less impairment losses	**1**	41	**1**	1
Loans to joint ventures and associates	**33 937**	35 937	**33 937**	35 977
Share of post-acquisition losses	**(18 582)**	(20 750)	**–**	–
	15 356	15 228	**33 938**	35 978
Impairment of joint ventures and associates	**(13 869)**	(13 620)	**(32 439)**	(34 369)
	1 487	1 608	**1 499**	1 609

The loans to joint ventures and associates are interest free, unsecured and have no fixed terms of repayment.

Agreements have been entered into between the CSIR and certain joint ventures and associates to subordinate the loans made to those joint ventures and associates. The subordination agreements will remain in force for as long as the liabilities of the relevant joint ventures or associates exceed their assets, fairly valued.

Details of the joint ventures and associates at 31 March 2010 are as follows:

Name of joint venture/associate	Place of incorporation	Portion of ownership interest	Portion of voting power held	Principal activity	Carrying value 2010 R'000	Carrying value 2009 R'000	Financial year-end
Joint ventures							
ZA Biotech (Pty) Ltd	South Africa	0%	0%	Development and trading in biotechnology and expertise	**–**	215	31 March
Sera (Pty) Ltd	South Africa	50%	50%	Commercialisation and licensing of patents	**13 869**	13 405	31 March
Ellipsoid Technology (Pty) Ltd	South Africa	50%	50%	Development of encapsulation technology	**1 487**	1 608	31 March
Associates							
Eyeborn (Pty) Ltd	South Africa	26%	26%	Holding, licensing and exploitation of intellectual property technology	**–**	–	31 March
					15 356	15 228	

Notes to the Annual Financial Statements

for the year ended 31 March 2010

8 INTEREST IN JOINT VENTURES AND ASSOCIATES (continued)

The following are details of the significant joint ventures' and associates' assets, liabilities, income and expenses:

	JOINT VENTURES GROUP		ASSOCIATES GROUP	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000
Current assets	**30 020**	35 208	**113**	1 946
Non-current assets	**1 076**	–	**–**	1 343
Current liabilities	**366**	3 459	**113**	1 693
Non-current liabilities	**67 874**	71 874	**–**	4 372
Income	**1 834**	5 819	**245**	10 151
Expenses	**2 367**	6 990	**245**	10 181

9 INTEREST IN SUBSIDIARIES

	CSIR	
	2010 R'000	2009 R'000
Shares at cost less impairment losses	**5 003**	5 355
Indebtedness	**22 526**	23 048
– by subsidiaries	**39 165**	39 687
– impairment of loans	**(16 639)**	(16 639)
	27 529	28 403

Details disclosed in Addendum A.

The loans to subsidiaries are interest free, unsecured and have no fixed terms of repayment.

Agreements have been entered into between the CSIR and certain subsidiaries to subordinate the loans made to those subsidiaries. The subordination agreements will remain in force for as long as the liabilities of the relevant subsidiaries exceed their assets, fairly valued.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

10 OTHER INVESTMENTS

	% held **2010**	Number of shares held **2010**	2009	Class of shares				
Unlisted shares					**–**	–	**–**	–
Breathetex (Pty) Ltd	**20,1**	**12 000**	12 000	Ordinary	**11 025**	11 025	**11 025**	11 025
		11 680	11 680	Preference				
Accumulated impairment losses					**(11 025)**	(11 025)	**(11 025)**	(11 025)
Fixed deposits					**–**	100 000	**–**	100 000
					–	100 000	**–**	100 000

11 TRADE AND OTHER RECEIVABLES

Trade receivables	**112 847**	103 820	**115 015**	132 736
Prepaid expenditure	**14 945**	30 573	**14 945**	30 573
Other receivables	**960**	4 332	**126**	1 411
	128 752	138 725	**130 086**	164 720

Trade receivables are shown net of impairment losses. Refer to note 22 for more detail on trade receivables.

12 INVENTORY AND CONTRACTS IN PROGRESS

Inventory	**4 060**	3 052	**2 003**	1 465
Contracts in progress less provision for losses	**76 868**	76 286	**76 821**	74 753
	80 928	79 338	**78 824**	76 218

Estimates on contract in progress recognition are based on cost to completion, budgets and percentage of completion. The write-down of inventory to net realisable value amounted to R nil (2009: R3 936).

13 DEFERRED TAX ASSET

Balance at the beginning of the year	**258**	–
Movement for the year:		
Accelerated capital allowances	**78**	(34)
Provisions	**21**	193
Impairment on trade receivables	**(99)**	99
	258	258

A subsidiary in the Group is in an assessed loss position and no deferred tax asset was raised for this assessed loss due to the uncertainty of the recoverability in future periods in respect of:

- deductible temporary differences, and
- the carry forward of unused tax losses.

Opening balance	**9 048**	5 943
Assessed tax loss (utilised)/generated for the year	**(5 013)**	3 105
Assessed tax loss carried forward	**4 035**	9 048

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

14 ADVANCES RECEIVED

Advances on contracts received from clients	**493 943**	571 734	**493 943**	571 734

Included in advances received is an amount of R116,8 million excluding VAT (2009: R116,8 million excluding VAT) that relates to the transfer of the building to the Department of Public Works (refer note 6.1).

