

NEWS LETTER

2019/2020

SOUTH AFRICA FORESIGHT EXERCISE FOR STI

**Digitalisation of Mining in South
Africa**

PREPARE FOR IMPACT OF CLIMATE CHANGE

**UKZN Research Capacity
continues to grow**

Making sure ^{it's} possible



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



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Joint Innovation Bridge-Science Forum South Africa attracts large numbers



More than 2 400 people attended the 5th Science Forum South Africa (SFSA) at the CSIR International Convention Centre last December. For the first time, SFSA was linked to another Department of Science and Innovation event, the Innovation Bridge (IB).

Held under the theme “Igniting conversations about science for innovation with impact”, the technology matchmaking and showcase event and the open platform for debating the science and society interface attracted participants from South Africa and abroad. The topics for discussion were broad, and included funding challenges for innovators, climate change and infectious diseases, ethical issues related to genetics and genomics, and the future of work under the 4th industrial revolution.

The Minister of Higher Education, Science and Technology, Dr Blade Nzimande, opened the IB-SFSA, saying the merging of the two events had enriched the science, technology and innovation discourse.

“The 2019 event has a strong focus on the commercialisation of research to benefit broader society with local technologies generated from publicly financed research and development, which is showcased to secure partners to convert these technologies into products and services that impact the lives of ordinary people.”

The Minister said that, five years on, the Science Forum remains a relevant platform for debate. “We believe our Science Forum is a powerful instrument and platform for science diplomacy and we are therefore grateful for the support we enjoy from the United Nations system, especially Unesco. I would like to acknowledge all its representatives, including Prof. Michel Kazatchkine, who served as one of the Secretary-General’s special envoys for HIV/Aids, and in 2018 received the Forum’s International Science Diplomacy Award.”

The technology showcasing part of the event saw the exhibition of technologies ranging from medical devices and solar technology to pharmaceutical products and cosmeceuticals.

- Making sure it's possible -



Panelists including WITS VC Adam Habib discussed an interesting topic looking at, What are the international expert groups useful for? Picture: Phil Moyane

A number of Department of Science and Innovation entities also showcased local technologies. The Technology Innovation Agency (TIA), which, among other functions, runs the Department's Grassroots Innovation Programme (GIP), exhibited work in the area of local innovation. The GIP is aimed at innovators in communities who have no formal training but have innovative ideas to address challenges in society. Nomahlubi Nuzo, who received funding under the GIP, has developed an anti-ageing cream from fish scales. The young innovator said that the cream could also be used to treat wounds. Nuzo and others hoped that the IB would help them access funding to take their products to full commercialisation.

Dr Kerry Faul, the Head of the National Intellectual Property Management Office at the time of the event, said that the Innovation Bridge provided a clear platform for companies like Nuzo's to find markets, funding partners, licensees, investors and manufacturers that would enable research output to get closer and closer to the market.

Dr Faul said that enabling mechanisms such as the offices of technology transfer (OTTs) had been established at universities and science councils to assist budding innovators, whether they had a potential TB diagnostic device or an idea for more efficient waste processing.

Sipho Dikweni, Commercialisation Specialist at the University of KwaZulu-Natal OTT, showcased a technology developed in partnership with TIA and Eskom. The technology, a power line inspection robot, was designed to improve the current inspection methods for power lines and to give real-time information regarding the extent of any damage.

The technology had already received seed funding of approximately R1,8 million from TIA to enable the building of

a prototype. It also received funding from the KwaZulu-Natal Department of Economic Development, among others, for live-testing the robot on energised lines. Dikweni hoped that the IB-SFSA platform would help his product reach the market. The Pelebox was one of the social impact innovations developed from publicly funded research that was exhibited. The innovation aims to reduce the average time patients spend collecting chronic medication from three and half hours to approximately two minutes. One of the Pelebox innovators, Thato Nqayi, explained that the innovation was a digital platform that managed various Internet-enabled smart lockers so that patients did not have to queue for hours at public clinics and hospitals to collect repeat prescriptions of chronic medication. Many patients currently have to take time off work to collect their medicines.

The key topics that resonated during the conversations at the event included the need to increase the focus on inclusivity, transformation and linkages in the national system of innovation. The need to enhance innovation culture in society and government, and making a more enabling environment for innovation was also highlighted. In an address concluding the event, the Director-General of Science and Innovation, Dr Phil Mjwara, remarked that the IB and SFSA remained fertile ground for fostering new science, technology and innovation partnerships.

"I am informed that the Innovation Bridge was most successful in this regard, linking researchers, entrepreneurs, funders and business in diverse range of new collaborations," said Dr Mjwara. The DG said the event also achieved its science diplomacy objective, with both multilateral and bilateral cooperation being initiated or reinforced through various interactions. "Science truly knows no borders," he said, thanking the international partners who contributed to the success of the IB-SFSA. ■

Minister of Higher Education, Science and Technology Dr Blade Nzimande engage a Grassroots Innovator at the SFSA/IB exhibition. Picture: Phil Moyane





South Africa Foresight Exercise for Science, Technology and Innovation

The National Advisory Council on Innovation (NACI) has released a synthesis report written as part of the South Africa Foresight Exercise for Science, Technology and Innovation 2030 (SAForSTI).

“Foresight” is an umbrella term for innovative strategic planning, policy formulation and solution design methods that do not predict or forecast the future, but work with alternative futures. Foresight exercises empower decision makers and policy planners to use new ways of thinking and talking about the unfolding future, and implementing strategic plans that are compatible with such a future.

NACI led the exercise as part of its contribution to the development of a decadal plan for implementing the 2019 White Paper on Science, Technology and Innovation, approved by Cabinet in March this year. The exercise sought to investigate the future of science, technology and innovation (STI) in South Africa, and the potential of STI to address ongoing societal challenges and support the creation of inclusive and sustainable socio-economic development.

The country’s societal challenges are systemic in nature and required long-term planning and a broad, holistic approach. “Throughout the foresight exercise, it was emphasised that, before a sustainable and just economy could even be discussed, there should be a broader understanding of both inequality (and its economic, gender, spatial and class dimensions, among others) and sustainability,” said the NACI Interim Chairperson, Shadrack Moephuli.

The Interim Chairperson stated that knowledge needed to inform policy, which meant that different areas of STI needed to be brought together to create new growth for South Africa. “Knowledge has been identified as important for the required transformation to an equitable society and a sustainable economy,” said Moephuli. Understanding the context of South Africa’s current challenges, including inequality, poverty, unemployment, health, education and climate change, the SAForSTI identified nine STI domains,

namely, the circular economy, education for the future, sustainable energy, the future of society, health innovation, high-tech industrialisation, information and communications technologies (ICTs) and smart systems, and nutrition and water security.

The SAForSTI also considered the current age of unprecedented and spectacular advances in the technosciences that are affecting every sphere of human life. These major advances include ICTs, biotechnology, nanotechnology, the Internet of Things, robotics, artificial intelligence, machine learning, blockchain technology and additive manufacturing, among many others.

All of these are elements of a fourth industrial revolution (4IR) that transforms production processes and products, markets, services and trading systems, whole industries and entire economies. South Africa, like other developing countries, must determine ways to use the opportunities offered by the 4IR while simultaneously preparing to deal with unintended and negative consequences. A younger population can be a catalyst and a great advantage in the context of rapidly accelerating technological innovation and the socio-technological transformations associated with the 4IR.

The premise of foresight is that the future is still in the making and can be actively influenced or shaped, rather than already decided and therefore merely to be awaited and accepted. This empowering realisation allows the governments of developing countries to construct their own narratives of desired futures, instead of relying on futures foreseen by highly developed countries, which are not necessarily relevant to the contexts of other countries. ■

– Making sure it's possible –

Students win big

at CHPC National Conference 2019



Director General of the DSI addressed the annual CHPC conference held in December 2019. Pictures: CHPC

High-performance computing boffins from across South Africa and the Southern African region squared off during several competitions at the Centre for High Performance Computing (CHPC) 2019 National Conference. The event was held under the theme, “Secure cyberinfrastructure within fast-converging platforms”.

The conference ran from 1 to 5 December and featured a number of tutorials and workshops, covering topics such as high-performance data access, next-generation sequencing, weather and climate modelling, and high-performance computing for medical interventional planning applications. A parallel expo zone showcased solutions by leading technology companies.

The 2019 conference saw three student challenges taking place, namely, the 9th Student Cluster Competition, the 3rd Student Cyber-Security Competition, and for the first time, the Student Datathon Challenge.

