



Central University of
Technology, Free State

Research and Innovation Achievements

2014-2020

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EXECUTIVE SUMMARY: RESPONSES TO RESEARCH AND INNOVATION: 2014 – 2020

The Central University of Technology, Free State (CUT) has made great strides in enhancing the strategic intent as outlined in the Research Development Plan, 2014 – 2020 under the following the main strategies:

- Increased trend in publication outputs.
- Increased postgraduate enrolments and graduations.
- Increased research-informed productivity, grants awarded and peer evaluation.

Our steady increase of 51% from 2014 to 2020 in financial investment towards research and innovation and funding received from the NRF and DHET has contributed to an increasing trend in research outputs and constant growth in the academic development of staff members, approximately 40% of whom hold doctoral degrees – justifiable evidence of commitment to the research agenda.

We have seen our university continuing to reflect a sustained increase in its overall research performance, including research training, research outputs, technology transfer and commercialisation of research outcomes. Over the years we have also witnessed an increase in financial investment into research and innovation.

- The investment has translated into a 59,76% growth in publication outputs from 2015 – 2020. In 2020 CUT obtained 0.56 per capita research publications outputs which is the second highest amongst the universities of technology (UoTs).
- For normalised weighted research outputs, CUT obtained 0.96 which is the third highest amongst the universities of technology (UoTs). This means that on average each permanently employed academic in the university produces about 0.96 research outputs per year (either research publications or graduates or any combination of the two).

Most significantly, the university analysed all research activities to align all research programmes with the Sustainable Development Goals (SDGs) of the United Nations (UN) and the reimagining drive of the university. This process was completed, and resulted in the establishment of the following research centres:

- Centre for Applied Food Security and Biotechnology (CAFSaB);
- Centre for Diversity in Higher Education Research;
- Centre for Enterprise and Entrepreneurship Studies;
- Centre for Rapid Prototyping and Manufacturing (CRPM);
- Centre for Sustainable Smart Cities; and
- Centre on Quality of Health and Living.

Structural processes and institutional strategic transformation of educational programmes also contributed to a shift away from disciplinary-driven research to multi-, inter- and transdisciplinary research. In addition, most of the research was undertaken under organised research clusters and associated research programmes common to many research systems.

In 2016, the university adopted a research and innovation organisational structure by repositioning and strengthening the Research, Innovation and Engagement portfolio through the establishment of the Research Development and Postgraduate Studies Department and appointment of Assistant Deans: RIE within faculties.

In support of this strategic intent, we are delighted as part of the 2021 annual report, to highlight some of the key performance trends and achievements guided by the 2014 – 2020 strategic blueprint. A number of activities to enhance research, innovation, and engagement practices at the university were recorded and are reflected below:

GUIDING STRATEGY: 2014 – 2020

Research Development and Postgraduate Studies Plan, 2014 – 2020

Research was guided at the Central University of Technology, Free State by the Research and Development Plan, 2014 – 2020.

The plan was implemented during the first term of 2014, with the following focus areas, objectives and activities as reflected in the table below:

Research and Development Plan, 2014 – 2020

Focus	Objective	Activity
Scholarly development through research and innovation training	Scholarly engagement with the research process and research cycle	<ul style="list-style-type: none"> • Pre-doctoral training • Doctoral training • Post-doctoral training • Programme on postgraduate supervision • Programme on scientific writing • Programme on technology transfer and innovation • Annual faculty research seminars • Colloquiums and discussion groups
Research partnership development	Capacity growth of research projects	<ul style="list-style-type: none"> • Multi-, inter- and transdisciplinary research • Joint ventures with national and international universities, research bodies and research councils • Joint ventures with quadruple helix partners
Development of research clusters and programmes	Strengthening of research capacity	<ul style="list-style-type: none"> • Student retention and throughput • Publications • Conference attendance • Patents • Rated researchers • Research funding

The aim of the plan is to contribute to:



Innovation



Socio-economic development



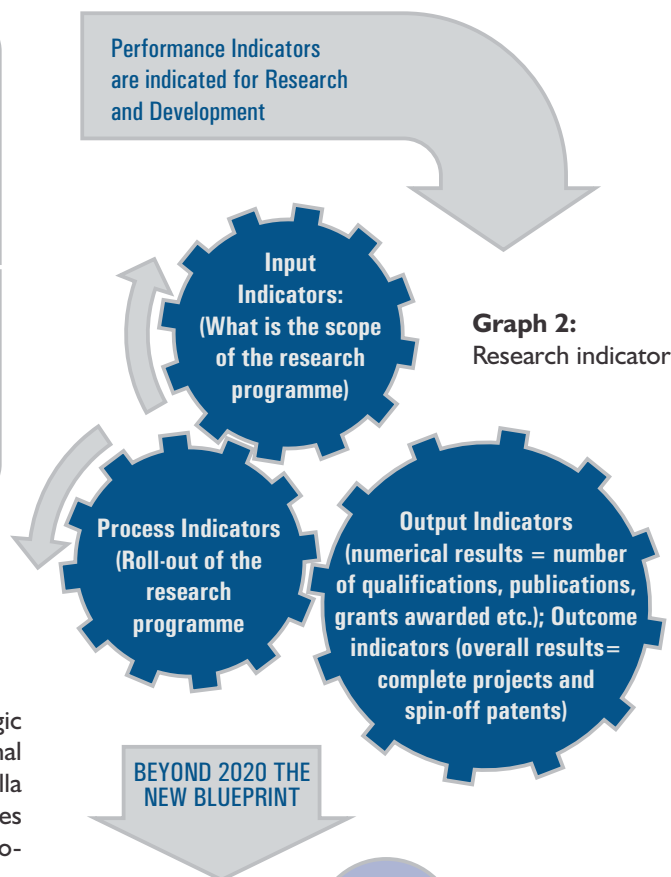
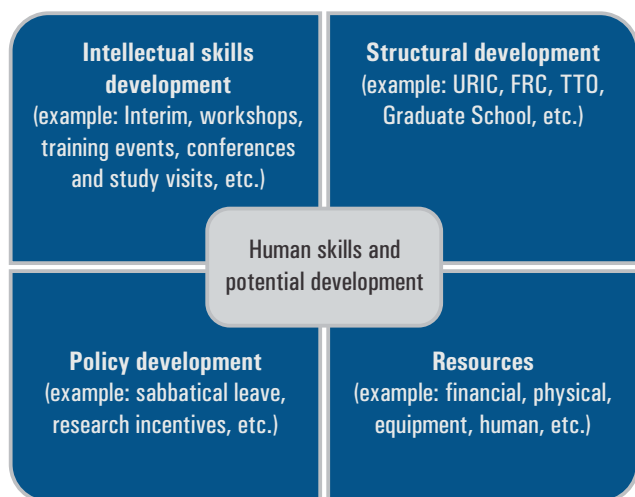
Entrepreneurship



Sustainability

The Research and Development Unit also developed a *managerial model* in support of its *monitoring* and *evaluation* function. The plan is based on (i) a multi-focused approach to capacity development, where human skills and potential development form the core of the capacity development activities, and (2) levels of performance indicators for research and development. This model can be presented graphically as follows:

Graph 1: Research management model



Research Development and Postgraduate Studies Plan, 2021 – 2025

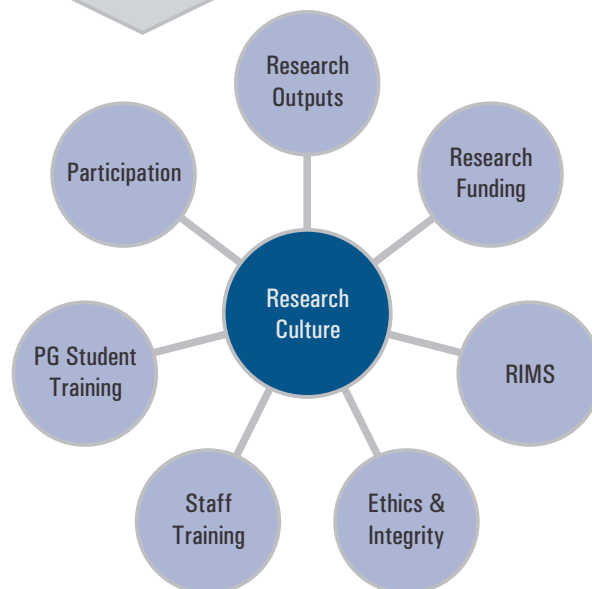
The Research Development & Postgraduate Studies Strategic Plan, 2021-2025 extends the already approved Institutional Strategic Plan, 2021-2025. The plan, under the umbrella division of Research, Innovation and Engagement, contributes to the university research and innovation value chain and ecosystem.

The Plan is guided by the current notion of “the future of universities”, according to which the relevance of research in contributing towards society and economy is becoming vital. In line with global practice, the concept of research development is understood as increasing (a) the quality and (b) the quantity of research outputs informed by publications and master’s and doctoral graduations.

The advent of the Fourth Industrial Revolution (4IR) and the recently released Report of the Presidential Commission on 4IR (2020) provide an opportunity to articulate the way in which the university will address the recommendations of the Report in the period 2021-2025.

In addition, the Plan supports three important objectives, namely *productivity* in research by all instruction and research staff (and not measured by outputs only); *capacity development* to deliver on quality and quantity of research outputs; and *increased support* for the Women in Research Programme.

These objectives are translated into seven foundational themes contained in the Plan, which will support Research Development & Postgraduate Studies during 2021-2025:



Strategic Objective 1: Develop a strong research culture based on quality research outputs and recognition.

Strategic Objective 2: Develop a strong research culture based on participation by instruction and research staff.

Strategic Objective 3: Develop a strong research culture based on competitive research funding.

Strategic Objective 4: Develop a strong research culture based on postgraduate studies through research education and supervisory training.

Strategic Objective 5: Develop a strong research culture based on research training for instruction and research staff.

Strategic Objective 6: Develop a strong research culture based on ethics and integrity, transformation, and compliance.

Strategic Objective 7: Develop a strong research culture based on Research and Information Management Systems (RIMS).

BUILDING RESEARCH STRUCTURE AND CAPACITY – THE ENABLERS

The strategic objectives are further supported through institutional support systems and infrastructure, including financial resources.

Research Focus

The Senate approved a University Policy on Centres, Units and Groups on 25 August 2014. The policy was informed by the University Research and Development Plan, 2014–2020, and it was implemented in 2015.

The objectives of this policy are directed at building a critical mass in research and optimising opportunities to grow research outputs. The policy identified the approved Research Clusters and Programmes as meaningful vehicles to meet the outputs of the Plan by 2020. Strategy 2 of the R & D Plan suggests meaningful structural support to achieve the desired outputs. One such mechanism is research performed by a critical mass organised in Centres/Units/Groups.

Table: CUT research clusters, programmes and aligned research entities

Research Centres (2020)	
Research Centres	Objective
Centre for Rapid Prototyping and Manufacturing (CRPM)	<p>Additive manufacturing (AM) is internationally recognised as one of the key disruptive technologies of the Fourth Industrial Revolution, also known as Industry 4.0. The CRPM's research and innovation programme is aimed at introducing and transferring this technology to the South African manufacturing industry in support of sustained growth of the industry. To achieve this, the following strategic objectives are being pursued:</p> <ul style="list-style-type: none"> • Maximisation of the product development and manufacturing benefits that can be derived from the characteristics of AM. • Full acceptance of AM by the manufacturing industry as technology that improves productivity and competitiveness. • Acceptance of AM by medical practitioners, the health care industry and medical aid funds as technology with unique benefits for improving the quality of life of patients. • Acceptance by the aerospace industry as technology that provides unique benefits for cost-effective and reliable manufacturing of aerospace components.
Centre for Sustainable SMART City (CSSC)	<p>The objectives of the centre are to focus on research that will be able to produce new technology, products, devices, structures, and methodology contributing towards the development of a sustainable city of the future. To sustain and advance an excellent and critical mass of human, physical and financial resources through empowerment, diversity management and capacity building.</p>
Centre for Applied Food Security and Biotechnology (CAFSaB)	<p>To produce sustainable and growing research outputs in terms of qualifications, publications, intellectual property entities and products that can be commercialised</p> <p>To establish and further develop the authority and acknowledgement of the standing of the centre both nationally and internationally.</p> <p>To advance the footprint of the centre in the local quad-helix arena.</p>
Biotechnology (CAFSaB)	<p>To produce sustainable and growing research outputs in terms of qualifications, publications, intellectual property entities and products that can be commercialised</p> <p>To establish and further develop the authority and acknowledgement of the standing of the centre both nationally and internationally.</p> <p>To advance the footprint of the centre in the local quad-helix arena.</p>

Centre for Diversity in Higher Education Research	To drive and facilitate intellectual debates with the intention of developing relevant methodologies that will be used in finding solutions to diverse challenges such as equity, multilingualism, access, pluralism as well as other forms of discriminatory practices.
Centre for Enterprise and Entrepreneurship Studies	To carry out scientific research that empowers society and enterprises from responsible entrepreneurship, in both public and private sectors. To conduct cutting edge translational research that will lead to the improvement of people's health and quality of life and to facilitate academic, research, innovative and commercial growth in Central University of Technology.
Centre on Quality of Health and Living	To conduct cutting edge translational research that will lead to the improvement of people's health and quality of life and will facilitate academic, research, innovative and commercial growth in Central University of Technology

Research Centres, Units and Groups (2015 – 2019)

A total of 2 Centres, 12 Units and 2 Groups were approved in 2016 and are clustered in line with the three themes below:

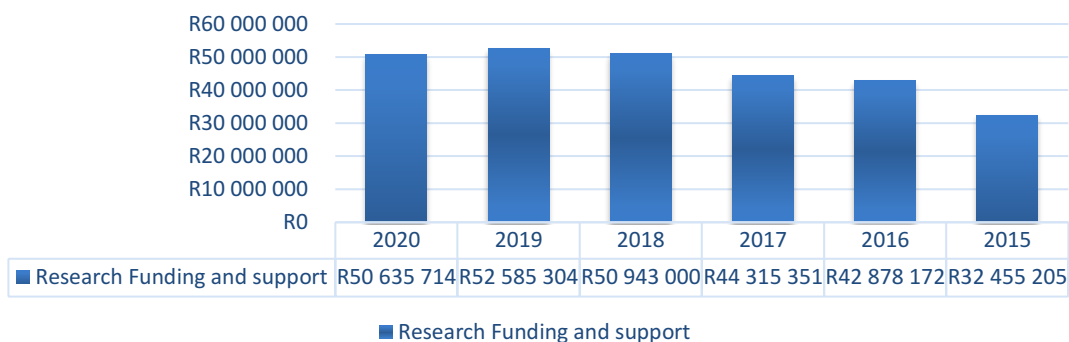
Research Cluster 1: Technologies and Innovations for Sustainable Development	Research programmes per research entity – Centre/Unit/Group
Objective To investigate and apply technologies and/or innovations to foster and promote sustainable development	Centre for Rapid Prototyping and Manufacturing (CRPM)
	Unit for Evolvable and Manumation Systems (RGEMS)
	Unit for Lean Construction and Sustainability
	Group for Sustainable Urban, Roads and Transport (SURT)
	Group for Soil Mechanics
	Unit for Sustainable Water and Environment
	Unit for Research on Informatics for Droughts in Africa (URIDA)
Research Group in Engineering Education (ARGEE)	
Research Cluster 2: Quality of Health and Living	Research programmes per research entity – Centre/Unit/Group
Objective To apply scientific research in different disciplines to improve on the quality of health and living standard of humans, animals and plants	Centre for Applied Food and Biotechnology (CAFBSB)
	Unit for Drug and Discovery Research
Research Cluster 3: Socio-Economic and Entrepreneurship Development	Research programmes per research entity – Centre/Unit/Group
Objective To do scientific research that empowers society for invaluable contributions to sustainable socio-economic development	Unit for Public Management and Administration Unit for Enterprise Studies
	Unit for Tourism Destination and Management
	Unit for Research in Scholarship of Teaching and Learning (RSoTL)
	Unit for Scholarship in Research Education
	Unit for Foundations of Education
Unit for Mathematics, Science and Technology Education Research	

RESEARCH PERFORMANCE HIGHLIGHTS

Evidence suggests that most of the targets were reached or are within reach in the immediate future. More important are the observations gained from the implementation of the R & D Plan (2014 – 2020) relevant to institutional plans.

Research funding and support: 2015 – 2020

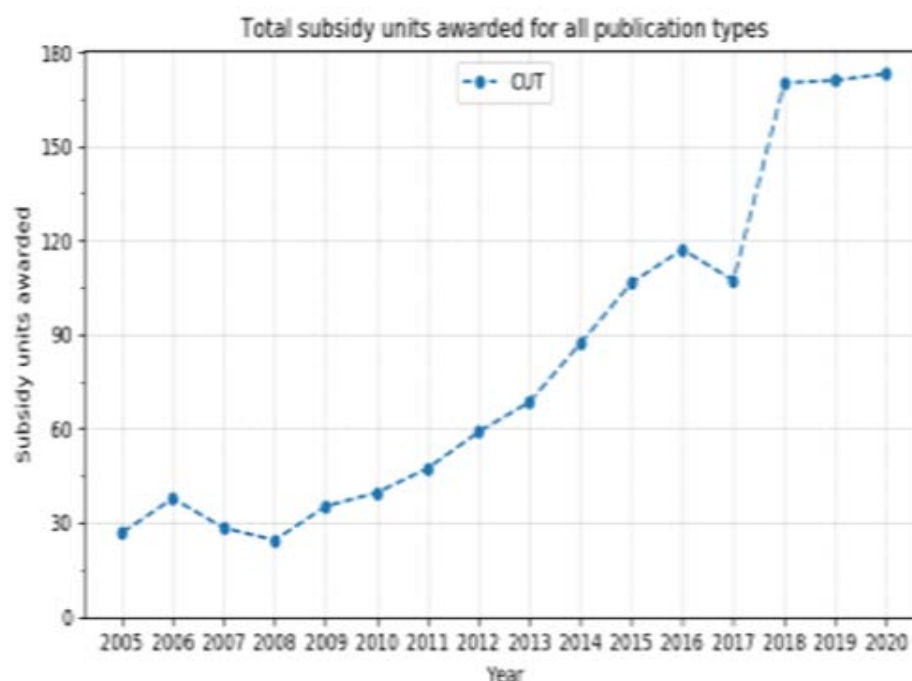
Research Funding And Support 2015 - 2020



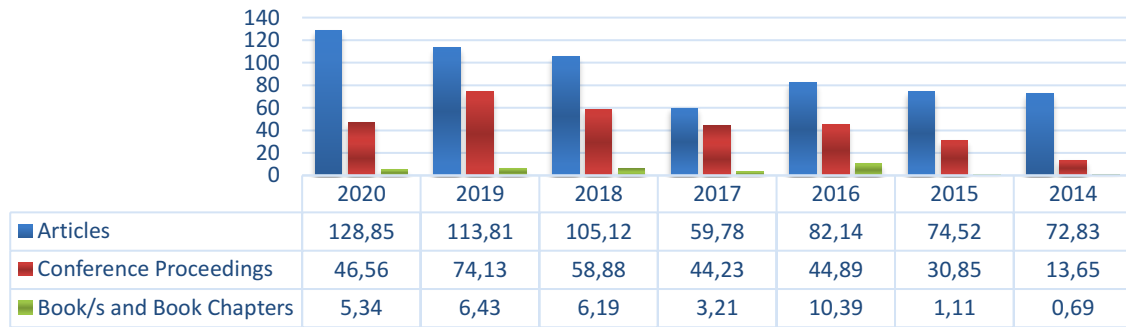
Funding in support of research initiatives and postgraduate scholarships increased by 56% and 61%, respectively from 2015 to 2020.

Scholarships, 2014 - 2020				
Year	M students	D students	Post-docs	Total
2014	R 957 880	R 628 494	R 880 000	R 2 466 374
2015	R 1 972 340	R 1 147 030	R 1 000 000	R 4 119 370
2016	R 5 229 930	R 3 205 660	R 600 000	R 9 035 590
2017	R 6 547 880	R 3 337 380	R 940 000	R 10 825 260
2018	R 8 466 230	R 2 761 860	R 1 010 000	R 12 238 090
2019	R 7 106 090	R 1 884 120	R 3 009 937	R 12 000 147
2020	R 6 318 940	R 1 909 430	R 2 590 000	R 10 818 370

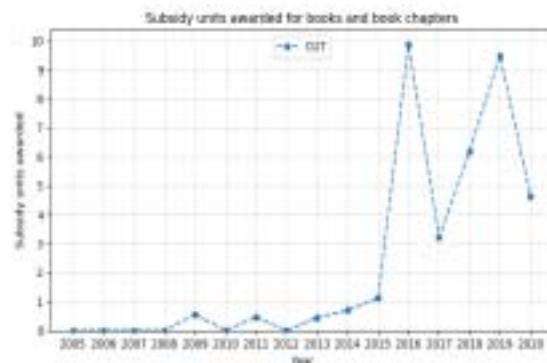
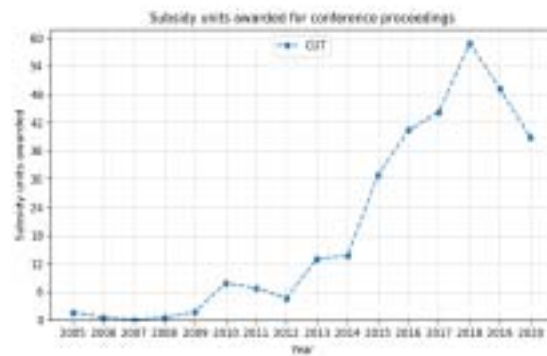
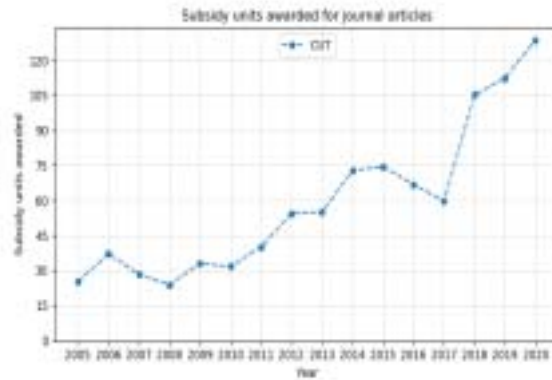
Publication outputs showed sustainable growth over time, although the challenge remains that (a) not all instruction and research staff with doctorates are publishing research results, and (b) participation in research publication outputs are not equal to academic ranks or in departments and faculties.



Research Publication Outputs 2014 - 2020



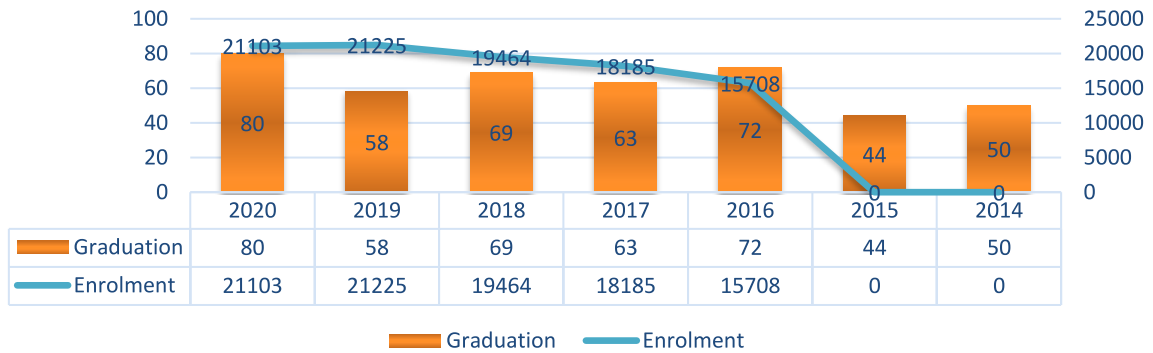
■ Articles ■ Conference Proceedings ■ Book/s and Book Chapters



Postgraduate enrolment and graduation showed a sustainable growth over time, although the challenge remains that (a) not all instruction and research staff with doctorates are participating in supervision, (b) not all programmes have doctoral students, and (c) there is a large number of part-time master's and doctoral students.

Postgraduate enrolment and graduation: 2015 – 2020

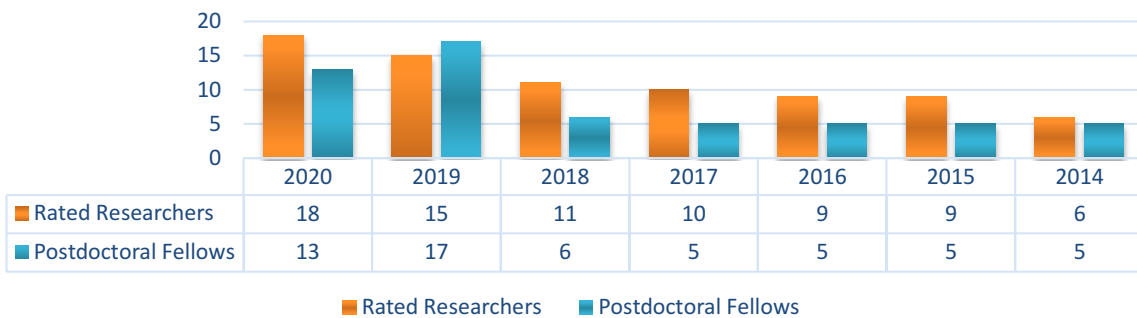
Graduation and Enrolment Figures 2014 - 2020



While the university is growing its share of **(inter-)national criteria** for competitive research participation and outputs, such as ratings, research grants and postdoctoral fellowships, the university is not yet optimising the opportunities available in these and other categories.

Rated Research and Postdoctoral fellows' figure 2014 – 2020

2014 - 2020 Stats



**RESEARCH INNOVATION
& EXCELLENCE**





Dr Molapo Qhobela, Former Chief Executive Officer: NRF; Prof. Brian O'Connell of the University of the Western Cape receiving the Lifetime Achievement Award and Former Minister of Science and Technology, Dr Naledi Mandisa Pandor.

CUT HOSTS NRF EXCELLENCE AWARDS

On 14 September 2017, the Central University of Technology, Free State (CUT) hosted 250 great South African minds under one roof at the 2017 National Research Foundation (NRF) Awards. The ceremony, themed “Sustainable Development through Knowledge Creation”, brought together a sterling line-up of renowned experts in various fields to celebrate research excellence, including Prof. Brian O'Connell, retired Rector of University of the Western Cape (UWC), who received a Lifetime Achievement Award, and distinguished scholars who, together, won nine special awards and obtained two P-ratings and sixteen A-ratings.

Regarded as the benchmark for research excellence, the 2017 NRF Awards purposely place the spotlight on the role of knowledge creation in supporting and enabling sustainable development in South Africa, as envisaged in the National Development Plan 2030.

The hosting of these awards at the CUT did not happen by accident: this occasion followed after the NRF acknowledged the university for being the most improved institution in terms of its research performance and output in 2015. For the CUT, this accolade attests to the hard work that the university has invested in its research and development, and its Vision 2020. The university has seen an increase in the number of master's and doctoral degrees that have been awarded, as well as an increase in the number of NRF-rated researchers amongst its staff. Amongst others, Prof. Ryk Lues of the Faculty of Health and Environmental Sciences, and Prof. Kanzumba Kusakana of the Faculty of Engineering and Information Technology (IT) added their names to these “Oscars of Academia” in 2016.