15 TRADE AND OTHER PAYABLES

Accounts payable and accruals	**305 847**	329 569	**306 413**	336 414
Salary-related accruals	**139 348**	134 245	**139 348**	134 205
	445 195	463 814	**445 761**	470 619

16 PROVISIONS

	2010			
	Opening balance R'000	Additional provisions R'000	Utilised and reversed R'000	Closing balance R'000
GROUP				
Warranty provision	1 427	381	(1 427)	**381**
The warranty provision relates to goods sold under a 12-month warranty. The provision amount is determined based on a percentage of the replacement value of all sales made within the current financial year. This percentage is management's estimate of the likely returns of goods under warranty for repairs.				
	1 427	**381**	**(1 427)**	**381**

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010	2009	**2010**	2009
	R'000	R'000	**R'000**	R'000

17 OPERATING LEASE COMMITMENTS

Financial commitments under non-cancellable operating leases will result in the following payments falling due:

Within one year:	**6 701**	7 110	**6 211**	6 502
Land and buildings	**4 670**	5 117	**4 180**	4 509
Vehicles	**2 031**	1 993	**2 031**	1 993
Within two to five years:	**6 868**	11 744	**6 868**	11 744
Land and buildings	**5 039**	9 219	**5 039**	9 219
Vehicles	**1 829**	2 525	**1 829**	2 525

Agreements relating to operating lease payments for vehicles vary from 12 to 60 months and payments are fixed for the term of the agreements.

The CSIR leases buildings under operating leases. The lease periods vary from 24 to 60 months. Lease payments are increased with a fixed annual escalation percentage to reflect market rentals. None of the leases include contingent rentals.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

18 RETIREMENT BENEFITS OF EMPLOYEES

18.1 CSIR Pension Fund

The fund is registered in terms of the Pension Funds Act, 1956, and is a defined contribution plan. The CSIR's liability to the fund is limited to paying the employer contributions. Life cover and dependants' pensions are fully secured by a continued income and life insurance policy. All the CSIR's permanent employees are members of the fund.

Employer contributions of R56,1 million (2009: R47,4 million) and employee contributions of R32,9 million (2009: R27,5 million) were paid over during the year. Employer contributions are charged against income when incurred.

18.2 Mine Officials Pension Fund and Sentinel

At the time of the merger with the Chamber of Mines Research Organisation (COMRO) in 1993, certain COMRO (Sentinel Mining) employees elected to remain members of the Mine Officials Pension Fund and Sentinel (previously Chamber of Mines Pension Fund). In terms of the agreement with the Chamber of Mines, this election holds no liability for the CSIR other than paying the monthly employee contributions. The funds are defined benefit plans.

On 1 March 2001 the members of the Chamber of Mines Pension Fund moved to Sentinel.

In respect of the two employees (2009: four employees) who had formally converted their secondment to a CSIR appointment, employer contributions of R107 781 (2009: R187 713) and employee contributions of R59 437 (2009: R103 065) were paid over during the year. Employer contributions are charged against income when incurred.

18.3 Associated Institutions Pension Fund (AIPF)

The fund is a defined benefit plan. The formula used to determine pensions is based on the pensionable earnings of the final year, and the aggregate period of uninterrupted membership.

The CSIR has two employees (2009: two employees) who are members of the AIPF. The fund is controlled by the state, which has assumed responsibility for the unfunded portions of these funds.

Employer contributions of R12 577 (2009: R9 178) and employee contributions of R7 860 (2009: R5 736) were paid over during the year to the AIPF.

18.4 Post-retirement medical benefits

The CSIR formed its own Medical Aid Scheme, based on managed health care principles, with a strong emphasis on co-responsibility between the fund and its members. The objective is to provide sustainable health care and simultaneously limit the cost, present and future, to a level that is affordable. The CSIR Board approved a cash payment of R190 million in 1997 to the Medical Aid Scheme, thereby transferring the liability for retirement benefits of members to the scheme. Due to changes in the Medical Schemes Act of 1998, the scheme can no longer accept the liability for retirement benefits of qualifying members of the scheme.

The accumulated benefit obligation and the annual cost of accrual of benefits are assessed by independent, qualified actuaries using the projected unit credit method. The estimated present value of the anticipated expenditure for the remaining 26 continuation members was recalculated by the actuaries as at 31 March 2010 and will be funded through cash and cash equivalents. These cash and cash equivalents have not been set aside specifically for this benefit.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

18 RETIREMENT BENEFITS OF EMPLOYEES (continued)

18.4 Post-retirement medical benefits (continued)

The amount included in the statement of financial position arising from the CSIR's obligation in respect of post-retirement medical benefits is as follows:

Present value of obligations	**9 875**	8 862	**9 875**	8 862
Net liability on statement of financial position	**9 875**	8 862	**9 875**	8 862

Amounts recognised in the statement of comprehensive income in respect of the scheme are as follows:

Interest cost	**709**	834	**709**	834
Actuarial loss/(gain) recognised during the year	**304**	(567)	**304**	(567)
Total	**1 013**	267	**1 013**	267

Movement in the net liability recognised in the statement of financial position is as follows:

Net liability at the beginning of the year	**8 862**	8 595	**8 862**	8 595
Movement for the year	**1 013**	267	**1 013**	267
Net expense recognised in the statement of comprehensive income	**1 013**	267	**1 013**	267
Net liability at the end of the year	**9 875**	8 862	**9 875**	8 862

Principal actuarial assumptions at the reporting date:

Discount rate at 31 March	**8,00%**	8,00%	**8,00%**	8,00%
Medical inflation costs	**3,85%**	3,85%	**3,85%**	3,85%

The above results are sensitive to changes in the assumed future rate of medical inflation.