The Datathon was hosted by the Data Intensive Research Initiative of South Africa (DIRISA), and challenged students to showcase how open research data can be used to find innovative solutions to some of the country's problems. The participating teams were chosen from the students who attended a DIRISA workshop in July, where they received training in the basic concepts of data science, research data management and Python. The students applied this knowledge during the Datathon Challenge.

“The judges of the competition do not focus so much on the technicality of the solutions, but more on the feasibility of the solutions and the effort that the students put into finding a real problem and a suitable solution,” said DIRISA’s Nobubele Shoji.

Students computationally manipulated the available data to come up with potential solutions for challenges such as improving ambulance response times and suicide alert efforts. The winning team of Jean Boguo, Kayleigh Slogrove and Ruan Spijkerman from the University of Johannesburg will be put in an incubation programme where they will have an opportunity to develop their solution even further. The trio also walked away with prizes courtesy of Redhat, NetApp and Altron.

The Student Cluster Competition starts in July every year and attracts students from universities across the country. The students are trained in Linux systems and high-performance computing, and each team is required to build



Students participate in the HPC challenge

a prototype cluster on the cloud. The teams selected from the July round go on to compete in the national round at the CHPC National Conference.

The 2019 winners are a team of six students from Wits University and the University of the Western Cape (UWC), and two reserves from UWC and the University of KwaZulu-Natal. Guy Axelrod, Victoria Bench, Michael Beukman, Sivenathi Madlokazi, Alungile Tshangela and Mikhail Vink make up the team, and Stephanie Agenbag and Kalreen Govender are the two reserves. This team will represent South Africa at the International Supercomputing Conference in Frankfurt, Germany in June 2020.

"The purpose of the competition is to expose young university students to high-performance computing and equip them with Linux skills. It's a great opportunity for the CHPC to be able to provide the students with real workplace skills that they can go on and use in their careers," said CHPC's Matthew Cawood.

Awards for the best male and female competitor in the Student Cluster Competition were also made. The winners,

Sivenathi Madlokazi and Alungile Tshangela from Wits University, each walked away with R65 000 courtesy of Intel. The competition was sponsored by Dell EMC, Eclipse Holdings, Intel, Altair, Bright Computing, Mellanox and Microsoft Azure.

Equally exciting was the 3rd Student Cyber-Security Competition, hosted by the South African National Research Network (SANReN). The competition is split into two rounds. In the first qualifying round, 125 teams comprising 416 students competed for a place in the final round, where 12 teams of four members each faced off at the CHPC National Conference.

The University of Pretoria, represented by Jared O'Reilly, Savvas Panagiotou and Tristan Sander-Hug, took first place in the competition, which was sponsored by Cyanre, Microsoft and F-Secure.

"A benefit of this challenge is the exposure that university students get to real cyber-related threats, as well as the pipeline of students that is built into the information security field," said SANReN's Ajay Makan. ■

– Making sure it's possible –

High-tech rock drills

to boost SOUTH AFRICAN mining industry

The Mandela Mining Precinct unveiled two new rock drill prototypes developed by local innovators to enhance drilling operations yesterday, in a significant move to advance the mining sector in the country.

The Mandela Mining Precinct is a public-private collaboration between the Department of Science and Innovation and the Minerals Council South Africa. Hosted and managed by the Council for Scientific and Industrial Development, the precinct is working towards the revitalisation of mining research, development and innovation in South Africa to ensure the sustainability of the industry.

Mining safety in South Africa continues to be a priority for the government, and the two new rock drill prototypes are expected to considerably reduce the exposure of operators to dangerous conditions. The prototypes are the culmination of an open innovation challenge launched in 2018 to develop a new rock drill for the South African mining industry.

"The Isidingo Drill Design Challenge was launched with specific industry requirements for improving efficiencies and reducing risk in mines, hence the name Isidingo," explained Mandela Mining Precinct programme manager, Martin Pretorius. Isidingo is isiZulu for "need".

Pretorius said that drilling is the most important part of the entire mining cycle, and that the precinct saw the opportunity to develop a new, locally manufactured rock drill for the industry.

The challenge was divided into three phases. The first phase entailed the introduction of a new and innovative rock-drill concept design. This was followed by the construction of a prototype associated with testing and monitoring. The third phase will entail manufacturing and underground performance testing. "After a rigorous evaluation, two

local companies, namely Novatek and HPE, were selected to develop prototypes, which were tested at the Mandela Mining Precinct today," said Pretorius, who is responsible for the Isidingo programme.

"The tests successfully illustrated both company's adherence to the primary criteria that will enhance the performance of the drill, reduce the exposure of operators to dangerous conditions and immediately contribute to zero harm. The underground testing will take place at a mine to be announced closer to the time," said Pretorius.

Both finalists found the balance between weight and robustness to be the most challenging.

"We needed the drill to be as light as possible, but still robust, and this was not easy," said Novatek Managing Director, Julian Wills.

"Our strengths lie in hydropower and stope drilling rigs, and we are guided by the development of appropriate technology. This is part of our internal value system – advocating for technology that must be appropriate for the type of mining,

the infrastructure, the resources and the skills of the end user," added Wills.

HPE Director, Ulrich Kienle, said that the development of their drill was a company-wide effort that adopted the HPE way of product development. Over a dozen concepts were considered and the list was finally reduced to three viable possibilities.

***"This challenge is
a reflection of the
collaborative nature
with which the Mandela
Mining Precinct
operates, bringing all
parties together to take
this country forward
– much like former
president Mandela."***



A series of 3D-printed drills comprising 90 uniquely engineered parts assisted the team to solve the weight conundrum.

“An important aspect of the HPE way is that any concept must be safe, cost viable and meet all set key performance indicators. If these requirements cannot be met, we do not have a product.

We believe that the fact that we were able to produce a high-performance and robust new drill that weighs just under 16 kg is a game changer for our industry,” said Kienle.

HPE presented a truly versatile drilling system. “With our new offering, drilling is now possible in three ways, with a novel new hole guide puller; a stope drill jig or in a conventional manner with a thrustleg,” said Kienle, adding that their drilling system is suitable for any angle and application.

“Once the first hole has been drilled, the hole guide puller repeats the process and guarantees correct burden spacing, parallelism and in-line thrusting.”

Nicknamed “the Buffalo”, Novatek’s drill incorporates a spring, shaped like a buffalo’s horns, which embodies its strength, accuracy and speed.

“What we delivered today meets some of the criteria really well. In our early tests, we encountered improvement in the noise levels, which we were not able to replicate, but we are eager to continue working on this for the next phase,” said Wills.

South Africa’s mining research, development and innovation is gaining momentum after a slow time following the closure of the Chamber of Mines Research Organisation in 1990. The Isidingo Drill Design Challenge is the first initiative for developing South African solutions to a South African problem, which the Mandela Mining Precinct is proud to pioneer.

“I find it encouraging that industry and government agencies are working together towards a common objective to reindustrialise South Africa, with emphasis on the cross sharing of ideas, and the Mandela Mining Precinct plays an important role in facilitating this,” said Wills.

Thanking HPE and Novatek for delivering new drills that tick some important people-centric boxes, Sietse van der Woude, Minerals Council South Africa’s Senior Executive for Modernisation and Safety, emphasised that the criteria developed for the new drills was based on the industry’s needs. ■



The two new rock drill prototypes are expected to considerably reduce the exposure of operators to dangerous conditions

— Making sure it's possible —

Early modern humans cooked starchy food (rhizomes) in border cave, South Africa, 170 thousand years ago



***Hypoxis angustifolia* growth habitat**

The discovery points to food being shared and the use of wooden digging sticks to extract the plants from the ground

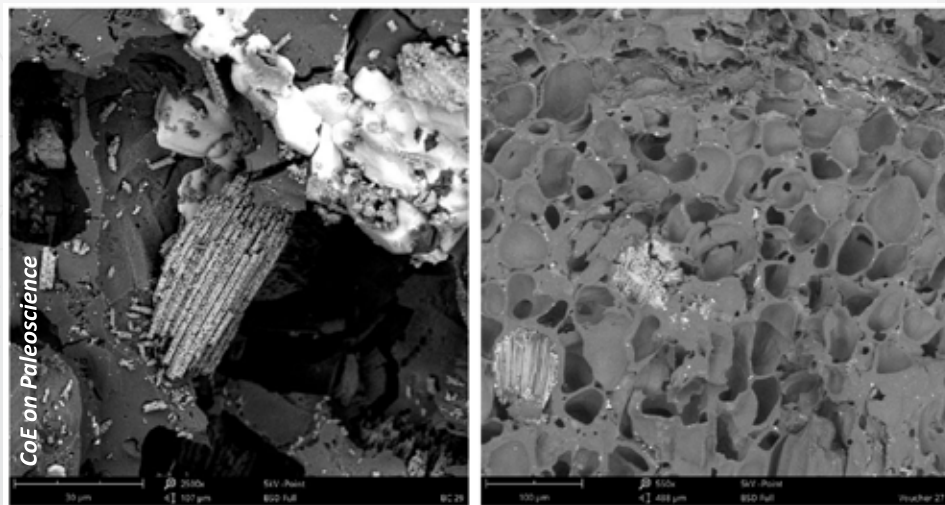
"The inhabitants of the Border Cave in the Lebombo Mountains on the KwaZulu-Natal/eSwatini border were cooking starchy plants 170 thousand years ago," says Professor Lyn Wadley, a scientist from the Wits Evolutionary Studies Institute at the University of the Witwatersrand, South Africa (Wits ESI). "This discovery is much older than earlier reports for cooking similar plants and it provides a fascinating insight into the behavioural practices of early modern humans in southern Africa. It also implies that they shared food and used wooden sticks to extract plants from the ground."