In addition, there was an 82% increase in research outputs from articles published in scientific journals, whilst the proportion of permanently appointed academic staff holding doctorates increased to 33% – a relatively high percentage in the university of technology (UoT) sector. Furthermore, in 2015, approximately 50% of the university's research outputs were published in international scientific journals.

The CUT continues to align the academic projects and research and innovation programmes with its Vision 2020, which focuses on producing quality social and technological innovations in socio-economic development, primarily in the central region of South Africa.

South Africa currently boasts 3 392 NRF-rated researchers. From 2013 to 2017, the number of Black researchers in the country increased by more than 70%, whilst the number of female researchers increased by more than 51%.



A photo of the local committee responsible for the organising of the SAARMSTE conference.

HOSTING THE SOUTHERN AFRICAN ASSOCIATION FOR RESEARCH IN MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION (SAARMSTE)

SAARMSTE is the Southern African Association dedicated to the advancement of research in Mathematics, Science and Technology Education (MSTE) in Southern Africa. Some of the aims of SAARMSTE include: fostering a sense of community among researchers in MSTE; promoting research to improve and develop MSTE programmes in response to current and future needs; and organising conferences at which the results of MSTE research can be presented.

In line with the latter aim of organising conferences, from the 17 – 20 January 2017, the Faculty of Humanities was privileged to host the 25th Annual Conference of the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE). The theme of the conference was "Research to learn and teach for diversity in Mathematics, Science and Technology Education".

Plenary speakers included:



Judith Bennett is the Salters' Professor of Science Education and leader of the University of York Science Education Group (UYSEG). UYSEG has an international reputation for its research and research-informed curriculum development work. Prior to taking on the role of Salters' Professor in 2014, Judith was head of the Department of Education at the University of York for eight years.

Prof. Judith Bennett from York University, United Kingdom. Her talk was entitled "What does research uncover about strategies for engaging more young people with STEM subjects and widening participation?". She also ran a workshop entitled: "Teaching difficult ideas in secondary science – how research can help".

Mike Askew is a Distinguished Professor of Mathematics Education at the University of Witwatersrand. He has previously been Foundation Chair Professor of Primary Education at Monash University, Melbourne, Professor of Mathematics Education at King's College, London and Director of BEAM Education, London. In 2006/07 Mike was distinguished visiting scholar to the 'Math in the City' project, City College, New York, and in 2011 he was awarded the Claude Leon Foundation position of Distinguished Scholar and Visiting Professor at the University of the Witwatersrand. He was recently elected President Designate for the UK's Mathematical Association. His talk was entitled: "Quality teaching: an under-researched imperative?" He also ran a workshop entitled: "Qualitative data analysis: from codes to themes".



Prof. Mike Askew from the University of the Witwatersrand, previously from Monash University, Australia.

Piet Ankiewicz is currently head of the Department of Science and Technology Education in the Faculty of Education, University of Johannesburg. Prof. Ankiewicz originally trained as a Physical Sciences teacher, before becoming a Deputy Director of Education Policy for science education as well as technology education at the former Department of National Education, and a science teacher educator at the Faculty of Education at the then RAU. Due to his exposure to technology education at the former Department of National Education, he also took it upon himself to establish technology education at university level, and then became involved mainly in the teaching methodology of technology education as well as research in the broader field of technology education. His research interests include the implications of the philosophy of technology for technology classroom pedagogy, teacher education and STS studies.



Prof. PJ (Piet) Ankiewicz from the University of Johannesburg. His talk was entitled: “The affordances of the philosophy/nature of technology for diversity in technology education”. He also ran a workshop on: “Using a stage model as organisational framework to develop technological procedural knowledge through practice”.



CUT HOSTS ASTRONAUT CANDIDATE FOR THE 100 MARS ONE PROJECT

The Faculty of Health and Environmental Sciences hosted a public lecture in which Dr Adriana Marais, a renowned speaker at academic, corporate, educational and public events, presented a lecture on the prospects of taking an exit journey to Mars.

Dr Marais is a theoretical physicist, Head of Innovation at SAP Africa and aspiring extra-terrestrial who believes that humanity has reached a turning point as science and technology are developing at an unprecedented rate and the expansion of a living space beyond the outer limits of the earth is within reach.

In her public lecture, she spoke about her research in quantum biology, the origins of life, the technology required to sustain terrestrial life on Mars, and the various projects aimed at sending human missions there. She described how the establishment of such a project, and the potential discovery of evidence of life on Mars, would be some of the most profound contributions of science to humanity. She also tackled big questions such as where we come from, how life emerged on earth, where water comes from, where we are going and why she wants to go to Mars.

In unpacking her lecture, Dr Marais said that, as humans, we live in an unprecedented era where we have more information at our fingertips than ever before. We are unique in terms of creating knowledge and data, and we are storing information at a capacity that is both wondrous and extremely inundating, which she said can be terrifying at times, not only in the history of humanity, but also in the history of the planet.

She stated that life is the most mysterious phenomenon ever encountered and it is also tricky to study life as a living system. “One of the very crucial developments in understanding terrestrial life is understanding that all living systems on earth contain DNA. Life on earth is a one big interconnected system and we are all interdependent. The air we breathe comes from the photosynthetic organisms, and we are a beautiful living network,” she said.

She mentioned that water has been facilitating life from the beginning, but from a scientific perspective, how life emerged on earth is still not understood. “My favourite theory in terms of how life may have arrived on earth is called panspermia. It is the theory that life on earth may have been delivered to the planet by a meteorite, which may have contained fungal spores known to be able to survive journeys through space in a vacuum at extremely cold temperatures. There is no consensus from a scientific perspective on how life on earth began, but what we do know is that life on earth is abundant and can be seen from space. Water is an entrancingly important molecule for life, and it may have even facilitated the formation or origins of life on whichever planet it first emerged on.”

Dr Marais mentioned that everyone is a decedent of some brave ancestor who has made a one-way trip. “Assuming that none of us is still living in the Central Eastern Africa where homo sapiens first emerged, I think the next step by humanity will be ancestors of future generations who will make one-way trips off the surface of the earth.”

She further spoke about the Curiosity rover that has been taking videos and images and sending data for public viewing and research purposes. The information collected is used to research Mars based on the radiation levels, which pose potential health risks, the sunlight disposal for power and analysing the composition of the sand. “With all this data, the first settlers on Mars will have more information about their destination.”



At the public lecture: Dr Adriana Marais, 100 Mars One Project astronaut candidate in the running receiving a token of appreciation from the Dean of Health and Environmental Sciences, Prof. Samson Mashele.

“We are living in a unique era and technology is happening faster than ever before. We have access to the sum of human knowledge, and we can watch the grandest adventure, not only in the history of humanity, but also in the history of life on earth. It has taken about 4.5 billion years to get the earth to this day and point where we are discussing potential missions to live on the surface of Mars.

Asked about survival methods on Mars and how they will overcome other risks that come with the trip, she said that all skills required for survival are there but basically they will have water management systems in place, grow their own food, using precision farming systems, extract ice from the sand, collect water and recycle it, use solar power for heating systems, use the oxygen that comes from the water extraction for breathing, live underground for radiation and sun protection and also use 3D printing to build most of the components that will keep them running on the planet and to create new pieces. “We need a perspective shift in terms of how we are using the technology here on earth. We already know what to do, but I do not believe we are doing it fast enough and perhaps, it would take demonstrating on how we can survive in a desert with negative 50 degrees and an atmosphere filled with radiation. If we can live there and be happy, then I believe there is no longer an excuse for poverty on earth.”

Dr Adriana Marais is one of the 100 Mars One Project astronaut candidates in the running to move to the red planet in the next decade. The Mars One project is to send humans to Mars on a one-way ticket. Willing to take a one-way trip off to Mars, she believes that people should not live in fear and must learn to appreciate everything no matter how small. She also said that she is proud to be one of the people who will be bringing the life to Mars and is confident that the skills and training acquired for the team will help them survive against all odds. “We are unique as being knowledge creators and our future cannot be confined to earth. The reason why I want to go to Mars is simple: The allure of the unknown is far more powerful than the comfort of the known,” she concluded.

INTELLECTUAL PROPERTY AND TRANSFER OF TECHNOLOGY: SUMMER SCHOOL

The CUT launched the 10th Summer School on Intellectual Property and Transfer Technology. The summer school began on 26 November and ended on 7 December 2018 and was hosted at CUT in partnership with the World Intellectual Property Organization (WIPO), the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industry (DTI), the National Intellectual Property Management Office (NIPMO) of the Department of Science and Technology as well as the Japan Patent Office (JPO).

The main objective of the Summer School was to provide an opportunity for university students and young professionals from the continent to acquire a deeper knowledge of Intellectual Property (IP), and how it can be used as a tool for sustainable development, as well as the role of WIPO in the administration and the provision of global IP services. The Summer School was bound to have a high impact with regard to the protection of IP on an international scale for CUT innovators, exposure to the international nature of IP protection and the interface between IP and other disciplines.

The two-week training, which was divided into nine interactive sections, was an international event that was attended by speakers from all over the world. A broad scope on various topics was covered and about 20 renowned experts and specialists from academia, government and industry made presentations and participated in debates on the issues



WIPO Summer School attendees from different countries who came not only to broaden their knowledge of intellectual property and technology transfer, but also to network and interact with one another.

The programme consisted of lectures, case studies, simulation exercises and group discussions on selected IP topics, with an orientation towards the interface between IP and other disciplines. Certificates of participation were awarded to participants who successfully completed the programme requirements.

In his address, Prof. Henk de Jager, Vice-Chancellor and Principal, said that hosting a prestigious event such as the WIPO Summer School brought new vigour to intellectual property (IP) development in the region and its use as a tool for sustainable development. He said that the CUT sought to consolidate its uniqueness and comparative advantage and to contribute substantively to addressing the developmental needs of the Free State Province, the Central Region of South Africa and the whole African continent. “CUT is focused on quality education, applied research and innovation in the science, engineering and technology space. The days of producing graduates to become job seekers have passed. We need to produce graduates with an entrepreneurial flavour who will be the new young minds that will be able to promote the economy.”

Dr Nompumelelo Obokoh represented Mr Rory Voller, the Commissioner: Companies and Intellectual Property Commission (CIPC). In relaying his message, she said that through the collaborative partnership with NIPMO and WIPO, the Summer School was rapidly being recognised as an effective means of empowering students to build their knowledge of Intellectual Property with the key focus being on the transfer of technology.

“It is our strategic goal to contribute to a knowledge-based economy and competitive local industry by supporting the International IP system and to promote local innovation and creativity by maintaining an accurate and secure registry of patents, designs, film productions and creative works. I am confident that the WIPO Summer School will provide you with a platform to engage and acquire specialised knowledge to help you add value in today's technology-driven world.”

Mr Saadallah Sherif, Executive Director, WIPO Academy Geneva, Switzerland, Mr Mmboneni Muofhe, Deputy Director-General: Technology Innovation; Department of Science and Technology, Pretoria, South Africa and Mr Yasushi Naito, Counsellor Head, Embassy of Japan in South Africa, Cape Town also sent their messages and wished participants success in their endeavour.

The WIPO Academy is a specialised entity for intellectual property training within WIPO. During the last year, over 45 000 participants benefited from the WIPO Academy's programmes. The Academy delivers its training and educational programmes in collaboration with IP offices and other governmental entities, universities, educational institutions and international organisations. In total, it has collaborated with some 50 institutions worldwide. A record number of 193 countries have taken part in the WIPO Academy programmes with beneficiaries coming from all geographical regions of the world. The WIPO Summer School programme is part of our work to promote a deeper and more informed understanding of the functioning of a modern and balanced IP system which could effectively be used to encourage economic, social and cultural development.

Mr Yasushi Naito, Counsellor Head from the Embassy of Japan in South Africa, Cape Town, said that Japan had established the Japan Funds-in-Trust for Africa at the WIPO in 2008, during TICAD IV. The Trust funds for Africa are provided to support capacity building in the field of industrial property. The main purposes of the Trust funds for Africa are to raise awareness on the importance of the intellectual property systems; to support countries in establishing and enhancing laws and organisations related to industrial property; and to develop human resources who are involved in making use of industrial property rights. "As support for this summer school organised by the Trust fund for Africa, Japan has awarded a scholarship annually since 2013 to 10 selected students. This is one of the initiatives of implementing the commitment we made in 2008," concluded Mr Naito.

THE 4TH INDUSTRIAL REVOLUTION AND CIRCULAR ECONOMY TASKFORCE LAUNCHED

On 17 September 2018, the Central University of Technology, Free State (CUT) launched the 4th Industrial Revolution-and-circular-economy taskforce to prepare the institution for a rapidly changing world.

Prof. Henk de Jager, Vice-Chancellor and Principal, said that the reason for launching the task force was to prepare the institution for the 4th Industrial Revolution. He mentioned that the task force would specifically focus on identifying areas that should be addressed to prepare for IR and CE, develop a roadmap of broad issues and timelines, develop a budget and mobilise funds.

“It is important for us to lead the region and to take a proactive step in driving the 4th Industrial Revolution and it is for that purpose that we should think out of the box, reposition and realign ourselves with the Sustainable Development Goals (SDG) and technologies within the revolution.”

At the launch, Prof. Seeram Ramakrishna, one of the world's most influential scientists, delivered a presentation on the Circular Economy and 4th Industrial Revolution, giving practical examples from Singapore.

He said that the amount of resources humans are presently consuming, especially over the past 50 years, exceeds what was consumed by the rest of humanity that lived on planet earth. “Many countries are trying to move away from the linear economy of using products then throwing them away, causing a variety of waste to pile up. Singapore has moved to the concept of the circular economy which is to ultimately have zero waste. This is an ideal concept but difficult to achieve. The whole vision is to mine once, produce a product and use it in every possible way so that the waste is zero or minimum.”