The effect of a one-percent increase in the assumed future rate of medical inflation would have the following effects:

Effect on defined-benefit obligation	**749**	695	**749**	695

The effect of a one-percent decrease in the assumed future rate of medical inflation would have the following effects:

Effect on defined-benefit obligation	**(657)**	(608)	**(657)**	(608)

Historical information	**2010**	2009	2008	2007	2006
Present value of the defined-benefit obligation	**9 875**	8 862	8 595	12 751	14 897
Deficit in the plan	**9 875**	8 862	8 595	12 751	14 897

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for the year ended 31 March 2010

19 REMUNERATION OF BOARD MEMBERS, DIRECTORS AND EXECUTIVE MANAGEMENT

	Entity	Fees for services as director	Managerial Services			Total
			Basic salary	Bonuses and performance-related payments	Retirement fund and medical aid contributions	
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr S Sibisi	CSIR	–	2 504	1 861	419	**4 784**
Foreign subsidiaries						
Mr AA Davidson	Quotec Limited (UK)	–	938	–	12	**950**
Dr A Hickman	Quotec Limited (UK)	–	1 134	–	13	**1 147**
Remunerated in British pound						
Non-executive Board members						
Mr N Behrens	CSIR	30	–	–	–	**30**
Professor DR Hall	CSIR	37	–	–	–	**37**
Mr A Knott-Craig	CSIR	67	–	–	–	**67**
Professor F Petersen	CSIR	60	–	–	–	**60**
Mr M Sibanda	CSIR	69	–	–	–	**69**
Mr M Silinga	CSIR	35	–	–	–	**35**
Ms KL Thoka	CSIR	52	–	–	–	**52**
Professor M Wingfield	CSIR	15	–	–	–	**15**
Executive Management						
Dr T Dlamini	CSIR	–	1 259	421	101	**1 781**
Dr JH Maree	CSIR	–	1 414	813	209	**2 436**
Ms K Njobe	CSIR	–	1 424	730	173	**2 327**
Mr CR Sturdy	CSIR	–	1 355	744	210	**2 309**
Mr RM Zondo	CSIR	–	1 221	551	124	**1 896**
2010		**365**	**11 249**	**5 120**	**1 261**	**17 995**

Notes to the Annual Financial Statements

for the year ended 31 March 2010

19 REMUNERATION OF BOARD MEMBERS, DIRECTORS AND EXECUTIVE MANAGEMENT (continued)

	Entity	Fees for services as director	Managerial Services			Total
			Basic salary	Bonuses and performance-related payments	Retirement fund and medical aid contributions	
		R'000	R'000	R'000	R'000	R'000
Board members and Executive Directors						
Dr S Sibisi	CSIR	–	2 275	819	383	3 477
Foreign subsidiaries						
Mr AA Davidson	Quotec Limited (UK)	–	1 078	113	4	1 195
Dr A Hickman	Quotec Limited (UK)	–	1 325	113	13	1 451
Remunerated in British pound						
Non-executive Board members						
Mr N Behrens (since Jan 09)	CSIR	20	–	–	–	20
Professor C de la Rey (until Dec 08)	CSIR	12	–	–	–	12
Dr N Dlamini (until Dec 08)	CSIR	9	–	–	–	9
Professor DR Hall	CSIR	25	–	–	–	25
Mr A Knott-Craig (since Jan 09)	CSIR	20	–	–	–	20
Mr EH Mayet (until Dec 08)	CSIR	11	–	–	–	11
Dr N Msomi (until Dec 08)	CSIR	6	–	–	–	6
Professor F Petersen	CSIR	55	–	–	–	55
Ms N Shikwane (until Dec 08)	CSIR	21	–	–	–	21
Mr M Sibanda (since Jan 09)	CSIR	30	–	–	–	30
Mr M Silinga (since Jan 09)	CSIR	20	–	–	–	20
Ms KL Thoka (since Jan 09)	CSIR	20	–	–	–	20
Professor M Wingfield	CSIR	39	–	–	–	39
Executive Management						
Dr T Dlamini (Interim: since Feb 08)	CSIR	–	906	112	68	1 086
Dr JH Maree	CSIR	–	1 284	330	191	1 805
Ms K Njobe	CSIR	–	1 264	305	155	1 724
Mr CR Sturdy	CSIR	–	1 234	268	150	1 652
Mr RM Zondo	CSIR	–	1 107	243	113	1 463
2009		288	10 473	2 303	1 077	14 141

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

20 CONTINGENT LIABILITIES AND FACILITIES

Facilities of subsidiaries guaranteed by the CSIR	**20 000**	20 000	**20 000**	20 000

Legal costs and litigation

In the nature of the CSIR's business, agreements with complex deliverables may be entered into. All necessary steps are taken to manage the risks inherent to these transactions. If and when it is evident that there is a reasonable probability that a dispute on a transaction could lead to costs against the CSIR, such costs will be disclosed.