"It is extraordinary that such fragile plant remains have survived for so long," says Dr Christine Sievers, a scientist from the University of the Witwatersrand, who completed the archaeobotanical work with Wadley. The underground food plants were uncovered during excavations at Border Cave in the Lebombo Mountains (on the border of KwaZulu-Natal Province, South Africa, and eSwatini [formerly Swaziland]), where the team has been digging since 2015. During the excavation, Wadley and Sievers recognised the small, charred cylinders as rhizomes. All appear to belong

to the same species, and 55 charred, whole rhizomes were identified as *Hypoxis*, commonly called the Yellow Star flower. "The most likely of the species growing in KwaZulu-Natal today is the slender-leaved *Hypoxis angustifolia* that is favoured as food," adds Sievers. "It has small rhizomes with white flesh that is more palatable than the bitter, orange flesh of rhizomes from the better known medicinal *Hypoxis* species (incorrectly called African Potato)."

The Border Cave plant identifications were made on the size and shape of the rhizomes and on the vascular structure examined under a scanning electron microscope. Modern *Hypoxis* rhizomes and their ancient counterparts have similar cellular structures and the same inclusions of microscopic crystal bundles, called raphides. The features are still recognisable even in the charred specimens. Over a four-year period, Wadley and Sievers made a collection of modern rhizomes and geophytes from the Lebombo area. "We compared the botanical features of the modern geophytes and the ancient charred specimens, in order to identify them," explains Sievers.

Hypoxis rhizomes are nutritious and carbohydrate-rich with an energy value of approximately 500 KJ/100g. While they are edible raw, the rhizomes are fibrous and have high fracture toughness until they are cooked. The rhizomes are rich in starch and would have been an ideal staple plant



Scanning Electron Microscope image of raphide crystals on a Border Cave rhizome, and raphides and parenchyma cells in modern *Hypoxis*



Border cave excavation

food. "Cooking the fibre-rich rhizomes would have made them easier to peel and to digest so more of them could be consumed and the nutritional benefits would be greater," says Wadley.

Wooden digging sticks used to extract the plants from the ground

"The discovery also implies the use of wooden digging sticks to extract the rhizomes from the ground. One of these tools was found at Border Cave and is directly dated at circa 40,000 years ago," says co-author of the paper and co-director of the excavation, Professor Francesco d'Errico, (Centre National de la Recherche Scientifique (CNRS), Université de Bordeaux, France and University of Bergen, Norway). Dr Lucinda Backwell (Instituto Superior de Estudios Sociales, ISES-CONICET, Tucumán, Argentina) also co-authored the paper and was a co-director of the excavation.

The plants were cooked and shared

The *Hypoxis* rhizomes were mostly recovered from fireplaces and ash dumps rather than from surrounding sediment. "The Border Cave inhabitants would have dug *Hypoxis* rhizomes from the hillside near the cave, and carried them back to the cave to cook them in the ashes of fireplaces," says Wadley. "The fact that they were brought back to the cave rather than cooked in the field suggests that food was shared at the home base. This suggests that the rhizomes were roasted in ashes and that, in the process, some were lost. While the evidence for cooking is circumstantial, it is nonetheless compelling."

Discoveries at Border Cave

This new discovery adds to the long list of important finds at Border Cave. The site has been repeatedly excavated since Raymond Dart first worked there in 1934. Amongst earlier

discoveries were the burial of a baby with a *Conus* seashell at 74,000 years ago, a variety of bone tools, an ancient counting device, ostrich eggshell beads, resin, and poison that may once have been used on hunting weapons.

The Border Cave Heritage Site

Border Cave is a heritage site with a small site museum. The cave and museum are open to the public, though bookings are essential [Olga Vilane (+27) (0) 72 180 4332]. Wadley and her colleagues hope that the Border Cave discovery will emphasise the importance of the site as an irreplaceable cultural resource for South Africa and the rest of the world.

About *Hypoxis angustifolia*

Hypoxis angustifolia is evergreen, so it has visibility year-round, unlike the more common deciduous *Hypoxis* species. It thrives in a variety of modern habitats and is thus likely to have had wide distribution in the past as it does today. It occurs in sub-Saharan Africa, south Sudan, some Indian Ocean islands, and as far afield as Yemen. Its presence in Yemen may imply even wider distribution of this *Hypoxis* plant during previous humid conditions. *Hypoxis angustifolia* rhizomes grow in clumps so many can be harvested at once. "All of the rhizome's attributes imply that it could have provided a reliable, familiar food source for early humans trekking within Africa, or even out of Africa," said Lyn Wadley. Hunter-gatherers tend to be highly mobile so the wide distribution of a potential staple plant food would have ensured food security.

The ground breaking research was supported by the Department of Science and Innovation-National Research Foundation's Centre of Excellence in Palaeosciences. ■

– Making sure it's possible –

Research towards the digitalisation of mining in SA

The Mandela Mining Precinct, supported by the Department of Science and Innovation, is working on an innovation that will improve safety and efficiency in the mining sector. The Mandela Mining Precinct is a public-private collaboration between the Department of Science and Innovation and the Minerals Council South Africa. Hosted and managed by the Council for Scientific and Industrial Research, the precinct is working towards the revitalisation of mining research, development and innovation in South Africa to ensure the sustainability of the industry.

Mining continues to be hazardous, and the Real-Time Information Management Systems (RTIMS) programme aims to reduce risks by developing a 360-degree holistic offering to digitalise the South African mining industry. Digitalisation enables the right information to reach the right place or person at the right time, with RTIMS collecting and relaying information digitally between tagged equipment and people underground and above ground, ensuring ongoing communication for improved efficiency and safety.

RTIMS technologies range from a visual positioning system (which incorporates proximity detection, collision avoidance and predictive analyses), to an enterprise architecture framework that is expected to enhance operational

efficiency using new technologies alongside people. RTIMS is expected to take the country's mining sector into the future through a host of applications that get data to the surface, and then analyse it so that action can be taken. The RTIMS team, under programme manager Jean-Jacques Verhaeghe, are laying a very important foundational framework for the digitalisation of the mining industry, which will prepare individual mining companies for the 4th industrial revolution from a technology and data consumption perspective.

CSIR engineer Stephen Marais, who is involved in the visual positioning system, sees RTIMS addressing government and industry concerns about safety. He explained that the end goal is to have everything and everyone tagged, and then produce a floor plan using 3D technology and a lidar backpack to minimise accidents. It is envisaged that miners will interact with one another and all sorts of equipment, much like soldiers who have audio-visual equipment attached to their helmets.

All of the RTIMS projects' concepts were tested in 2019 and they will soon be deployed at a suitable operational mine site so that their performance in real underground conditions can be examined. ■



Digitalisation of the country's mines will enable the right information to reach the right place or person at the right time.



Mining continues to be a hazardous environment



The annual event attracts young people from institutions across the country.

Nanoscience for a better world

As South Africa grapples with increasing energy demands, local and international industry experts, academics and postgraduate students believe that nanoscience can be employed to address the effective and efficient use of solar power.

Nanoscience stakeholders are meeting at the 5th South African Nanoscience and Nanotechnology Summer School taking place in Stellenbosch from 25 to 29 November 2019. The annual summer schools are designed to equip master's and PhD students with the skills needed to conduct research in nanoscience and nanotechnology. They complement other human capital development initiatives in the field, and are one of several platforms for implementing the 2005 National Nanotechnology Strategy.