He also spoke about the 4th Industrial Revolution and said it is all about finding ways to improve the efficiency, productivity and value for the investment. “It is a very broad term defined as a concept of robots, artificial intelligence, automation, internet of things, machine learning, computing, 3D printing and nanotechnology. These have a transformative effect on the way products are designed, made and delivered and the services to the people, so the business models are changing and so is the economy. This is why particularly the 4th IR is prominent in so many countries. Singapore alone has invested 5 billion dollars. The machines learn how the humans behave and assist to be more productive and efficient human beings. These technologies are moving towards making every step of human activity more efficient and productive.”

When speaking about the drivers and the combination of the 4th IR and the circular economy, he said that people no longer want to repair, they use and throw away, and that is what generates e-waste, which is one of the fastest accumulating types of waste in the world. “We are now moving in the 4th IR technology of gen robots and trying to apply them to sort this e-waste automatically. There are other IR technologies like sensors where you aggregate the type of waste being piled up.



Prof. Seeram Ramakrishna, one of the world's most influential scientists, presenting the 4th industrial revolution and circular economy.

There is a term called remanufacturing: after service life, components are remanufactured using technologies like 3D printing, which is a similar technology to that which you have at CRPM. I think for SA remanufacturing is extremely important and relevant because there are a lot of industries.”

He mentioned some of the technological advancements and devices used in Singapore such as smart bins, converting food waste to energy, solar energy, designing buildings with wood, automatic cleaners, smart toilets and robots.

The 4th Industrial Revolution technologies provide a means for realising circular economy vision which essentially embeds all the United Nations Sustainable Development Goals (SDG). The SDG are tightly linked to the circular economy concepts, which can only be realised by applying 4th Industrial Revolution technologies. There is a new ranking of universities coming up, focusing on SDG, and he hoped that CUT will appear strongly.

Members of the task force were selected, based on the faculty's contributions. They are Mr Watson Manduna, Prof. Moosa Sedibe, Prof. Deseré Koko, Prof. Herman Vermaak, Prof. Laetus Lategan, Dr Gary Paul, Prof. Muthoni Masinde, Mr Gcobane Quvile, Prof. Alfred Ngowi and Prof. Seeram Ramakrishna.



From left: Prof. Henk de Jager, Vice-Chancellor and Principal, Prof. Alfred Ngowi, Deputy Vice-Chancellor, Research Innovation and Engagement; Prof. Seeram Ramakrishna, CUT Alumni and Professor of Mechanical Engineering and Bioengineering: National University of Singapore; Prof. Muthoni Masinde, HoD: Information Technology, Prof. Laetus Lategan, Director: Research, Postgrad Studies, Mr Leolyn Jackson, Director: International Office, Prof. Samson Mashele, Dean: Health and Environmental Sciences, Prof. Herman Vermaak, Dean: Engineering and Information Technology and Mr Silus Newaku from Namibia University of Science and Technology (NUST).

CUT ACADEMICS AMONGST THE NSTF-SOUTH32 AWARDS FINALISTS

The CUT Centre for Rapid Prototyping and Manufacturing (CRPM) recently participated in and won the Innovation Award: Corporate Organisation category for innovations and research and/or development at the 21st annual National Science and Technology 2018/2019 NSTF-South 32 awards, also known as the 'Science Oscars' of South Africa.

The prestigious event was held on 27 June 2019 in Gauteng. The awards were celebrated along with over 600 guests and more than 50 different organisations from the broader community. The CUT-CRPM team forms part of the cream of the crop of the Science, Engineering and Technology (SET) community.

The university is proud of the CRPM, which won the 2018/2019 NSTF Awards. This award is based on many years of investment that the CUT has put into the CRPM. This Innovation-Corporate Organisation Award was given to the CUT in recognition of its distinction in leading additive manufacturing (AM) in the higher education sector in Africa and the pivotal role it is currently playing within the medical field. Through this, the university will continue to provide its partners with exceptional tools and solutions to maintain a lead in 3D printing technology and to bring about social and technological innovations in the country.



At the gala dinner, Dr Gerrie Booysen, Director: CRPM (centre), received the prestigious award on behalf of his team of engineers.

The NSTF Awards were established in 1998 as a collaborative effort to recognise outstanding contributions to SET and innovation by SET-related professionals and organisations in South Africa. This includes experienced scientists, engineers, innovators, science communicators, engineering capacity builders, and organisational managers/leaders, as well as data and research managers.

The university currently hosts the Research Chair in Medical Product Development through Additive Manufacturing (3D printing technology), an initiative intended to advance South Africa's research outputs and innovations in areas that are crucial to our national innovation strategy. The research chairs are tenable at universities and research agencies that are deemed to be leaders in selected fields, such as the CUT in additive manufacturing and 3D printing technology. This is a highly competitive initiative amongst all South African universities and research agencies.

Hosting of the Research Chair by the CUT is just one more achievement to add to its long list of achievements. Since 2015, the university has created new platforms through additive manufacturing (AM); allowing staff and students to open up new ideas that come with this technology. The CRPM's goal is to create safe environments for medical practitioners to share their ideas and to form a consortium between doctors and the CUT's product development centres to drive development.

CUT CRPM SCOOPS THE MOST INNOVATIVE LOCAL BUSINESS AWARD

The Courant Newspaper in collaboration with the First National Bank held the Best of Bloemfontein Breakfast Awards on 18 October 2018, to acknowledge and recognise the best deserving businesses and institutions in Bloemfontein. Amongst the recipients was the CUT-CRPM team led by Mr Gerrie Booysen in the category of the Most Innovative Local Business in Bloemfontein.

The CRPM is a research centre within the CUT, offering a 3D printing service to industry, academia and postgraduate students. Established in 1997 as part of a research initiative, the centre has advanced dramatically in making an impact and changing the lives of ordinary people around the country through applying innovative technology. Internationally, many reports showcase the benefits of 3D printing in healthcare. Aspects like reduced theatre time using 3D printed implants, cutting/drill guides and pre-operative planning models are elaborated upon. The reduced theatre time has a ripple effect on faster patient recovery time.

Over the past ten years, the primary focus has been on 3D printing of patient-specific implants and devices, which led to the first SA 3D-printed hemi-mandible implant in 2014. The CRPM has since received ISO 13485 certification in 2016 for design and manufacturing of patient-specific implants by means of 3D printing, making it the first university on the African continent to obtain this standard.

3D printing is a process of joining materials to make objects from 3D data, usually layer upon layer, as opposed to subtractive manufacturing methodologies. A design of the product is created and translated into data and loaded on the 3D printer. The product is “grown” using various powders, i.e. nylon or titanium. The powder is then spread on a powder bed where a laser melts the first layer of powder according to the data which has been programmed onto the printer. This process is repeated until the design has been manufactured into an actual product.

INAUGURAL AFRICAN ADVANCED MANUFACTURING INNOVATION AWARDS: CUT ACKNOWLEDGED

Several organisations leading South Africa into the 4th Industrial Revolution were recognised at the inaugural African Advanced Manufacturing Innovation Awards held at the Tramways in Port Elizabeth on 7 November 2018. The awards were presented to 25 organisations in six categories, according to the organisers, as a means to identify, promote and reward innovation in the advanced manufacturing and composites industry, including 3D printing, robotics and automation.

CUT's own Mr Gerrie Booysen, Director: CRPM, and Prof. Willie du Preez were amongst the nominees who scooped the awards at the prestigious ceremony. Mr Booysen received the Gold Award for Scholarly Impact in Advanced Manufacturing for the work done by the Centre for Rapid Prototyping and Manufacturing (CRPM) around patient-specific titanium printed facial implants, while Prof. Willie du Preez received special recognition for Scholarly Impact in Advanced Manufacturing for his lifelong contribution to Advanced Manufacturing. Working with state hospitals and doctors, the high-tech work of the university has

transformed the lives of hundreds of patients with muscular-skeletal irregularities.

To be considered for the award in this category, winners had to demonstrate contributions to R & D in AM, provide proof of published articles, literature and the impact of this knowledge in the industry as well as demonstrate their contribution pertaining to new and fresh thinking, models and paradigms.

It is noteworthy that South Africa is the first country to produce 99.9% pure platinum and the Central University of Technology, Free State (CUT) was instrumental in developing the 3D printing parameters to process this pure platinum powder.



Mr Gerrie Booysen accepts his award from Prof. Sibusiso Moyo, Deputy Vice-Chancellor: Research, Innovation and Engagement at the Durban University of Technology.

CHANGING FACES CHANGING LIVES: CRPM CELEBRATES YEARS OF INNOVATION AND EXCELLENCE THROUGH 3D PRINTING TECHNOLOGY

The Centre for Rapid Prototyping and Manufacturing's (CRPM) capabilities in the design and manufacturing of patient-specific implants through 3D-printing technology have taken significant strides. For the past four years, the CRPM has been the beneficiary of the Carl & Emily Fuchs Foundation grant to the value of R2,25 million for the Changing Faces, Changing Lives project. Through the project, the lives of many ordinary people have been changed for the better and to date, the centre has designed 17 3D printed implants. On 22 May 2019, the Centre celebrated the impact that additive manufacturing (AM) has made in changing faces and lives through the grant support from the Carl and Emily Fuchs Foundation. Prof. Alfred Ngowi, DVC: Research Innovation and Engagement, said that the Changing Faces Changing Lives project is aligned with the CUT's vision of technological and social innovation. Dr Gerrie Booysen, Director: CRPM, applauded the patients for their bravery, courage, willingness and most importantly, for entrusting their lives to them. He said that the purpose of the 4-year project was to focus on the medical niche and the pool of expertise to improve and better the quality of life not just for state patients but also for private patients where there is a backlog of patients waiting for operations.

Ms Corne Booysen, representative of the Carl and Emily Fuchs Foundation, gave a brief background of how and when the foundation started. She congratulated Dr Gerrie Booysen and his team on their dedication and achievements. "It is always a pleasure to work with people who are passionate and dedicated about making a difference in other people's lives. I am feeling proud about what we are all achieving in the centre of our beautiful country. Congratulations to you and your team."

In her testimony, one of the recipients and car hijacking victim, Ms Princess Moshokane, said, "I lost my teeth, confidence and smile which took me seven years to get back. They were the darkest and most challenging years of my life as I was told that the reconstruction surgery is unaffordable. At the time I was a breadwinner at home, working at a bank as a consultant, so I knew there was no way I was going to get that sum of money. I was devastated and didn't know what to do until I met Prof. Cules van den Heever and through him, I met Dr Gerrie Booysen. I was then told that there was a company in Germany that was interested in funding my surgery. There was hope and I knew that God was on my side. Today I am standing in front of you with a smile and confidence. I no longer hold up my hand to cover my mouth, I'm able to smile again, socialise with people like before and go out with my friends. I am very thankful and happy. I came through a long journey and I want to thank Prof. Cules, Dr Gerrie, and the rest of the team for what they have done for me, I will remain forever grateful."



Mr Skhumbuso Makhoesa is not shy to show off his new ear. He was born with one normal ear, and the other one was underdeveloped. The CRPM team intervened and designed a prosthetic ear, which he wears with confidence.



Ms Princess Moshokane, a victim of car hijacking, who was shot in the face has since regained her smile and confidence, thanks to the Carl and Emily Fuchs Foundation, Prof. Cules van den Heever, Dr Gerrie Booysen, and his team for her facial reconstruction.

CHANGING FACES – CHANGING LIVES: COMMUNITIES BENEFITING FROM 3D PRINTING TECHNOLOGY

A team from the Centre for Rapid Prototyping and Manufacturing (CRPM) at the CUT, in partnership with three Durban surgeons, medical specialists, and Life Chatsmed Gardens Hospital, gave a new lease on life and restored dignity to three Durban patients who had benign tumours that were slowly causing their jawbones to disintegrate and disfiguring their faces. The patients were successfully operated on and received titanium implants which were manufactured at the CRPM. This story was covered by Carte Blanche and broadcast on 9 July 2017.

The CRPM team of experts, led by Prof. Cules van den Heever (CUT Professor Extraordinary in the Faculty of Engineering and Information Technology), played a vital role in the reconstructive surgery through the use of additive manufacturing (AM) technology, also known as 3D printing, in assisting surgeons to plan complicated surgery down to the finest detail; thereby shortening the operating time considerably and mitigating risks of complications due to prolonged procedures which may result in infections, excessive blood loss and exposure to radiation. Through this technology, the CRPM's capabilities in the design and manufacturing of patient-specific implants have taken significant strides and its goal is to expand its wealth of knowledge and research while forming deeper alliances with partners within business, industry and government, and also with medical professionals in private and public hospitals.

The innovative nature of the work requires both medical and technological teams to be present in the operating room. While the medical team performs the surgery, the technical team observes in order to improve the design or process in the next cycle.

According to Dr Vivesh Rughubar, maxillofacial and oral surgeon from King Edward state hospital, this procedure not only changed the way in which the medical community views 3D printing, but also costs much less than traditional jaw implant surgery. "Our past frustrations are over now; the 3D printing technology is the way to go and has reduced the surgical operations that would have otherwise taken us the entire day to perform."



The project research team from CRPM and partners including the Fuchs Foundation and Life Hospital team members.



Prof. Henk de Jager, Vice-Chancellor and Principal (left), Prof. Cules van den Heever CUT Professor Extraordinary in the Faculty of Engineering and Information Technology and Head of Maxillofacial Periodontics Unit based in Bloemfontein, and Mr Gerrie Booysen, Director of the Centre for Rapid Prototyping and Manufacturing (CRPM) (right back) with four patients who benefitted from the 3D printing technology. L-R: Amogelang Rasedimo (baby girl), Thabo Masa, Chevane Lawan and Valerie Taaibos

IMPACTING ON MEDICAL SCIENCE IN AFRICA

The CUT has proudly taken the lead in innovation and technology through additive manufacturing (AM), also known as 3D printing, changing the face of medical science in Africa. The university has proven to be a true university of technology by breaking barriers and sparking innovation in the medical field through this technology. On 23 August 2017, CUT-CRPM invited media houses, partners and investors to create a more interactive session and showcase the ground-breaking work that the university has done to date on medical product development through 3D printing.