21 CAPITAL COMMITMENTS

Property, plant and equipment	**7 770**	47 149	**7 770**	47 149

This capital expenditure is to be financed from internal sources.

22 FINANCIAL INSTRUMENTS

The Group has exposure to the following risks from its use of financial instruments:

- market risk
- credit risk
- liquidity risk.

This note presents information about the Group's exposure to each of the above risks and the Group's objectives, policies and processes for measuring and managing risk. Further quantitative disclosures are included throughout these consolidated financial statements.

The Board has overall responsibility for the establishment and oversight of the Group's risk management framework.

The Group's risk management policies are established to identify and analyse the risks faced by the Group, to set appropriate risk limits and controls, and to monitor risks and adherence to limits. Risk management policies and systems are reviewed regularly to reflect changes in market conditions and the Group's activities. The Group, through its training and management standards and procedures, aims to develop a disciplined and constructive control environment in which all employees understand their roles and obligations.

The Audit Committee oversees how management monitors compliance with the Group's risk management policies and procedures and reviews the adequacy of the risk management framework in relation to the risks faced by the Group. The Group Audit Committee is assisted in its oversight role by Internal Audit. Internal Audit undertakes both regular and *ad hoc* reviews of risk management controls and procedures, the results of which are reported to the Audit Committee.

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22 FINANCIAL INSTRUMENTS (continued)

22.1 Market risk

Foreign currency risk

The Group is exposed to currency risk on sales and purchases that are denominated in a currency other than the respective functional currencies of Group entities, primarily the rand, and on investments in foreign operations.

The Group enters into forward exchange contracts to buy specified amounts of foreign currencies in the future at a predetermined exchange rate.

Forward exchange contracts are entered into mainly to cover import orders. The Group has no policy to enter into forward exchange contracts for anticipated foreign receipts. The Group does not use derivative financial instruments for speculative purposes.

The Group's exposure to foreign currency risk was as follows, based on notional amounts:

	31 MARCH 2010					
	Total R'000	**ZAR R'000**	**EURO R'000**	**USD R'000**	**GBP R'000**	**Other R'000**
Trade receivables	**112 847**	96 869	4 397	9 293	1 268	1 020
Bank accounts	**87 764**	24 646	8 586	53 658	697	177
Trade payables	**(445 195)**	(443 283)	–	–	(1 912)	–
Gross statement of financial position exposure	**(244 584)**	(321 768)	12 983	62 951	53	1 197
Forward exchange contracts	**(2 564)**	–	(2 564)	–	–	–
Net exposure	**(247 148)**	**(321 768)**	**10 419**	**62 951**	**53**	**1 197**

	31 MARCH 2009					
	Total R'000	ZAR R'000	EURO R'000	USD R'000	GBP R'000	Other R'000
Trade receivables	103 820	87 268	3 976	9 168	1 438	1 970
Bank accounts	91 164	39 136	10 384	34 159	6 859	626
Trade payables	(463 814)	(456 623)	(4 411)	(187)	(2 585)	(8)
Gross statement of financial position exposure	(268 830)	(330 219)	9 949	43 140	5 712	2 588
Forward exchange contracts	(5 003)	–	(5 003)	–	–	–
Net exposure	(273 833)	(330 219)	4 946	43 140	5 712	2 588

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP	
	2010	2009

22 FINANCIAL INSTRUMENTS (continued)

22.1 Market risk (continued)

Foreign currency risk (continued)

The following significant exchange rates applied during the year:

Average rate of forward exchange contracts	**R**	R
Euro	**9.9392**	13.1323
Year-end spot rate		
Euro	**9.9426**	12.8286
USD	**7.3926**	9.7205
GBP	**11.1420**	13.8163

Sensitivity analysis

A 10% strengthening of the rand against the following currencies at 31 March would have decreased profit or loss by the amounts shown below. This analysis assumes that all other variables remain constant. The analysis is performed on the same basis for 2009.

	R'000	R'000
Euro	**(1 042)**	(495)
USD	**(6 295)**	(4 314)
GBP	**(5)**	(571)
Other	**(120)**	(259)

A 10% weakening of the rand against the above currencies at 31 March would have had the equal but opposite effect on the above currencies to the amounts shown above, on the basis that all other variables remain constant.

Interest rate risk

Interest-rate exposure and investment strategies are evaluated by management on a regular basis. Interest-bearing investments are held with several reputable banks in order to minimise exposure.