The summer school is run by the National Nanoscience Postgraduate Teaching and Training Platform, a collaborative initiative between the Department of Science and Innovation, the University of the Western Cape (UWC), the University

of Johannesburg, the University of the Free State and Nelson Mandela University.

The Deputy Minister of Higher Education, Science and Technology, Buti Manamela, opened the School in Stellenbosch on Monday, 25 November 2019. He said the country's National Nanoscience Strategy had been very successful in terms of human capital development.

He cited a review of the 2006 Nanoscience and Nanotechnology 10-Year Research Plan, which showed that South Africa had produced 418 master's and 398 doctoral graduates over the 10-year period, surpassing the plan's targets of 400 master's and 50 PhD graduates. Furthermore, almost 5 000 nanotechnology publications had been produced, far exceeding the target of 150, while 44 new patents were reported against a target of 10, and three companies had been started from the research conducted at various universities.

"Today, there is no doubt that significant research activity is taking place at the majority of universities across the country. While this research is largely fundamental in nature, the scope of areas of application identified in the National Nanotechnology Strategy is being well covered. These

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The Deputy Minister of Higher Education, Science and Technology delivered the keynote address at the Summer School. Picture: Phil Moyane

areas of application range across water, energy, health and pharmaceuticals, chemicals and bioprocessing, mining and minerals, and advanced materials and manufacturing," he said.

The Deputy Minister praised the organising committee for making commercialisation and innovation the theme of this year's summer school.

Given the potentially massive returns nanoscience and nanotechnology can bring to the development of this country and its people, the UWC's Deputy Vice-Chancellor: Academic, Prof. Vivienne Lawack, said she was proud to be involved.

"You have the science," she told the assembled delegates. "And now the question is, what do you do with it? How do we apply this research in innovative ways, and bring new technology into common use? I encourage all of you, as you deliberate, to think of the impact your work could have, and the vast benefits that we could reap from these interventions as a society."

The gathering agreed that while nanoscience might work at the scale of millionths of millimetres, its applications were significant and far reaching. Prof. Ruud Schropp, Extraordinary Professor in Physics at UWC, said that rapid increase in energy consumption globally and the exponential

growth of the world's population were resulting in a variety of challenges.

"We need to meet our increasing energy needs in a sustainable way, and for that we need solar power. And for effective and efficient solar power, we need to employ nanoscience," he said.

In his presentation on nanostructured thin films for multiband-gap silicon tandem and triple-stacked solar cells, Prof. Schropp noted that stabilising carbon dioxide emissions at a level that limits global warming to 2°C will require that at least 14 terawatts of renewable energy capacity would have to be installed by 2050.

"If we were going to replace that amount of fossil energy with nuclear energy, we would need to build a power plant every two days, and that would come with some serious safety concerns," he said.

"Other renewable power sources are promising, but don't scale as easily. It is clear that, among the various renewable energy options, only solar energy offers ample resources to cover this demand."

Given the large scale needed, the solar technologies developed should use earth-abundant and preferably non-toxic materials. Among the various options available, silicon solar cells are dominating the market.

Silicon is the second most abundant material in the Earth's upper crust, but the high purification needed and indirect optical absorption make it an expensive source material. Therefore, further price reduction has to come from the use of thin films, the implementation of nanostructures, and the use of tandem solar cells.

"What we can do is try to make the best possible solar devices – devices that are cheap and efficient, and whose production is scalable – which will convince people to adopt solar power for their energy needs," Prof. Schropp noted. "When it comes to solar panels, thin is beautiful: the light doesn't have to travel as far, or through as much material, and that means less wasted energy." As a source of energy, solar power is in ample supply. To meet the world's projected energy demand in 2050 using solar cells, only 1,7% of global land area would be needed.

"Renewable energy supply from solar cells can help build a sustainable society," said Schropp, "And further research can build technologies that are highly efficient and inexpensive, so that solar electricity will be abundantly available to everyone." ■



Burgeoning moringa industry could become bigger than cocoa



Moringa stakeholders believe that the industry has the potential to surpass the cocoa industry, as cocoa is used mainly in chocolate and coffee, while the Moringa plant is regarded as a superfood with many uses – addressing nutritional deficits, tackling environmental factors such as drought and climate change, and creating opportunities in the cosmeceutical sector.

This sentiment was expressed at the 2019 International Symposium on Moringa (ISM2019) held in Pretoria last week by Rene Munya, the General Secretary of the Moringa

Workers at the Lefakong Moringa Farm in Bosplaas, near Hammanskraal. Delegates who attended the 2019 International Symposium on Moringa were impressed with the work done at the farm. Picture: Julian Leshilo-Sebake

Development Association of South Africa (MDASA). The MDASA, the Agricultural Research Council (ARC), the Department of Science and Innovation (DSI), and various universities under the aegis of the International Society for Horticultural Science organised the gathering, which brought together experts and interested parties from all over the world to share best practices and scientific information on the production and many different uses of moringa.

"In 2017, world production of cocoa beans was 5,2 million tons, and cocoa produces only a few products (chocolate, coffee), while Moringa produces a wide range of products including gins, tea, facewashes, lip balms, hair treatments, etc.

– Making sure it's possible –

"To achieve this, the MDASA has developed a Vision 2030 strategy that includes the establishment of 12 training centres and the training of 200 entrepreneurs, with the expectation that about 100 of them will become agroprocessors," said Munya.

Munya was speaking during a site visit, part of the three-day symposium, to the Lefakong Moringa Farm in Bosplaas, near Hammanskraal, north of Pretoria.

The farm was established in 2015 with the support of the DSI, and 10 000 moringa trees have been planted on an eight hectare plot. Trained young people and women from the Bosplaas community are employed to hand pick and dry the leaves, which are then sent to the ARC, which is the contract manufacturer. The farm produces moringa products that include organic tea bags, capsules, powder, health salt and iced tea. A gin recipe has just been formulated, and will be available soon.

The ARC research team, with funding from the DSI, is active in establishing moringa farms. The analytical laboratory at its facility in Roodeplaat assists moringa farmers to produce quality moringa dry powder that meets international standards and can be exported. The institute also maintains 14 different moringa cultivars.

The award-winning owner of the Lefakong Moringa Farm, Maboang Matlou, said moringa had thrown her and the community a lifeline.

"The farming has enabled us to empower the community by transferring farming skills. I encourage my employees to start their own home gardens. We all have space in our yards and we can use these gardens to feed our families or generate additional income," she said.

The farm employs four full-time staff and there are some part-time employees too.

The DSI's indigenous knowledge-based technology innovation programme has been supporting moringa technologies. Speaking at the official opening of ISM2019,

the DSI's Deputy Director-General: Technology Innovation, Mmboneni Muofhe, said that the new White Paper on Science, Technology and Innovation, approved earlier this year, included indigenous knowledge as one of the pillars for development.

"As a Department we want to grow the indigenous knowledge area because we are confident that it will create many opportunities. We are of the view that indigenous knowledge will be a mainstay for future health and nutrition solutions, as well as the establishment of small businesses that are crucial for job creation," said Muofhe.

The symposium included an exhibition showcasing local moringa products.

Florratt Cosmetics, a start-up company that uses moringa and herbal extracts to produce skin and hair care products, already employs more than 30 people, mainly women. Owner Mampho Mantji said her personal experience with moringa gave birth to the idea of Florratt Cosmetics.

The company sources its raw materials from a farm in Limpopo and has plants in Maseru and Johannesburg. According to Tjabane, the company has seen rapid growth, with demand for its products from southern Africa, India, Australia, Mauritius and the United Kingdom.

Prof. Stephanie Burton, Vice-Principal responsible for Research and Postgraduate Education at the University of Pretoria (UP), addressed the event, said that the theme of the symposium, "The power of moringa in solving global challenges", was well aligned to the approach UP was taking in its academic programmes and research.

"UP recently opened the Future Africa Campus, a flagship institute established to promote research that is relevant to Africa. The broad research themes to be conducted at Future Africa include some of the objectives and the mission of this symposium, such connecting Africa and its people, and sharing the use of technology for new ways of living," she said. ■

"The farming has enabled us to empower the community by transferring farming skills. I encourage my employees to start their own home gardens. We all have space in our yards and we can use these gardens to feed our families or generate additional income,"

Municipalities welcome a new tool for measuring innovation capabilities

South African leaders are doing a reasonably good job in developing innovation strategies and communicating them to help drive sustainable growth in their organisations.

This was one of the findings in the 2018-2019 State of Innovation Report presented by Paul Steenkamp in Cape Town at a two-day learning forum on the Municipal Innovation Maturity Index (MIMI).