Prof. Henk de Jager, Vice-Chancellor and Principal, said that the CUT has made a commitment in its vision to produce social and technological innovations to improve the lives of people and to enhance the socio-economic development of the region. "CUT as a university of the people is playing a fundamental role in addressing social responsibilities and making a difference in people's lives. Today as we are celebrating with our community members and partners within the region, we are proud to say that our university does not merely pay lip service but makes a difference in the immediate environment."



CUT's Professor Extraordinary in the Faculty of Engineering and Information Systems and head of the Maxillofacial Prosthodontics Unit based in Bloemfontein, Prof. Cules van den Heever, displays Mr Chevane Lawan's head model that was developed at the CUT to show surgeons where to place implants for future ears and a positioning device. CRPM played a vital role in collaboratively addressing national priorities in research areas.



Another beneficiary, Mr Chevane Lawan from Kimberley, Northern Cape, was born without ears. His day was made when he received his new prosthesis ear on the morning of the event.

One of the beneficiaries and a living testimony to the fundamental role the institution plays in changing lives of ordinary citizens is Mr Thabo Masa from Botshabelo, who lost his ear in a traumatic situation. Mr Masa said that after healing from the physical trauma, he suffered an emotional one, as he could not accept his loss and could not face the community with only one ear. "I am happy that the CRPM team managed to design a prosthesis ear that fits perfectly. I am no longer hiding under my beanie. I feel confident and normal again and I am very grateful and ready to face the world."

A MAXILLARY FRAME IMPLANT

The patient below presented with a myxoma of the midface. A maxillary frame implant was designed and manufactured by the CRPM in titanium in order to restore facial profile and symmetry. The Carl and Emily Fuchs Foundation funded the prosthesis development. An obturator and dental bar will restore mastication and speech functionality.

This operation took place at Kimberley Hospital Complex and the surgeons were Drs Kobus and Werner Hoek, Dr Cules van den Heever and Dr Cornelius Borstlap. The operation was very successful, and the patient had a follow-up consultation three weeks after the operation. The patient is in high spirits, is able to swallow and has started to speak.



Planning
model



3D printed
titanium implant
after post
processing



Tylor Baker with both colour- and texture-matched external silicone ears.

PROSTHESES DEVELOPMENT THROUGH THE USE OF AM TECHNOLOGY

This life-changing journey started when Prof. Cules van den Heever and Mr Gerrie Booysen were contacted by Dr Estie Meyer to do a presentation on how additive manufacturing (AM) could benefit the Ear, Nose and Throat (ENT) department at Groote Schuur hospital. At the time, Dr Meyer had a case of a boy who had been born without ears, who had asked her for ear prostheses.

Due to steep costs related to a procedure of this nature, the CRPM deemed it fit to discuss this project with the Carl and Emily Fuchs Foundation, towards the design and manufacturing of external prostheses. The CRPM was awarded R2.25m for the period 2016 to 2019 to assist with these patient-specific devices.

Tylor Baker was the first patient to undergo this kind of procedure at the Groote Schuur hospital. The excellently done procedure left Tylor and his family both overwhelmed by emotion and ecstatic at the same time. The team from the CRPM played a vital role in the reconstructive surgery and prostheses development through the use of AM technology, also known as 3D printing. The CRPM made it possible by designing and 3D printing of drill guides and moulds, to accurately place the prosthetic implants and external prostheses which completed the boy's facial features. The prosthetic ears and surgery were sponsored by the Fuchs Foundation to the tune of R62000.

The images give an indication of how Tylor looked before and after the procedure



Positioning mask/moulds 3D printed by CRPM



3D design of patient's skull, soft tissue and positioning mask completed by CRPM



Stakeholders who made it possible for the patients. Front row from left is Ms Baesi Ramodula, CEO: Pelonomi Hospital, Ms Corne Booyens, representative from Carl and Emily Fuchs Foundation. Back row: Dr Gerrie Booysen, Director: CRPM, Prof. Alfred Ngowi, DVC: Research Innovation and Engagement and Mr Gcobane Quvile, CEO: CUTis.

Prof. Henk de Jager, Vice-Chancellor and Principal, recently held a breakfast meeting with the CRPM team to salute and applaud them for their exceptional work in changing the lives of ordinary people across the country and putting the CUT name on the map. Prof. De Jager further acknowledged the team for their hard work, commitment and dedication since its inception in 1997. "The CRPM is a flagship centre that has been recognised around the globe for their innovation and technological excellence and today, I want to thank and appreciate you for the extra efforts and walking the extra mile in all you do. This centre has become the biggest asset in terms of marketing our university. I want to acknowledge you for the outstanding work, for excelling nationally and internationally and promoting the CUT brand in the process."



The project team from the CUT, TIA and Pelonomi who worked tirelessly to bring the dream to fruition for the hospital.

The Centre for Rapid Prototyping and Manufacturing (CRPM) at the Central University of Technology, Free State (CUT) scooped yet another prize at the Fuchs Golden Years Anniversary Project for their medical technology excellence. The foundation introduced a national flagship project for their 50th anniversary, branded “Fuchs – The Golden Years”, to mark this important milestone in its history. The anniversary celebration was held on 1 August 2019.

The Changing Faces, Changing Lives team competed against 11 other top contestants in the Science, Engineering and Technology (SET) community, and were crowned the best overall winners, walking away with the grand prize of R1 million.



Dr Gerrie Booyesen (centre), Team Leader and Director of the CRPM, proud of their achievement as overall winners of the Fuchs Foundation – the Golden Years prize. He is flanked by his dedicated team of engineers.

This accolade follows their recent win of the National Science and Technology Forum (NSTF)- South32 Award, also known as the “Science Oscars” of South Africa, for innovation using 3-D printing to reconstruct the deformed faces of many South Africans from disadvantaged backgrounds. The prestigious event was held in Gauteng on 27 June 2019.

The university currently hosts the Research Chair in Medical Product Development through Additive Manufacturing (3-D Printing Technology), an initiative intended to advance South Africa's research outputs and innovations in areas that are crucial to our national innovation strategy. The hosting of the Research Chair by the CUT is just one more achievement to add to its well-notched belt. Since 2015, the university has created new platforms through additive manufacturing, allowing staff and students to open up to new ideas that embrace this technology.

The Carl & Emily Fuchs Foundation was established on 1 August 1969 (50 years ago) by founders Dr Carl and Mrs Emily Fuchs. The foundation is a private philanthropic institution that makes grants available in order to fund development initiatives nationally within South Africa.



PDTS REALISES CAMINO DREAM FOR FRIENDS

Teamwork made Rensché du Toit and Corine de Jonge's Camino walk possible. Pictured in the back row, from left to right, are Mr Marinus Potgieter, Manager: PDTS; Ms Corine de Jonge; Mr Allan Kinnear, Project Engineer: PDTS; and Mr Katlego Makgeledisa, PDTS Intern. In the front row, from left to right, are Ms Rensché du Toit enjoying her unique, custom-made wheelchair, and Mr Schalk van der Merwe, initiator of the project.

The Product Development Technology Station (PDTS) at the Central University of Technology, Free State (CUT) continues to contribute positively to communities through its social and technological innovations.

The centre played a significant role in realising retired, lifelong friends Rensché du Toit and Corine de Jonge's dream to do the Camino Pilgrim Walk. According to Du Toit, who has post-polio syndrome, and De Jonge, who suffers from Hashimoto's autoimmune disease, they have always wanted to do the walk, but the rough terrains made it almost impossible for a wheelchair-bound person to navigate.

“Without the wheelchair, it would have been impossible. It gave us access to places where it would have been impossible for an ordinary wheelchair to manoeuvre. The concept is excellent for rough terrains and rural areas, and will empower people with disabilities, increase their flexibility as well as mobility. Looking back at where

it all started, I would say I am grateful to the PDTS Team and Mr Van der Merwe for realising our dream. This was a special trip for us, and I am proud to say that we made it,” she said. Walking the Camino is a great achievement that requires much perseverance, courage, and strong mobility. The Camino de Santiago is a 780 km pilgrimage route through Spain, popularly known for its hiking trails and rough terrains.

The PDTS in collaboration with Mr Schalk van der Merwe managed to design and build a three-in-one sustainable wheelchair. Mr Schalk van der Merwe has been wheelchair-bound for 27 years. As the initiator of the project, all that Mr Van der Merwe wanted was a sustainable, multifunctional, affordable, durable, and flexible wheelchair that is suitable for rough terrains and rural areas. “My wish was to have a multifunctional and low-maintenance wheelchair, and I am glad that the PDTS designed a three-in-one special wheelchair that can drive on tough terrain, has a hand cycle that can be connected to it, and a free-wheel version. What is more important, is that it can be made generally available to anyone at an affordable cost.”

The PDTS, however, only had approximately two weeks to design and build the wheelchair before the Camino journey, which took place from 4 to 20 September 2018.

Mr Allan Kinnear, Project Engineer: PDTS, said that although the request was made at short notice, he was delighted that it passed the Camino test. “The fact that this mobile chair overcame some of the obstacles on the route, shows it works perfectly. Our greatest objective was to have a sustainable wheelchair that can be serviced every two years and last a lifetime.” He further stated that the challenge faced in South Africa is not about wheelchairs, but sustainable wheelchairs. “Normal chairs break regularly, and have to be replaced often, and for me, that is not durability,” he said.

Mr Kinnear also mentioned that the product would be further improved, and that possible adjustments would be incorporated according to Ms Du Toit's feedback on the prototype.

Asked about his experience in the project, Mr Katlego Makgeledisa, PDTS intern, said there were many challenges in the making of the wheelchair, but through teamwork, they managed to meet the deadline. “This wheelchair was specifically designed to withstand conditions of walking through the trails of Camino. When we started, it seemed impossible, but once we were done and saw it functional, it was the best feeling ever,” he said.

When asked about the material used and their future plans, the team said that, because normal chairs break regularly and have to be replaced constantly, they opted for custom-made castor wheels, which are more durable.

Although the chair is one of the first prototypes, similar chairs are available in the market. However, they are more expensive, and are only manufactured and sold on request. The centre currently awaits funding to commercialise the product.

CRPM CELEBRATES 21 YEARS OF INNOVATION AND EXCELLENCE, LAUNCH OF DST INNOVATION AND COMMERCIALISATION OF ADDITIVE MANUFACTURING CHAIR

The Central University of Technology Centre for Rapid Prototyping and Manufacturing celebrated 21 years of innovation and excellence in changing and touching the lives of ordinary people in South Africa. Established in 1997 as a centre for commercial work and research using rapid prototyping, rapid manufacturing, rapid tooling and medical product development technologies, the centre currently has ten additive manufacturing (AM) machines, which makes it one of the best equipped AM centres of its kind in the southern hemisphere. The AM technologies opened the possibility to go directly from computer-aided design (CAD) to a physical prototype or model. These prototypes are used by industrial product designers for form and function tests as well as final prototypes before tooling commences.



Proud moments at the unveiling ceremony: partners (from left) Mr Heinrich van der Merwe, Operations Manager at the Vaal University of Technology, Ms Sheryl Pretorius, Senior Manager Client Services at merSETA, Mr Sechaba Tsubella, Acting Director: Advanced Manufacturing Technologies from the Department of Science and Technology (DST) and Prof. Henk de Jager, Vice-Chancellor and Principal.

“The CUT’s innovation drive and value chain is demonstrated through many successful projects, one of which is the CRPM, that serves as an important link between our Innovation eco-system and the external stakeholders. CRPM is a world-renowned centre for its innovations and the impact it is making on society, thus CUT is gaining momentum in its drive to be reimagined as a transformational university and “model” university of technology (UoT) in Africa, impacting on the socio-economic development of the central region, country and beyond.” These were the words of Prof. Henk de Jager, Vice-Chancellor and Principal, at the 21st anniversary of the CRPM held on 18 September 2018.



Prof. Henk de Jager, Vice-Chancellor and Principal, congratulating Prof. Deon de Beer, the newly appointed DST Innovation and Commercialisation of Additive Manufacturing Chair (DST ICAM Chair) at the DST ICAM Chair Launch and CRPM 21st anniversary celebration.

“As we celebrate this milestone and years of hard work, commitment and determination, we are also launching the first DST Innovation and Commercialisation of Additive Manufacturing Chair (DST ICAM CHAIR).”

Prof. De Jager also stated that strong partnerships are needed to build external networks as well as internal cross-unit networks to generate ideas from new connections. “You cannot take the university to the next level without partnerships. CUT is a university of the people and the region and has been forthcoming with encouraging idea generation and building strong external networks. In the space of innovation ecosystems, we have to join hands and not compete against one another,” he said.

Upon taking the audience through the 21-year journey of the centre, Mr Gerrie Booysen, Director: CRPM, shared the impact made using 3D technology in changing the lives of ordinary people in the region and the country. He presented some of the successful cases dating back to 2015, when it produced about 3614 prototypes, and described how the centre had grown immensely, producing more than 13 000 components annually.

He further mentioned that the centre had been awarded an international certification (ISO 13485) in 2016 and is the only manufacturer of titanium implants on the African continent, as well as the South Africa Research Chair Initiative (SARChI) for medical product development through additive manufacturing. “I am really excited about our growth, the team efforts and dedication, support from our management and council, and our incredible partners and sponsors for making us realise this dream. All these achievements will open the doors for commercial manufacturing of medical devices here in South Africa and also offer us global export opportunities.”

He said that the centre is always looking for new ways and methods of doing things, and it is currently developing custom-made designs of temporomandibular joints with cutting guides. “In the past, we used to have just a fixed implant and now, we will also have moving components, and this is our current big research project,” he concluded.