At the reporting date the interest-rate profile of the Group's interest-bearing financial instruments was as follows:

Fixed rate instruments: carrying amount

	R'000	R'000
Financial assets: Fixed deposits	**518 115**	555 620

The Group does not account for any fixed rate financial assets and liabilities at fair value through profit or loss, and the Group does not designate derivatives (interest rate swaps) as hedging instruments under a fair value hedge-accounting model. Therefore, a change in interest rates at the reporting date would not affect profit or loss.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP	
	2010	2009
	R'000	R'000

22 FINANCIAL INSTRUMENTS (continued)

22.1 Market risk (continued)

Interest rate risk (continued)

Variable rate instruments: carrying amount

Financial assets: Call deposits	**193 724**	235 364
Financial assets: Bank balances	**87 764**	91 164
	281 488	326 528

Sensitivity analysis

An increase of 100 basis points in interest rates at the reporting date would have increased equity and profit and loss by the amounts shown below. This analysis assumes that all other variables, in particular foreign currency rates, remain constant. The analysis is performed on the same basis for 2009.

Variable rate instruments	**2 815**	3 265

A decrease of 100 basis points would have had the equal but opposite effect to the amounts shown above.

22.2 Credit risk

Credit risk is the risk of financial loss to the Group if a customer or counterparty to a financial instrument fails to meet its contractual obligations, and arises principally from the Group's bank balances and deposits, trade and other receivables and loans to joint ventures, associates and subsidiaries.

Trade and other receivables and loans to joint ventures, associates and subsidiaries

Trade and other receivables and loans to joint ventures, associates and subsidiaries are presented net of impairment losses. Credit risk with respect to trade receivables is limited due to the large number of customers comprising the Group's customer base and their dispersion across different industries and geographical areas. Accordingly, the Group does not have a significant concentration of credit risk.

The carrying amounts of financial assets included in the statement of financial position represent the Group's exposure to credit risk in relation to these assets.

The Group does not have any significant exposure to any individual customer or counterparty.

Bank balances and deposits

The Group's bank balances and cash are placed with high-credit, quality financial institutions.

Guarantees

Refer to note 20 for details on bank guarantees issued with respect to facilities.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

22 FINANCIAL INSTRUMENTS (continued)

22.2 Credit risk (continued)

Exposure to credit risk	GROUP 2010 R'000	GROUP 2009 R'000
The carrying amount of financial assets represents the maximum credit exposure.		
The maximum exposure to credit risk at the reporting date was:		
Held-to-maturity investments:		
– *Non-current fixed deposits*	–	100 000
– *Current fixed deposits*	**518 115**	455 620
Other cash and cash equivalents:		
– *Call deposits*	**193 724**	235 364
– *Bank balances*	**87 764**	91 164
– *Cash on hand and cash deposits*	**379**	380
Loans and receivables:		
– *Trade and other receivables*	**128 752**	138 725
– *Contracts in progress less provision for losses*	**76 868**	76 286
	1 005 602	1 097 539
The maximum exposure to credit risk for trade receivables at the reporting date by type of customer was:		
Local public	**71 173**	68 149
Local private	**22 611**	17 762
International	**19 063**	17 909
	112 847	103 820

The Group's most significant customers are government institutions.

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22 FINANCIAL INSTRUMENTS (continued)

22.2 Credit risk (continued)

Exposure to credit risk (continued)

The aging of the Group's trade receivables at the reporting date was:

	2010		2009	
	Gross R'000	Impairment R'000	Gross R'000	Impairment R'000
Not past due	**82 305**	**1 909**	77 664	1 300
Past due 0 – 30 days	**19 059**	**1 935**	15 950	1 592
Past due 31 – 120 days	**15 060**	**3 205**	17 263	5 066
Past due more than 120 days	**7 521**	**4 049**	11 754	10 853
	123 945	**11 098**	122 631	18 811

The movement in the allowance for impairment in respect of trade receivables during the year was as follows:

	GROUP	
	2010 R'000	2009 R'000
Balance at 1 April	**18 811**	12 036
Impairment loss (reversed)/recognised	**(7 713)**	6 775
Balance at 31 March	**11 098**	18 811

The allowance account in respect of trade receivables is used to record impairment losses unless the Group is satisfied that no recovery of the amount owing is possible; at that point the amount considered irrecoverable is written off against the financial asset directly.

The movement in the impairment allowance account is due mainly to the following: recoveries of R11,7 million (2009: R7,8 million), utilisation of R6,3 million (2009: R0,8 million) and new impairment allowances of R10,3 million (2009: R15,3 million).

22.3 Liquidity risk

Liquidity risk is the risk that the Group will not be able to meet its financial obligations as these fall due. The Group's approach to managing liquidity is to ensure, as far as possible, that it will always have sufficient liquidity to meet its liabilities when due, under both normal and stressed conditions, without incurring unacceptable losses or risking damage to the Group's reputation.

The Group monitors its cash-flow on a daily basis. Typically, the Group ensures that it has sufficient cash on demand to meet expected operational expenses for a period of 60 days, including the servicing of financial obligations; this excludes the potential impact of extreme circumstances that cannot be predicted reasonably, such as natural disasters.

The CSIR has a short-term general banking facility of R500 000 (2009: R5,0 million) available.