Steenkamp is co-founder of the Creative Leadership Collective, which partnered with Stellenbosch University's Business School on the report.

The MIMI forum was hosted by the Department of Science and Innovation and attended by local government officials responsible for innovation and technology in municipalities across the country.

The Department funded the development of MIMI, a decision-support tool to measure how prepared local authorities are to deploy technology and innovation for better service delivery. The tool was developed by the Human Sciences Research Council and the University



The DSI's Director for Sustainable Human Settlements, Tshepang Mosiea addressed the two-day Municipal Innovation Maturity Index (MIMI). Picture: Phil Moyane

of KwaZulu-Natal, supported by the South Africa Local Government Association.

The State of Innovation Report gives a snapshot of where South Africa is in the development of an innovation ecosystem, and who forms part of this process in the corporate and broader organisational spaces.

Steenkamp said that, despite the good strategies, innovation practices were generally immature, and it seemed as if the world was leaving South Africa behind.

The surge of innovation uptake is largely linear, prioritising scientific research as the basis of innovation and downplaying the role of later players in the innovation process.

The approach of organisations to innovation funding tends to involve making single payments available annually for innovation projects.

– Making sure it's possible –



Government is committed to ensuring that the country's people have access to quality basic services. Picture: File

"Organisations need to move away from lump-sum funding to incremental funding, where projects are funded based on the achievement of measurable learnings. In that way they keep innovation projects teams 'hungry', rather than having zombie projects that run out of resources quickly," he said.

Talking about the kind of skills that are generated at tertiary education level, Steenkamp emphasised that organisations and higher education institutions needed to work harder to improve the match between the skills students were taught, and the need for employees able to drive continuous innovation in organisations.

"There is a huge mismatch between continuous innovation requirements that we have in our economy and what our education system is producing," he said.

Speaking about the state of the municipality's readiness to adopt innovation for improved service delivery, Bridgette Morris, Manager for Innovation and Operational Effectiveness at the City of Cape Town, stated that the City realised that it could not be "business as usual" when it came to innovation. Cape Town was pushing to "ensure that we can compare

ourselves with innovative cities around the world". Given the City's tourist attractions and the way it is configured, the City had looked at what cities such as New York, London, Paris, Singapore and San Francisco did. It was clear that all initiatives should be filtered for sustainability, citizen entrepreneurship should be fostered, a culture of internal and external collaboration should be created, and effective and citizen-centric service delivery should be prioritised.

Isaiah Engelbrecht, the City of Tshwane's Divisional Head for Innovation and Knowledge Management, said that Tshwane had made MIMI part of its performance management strategy.

An innovation index score of 44.25 in 2014 and 50.25 in 2018 means that Tshwane is well on the way to embedding the culture of innovation outlined in its innovation strategy, and that its capacity building programmes are assisting in building the desired innovation outcomes.

"With the city blessed with a youthful and purposeful population, home to four distinguished universities, and housing the most advanced research councils, technology parks and innovation funding institutions, it is positioned as the innovation capital," said Engelbrecht.

Project Manager of Urban Data at the South African Cities Network (SACN), Jonathan Wilson, said the SACN had for a number of years administered the capturing and distribution of data on various statistics, and the development of indicators for different cities and municipalities in South Africa.

"As cities report on over 2 500 indicators to national and provincial departments, regulators and other entities every year as part of their monitoring and evaluation, they are heavily over-burdened with compliance reporting and data requests from other spheres of government," added Wilson.

To ease this burden, the SACN established the Common Data Framework for Cities (CDFC) to assist local authorities manage data, indicators and reporting requirements. One of the benefits of the CDFC is that it empowers cities to use data and internal systems effectively to inform data-driven decision making and planning.

Dr Sithembiso Myeni, of the University of KwaZulu-Natal's School of Built Environment and Development Studies, described the MIMI project as the result of different stakeholders working as partners. He was also pleased with the likelihood of an institutional home for the tool. ■



South Africa's expenditure on R&D shows yet another increase

Spending on research and development (R&D) in South Africa has continued to increase but at a slower rate than before. This is the key finding of the 2017/18 national research and experimental development survey, which was published today.

South Africa's gross domestic expenditure on research and development (GERD) amounted to R38.725 billion at current Rand values in 2017/18, showing an increase of 8.5 percent from the R35.693 billion recorded in 2016/17. At constant 2010 prices, GERD grew by 3.1 percent year-on-year to reach a level of R25.963 billion.

Although this was the seventh consecutive year that the GERD has increased after contracting in 2009/10 and 2010/11, the growth in real terms shows a declining trend, especially when compared to the peak of 8.3% reported in 2014/15. GERD is an aggregated measure of in-house R&D expenditure performed domestically in five sectors, namely government; science councils; higher education; business sector; and the not-for-profit sector.

GERD as a percentage of the country's gross domestic product (GDP), an indicator of R&D intensity, remained relatively unchanged, moving one basis point from 0.82 percent in 2016/17 to 0.83 percent in 2017/2018.

Conducted annually on behalf of the Department of Science Innovation (DSI), the R&D Survey provides statistics on the country's performance in terms of key indicators of R&D expenditure, investment and human resources. It is undertaken by the Centre for Science, Technology and Innovation Indicators (CeSTII), located within the Human Sciences Research Council, with support from Statistics South Africa.

The headcount of R&D personnel in the country increased by 4 233 (5.3 percent) to 84 262 from 80 029 reported in 2016/17. According to the report, the robust increase in R&D personnel reported since 2011 are mainly due to the net intake of researchers.

The ratio of full-time equivalent (FTE) researchers per 1 000 employed was 1.8, a modest shift from the 1.7 reported for the two years 2016/17 and 2015/16. A concern is with

respect to the headcount of technicians and other R&D staff, which have remained constant, at around 11 300 and 11 600 respectively since 2012/13. The number of technicians in particular needs to expand given the requirements of the fourth industrial revolution.

There have been important shifts in the structure of the R&D system over the past one and a half decade, notably with respect to the composition of R&D funding sources, R&D performing sectors, role of R&D in services industries, and the shifts in research types.

With regard to sources of funding for R&D, government continued to be the largest source of funding, contributing 46.7 percent of total investment in 2017/18, a trend that started in 2007/08. The business sector is now second contributing 41.5 percent of funding towards GERD. Foreign sources funded 10.2 percent with other local sources funding 1.6 percent of GERD.

While the business sector remains the largest R&D performer at 41 percent during the period, its role has reduced compared to 2006/07 where it had 56 percent of the GERD. The higher education sector increased its contribution from 20 percent to 37 percent over the same period.

The composition of business R&D has changed over time per major industrial categories, mostly in line with broader changes in the structure of the economy. There have been robust increases in GERD attributed to services industries, while manufacturing and mining related R&D declined. R&D in the financial intermediation, real estate and business services sector now dominates, contributing about 48.8% of BERD in 2017/18. This sector's R&D spend has surpassed that of the manufacturing sector since 2011/12.

The R&D Survey provides valuable information to understand the trends in an important aspect of the country's economic system. The Department will undertake a deeper analysis of the results, and facilitate discussions with relevant stakeholders in order to identify what can be done to maintain and improve the situation, especially given the intents of the 2019 White Paper on Science Technology and Innovation. ■

— Making sure it's possible —

Paving the way for the accreditation of indigenous knowledge practitioners



The DSI held its first Recognition of Prior Learning workshop for IK Practitioners last year at UKZN. Picture: Phil Moyane

The establishment of the Steering Committee for the Recognition of Prior Learning (RPL) of Indigenous Knowledge Practitioners was long overdue, said the Chairperson of the Kwazulu-Natal House of Traditional Leaders, Inkosi Phathisizwe Chiliza.

Inkosi Chiliza was speaking at an induction workshop for the steering committee that concluded at the Belville Campus of the University of Kwazulu-Natal on 11 October 2019. During the workshop, the 13-member committee received letters of appointment from the Minister of Higher Education, Science and Technology, Dr Blade Nzimande.

The committee will focus on the accreditation of institutions for RPL in African Traditional Medicines. It will also facilitate the implementation of a Discipline of Competence (DoC) for the Traditional Health Practice domain, which will run as a pilot programme to develop and test competence norms and standards in a real-life setting. The pilot will run for a period of three years and will ultimately result in a model for RPL that will be rolled out to the other provinces.