Ms Sheryl Pretorius, Senior Manager, Client Services: merSETA, indicated that the future of AM looks bright. “In the future, 3D printing will position itself more prominently in the manufacturing landscape. The time is now where industry needs to be capacitated on the relevancy of adjusting to 4.0 technology. We entered a partnership with the CUT to benefit the merSETA stakeholders as well as the CUT and more importantly, it will be a benefit to the merSETA sector and South Africa as a whole.”

Mr Jaco Hart, industry partner from the CSIR, spoke about the impact of additive manufacturing products and the involvement of CRPM in assisting them in producing CORONA cameras through additive manufacturing. He applauded the CUT for their consistency and excellent service.

Furthermore, the Department of Science and Technology in collaboration with merSETA launched the first DST Innovation and Commercialisation of Additive Manufacturing Chair (DST ICAM CHAIR) under the leadership of Prof. Deon de Beer.

The DST ICAM CHAIR comes in three years after the South African Research Chairs Initiative (SARChi) Chair launch in 2015 by the Department of Science and Technology and the National Research Foundation of South Africa. The launch is a response to the requirements of the industry and science to improve research and innovation capacity of public universities to produce high-quality postgraduate students. Led by another CUT professor, Ihar Yadroitsau, the SARChi chair is a great recognition for the university as a leader in medical product development in South Africa.

The newly appointed DST ICAM CHAIR, Prof. Deon de Beer, said that the value proposition of the Chair in Innovation and Commercialisation of AM is to drive technological outputs from conceptualisation through implementation to full commercialisation, and to develop and lead a team of industry collaborators, researchers, and postgraduate students to resolve challenges of commercialising AM products and processes. The outputs are aimed at benefiting the AM community and all relevant industry sectors.

“I feel honoured to have been selected as incoming Chair and privileged to be able to dedicate my time and efforts to support innovation and commercialisation of AM. It is my sincere intention to develop a collaborative spirit and pull the best national expertise and resources in the field. Successful outcomes will be beneficial to the whole industry and will ensure the growth of our manufacturing industry. I would not be doing my job if I do not seize today's opportunity to remind you all that there are significant collaboration and investment opportunities available. I would like to thank the CUT executive management for the strategic vision, support and readiness for having acted innovatively. I would also like to convey my sincere gratitude to our partners, DST, VUT and merSETA for the collaborative spirit and support, and the South African additive manufacturing community for continuous collaboration and positive response received.”

Mr Sechaba Tsubella, Acting Director: Advanced Manufacturing Technologies at DST, applauded CRPM for reaching a hearty 21 years and also captured the journey of the DST around AM, “I am happy to announce that the DST through CPM has sponsored many post-master's students who will form our future scientist and engineer body so that we have the critical skills base when this industry takes off.” He also congratulated Prof. Deon de Beer on his new position as the DST ICAM CHAIR. “We believe that this technology has immense potential to create industries and opportunities for all of our people, create the competencies and develop the skills base to maintain and develop this industry further.”



Mr Letsoalo Letsoalo, Project Engineer at the CRPM (right) showcasing some of the prototypes produced to the delegates from Botswana International University of Technology during the centre tour. The guests are from left: Prof. Ochieng Aoyi, Prof. Edward Lungi, and Dr Mmoloki Mangwala.

He also thanked the CUT, NRF, DST, THRIP, industry and corporate sponsors for making this dream come true. Other partners include Pelonomi Hospital, EOS, Materialise, the Department of Science and Technology (CPAM project), the National Research Foundation (SARChi Chair), the Technology Innovation Agency (TIA), the Fuchs Foundation, the Council for Scientific and Industrial Research (CSIR), the Central Analytical Facilities (CAF), PDTS, CUTis, Medical Professionals, the Life Healthcare group, the FS Provincial Government, the FS Department of Education, the FS Department of Health, DESTEA, the FS

Department of Public Works, the Department of Trade and Industry, the IDC, Botswana International University of Science and Technology, Botswana Institute for Technology, Research and Innovation, Rapid 3D, Metal Heart, LHA, FDC, MRC, Universitas Hospital, SEDA, SqwidNET, Sefako Makgatho University, the UFS, VUT, NW University, the University of Johannesburg, the University of Pretoria, Stellenbosch University, the University of Namibia, the National University of Singapore, SABS, SAAB, Grintek Defence, Denel, Bloemfontein Chamber of Commerce and Industry, SAMTI, South African Airways, Gauteng Tooling Initiative, UV Tooling, CSAR, Gold Yard, Rapdasa, Phatsoane Henney Attorneys and the media houses.



Mr Gerrie Booysen, Director: CRPM; Ms Christel Basson, Mahareng Publishing General Manager; Mr Stephen Gooch, FNB Free State Regional Head; and Mr Johan Els, Operations Manager, Centre for Rapid Prototyping and Manufacturing (CRPM).

Photo Credit: Pierce van Heerden, Courant



CRPM EXHIBITING AT ARAB HEALTH 2018 IN DUBAI

Mr Gerrie Booysen, Dr Kobus van der Walt and Mr Letsoalo Letsoalo attended the Arab Health Congress which took place from 29 January to 2 February 2018 at the International Convention Centre in Dubai. Arab Health is the second largest medical exhibition in the world with more than 100 000 delegates attending each year.

The CRPM was approached by the Medical Device Manufacturers Association of South Africa (MDMSA), which is an association that brings companies that produce medical devices together in South Africa, to exhibit at the trade shows. The MDMSA is supported by the Department of Trade and Industry to promote local development of medical devices and to advertise the services of the companies internationally. The CRPM applied for funding support from the MDMSA to attend the Arab Health Congress and they kindly agreed to cover the flight and accommodation costs of Mr Letsoalo. The MDMSA also covered the cost of shipment of the CRPM's exhibition material to Dubai as well as daily shuttle costs between the hotel and pick-up and delivery to the airport for the three staff members of the CRPM. The CRPM's exhibit formed part of the larger MDMSA pavilion at the congress.

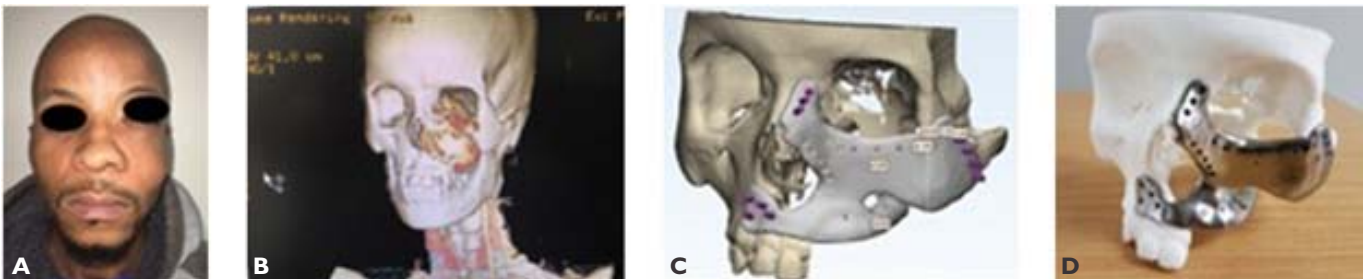


This was the first time that the CRPM had the opportunity to exhibit their services in custom-made medical device design and manufacturing internationally.

Exhibiting at the show was considered very worthwhile with significant interest shown in the services of the CRPM by attendees and a good number of business opportunities were discussed. Around sixty leads were generated during the 4-day event.

The CRPM team would like to express their sincere gratitude toward the MDMSA for the opportunity to exhibit as part of the South African pavilion at Arab Heath 2018 and for funding support from DTi to cover the costs of attendance of Mr Letsoalo. Thank you also to the Department of Science and Technology funded Collaborative Programme in Additive Manufacturing for covering the costs of Dr Van der Walt to attend the 3D printing conference, flights and accommodation. A special word of thanks also to CUT's Advancement and Marketing Department and CUT's International office for contributing to the costs of attendance of Mr Booysen.

Medical case studies: Ossifying fibroma: this patient presented with an ossifying fibroma, a slow-growing benign bone-producing fibrous tumour of the upper jaw. A patient specific titanium implant (designed and manufactured at CUT) with titanium screws (KLS Martin) will be placed in the defect, followed by meticulous tissue closure.



- A - Patient before the operation.
- B - 3D rendering of tumour.
- C - Proposed 3D design of implant.
- D - Titanium 3D printed implant fitted to pre-operative planning model.

THE CARL AND EMILY FUCHS FOUNDATION

In an endeavour to continuously improve quality of life, the CRPM applied for funding from the foundation. A grant of R 2 250 000 was approved and will be rolled out over a period of 4 years, starting in 2016. The foundation has fulfilled its obligation of releasing 2 tranches to the amount of R600 000 for 2018 financial year.

The objectives of this project are to improve peoples' lives with cutting-edge technology. By making use of 3D printing technology, the CRPM can design and manufacture patient-specific implants, surgical guides and external prostheses. Some of the outcomes that the CRPM expects to see from this project are fully documented case studies showing patient and clinical advantages of making use of 3D printed pre-operative models to shorten operation time, which in turn will lead to faster recovery time for the patient. The CUT has been co-funded with R150 000 and Wohlers Associates (USA) with R100 000 to assist patients in cases where tumours are removed, and no reconstruction is done.

PRODUCT DEVELOPMENT TECHNOLOGY STATION (PDTs)

Wheelchair Rugby Development Programme

The PDTs, together with Jared Macintyre, has started developing a wheelchair rugby development programme for disabled athletes enrolled in schools in Bloemfontein. Wheelchair rugby (WCR) is a team sport for athletes with physical disabilities that is practised in forty (40) countries around the world. WCR allows persons with most disabilities to compete even against abled-bodied persons at the same level of performance.

The main problem hindering the growth and development of this life changing sport in developing countries is the high cost and availability of these wheelchairs. There are currently no South African manufacturers of these wheelchairs, which are imported at a cost of about R120 000 each. Due to the financial pressures already on the families that have a child with a disability, there are no financial means to enable the child to participate in a sport specifically for persons with disabilities. The implication is that these people tend to have less opportunity for participation in recreational and social activities, which leads to exclusion from friends and the community. By lowering the cost of the wheelchairs, a development programme can be started in local schools for persons with disabilities in South Africa. Mr Jared Macintyre and the PDTs started an initiative to manufacture rugby wheelchairs at an eighth of the imported cost. A pilot project has been done that entailed creating a Wheelchair Rugby (WCR) team at Tswelang School. This pilot project proved that the concept was viable, and now the PDTs is seeking more funding from large organisations to expand the WCR concept so that more schools locally and eventually nationally, can participate.

The advantages offered by this sport are wider than just providing a fun social activity. WCR will give disabled sportsmen the opportunity to participate in a sport on a competitive level, leading to stimulation of the brain in ways not usually provided for, and leading to improved physical health because of the building of stronger muscles. Brain stimulation, building muscle and encouraging fitness are but a few of the many benefits that can be offered to persons with disabilities by the WCR project in local schools. Furthermore, social participation and group cohesion will develop due to the sense of belonging, leading to improvement of communication skills (verbal and non-verbal), conflict management, respect for others and discipline (both on and off the court). Thus, it is clear that WCR holds advantages on physical, psychological and emotional levels that lead to improving the general well-being of persons with physical disabilities in South Africa.





development project has been red in such a way as to empower other d people in Bloemfontein, who are d in actually producing the rugby hairs locally. Empowering people with ies with the knowledge and skills to be manufacture wheelchairs will help to me their state of occupational injustice giving them an opportunity to be part of

the open labour market, leading to feelings of belonging and well-being. This part of the project aims to uplift people in the disabled community by providing skills development and employment. The manufacturers of the wheelchairs will be able to feel needed and valuable in the community. The wheelchairs will therefore be manufactured for disabled athletes by persons with disabilities.

The PDTS has set up a pilot workshop that employs two people, each with a different disability. This workshop can produce twenty (20) rugby wheelchairs per month. The wheelchairs produced in this process will have a huge impact on the wheelchair rugby community. The aim of the project is to grow this pilot into a full-scale factory producing disabled sports equipment by persons with disabilities.

The learners from Tswelang School are already taking part in Saturday morning practices with the Mustangs (Bloemfontein wheelchair rugby team) at the UFS RAG farm. This shows the enthusiasm that they have for the sport and how eager they are to participate on a competitive basis against other people with disabilities. By implementing the pilot project at Tswelang School, stumbling blocks like transport, travelling time, and only practising once a week can be limited and even overcome. The facility is closer to their homes, allowing them to involve their communities in the practice sessions and even competing against able-bodied persons.

Being part of a team drives the individual to greater heights, to become more aware of the challenges in the game, and to work with the game plan rather than just following one's own head and playing only for oneself. Once they are part of a team and enjoying the game, they do not want to disappoint their teammates and try to be the best they can be. When the project is fully implemented and more schools get involved with more teams competing in a league, these benefits will only become greater. To see these people bursting with enjoyment and pride is truly a heart-touching experience.

**Musa Simelane
(Mustangs athlete) – A success story**



Musa Simelane is a former Tswelang scholar, headboy in Grade 7 and a member of the Wheelboks (South African National Wheelchair Rugby Team). Musa has been given the opportunity to represent his country by taking part in wheelchair rugby. The project to further encourage disabled athletes to take part, together with the project to enable other disabled persons to get involved in manufacturing the wheelchairs, will empower persons with disabilities by becoming involved in sport at the highest level, as well as by job creation and skills development. To start off, disabled members of the school will be able to participate in wheelchair rugby at a competitive level, close to their homes to ensure easy accessibility. The project is seeking further funding in order to reach other local schools for persons with disabilities. This will lead to greater well-being and even an inter-schools competition in a WCR league, thus generating future national sportsmen.



QBELL TOOLING

All hospitals have a system in place where patients can call for assistance by pressing a call button. Many of the call buttons in use in South African hospitals offer a range of functions, including a nurse call, adjusting of the bed, and changing the television channel. Patients with reduced motor function (forms of paralysis) however, do not have the dexterity necessary to select or press the correct button to call a nurse for assistance. There is therefore a need for a call button designed for patients with reduced motor function.