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22 FINANCIAL INSTRUMENTS (continued)

22.3 Liquidity risk (continued)

The following are the contractual maturities of financial liabilities, including interest payments and excluding the impact of netting agreements for the Group:

	2010			2009		
	Carrying amount	**Contractual cash-flows**		Carrying amount	Contractual cash-flows	
		6 months or less	**6–12 months**		6 months or less	6–12 months
	R'000	**R'000**	**R'000**	R'000	R'000	R'000
Non-derivative financial liabilities						
Trade and other payables	**(445 195)**	**(445 195)**	**–**	(463 814)	(463 814)	–
Derivative financial liabilities						
Forward exchange contracts	**(115)**	**(2 679)**	**–**	(190)	(5 194)	–
	(445 310)	**(447 874)**	**–**	(464 004)	(469 008)	–

Rate of forward exchange contracts:

	GROUP	
	2010	2009
	R	R
Euro	**10.3849**	13.6316

22.4 Fair values

At 31 March 2010 the carrying amount of bank balances and cash, deposits, trade and other receivables, contracts in progress and trade and other payables approximated their fair values due to the short-term maturities of these assets and liabilities.

Basis for determining fair values

Interest free employee loans

The fair value of interest-free employee loans is calculated based on the present value of future cash-flows, discounted at the market rate of interest at the reporting date.

Trade and other receivables and trade and other payables

The fair value of trade and other receivables and trade and other payables is calculated based on the present value of future cash-flows, discounted at the average return on investment rate at the reporting date.

22.5 Fair value hierarchy

The table on the next page analyses financial instruments carried at fair value, by valuation method. The different levels have been defined as follows:

Level 1: quoted prices (unadjusted) in active markets for identical assets or liabilities

Level 2: inputs other than quoted prices included within level 1 that are observable for the asset or liability, either directly (as prices) or indirectly (derived from prices)

Level 3: inputs for the asset or liability that are not based on observable market data (unobservable inputs).

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22 FINANCIAL INSTRUMENTS (continued)

22.5 Fair value hierarchy (continued)

	Level 1	Level 2	Level 3	Total
31 March 2010				
Derivative financial liabilities		(115)		**(115)**
31 March 2009				
Derivative financial liabilities		(190)		(190)

23 RECONCILIATION OF OPERATING PROFIT TO CASH GENERATED FROM OPERATING ACTIVITIES

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000
Operating profit for the year before taxation	**57 729**	59 763	**52 422**	59 265
Adjusted for:				
(Profit)/loss on disposal of interest in subsidiaries, joint ventures and associates	**(559)**	330	**–**	–
Depreciation and amortisation	**42 787**	37 409	**42 142**	37 140
Net unrealised foreign exchange loss/(gain)	**7 254**	(4 568)	**8 411**	(4 955)
Net finance income	**(71 316)**	(85 646)	**(68 769)**	(82 702)
Post-retirement medical benefits	**1 013**	267	**1 013**	267
Straight-lining adjustment of operating leases	**45**	271	**45**	271
Leave accrual and warranty provision	**7 080**	11 760	**8 126**	10 333
(Reversals of impairments)/impairments	**(6 944)**	2 422	**(7 252)**	4 113
(Profit)/loss on disposal and write-off of property, plant and equipment	**(647)**	3 621	**(658)**	3 621
Share of loss of joint ventures and associates	**214**	3 503	**–**	–
Bad debt written off	**3 558**	1 645	**3 558**	1 645
Write-down of inventory to net realisable value	**–**	4	**–**	4
Operating profit before changes in working capital	**40 214**	30 781	**39 038**	29 002
Decrease in trade and other receivables	**13 444**	124 233	**38 154**	94 025
Increase in inventory and contracts in progress	**(4 676)**	(17 630)	**(5 692)**	(14 510)
(Decrease)/increase in advances received	**(77 791)**	122 880	**(77 791)**	122 880
Decrease in trade and other payables and provisions	**(30 266)**	(37 192)	**(36 505)**	(28 489)
Net working capital changes	**(99 289)**	192 291	**(81 834)**	173 906
Cash (utilised)/generated from operating activities	**(59 075)**	223 072	**(42 796)**	202 908

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for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000
24 CASH AND CASH EQUIVALENTS				
Fixed deposits	**518 115**	455 620	**491 000**	416 000
Call deposits	**193 724**	235 364	**189 000**	235 000
Bank balances	**87 764**	91 164	**85 903**	83 460
Cash on hand and cash deposits	**379**	380	**375**	370
	799 982	782 528	**766 278**	734 830

25 RELATED PARTY TRANSACTIONS

The CSIR is one of 29 schedule 3B National Government Business Enterprises in terms of the Public Finance Management Act, Act 1 of 1999 as amended by Act 29 of 1999, and therefore falls within the national sphere of government. As a consequence, the CSIR has a significant number of related parties, being entities that fall within the national and provincial sphere of government. Amounts due from/(to) these entities are subject to the same terms and conditions as normal trade receivables and trade payables.

In addition, the CSIR has a related party relationship with its subsidiaries (see Addendum A) and joint ventures and associates (see note 8). Unless specifically disclosed, these transactions are concluded at arm's length and the Group is able to transact with any entity.