Each province will have its own RPL to allow for different cultural practices. Minister Nzimande said that the Indigenous Knowledge Systems Policy (IKS Policy), adopted by Cabinet in 2004, created an enabling framework to stimulate and strengthen the contribution of indigenous knowledge to social

and economic growth in South Africa. "The establishment of mechanisms to recognise areas of indigenous knowledge as professional disciplines with their own institutions, governance structures, and approaches to quality assurance is an important step towards affirming indigenous knowledge as a knowledge domain in its own right," the Minister said.

Traditional healer Thulani Shangase, who is a member of the steering committee, believes that traditional practitioners should be included in nation-building activities. Shangase said that the committee would promote the recognition and integration of indigenous knowledge into the landscape of the country. "As traditional practitioners we can provide solutions to some of the challenges faced by society," he said. Welcoming her appointment to the steering committee, Nonhlanhla Nkomo, Secretary of the National Unitary Professional Association for Traditional Health Practitioners of South Africa, said the results of the pilot programme would give traditional practitioners a sense of identity and end the ridiculing of their profession.

Well-known spiritualist and traditional healer, Dr Velaphi Mkhize of the Umsamo Institute, commended the work done by the Department of Science and Innovation (DSI) in the field of indigenous knowledge. He encouraged the members of the steering committee to be diligent and leave a legacy for generations to come.

"Our profession is frowned upon because there is a perception that we do wrong things," Dr Mkhize said. "Your job is going to be very tough, but let us make it a point that we clean, and the cleaning process will not happen overnight but will take some years to complete." In congratulating the steering committee members, the DSI's Chief Director: Science Missions, Prof. Yonah Seleti, said the appointment of the steering committee members marked a historic moment.

"With the signing into law of the Protection, Promotion, Development and Management of Indigenous Knowledge Act, we can consider the recognition of RPL of traditional healers as part of the legitimate landscape of this country. We have to tackle this responsibility cautiously and take ownership of it, because it propels us into a future that a few years ago was not thought possible," said Prof. Seleti. ■



South Africans urged to prepare for impact of climate change

South Africans have been urged to protect themselves against the effects of climate change. This comes in the wake of the high temperatures that the country has been experiencing.

Most parts of the country have been experiencing heatwaves, as a result of changes in temperatures. Although there will be some relief in days to come, as evidenced by the rainfall that has been forecast, climate change experts from the Council for Scientific and Industrial Research (CSIR) have given warnings of increased temperatures and extreme heat events throughout the summer season.

Experts urged citizens to take extra precautionary steps during this hot season. "Although we are expecting some rainfall in the next few days in the eastern and northern parts of the country, climate change is here. We need to come up with alternative ways of adapting to climate change. Farmers and the entire society must prepare for lifestyle modifications that climate change brings forth," said CSIR meteorologist Dr Johan Malherbe.

Malherbe said the highest temperature increases occurred in the northern parts of the country, with temperatures going beyond 40 °C.

"This is typically the time of year during which we see these types of heatwaves. Our future climate projections also indicate that these increases in temperature will continue, and can have a huge impact on the occurrence of fires, for example. Furthermore, South Africa does not sit with the problem of too much rain; it is generally just enough or too little. Therefore, if temperatures go up, but rainfall does not occur, the heat conditions will only become worse," he said. CSIR environmental health scientist Juanette John looked at some of the effects that this climate phenomenon could have on human health. The potential health impacts may result from direct exposure to an increase in temperatures and extreme weather events or from indirect exposure, such as changes in air quality and through impacts on agriculture. John emphasised that the effect of climate change is felt differently in different areas and by different individuals, as it is not only based on their exposure, but also on a variety

of other factors. "The impact and effect of climate change is dependent on where people live, the type of work they do and their age, among other factor. Therefore, the interventions that need to take place have to be based on these considerations; sometimes interventions can actually be very simple. They may range from drinking enough water to staying in well-shaded areas when it is very hot," said John. "Climate change is expected to have a huge impact on health, but not enough is known about the effects of the impact that it has already had and how it may affect future impact. Many current health issues are climate-sensitive and thus may be impacted by climate change, adding an additional stressor to the health field. Projections of the number of hot days for South Africa into the future show that they will increase. Moving forward, we need to quantify potential risk and, for that, we need local relationships of temperature and mortality," added John.

The experts also urged government and other key stakeholders to focus on outcomes that will improve climate resilience and to think about actionable adaptation options to mitigate the negative impacts of climate change. They said that the solution to climate change is not simple and requires a collective effort across sectors and disciplines. ■



CSIR meteorologist Dr Johan Malherbe and Health Scientist Juanette John caution South Africans to take care as the climate change impact continues to affect the environment.

– Making sure it's possible –

Effective management of intellectual property is a tool for sustainable development



The overwhelming sentiment at the 11th World Intellectual Property Organization (WIPO) South Africa Summer School on Intellectual Property and Technology Transfer, under way in Bloemfontein, was that local technological innovations are key drivers of socio-economic development.

The annual event is organised by the Department of Science and Innovation's National Intellectual Property Management Office (NIPMO) and the Department of Trade, Industry and Competition's Companies and Intellectual Property Commission (CIPC), in partnership with the Japan Patent

Office. The Central University of Technology in Bloemfontein is hosting the summer school, which runs until 6 December.

Addressing the opening on Monday, 25 November, Maria-Stella Ntamark from the WIPO Academy in Geneva said that no country should base its development on imported technological inventions from other nations. "Every country needs to have a strong foundation of its own technology, created first through research and development institutions and then through established industrial affiliates. This summer school provides a platform to learn, share, exchange and question how our nations could benefit from technology transfer," she said.

Paballo Phiri, the Director responsible for Funds and Incentives Management at NIPMO, said that intellectual property (IP)



had become a critical factor in ensuring socio-economic growth, and emphasised the importance of managing IP resulting from publicly funded institutions effectively.

NIPMO, a specialised service delivery unit of the Department of Science and Innovation, is responsible for implementing the Intellectual Property Rights from Publicly Financed Research and Development Act. The Act aims to ensure that intellectual property emanating from publicly financed research and development is identified, protected, utilised and commercialised.

"The optimal use of intellectual property, as well as appropriate national and institutional intellectual property policies, will help nations in identifying and claiming legal rights and economic value for their IP," Phiri added.

The WIPO-South Africa Summer School, which focuses on intellectual property and technology transfer, is the only one of its kind; other WIPO summer schools convened around the world are more general in nature. Drawing participants from across the African continent, the 45 students in the 2019 cohort represent countries like Kenya, Cameroon, Ghana, Nigeria and Tanzania.

More than 20 local and international experts from academia and the public and private sectors will be at the summer school, and Rory Voller, CIPC Commissioner, urged the

participants to take full advantage of the presence of top-level experts in the field of intellectual property and technology transfer. "I am confident that the WIPO Summer School will provide you with a platform to engage and acquire specialised knowledge that can add to your current areas of work. Given the rapid technological advancement in the 4th Industrial Revolution environment, it has become very important to stay abreast of all the changes," said Voller.

This year's event included learners in a bid to create awareness of IP at an early age. Nthatsi Matobako, a grade 11 learner from Tsoseletso High School in Mangaung, said that she had enjoyed getting exposure to a subject that was unfamiliar to her. She said it was interesting hearing about intellectual property, 4IR and the protection of brands.

Mojalefa Khoza, Senior Education Specialist at the CIPC, said that intellectual property should be part of the school curriculum. "By the time learners complete the National Senior Certificate, they would have an understanding of the concept of

intellectual property," she said.

The Summer School is designed mainly for postgraduate and senior undergraduate students, as well as young professionals. The programme includes lectures, case studies, simulation exercises and group discussions on intellectual property topics. ■

The Summer School is designed mainly for postgraduate and senior undergraduate students, as well as young professionals. The programme includes lectures, case studies, simulation exercises and group discussions on intellectual property topics.

– Making sure it's possible –

The country's additive manufacturing capability has matured to fully fledged technology that's being used to manufacture medical devices among others.



South Africa's additive manufacturing technology heralded

Over 300 additive manufacturing (3D printing) technology systems have been established locally as a result of programmes put in place by the government, academic institutions and industry role players.

This collaborative approach has made it possible to establish and develop an infrastructure base that allows for meaningful research, and has allowed manufacturing designers and engineers to produce complex designs and creations without the need for individual tooling components.

Additive manufacturing (AM) technology has matured from prototyping technology into fully fledged manufacturing technology, widely used in the medical, automotive, jewellery and aerospace sectors, among others.

Significant investment in the sector has seen South Africa demonstrating world-class capabilities in additive manufacturing. This has positioned the country to participate

in sub-sectors with high growth potential in AM, such as aerospace applications and medical and dental devices.