The Qbell is a device compatible with existing hospital systems, which will assist weak and vulnerable patients by making it simpler and easier to call a nurse. The aim of the Qbell is to give back independence and security to vulnerable people, even though they are confined to a hospital bed. The applicant and innovator behind the Qbell, Heinrich Williams, came up with the idea when he was left disabled after contracting a bacterial infection in China. With the help of eNtsa and the Nelson Mandela University Innovation Office, the initial R & D was conducted and the technology was developed to the point that several prototypes of the device have been made and tested at local hospitals. The PDTS was contracted to design a 2nd generation QBell, and to manage manufacturing of the tooling and the production of the first 500 sets. The manufacturing of the tooling and production was outsourced to Hanren Precision Engineering, because of their extensive experience in injection moulding tooling.

Description of the Qbell device:

The Qbell device incorporates the following key features:

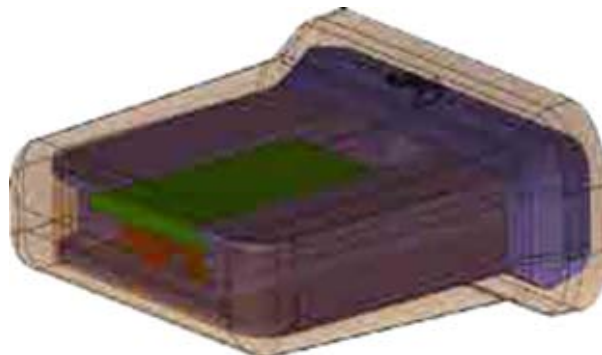
- A simple, large and easy to press button for calling for assistance.
- The force required to press the call button is low enough to allow those with minimal motor control to easily operate the unit.
- The body has an outer surface that does not irritate the user or cause discomfort.
- The unit is resistant to water ingress and has no inaccessible areas, thus making disinfecting the unit possible.
- The button plugs into the existing hospital infrastructure, making it a plug and play solution.
- There are multiple actuators within the unit for redundancy and reliability.
- A power light indicates that the unit is operational.

The device features a rigid plastic housing to accommodate the electronic hardware, and an elastic rubber sleeve to cover the electronics. The rubber sleeve gives the device a comfortable feel and keeps the inner parts clean.

This device will make a massive difference to patients in hospitals. It can be easily operated with minimal pressure and the large activation area allows a patient to use other limbs or appendages to operate the device. The client already has hundreds of orders, and many still to come. This device will make hospital life much easier for injured, handicapped, or disabled patients.



Qbell prototype



Product run and design



PDTs INNOVATES TO IMPROVE CARE FOR PATIENTS AT PELONOMI HOSPITAL

The CEO of Pelonomi Hospital, Mrs Baesi Ramodula and her team launched the QCare System, an innovative bed management system solution that is tailor-made for spinal unit patients at Pelonomi Hospital. She is seen here with Mr Marinus Potgieter, Project Engineer: Medical devices and Deputy Director of PDTs.

The Chief Executive Officer (CEO) of Pelonomi Hospital, Ms Baesi Ramodula, and her team launched the Qcare System, an innovative bed management system solution that is tailor-made for spinal unit patients, at Pelonomi Hospital on 10 October 2019. This solution is the first of its kind in the country's healthcare system. The initiative came to fruition owing to the expertise of a team of engineers from the Product Development Technology Station (PDTs) at the Central University of Technology, Free State (CUT), in collaboration with the hospital, and the generous support of the Technology Innovation Agency (TIA).

Unlike imported medical products that do not always solve our healthcare challenges, this system is a locally developed solution aimed at improving patient care. What is truly remarkable about Qcare, is that it incorporates an ergonomic call button that spinal unit patients can use effortlessly to activate an alarm at a nursing station through a wireless network. A monitor will then display the bed that needs assistance and once the nurse is at the bed, he/she will deactivate the alarm with his/ her RFID staff card. The Qcare software can also report on nurses' response time, effectiveness and utilisation, as well as bed occupancy. It is thus not only a call system, but a bed management system.

“Currently most of the assistive devices in South Africa are imported, and provincial hospitals cannot afford them. Through our work, we are hoping to make a huge impact on the healthcare sector in the region and beyond,” said Mr Allan Kinnear, Project Engineer: Medical Devices at PDTs.

Qcare is just one of the medical assistive devices the team has developed to support Pelonomi Hospital. “I think this is something that sets the CUT apart from others. We are small, but innovative; we bring much wider variety and diversity into the higher education scene. The stakes have changed, and this is how the universities' research work must impact on their communities,” said CUT spokesperson Mr Dan Maritz.

The PDTs continues to make a difference by converting challenges within South Africa's healthcare system into innovative product solutions tailored to African conditions and environments. Thus far, the PDTs has turned R595 000 worth of TIA funding into seven commercially ready medical devices that address the needs of society and industry, one of which is the Qcare system.

Mr Kinnear said that South Africa has pressing health problems and blatant challenges. “From a product development point of view, this is an opportunity for us to create African solutions for South African challenges. Not only will we improve the cost, availability and accessibility of medical devices, but we will also create opportunities for economic growth. If we design devices to function in the toughest conditions that our people face, these devices will function perfectly in first-world countries. Our challenges, when solved, create an exciting opportunity for export, stimulating the manufacturing sector in central South Africa. This was a team effort, and people came together to create something special.”

Ms Ramodula said that the launch of the Qcare system is a milestone for the healthcare sector in general. “This is the first tailor-made innovation for our facility. One thing that I appreciate, is that the system has been designed and produced locally, which makes it affordable for us to manage and maintain. This system is going to assist us in improving our patient care. They have demonstrated how the patients can get the attention of the nurses without screaming for attention. As healthcare givers, we develop a mutual relationship with these patients; they are our families, and we are sometimes limited to reach them, and that is where the Qcare management system comes in. Today we are celebrating a milestone.”

Mr Thabiso Letsebe from TIA's Technology Station Programme, said that these activities are exactly why the PDTs is one of their leading stations in the programme. “We have about 18 of these stations based at various universities. Looking at the two main objectives why the programme exists is for the universities to be more responsive to the needs of the industry, and for the industry to be able to benefit from the know-how of the experts. The station here has done very well to be working with the industry. As TIA, we are very proud, and would like to congratulate the team for the good work.”

CUT PROFESSOR PRESENTS AT WORLD BANK WATER WEEK IN WASHINGTON, DC

Prof. Muthoni Masinde, Head of the Department of Information Technology (IT) in the Faculty of Engineering, Built Environment and IT, was invited to present an innovative drought-forecasting tool, developed by her in 2016, at the renowned World Bank Water Week from 2 to 4 April 2019 in Washington, DC. Leading innovators, thought leaders, partners, etc. attended the conference to link the best global knowledge with implementation, whilst bringing cutting-edge solutions to critical challenges.


The tool developed by Prof. Masinde combines the use of indigenous knowledge (including insects predicting drought) with scientific weather forecasts, to predict localised weather, augmented by Information and Communication Technology (ICT) aids such as artificial intelligence, wireless sensor networking and mobile phones, where all data is fed into computer models to determine the prospects for rain or drought. Prof. Masinde's innovation is a blessing to farmers in South Africa, Kenya and Mozambique, given the fact that drought accounts for 80% of the catastrophes that transpire in the regions.

According to Prof. Masinde, growing up in Kenya experiencing these drought conditions, and seeing how rain patterns impacted on the region, sparked her career interest in meteorology. "My motive is simple: if farmers can predict when and where rain will or will not fall in a specified region, they can plan accordingly with water conservation, planting and irrigation. This is a truly unique innovation, as only the farmers in the regions can know that the knowledge they live with daily can help predict weather patterns."

"The weather and planting information is distributed to the farmers through text messages that can be received on simple and low-cost mobile phones. We have achieved significant progress thus far, and I want to do what I can to support Africa and overcome our challenges. Conferences such as these are perfect global platforms that give me a chance to tell our unusual story," she said.

Prof. Masinde said that the tool is a unique innovation that will help farmers deal with and adapt to the changing climate. "The weather and planting information is distributed to the farmers through text messages in their home languages and can be received on simple and low-cost mobile phones. We have achieved significant progress thus far, and we want to do what we can to support Africa and overcome our challenges. The tool has effectively been implemented in Mozambique, Kenya and South Africa and we are looking to expand into other African countries."

Indigenous knowledge ensures that the system is relevant, acceptable, and resilient. The Information Technology and Indigenous Knowledge with Intelligence (ITIKI) tool further employs three information and communications technology (ICT) tools, i.e., mobile phones, wireless sensor networks, and artificial intelligence to enhance the system's effectiveness, affordability, sustainability, and intelligence.



Prof. Muthoni Masinde demonstrating the simplicity of the ITIKI Drought Prediction Tool app on her mobile phone.

She also believes that the data and language used by the weather bureau may be difficult for ordinary people to understand. "With our ITIKI Drought Prediction Tool, my team can send out SMS reports in many different tribal languages."

She further mentioned that indigenous knowledge is not a mysterious methodology, but lessons that have been cultivated by generations through nature's hints. "In the village where I grew up, we learnt that, if a particular insect appeared in large numbers, it basically signified something. This I learned from my mother, who also learnt from hers. Basically, what we have is a bridge between two knowledge systems – indigenous knowledge and science."

When asked about the future of the ITIKI Drought Prediction Tool, Prof. Masinde said she is looking to expand the programme to other African countries. "We aim for three areas of impact: accuracy, relevance to small farmers, and increasing yields for the farmers." Prof. Masinde was one of approximately 500 delegates to be invited to the flagship event.

ITIKI BRINGS SOLUTION TO DROUGHT CHALLENGES IN AFRICA

As a threatening natural hazard, drought may cause tremendous losses to agriculture, ecosystems, and other sectors. In ancient times, small-scale farmers used to rely heavily on indigenous knowledge to predict the occurrence of rainfall and to make critical cropping decisions, but this knowledge seems to be disappearing due to climate change.

Growing up in Kenya and inspired by her own experience, Prof. Muthoni Masinde, HoD: Faculty of Engineering Built Environment and Information Technology (FEBIT), came up with a drought predicting tool that bridges the gap between indigenous knowledge and scientific knowledge. This drought predicting tool for Africa's small-scale farmers and flagship project called Information Technology and Indigenous Knowledge with Intelligence (ITIKI) was officially launched on 20-21 June 2019.

The drought early warning system forecasting tool integrates indigenous and scientific drought forecasting and uses a mobile application, a web portal, and an SMS service to pull weather information through a network of sensors that monitor weather conditions for farmers. The system is anchored on the novel integration framework called ITIKI and forecasts are available via the ITIKI Smartphone App and USSD service.



ITIKI Team celebrating five years of success. From left is Jason Brown, Administrator and App Developer; Prof. Muthoni Masinde, Associate Professor and Head of Department of Information Technology, CEO and Founder of ITIKI project, and Adeyinka Akanbi, Lecturer, IT and Operations Manager of the project.

NATIONAL WINNER WOMEN IN SCIENCE AWARDS - DR MUTHONI MASINDE



Dr Muthoni Masinde, top researcher, senior lecturer and head of the Information Technology Department, with teaching experience at university level spanning over 16 years, walked away with honours at the annual Women in Science Awards (WISA) for her innovative tool that can accurately predict drought-stricken environments for the farming sector.

The tool taps into African indigenous knowledge of natural disasters and augments it with ICT such as artificial intelligence, wireless sensor networks, and mobile phones. This contribution was recognised by the International Telecommunications Union and emerged in the top five in the Union's Green ICT Application Challenge. Dr Masinde's contribution to drought forecasting solutions for the Free State was recently featured on the BBC World Service and led to the establishment of a unit at the Central University of Technology, Free State (CUT) for research on informatics for drought in Africa. Since she became head of department in 2013, the number of staff members enrolled for or in possession of higher degrees doubled and, through an elaborate research strategy that she developed, the department's research output increased from two to over 15 articles a year. The department's postgraduate enrolment increased from three to over 20 students a year, and for the first time in the history of the department, between 2014 and 2016 she recruited three doctoral students, one of whom will receive his degree in September 2016.

Through an elaborate research strategy that she developed, the department's research output increased from two to over 15 articles a year.



WINNER OF TATA FELLOWSHIP PROGRAMME AND SPECIAL AWARD WOMEN IN SCIENCE AWARDS - MS MPHO MBELE (3)

An elated Mpho Mbele with Minister of Science and Technology, Ms Naledi Pandor at the WISA Awards Ceremony.

Ms Mpho Mbele is a master's student and part-time lecturer in the Department of Information Technology at Welkom Campus. Mpho made CUT proud at the Women in Science Awards when she walked away with Tata Fellowship Programme and Special Award from the Department of Science and Technology for her outstanding academic research abilities on Indigenous Knowledge. Her research was based on integrating local with scientific knowledge regarding environmental pollution caused by mine waste in Lejweleputswa district. She won a sponsorship from TATA to advance her studies further in research, acquire more knowledge,



and publish papers on her work. For this year, Mpho intends buying all the relevant equipment that will allow her to advance her research and the remaining money will go towards her tuition fees next year.

Mpho Mbele was among a new breed of scholars under the leadership of Dr Muthoni Masinde, pursuing her research work on the integration of indigenous and scientific knowledge. Ms Mbele's secret recipe to success is simple: dedication, passion and hard work. Ms Mbele has also been featured in Mail & Guardian, the New Age, City Press, SABC 2, and Soweto TV.

PASSIONATE ABOUT INDIGENOUS KNOWLEDGE – DR NTSOAKI MALEBO

Dr Ntsoaki Joyce Malebo is a National Research Foundation Career Advancement fellow, currently appointed as senior lecturer and head of department in the department of life science at the Central University of Technology in South Africa. Her research interests lie in the fields of microbiology and food safety, particularly the use of plants-based oils as alternatives antimicrobials against antimicrobial-resistant food-borne pathogens.