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	2010 R'000	2009 R'000
25 RELATED PARTY TRANSACTIONS (continued)				
25.1 Transactions with related parties				
The following is a summary of transactions with related parties during the year and balances due at year-end:				
Constitutional institutions				
Services received	**335**	362	**335**	362
Amount due to	**–**	(101)	**–**	(101)
Major public entities				
Services rendered	**216 163**	189 430	**216 163**	189 430
Services received	**6 759**	7 835	**6 759**	7 835
Amount due from	**16 778**	21 006	**16 778**	21 006
National public entities				
Services rendered	**61 292**	53 105	**61 292**	53 105
Services received	**2 297**	156 022	**2 297**	156 022
Amount due from	**7 163**	6 934	**7 163**	6 934
National government business enterprises				
Services rendered	**2 302**	2 776	**2 302**	2 776
Services received	**3 101**	2 276	**3 101**	2 276
Amount due (to)/from	**(2 478)**	999	**(2 478)**	999
Provincial public entities				
Services rendered	**1 421**	975	**1 421**	975
Services received	**–**	10	**–**	10
Amount due from	**309**	–	**309**	–
Provincial government business enterprises				
Services rendered	**2 460**	1 933	**2 460**	1 933
Services received	**10**	150	**10**	150
Amount due from	**331**	339	**331**	339

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP		CSIR	
	2010 R'000	2009 R'000	**2010 R'000**	2009 R'000

25 RELATED PARTY TRANSACTIONS (continued)

25.1 Transactions with related parties (continued)

Government departments				
Services rendered	**924 890**	745 355	**924 890**	745 355
Services received	**5 801**	100	**5 801**	100
Amount due from	**84 192**	31 105	**84 192**	31 105
Subsidiaries				
Services rendered			**4 485**	16 979
Services received			**3 858**	–
Amount due (to)/from			**(212)**	21 918
Assets sold to subsidiaries			**–**	4 290
Associates				
Services rendered	**527**	2 243	**527**	2 243
Amount due from	**80**	1 174	**80**	1 174

25.2 Transactions with key management

Total remuneration of key management is included in employees' remuneration (refer to note 19 for remuneration of Executive Management).

Notes to the Annual Financial Statements

for the year ended 31 March 2010

	GROUP
	2009
	R'000

26 DEREGISTRATION AND LIQUIDATION OF SUBSIDIARIES

26.1 Implico BV

The Group held 100% of the issued share capital in Implico BV. The company was deregistered on 9 October 2008.

The net assets of Implico BV on deregistration were as follows:	
Net asset value disposed	327
Loss on deregistration	(327)
Total consideration	–
Net cash outflow arising on deregistration of interest in subsidiary	
Bank balance and cash disposed	–

26.2 South African Inventions Development Corporation (SAIDCOR)

The Group held 100% of the issued share capital in the South African Inventions Development Corporation. The Inventions Development Act, 1962 (Act No. 31 of 1962) was repealed upon the promulgation of the Technology Innovation Agency Act, 2008 on 17 November 2008 and SAIDCOR was thereby disestablished.

The net assets of SAIDCOR on disestablishment were as follows:	
Net asset value disposed	3
Loss on deregistration	(3)
Total consideration	–
Net cash outflow arising on deregistration of interest in subsidiary	
Bank balance and cash disposed	–

Addendum A: Interest in subsidiaries

31 March 2010

Consolidated subsidiaries	Country of incorporation	Interests of the CSIR					
		Issued capital	Effective holding		Financial year-end	Shares at cost less accumulated impairment losses	
			2010	2009		2010	2009
		R'000	%	%		R'000	R'000
Direct investments							
Technology Finance Corporation (Pty) Ltd (Technifin)	South Africa	**5 200**	**100**	100	31 March	**4 650**	4 650
Technovent (Pty) Ltd	South Africa	**5 000**	**100**	100	31 March	**–**	–
Quotec Limited	United Kingdom	**20**	**100**	100	31 March	**353**	705
						5 003	5 355

The Group has interests in three dormant companies. Details of these interests are available at the CSIR's registered office.

Interests of the CSIR						
Net indebtedness less accumulated impairment losses				Net investment		General nature of business
to subsidiaries		by subsidiaries				
2010 R'000	2009 R'000	**2010 R'000**	2009 R'000	**2010 R'000**	2009 R'000	
–	–	**13 262**	13 216	**17 912**	17 866	The acquisition and transfer of technology to industry by licensing new inventions, providing finance to develop technology and venture capital for the exploitation thereof.
–	–	**4 464**	4 464	**4 464**	4 464	The company sources technologies and entrepreneurs from the CSIR, other S&T institutions, universities or any developer of technology and develops these into viable businesses with the aim of spinning them off for capital gain and/or public good.
–	–	**4 800**	5 368	**5 153**	6 073	The principal activity of the company is that of consultants on technology auditing, technology evaluation and technology transfer on behalf of clients in the public and private sectors.
–	–	**22 526**	23 048	**27 529**	28 403	

disclosure of expenditure relating to the soccer world cup for the year ended 31 March 2010

Details of the distribution of soccer tickets acquired after financial year-end are as follows:

	Quantity	R'000
Clients/stakeholders	10	115
Accounting authority: executive	3	34
Accounting authority: non-executive	2	23
Senior management	16	97
Other employees	9	45
	40	**314**

The CSIR incurred expenditure of R199 293 on 397 soccer shirts delivered after financial year-end. None of the above expenditure was funded from CSIR Parliamentary Grant income.