Recognised as one of the technology pillars that will enable the smart factory of the future (alongside autonomous robots, the industrial Internet of Things and big data, among others), AM technology allows for the production of customised parts and components to support the shift towards mass customisation and digital manufacturing.

Last week role players in the AM sector met at the annual 20th Annual International Conference of the Rapid Product Development Association of South Africa (RAPDASA). The event was held in Bloemfontein from 5 to 8 November under the theme "Creating the future of manufacturing – layer by layer", with "Establishing the 3D printing process chain" as the sub-theme.



RAPDASA is a non-profit organisation established to create a network for innovators, entrepreneurs, industry partners and academics in the South African AM sector.

The Department of Science and Innovation (DSI) partnered with the Central University of Technology (CUT) to host the event. The DSI also hosted a pre-conference seminar on titanium additive manufacturing.

Addressing the pre-conference event, the Acting Director: Advanced Manufacturing Technologies at the DSI, Sechaba Tsubella, said that AM in South Africa had matured quickly because of high participation by industry and universities.

"About two-thirds of South African universities currently have AM facilities, 25% of which are used for research purposes," said Tsubella.

"South Africa is well positioned to accelerate the development of AM technology, with several initiatives in the local manufacturing sector. Titanium AM, in particular, has gained prominence through the activities of the Titanium Centre of Competence at the Council for Scientific and Industrial Research (CSIR), as well as interest from other industry players. This has sparked many developments and applications for metal AM."

The Centre for Rapid Prototyping and Manufacturing (CRPM) at CUT has had huge success in using titanium AM to customise medical implants. The CRPM, established in 1997, does commercial work and research using rapid prototyping, manufacturing and tooling, and medical product development technologies.

Prof. Maina Maringa, from CUT's Department of Mechanical and Mechatronic Engineering, said that the CRPM had come a long way in advancing AM in South Africa.

"The application of AM is universal; the centre's focus has been on manufacturing health devices, but will be moving to the aerospace and automotive sectors. AM can be used by many sectors to produce high-quality manufactured components," Maringa said.

Another major AM centre in South Africa is the Aeroswift platform hosted at the DSI entity the CSIR, and supported industry partner Aerosud. With one of the biggest AM machines in the world – a first-generation functional, high-speed, large-area laser-based melting system – the platform allows for the manufacture of large titanium components (up to 2 000 mm x 600 mm x 600 mm) for the aerospace industry.

Attending the Bloemfontein pre-event seminar was Aeroswift candidate researcher, Londiwe Motibane, who is doing an MSc in Materials Engineering at the University of Cape Town and is currently based at the CSIR platform. Her research focuses on the thermal stress management of applications created by the 3D printer.

Motibane's research looks at addressing residual stresses in selective laser melting. These stresses can cause the cracking and distortion of parts, negatively affecting the mechanical properties of the parts produced. An inferior mechanical process means premature failure in service, which could result in the loss of revenue or even lives.

"AM provides a platform for the adoption of new concepts in a traditional industry such as manufacturing. It enhances the existing technologies and takes them right to Industry 4.0. The widespread introduction of AM at undergraduate level could help open up this technology," Motibane said.

Speaking passionately about science and engineering, the young candidate researcher said she has always had a love for the sciences and would like to make a contribution to society.

"South African learners need to know that there are endless opportunities in maths and science-related fields, and that these subjects have the potential to change and improve people's quality of life," Motibane said.

An equally enthusiastic young scientist attending the RAPDASA conference, Nkele Baloyi, is working on a DTech in metallurgy, which is the scientific study of metals, their properties and their uses in the extraction and processing of minerals.

With a bachelor's degree in metallurgical engineering and a master's degree in materials science from the Tshwane University of Technology, Baloyi is currently focused on microstructural investigation.

The RAPDASA platform allows young researchers like Motibane and Baloyi to share ideas and engage with senior researchers and industry.

The DSI has played an active role in supporting RAPDASA through the funding of workshops and conferences to develop a new generation of knowledge that can support the burgeoning AM industry. ■



Generating knowledge for societal benefit through the UK-SA Research Chairs Programme

UKZN research capacity

continues to grow

The University of KwaZulu-Natal (UKZN) increased its research output by 60% between 2011 and 2017 and, according to the Department of Higher Education and Training's, *Report on the Evaluation of the 2017 Universities' Research Output*, is now one of the top 5 achievers in terms of research output.

The report, released in December 2019 at the UKZN annual research awards dinner, provides an analysis of the research performance of South African public higher education institutions, focusing on research outputs in accredited journals, books and approved published conference proceedings.

UKZN is one of the leading research-intensive universities in South Africa and on the African continent," said UKZN's Prof. Deresh Ramjugernath, who addressed the dinner.

"We've also done fairly well with regard to world rankings; we find ourselves in the top 500 universities globally. There are over 20 000 universities that participate in the global rankings, so that's a real achievement." Ramjugernath is the Deputy Vice-Chancellor of the Research, and the incumbent of the Department of Science and Innovation-National Research Foundation South African Research Chair for Fluorine Process Engineering and Separation Technology. He is also the Director of the Thermodynamics Research Unit, leading a globally recognised team of postgraduate students and researchers.

Ramjugernath said the country's 26 higher education institutions were producing about 2 700 PhDs a year. "In 2018, UKZN produced 503 PhDs – almost one-fifth of the PhD graduates in the country. In terms of master's students,

1 351 graduated. This is a remarkable achievement in terms of adding to the economy and to the nation's high skills set," he said. The university's success was also commended by the Director-General of Science and Innovation, Dr Phil Mjwara. He said that UKZN had developed a rich research culture, that attracted national and continental attention."

During the period 2011 to 2017, you hosted 18 research chairs and the Centres of Excellence in HIV Prevention and Indigenous Knowledge Systems, and filed 22 intellectual property disclosures and 16 patent applications," he said. Dr Mjwara also praised the university for not only increasing its research output, but also making progress in gender equity, helping to unlock the country's developmental objectives, through its Imbokodo programme, which is aimed at empowering women in both academia and professional services.

UKZN has also established a Science and Technology Innovation Park, with its primary focus on projects that address energy and environmental sustainability. The institution is playing a significant role in science, technology and innovation on the international stage. Dr Mjwara spoke of HIRAX, the Hydrogen Intensity and Real Time Analysis eXperiment radio telescope, which will be linked to the Square Kilometre Array project.

UKZN also has a partnership with China, the National Astronomical Observatory of China Joint Centre for Computational Astrophysics. This centre facilitates the exchange of students to work on computational astrophysics and cosmology related to new observational facilities in South Africa and China. ■

SKA Africa Partners visit core site

The Northern Cape Premier, Dr Zamani Saul, welcomed successes made at the Square Kilometre Array (SKA) site in Carnarvon, which has developed into a powerful radio astronomy region. Dr Saul, who was appointed Premier in May 2019, visited the site last October.

Dr Saul said the province had witnessed the site grow massively over the years. With an investment by government of over R4 billion, the desert site now hosts over 70 radio telescopes. The project has proven South Africa's ability to do world-class science and engineering.

The Premier hosted senior officials and experts from the nine SKA African partner countries, who were at the site to view the progress of the SKA and the African Very Long Baseline Interferometry Network (AVN) following their annual meeting. The AVN project aims to establish a network of self-sufficient radio telescopes in Africa through the conversion of redundant telecommunications antennas into radio telescopes, "new-build" telescopes, or training facilities with training telescopes. This network will strengthen the science that the international VLBI community can do.

The site visit included a tour of the KAT-7 and the MeerKAT telescope arrays. The MeerKAT is a 64-dish system which will be incorporated into Phase I of the SKA. The completed MeerKAT array, launched last year, is to date the most sensitive telescope of its kind in the world, and is already performing important science and making significant discoveries. One notable scientific achievement was the production of the clearest view so far of the centre of the Milky Way.

The officials also visited the Karoo Array Processor Building at the Losberg site complex. A total of 170 km of buried fibre cables connect receptors to the building, processing very large amounts of data coming from the antennas.

"We are excited about the Northern Cape being able to contribute to the socio-economic development of



Northern Cape Premier, Dr Zamani Saul visited the SKA core site near Carnarvon for the first time in October last year.

Picture: Phil Moyane

this country, and the South African Radio Astronomy Observatory's (SARAO) efforts to grow human capital in radio astronomy," said the Premier.

SARAO has invested heavily in the Northern Cape province – upgrading knowledge centres, creating jobs and providing deserving students with much-needed academic funding.