She is also passionate about research that links the “Western knowledge” with African indigenous knowledge systems. She believes that knowledge should be shared, and skills should be transferred in order to have successful researchers and to empower knowledge holders within communities. Very little indigenous knowledge has been incorporated into mainstream education and research, so her objective is to see indigenous knowledge incorporated into mainstream “research and knowledge”.

She has successfully supervised master's students and currently supervises master's and doctoral students. Dr Malebo has more than 10 publications in international journals and has presented her work at more than 30 local and international conferences. She is married and has two beautiful daughters.

She has been featured in the Department of Science and Technology (DST) African Researchers Booklet, which showcases the role of researchers in supporting African researchers undertaking ground-breaking research to address Africa's challenges and the promotion of science, technology and innovation in Africa.



CUT SCHOLAR BRINGS HOPE TO CANCER PATIENTS WITH HER GROUND-BREAKING RESEARCH

The recently hooded Dr Polo-Ma-Abiele Mfengwana, lecturer and mentor to many, is seen here in class doing what she loves most. She is currently a New Generation of Academics Programme (nGAP) Lecturer in Biomedical Technology at CUT.

As we near 2020, CUT researchers not only continue to lead the way in finding solutions that will sustain the lives of those threatened by dreaded diseases, but they also focus on applied research that responds to societal issues.

The efforts and achievements towards the CUT's strong sense and focus on its vision to produce quality, social and technological innovations in socio-economic development, primarily in the central region of South Africa, and the university's powerful determination to succeed and excel in teaching and learning, have been eminent in the quality of the graduates, scientists and researchers produced by the university.

Seven doctoral candidates graduated at the 2019 Spring Graduation Ceremony, one of which was Dr Polo-Ma-Abiele Hildah Mfengwana, a 28-year-old, passionate researcher, mentor and lecturer from Aliwal North in the Eastern Cape. Dr Mfengwana obtained the Doctor of Health Sciences in Biomedical Technology degree for her ground-breaking research work, "Evaluation of pharmacological properties of traditional medicinal plants used for the treatment of cancer by South African and Lesotho communities," which is envisaged to bring hope to cancer patients and have a significant impact in the pharmaceutical industry. Cancer is a dreaded disease known for an abnormal growth of cells that tend to flourish in an uncontrolled way, and spread to destroy the human body. Researchers continue in their quest to find a cure for cancer, and this was also the case for Dr Mfengwana whose choice of study was motivated and informed by the need for alternative anti-cancer drugs, as current cancer treatments have bad side effects that destroy both normal and abnormal cells.

In her research, Dr Mfengwana evaluated the pharmacological properties of *Asparagus laricus*, *Gunnera perpensa* and *Senecio asperulus*, medicinal plants used by traditional healers in Lesotho and Limpopo for the treatment of prostate and breast cancer, and that are claimed to cure it.

Her study provides an insight into the antibacterial and anti-inflammatory activities of extracts of these plants and demonstrates their safety using current and classical cell biology techniques. She also discovered that *Asparagus laricus* is a suitable

aspirant for future breast cancer chemotherapeutic drug development, due to the selective cytotoxicity thereof on cancer cells, and the safety thereof for normal cells.

"The safety of this plant was proven at a genetic level through the comet assay (a test used to assess if the drug can cause DNA damage when exposed to cells). Upon assessment on kidneys, as well as on liver cells with and without the presence of S9 (a liver enzyme that mimics the metabolism of the liver when it is administered as a drug to the liver), *Asparagus laricus* further proved to have 28 unknown active compounds, which still need to be isolated and studied further before the in vivo investigations and clinical studies can be conducted. It is envisaged that my work will have a significant impact in the pharmaceutical industry," she said.

When asked whether she was the first researcher to discover the magical powers of this medicinal plant, Dr Mfengwana said: "Yes, this was the first discovery, more especially from the part of the plant that I used (leaves), as in most research, roots are used. My research findings are novel and very promising; thus, will definitely lead to drug development after the drug is tested on rats and clinical trials from *Asparagus laricus* active ingredients. Pharmaceutical industries will be able to develop a new breast cancer drug that will not have bad side effects, due to the selectivity of my plant." Her research findings were presented at national and international conferences, and two articles were published in high impact accredited journals. She has also published six articles and a book chapter, and her research presentations have won a couple of awards.

"The responses I have got so far have been positive and have opened doors for me. I now receive invitations to be a reviewer for some international journals, requests to deliver keynote addresses, and have since established collaborations with other South African universities, as novel researchers are now aware of my work, and have shown enormous interest to work with me," she said.



The magical plant: "*Asparagus laricus*", a potential future breast cancer drug that is safe for normal cells

BOU AND CUT FORMALISE RELATIONS



Dr Daniel Tau, Vice-Chancellor of Botswana Open University (BOU) signing towards their brighter future.

On 7 November 2018, the Central University of Technology, Free State (CUT) and Botswana Open University (BOU) signed a Memorandum of Understanding. The agreement establishes a framework for the negotiation of the proposed cooperation between the two Institutions. It includes, but is not limited to, the development of collaborative research projects; the organisation of joint academic and scientific activities, such as courses, conferences, seminars, symposia or lectures; the exchange of research and teaching personnel; the exchange of students; and the exchange of publications and other materials of common interest.

Botswana Open University was developed to meet the growing local demand for tertiary level programmes in Open and Distance Learning (ODL). The university is the result of the transformation of Botswana College of Distance and Open Learning (BOCODOL). The transformation was the actualisation of the recommendation of the Tertiary Education Policy that a comprehensive national distance education institution be established. The institution would develop, offer and accredit university level programmes independently without being tied to collaborating partners.

Prof. Henk de Jager, Vice-Chancellor and Principal of CUT, said that he was personally impressed by Botswana as a government. “As a country Botswana is doing exceptionally well on the African continent in terms of their economy and many other aspects.”

“It is a privilege for us to cement our partnership with BOU. We see ourselves as a real winning university of technology, and we ultimately want to be the leading university of technology in Africa on various aspects and it is because of this drive that we want to collaborate with winners. Any partnership must be a win-win situation, and I believe that strengthening this collaboration will be mutually beneficial. Although BOU is relatively new, I believe we can learn a lot from them and I am looking forward to a long relationship with our new partners.” He also said that building partnerships with SADC regions is a top priority. “We should collectively hold hands as Africans and show the world what we are capable of.”

Dr Daniel Tau, Vice Chancellor of Botswana Open University (BOU), said that their institution was new and that it was the latest addition to the existing 65 open universities globally. He also said that they have ahead of them the huge task of developing foundational systems.

He also mentioned that he was impressed by the CUT as a university of technology, and by the staff members who showed passion and enthusiasm in their work. “There is something attractive about this institution; there are many impressive projects that we have seen and heard about. I have noticed the passion, creativity, innovations and the quality of staff members you have. What we saw in the Faculty of Engineering and Information Technology will definitely take this institution to greater heights. There are many universities that have been around for a long time but are not as innovative and creative as you are, and do not exude the passion and enthusiasm that we have witnessed here. Keep up with the good work.”

He thanked the CUT for the opportunity afforded to formalise their union. “I would like to see tangible collaborations rolling out of this MoU. It is a framework and I believe that with time, there will be more specific agreements around certain specific projects and initiatives.”

CUT AND NHLS VENTURE INTO UMBRELLA PARTNERSHIP

The National Health Laboratory Service (NHLS) is the largest diagnostic pathology service in South Africa with the responsibility of supporting the national and provincial health departments in the delivery of healthcare. The NHLS provides laboratory and related public health services to over 80% of the population through a national network of laboratories.

On 26 October 2018, the Central University of Technology, Free State (CUT) entered into a partnership with NHLS to provide support to research outputs and infrastructure projects with a specific focus on laboratories. NHLS has entered into an umbrella agreement with universities of technology including the CUT.

Mr Welcome Gogoba, Research Compliance Manager: Academic Affairs and Research: National Health Laboratory Service, said that the changing world no longer allows dependence on commodities such as gold, copper and iron but encourages entrepreneurship and innovation. “I think this umbrella agreement changes the tune for us to focus more on innovation. South Africa has always been innovative, but the work has always been kept in publications and not exploited, marketed or commercialised. We have the potential and capacity, and our government is supportive and always ready to allocate us grants.”

He said that the partnership is a way to work smart in exploiting and improving innovation for revenues in the country as well as universities. “This is an opportunity for us to enhance our innovation within the universities by providing the infrastructure in terms of the laboratories. We understand that the universities are key to innovation, and we not only want to innovate but also to protect and become competitors in this field. By engaging in this partnership, we will also be enhancing teaching as well as developing our students to be more innovative, to commercialise their ideas and to develop Intellectual Property (IP).”



Mr Welcome Gogoba, Research Compliance Manager: Academic Affairs and Research: National Health Laboratory Service, Prof. Samson Mashele, Dean of Health and Environmental Sciences and Prof. Carlu van der Westhuizen, Assistant Dean, formalising the partnership with NHLS.

NUIST AND CUT DECLARE INTENTION TO FORM STRONG COOPERATION

On 12 October 2018, Nanjing University delegates visited the CUT to explore possible areas of collaboration and to sign a Memorandum of Understanding (MoU). Representatives from both universities gave brief presentations on their programmes to provide a broader understanding and a clearer picture of their different operations.

Amongst the possible areas of collaboration identified, the two parties agreed to establish a cooperation relation in academic personnel and student exchanges, training and education. They also declared their intention to undertake joint activities including research, preparation of reports, cooperation in development projects, cross-cultural exchanges, working on joint research papers and applying for a Confucius centre in the region.

Currently, NUIST consists of 19 professional schools and is on the list of China's national "Double First-rate" universities and disciplines and is also included in the provincial high-level universities in Jiangsu province



Mr Deng Zhiliang, Vice President of Nanjing University of Information, Science and Technology (NUIST) holding the Nanjing flag with Prof. Alfred Ngowi, Deputy Vice-Chancellor: Research, Innovation and Engagement



From left: Zhangjie Fu, Vice Dean, School of Computer and Software from Nanjing University of Information, Science and Technology, Mr Jinlong Si, Chinese Student Union representative and CUT alumni are listening attentively to presentations of the day by Mr Gerrie Booysen, Director of the Centre for Rapid Prototyping and Manufacturing.



REGIONAL COLLABORATION – A NEW HOPE FOR HEART DISEASES

A regional collaboration between CUT and the University of the Free State (UFS) brings hope to heart disease patients in Africa. CUT and the UFS are embarking on a new collaboration that will provide and advance universal access to cardiac surgical services mainly in Africa, but also to the world in general. A team from the two universities led by Prof. Francis Smith, Head of Robert W M Frater Cardiovascular Research Centre in the Department of Cardiothoracic Surgery at UFS and Mr Gerrie Booysen, Director of the Centre for Rapid Prototyping and Manufacturing (CRPM) at CUT, has developed a new polyurethane heart valve that will help treat rheumatic valvular disease – a disease that continues to affect over two million people in the Sub-Saharan region, China and Latin America. This is seen as the beginning of an exciting phase of collaborative development between the UFS, CUT and Stellenbosch University. For years, doctors across the continent have been battling to come up with solutions for younger patients requiring heart valve replacement, with a choice between a mechanical valve, requiring lifelong anticoagulation therapy, and a biological valve, which does not require anticoagulation. The polyurethane valve is an innovation in the medical field and was made possible by the university's School of Medicine.

This valve does not require anticoagulation and might be an ideal solution for the young African patient. The collaboration in its five-year plan is to deliver a

service to our community through manufacturing of implantable patient-specific prostheses as requested by medical practitioners. The valve has a titanium frame (which is 3-D printed by the CRPM) and then dip moulded using locally designed moulds and an automated dip moulding process developed at CUT. The

project was initiated by Prof. Francis Smit in collaboration with the CRPM at CUT, which specialises in additive manufacturing, while the Mechanical Engineering Department at the University of Stellenbosch will be focusing on computational fluid dynamics and finite element modelling.



CUT CRPM AND TWO BOTSWANA INSTITUTIONS SECURE FINNISH FUNDING TO DEVELOP ADDITIVE MANUFACTURING ECOSYSTEM FOR SOUTHERN AFRICA

The CUT Centre for Rapid Prototyping, in collaboration with the Botswana Institute for Technology, Research and Innovation (BITRI) and the University of Botswana, has successfully secured funding from the Southern African Innovation Support Programme (SAIS).

The SAIS programme is a development initiative that supports the growth of new businesses through strengthened innovation ecosystems and cross-border cooperation. Established in 2011, SAIS has provided capacity-building and funding for networking and knowledge-sharing and has supported projects piloting new mechanisms for enhanced innovation and enterprise development in the Southern African Development Community (SADC).



SAIS 2 Call for Proposals (2018/1/CN) will fund projects under three thematic areas, namely stronger ecosystems, scaling enterprises and inclusive innovations. The consortium of three institutions, the CUT, BITRI and UB, was successful in jointly securing € 150 000 (R2550000) under the stronger ecosystems thematic area.

To qualify for funding, the Project Consortium applying for a grant from the SAIS 2 Innovation Fund must consist of at least two independent legal entities from at least two different SADC member states, of which only one (in this case the CUT) can act as signatory to the grant agreement with the SAIS 2 Innovation Fund. The organisation signatory to the grant agreement with the SAIS 2 Innovation Fund has to be a legally registered entity in one of the five SAIS 2 partner countries, i.e. Botswana, Namibia, South Africa, Tanzania or Zambia.

The goals of the project are to develop a joint additive manufacturing (AM) ecosystem focusing on medical applications to commercialise AM implants and medical devices in SA and Botswana; knowledge transfer from CUT to BITRI and UB, with further joint development to ensure long-term sustainability in the medical AM market; and to expand into AM entrepreneurship and broad-based usage of product design and related AM in Africa for both industrial and medical use. The synergy between the institutions was identified in research and innovation projects.

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