abbreviations

AFIS	Advanced Fire Information System
AFM	Atomic Force Microscope
AFSSA	Action for a Safe South Africa
AIDC	Automotive Industry Development Centre
AIPF	Associated Institutions Pension Fund
ARC	Agricultural Research Council
ARVs	Anti-Retrovirals
ASGISA	Accelerated and Shared Growth Initiative for South Africa
ASR	Automatic Speech Recognition
BatCOC	Battery Centre of Competence
B-BBEE	Broad-Based Black Economic Empowerment
BG4A	Blue Gene for Africa
BMS	Bridge Management System
C4	CSIR Cluster ComPuting Centre
CC	Competency Centres
CHPC	Centre for High Performance Computing
COGTA	Cooperative Government and Traditional Affairs
COMRO	Chamber of Mines Research Organisation
DD	Digital Doorway
DHS	Department of Human Settlements
DIFR	Disabling Injury Frequency Rate
DIMS	Data Information and Management System
DPTRW	Department of Public Transport, Roads and Works
DRFM	Digital Radio Frequency Memory
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWAF	Department of Water Affairs and Forestry
EODC	Earth Observation Data Centre
EU	European Union
FCTR	Foreign Currency Translation Reserve
FFA	Forest Fire Association
FSI	Fluid-Structure-Interaction
FST	Flame, Smoke And Toxicity
GAAP	Generally Accepted Accounting Practice
GDP	Gross Domestic Product
Geo ICT	Geospatial Information and Communications Technology
Geo-4	Global Environmental Outlook Environment for Development
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GPS	GlobaL Positioning System
GRA	Global Research Alliance
GWI	Global Warming Impact
HCD	Human Capital Development
HIV	Human Immunodeficiency Virus
HLT	Human Language Technologies
HPC	High Performance Computing
HPLC	High Performance Liquid Chromatography
HVS	Heavy Vehicle Simulator
IAS	International Accounting Standards
ICS&S	Information and Communications Systems
ICT	Information and Communications Technology
IFRIC	International Financial Reporting Interpretations Committee
IFRS	International Financial Reporting Standards
IP	Intellectual Property
IPTTAC	Intellectual Property and Technology Transfer Advisory Committee
ISAR	Inverse Synthetic Aperture Radar
KPI	Key Performance Indicator
KRA	Key Results Area
Lidar	Light Detection and Ranging
M(X)DR	Mulit-Drug Resistant
MOU	Memorandum Of Understanding
MRC	Medical Research Council
NAP	National Accessability Portal
NASA	National Aeronautics and Space Administration

NATFIBIO	Natural Fibre Reinforced Biocomposites
NCNSM	National CentRe For Nano-Structured Materials
NEMP	National Estuarine Management Protocol
NEPAD	New Partnership for Africa's Development
NGO	Non-Government Organisation
NIKSO	National Indigenous Knowledge Systems Office
NMISA	National Metrology Institute of South Africa
NMR	Nuclear Magnetic Resonance
NSI	National System of Innovation
NWU	North-West University
OSS	Open Source Software
PABX	Private Automatic Branch Exchange
PBMR	Pebble Bed Modular Reactor
PCT	Patent Cooperation Treaty
PFMA	Public Finance Management Act
PG	Parliamentary Grant
PISA	South Africa Photonics Initiative
PKM	Parallel Kinematic Machine
PREMIS	Professional Real Estate Management Information System
PULSE	Public Understanding of Laser Science
R&D	Research and Development
RAP	Research Advisory Panel
RCS	Radar Cross Section
RD&I	Research, Devoplemt and Innovation
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
REAF	Rural Economic Assistance Fund
RICS	Research and Innovation Core Skills
RNA	Ribonucleic Acid
RRA	Regional Research Alliance
SAAF	South African Air Force
SABINA	Southern African Biochemistry And Informatics Network
SAEOS	Southern African Earth Observation Strategy
SAIDCOR	South African Inventions Development Corporation
SAN	South African Navy
SANAS	South African National Accreditation System
SANBIO	Southern African Network for Biosciences
SANDF	South African National Defence Force
SANERI	South African National Energy Institution
SANRAL	South African National Road Agency Ltd
SANREN	South African National Research Network
SAPS	South African Police Service
SASL	South African Sign Language
SCSR	Self-Contained Self-Rescuer
SEBAL	Surface Energy Balance Algorithm For Land
SET	Science, Engineering and Technology
SETI	Science, Engineering and Technology Institution
SEWES	Sensors and Electronic Warfare Engagement Simulation
SIL	Systems Integration Laboratory
SMS	Short Message Service
SODIS	Solar Disinfection South Africa
SRP	Strategic Research Panel
TEI	Tertiary Education Institute
TIP	Toolkit for Integrated Planning
TRLA	Technology Readiness Level Assessment
TTS	Text-To-Speech
TWO	Transboundary Waters Opportunity
UA	Unmanned Aircraft
UNESCO	United Nations Educational, Scientific And Cultural Organization
UNICEF	United Nations Children's Fund
USD	United States Dollars
USSD	Unstructured Supplementary Service Data
UV	Ultra Violet
VLDS	Very Large Data Sets
WASP	Wide Area Surveillance Project

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