The focused investment in social development in the region will ensure that neighbouring communities can benefit fully from the far-reaching astronomy project, through better education and training, investment in small businesses, and increased job opportunities. A total of about 1 000 students have received bursaries since 2006. Of the recipients, about 130 have come from SKA African partner countries, and many of them have returned to initiate radio astronomy programmes at their home universities.

Acting Deputy Director-General: Research Development and Innovation, Dr Daniel Adams, described the 6th SKA African Partner Countries Meeting as successful. He added that the visit was an opportunity for the partners to see developments on site. ■



The UK-SA Research Programme is aimed at improving the extent, delivery and impact of research capacity and providing mentorship opportunities for emerging researchers at South African universities.

Generating knowledge

for societal benefit through the UK-SA Research Chairs Programme

One in four children in South Africa remain stunted, despite a comprehensive social grant system, according to research by the UK-South Africa Bilateral Research Chair in Social Protection for Food Security at the University of the Western Cape, Prof. Stephen Devereux. "The social protection for food security research agenda is motivated by the fact that food insecurity in South Africa remains extremely high. Child stunting has not fallen below 25% since the early 1990s," Prof. Devereux said during a UK-SA Newton Fund partnership symposium held at the National Research Foundation this week.

This was the case, Prof. Devereux said, despite the fact that food production exceeds consumption needs, and despite the existence of a comprehensive system of child support grants that has reached 12 million children since its introduction in 1994. Prof. Devereux explained that his research chair aims to address the Sustainable Development Goal of ending poverty, preventing hunger and reducing inequalities, while indirectly promoting good health, gender equality and quality education, among others.

The chair forms part of the UK-SA Research Chairs Programme, which was launched two years ago to expand the South African Research Chairs Initiative (SARChI) through collaborative partnership. Sponsored through the National Research Foundation, the British Council and the British Academy, the programme is aimed at improving the extent, delivery and impact of research capacity and providing mentorship opportunities for

emerging researchers at South African universities. One of the beneficiaries of the programme, Zona Ndondo, was supervised by Prof. Devereux and obtained her master's degree in development studies, focusing on a comparative analysis of alternative food security indicators relating to farmworkers in the Northern Cape. The Department of Science and Innovation (DSI) has lauded the partnership as beneficial to South Africa, particularly in the areas of human capital development and innovation. "The UK-SA Newton Fund partnership has been a pillar of our cooperation and has produced impressive outcomes in most areas," Mr Khaya Sishuba, Director for Bilateral Relations (Europe and Gulf States) at the DSI, told the symposium. "Focusing on people, translation and research strands, we have now witnessed one of the most successful collaborations in our bilateral country portfolio, lifting our relations to an all-time high."

Three UK-SA Bilateral Research Chairs have been awarded, in Political Theory, Social Protection for Food Security, and Ocean Science and Marine Food Security. In addition, two SA-Africa-UK Trilateral Research Chairs have been awarded, in Transformative Innovation, the Fourth Industrial Revolution and Sustainable Development, and Mainstreaming Gender for Energy Security in Poor Urban Environments.

The latter chair is held by Prof. Josephine Musango of Stellenbosch University. As the chair, Prof. Musango collaborates with Dr Amollo Ambole of the University of Nairobi in Kenya and Dr Fabrizio Ceschin of Brunel University London in exploring gender-informed innovations



and commercialisation opportunities in poor urban societies. Mr David Barnes, Head of the UK Science & Innovation Network in South Africa, stressed the importance of the strategic collaborations that were being formed between the United Kingdom and South Africa, and also the trilateral partnership with Kenya. "Both the British and South African governments recognise the need to work collaboratively with partners across the globe to push the boundaries of knowledge. This is the concept behind the Newton Fund chairs, enabling leading researchers in their fields to access expertise in both countries and to build research capacity in South Africa and beyond into Africa," said Mr Barnes. As climate change continues to take its toll on the environment globally, the main research focus of the UK-SA Bilateral Research Chair in Ocean Science and Marine Food Security is to understand the fundamental drivers of marine food security in the western Indian Ocean, and most importantly to help governments to deal with emerging humanitarian disasters in the region.

Prof. Michael Roberts of Nelson Mandela University, who holds the chair, said that ocean science was at the core of this endeavour. "Ultimately, the emphasis rests on using the best available ocean and ecosystem models to project future food security scenarios under varying states of ocean and climate

change." The sentiment expressed during the symposium was that under the UK-SA Newton Fund partnership, lives are being improved through health research, young innovators are being supported to commercialise their ideas, and hundreds of early-stage researchers are strengthening their work through international collaboration.

One such researcher, Dr Albano Troco, is a beneficiary of the Research Chair in Political Theory held by Prof. Lawrence Hamilton of the University of the Witwatersrand. Dr Troco, whose research focused on electoral politics in post-war Angola between 2008 and 2017, obtained his PhD in July 2019 in record time. He acknowledged the impact of the Newton Fund in helping him reach this milestone. "The scholarship afforded me financial security to focus on the doctoral degree," Dr Troco said, adding: "I am the first PhD graduate in my family."

The UK-South Africa Newton Fund is part of the broader Newton Fund programme, which has a total UK government investment of £735 million up until 2021, with matched resources from partner countries. The UK-SA Newton Fund has already seen a co-investment of £30 million since its launch in 2014. ■

MEN'S DAY

Male employees in the Department of Science and Innovation are proud to be counted among country's men **who will stand up and protect women.**



The employees who attended the Men's Forum hosted by the Department were unanimous: South Africa needs courageous male role models who are prepared to change stereotypes. Picture: Phil Moyane

– Making sure it's possible –

Honeybush research for sustainable socio-economic benefits



Horticultural researchers are looking to reduce the harvesting of honeybush in the wild, as the practice risks making the indigenous plant species extinct. Currently, most honeybush on the market is still harvested from the wild. Horticulturalists have also cautioned that harvesting plants in the wrong way can prevent their regrowth.

The Department of Science and Innovation and the Agricultural Research Council continue to invest in research and development towards growing a lucrative honeybush sector. About 200 tons of honeybush are exported annually to 25 countries, including Germany, the United Kingdom and the United States of America. Most of the rest goes to local cosmeceutical and nutraceutical industries, making it difficult for South African consumers to buy honeybush for their personal use.

The global demand for honeybush is high, as the plant is rich in antioxidants and contains many healing properties.
Picture: Phil Moyane

Like rooibos, honeybush is unique to South Africa, growing in the Western and Eastern Cape. There are 23 known honeybush species, all belonging to the genus *Cyclopia*. The plant has many health properties. It is caffeine free, rich in antioxidants, and can assist in the treatment of cancer and diabetes. South Africa is home to the Cape Floral Kingdom, which boasts 1 300 species per 10 000 km².

The world's next most biodiverse area is the Amazon basin, with just 400 species per 10 000 km². Very little research has been conducted to take advantage of the economic and health benefits South Africa's rich biodiversity, says Dr Cecilia Bester, a senior lecturer at Stellenbosch University's



Research and development around the expansion of the honeybush industry continues with the DSI and the Agricultural Research Council investing in projects aimed at benefitting the community. Picture: Phil Moyane

Department of Horticulture. Bester has been investigating ways to grow the honeybush tea industry in South Africa for more than two decades. Her research focuses on breeding, horticulture and agroprocessing. The aim is to produce a better seed that will enable increased farming of the honeybush to meet the demand.

Currently the honeybush industry is still small, with a turnover of around R50 million per annum. The honeybush industry started about 25 years ago, with the plant being harvested in the wild. Dr Bester hopes to reduce harvesting in the wild.

"Ultimately, we want to have fewer people harvesting the wild grown trees because this might lead to extinction," says Bester. "The people who harvest the plant might not know how to do this sustainably. For instance, if you remove the plant material before the plant produces seeds, there will be no seeds left to grow again."

Dr Bester said years of research was starting to yield positive results. "People are buying seeds from me; at this

stage I am able to sell 20 kg of seeds a year." Benefiting local communities is an integral part of the socio-economic approach to growing the honeybush industry.

Currently five communities from the Tsitsikamma, Storm River Bridge, Mossel Bay and Haarlem areas are being supported through a DSI funded honeybush project. The communities receive training in farming skills and business management.

Dr Bester said that the communities are implementing research outcomes. "Communities are able to generate income for themselves by selling seeds to nurseries and private farmers." The honeybush project falls under the DSI's Indigenous Knowledge-based Technology Innovation unit, which is contributing to the implementation of the national Bio-economy Strategy. The goal is to address poverty, unemployment and inequality directly. ■

