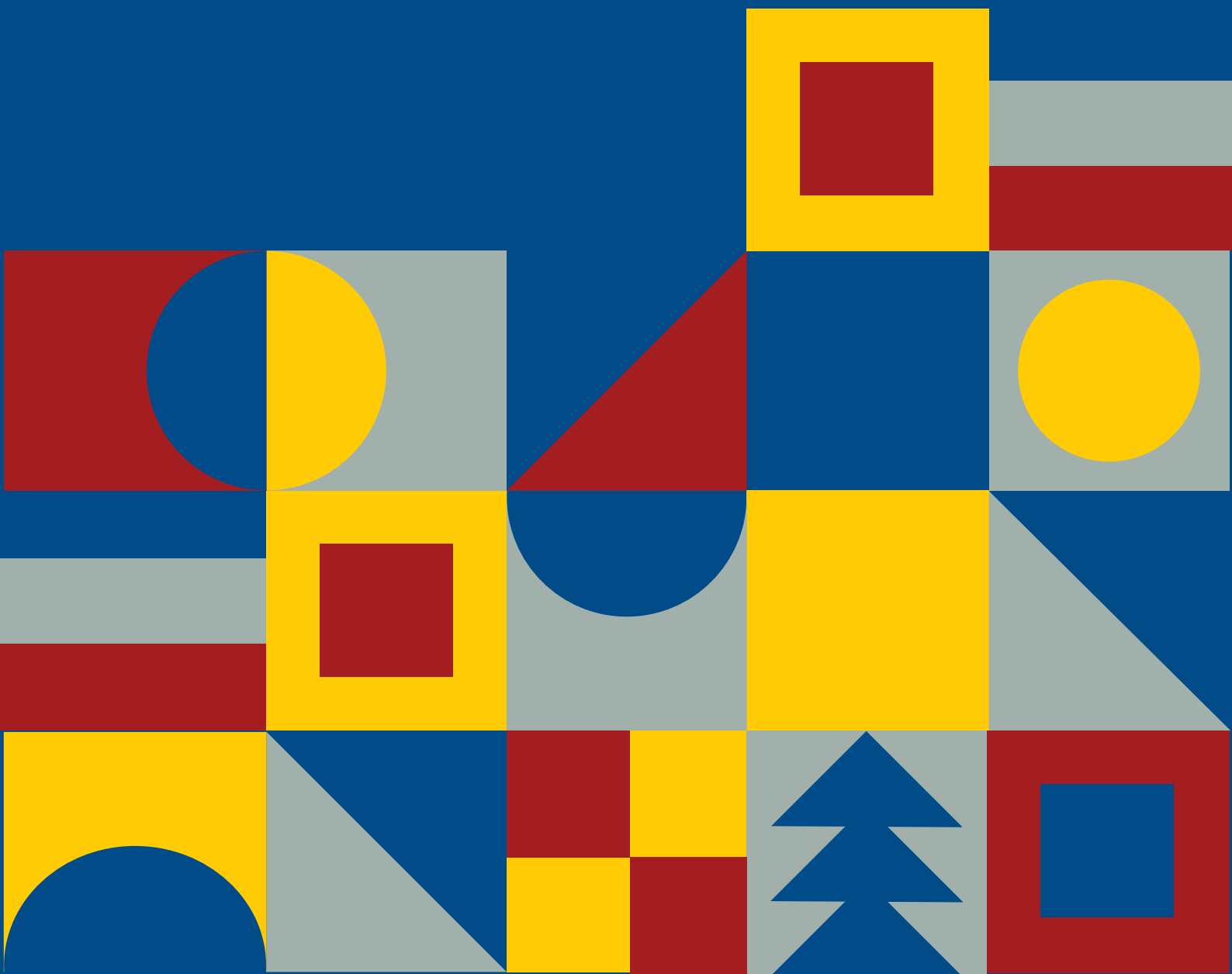
RESEARCH & INNOVATION REPORT

SIGNIFICANT ACHIEVEMENTS

2019

Central University of Technology, Free State



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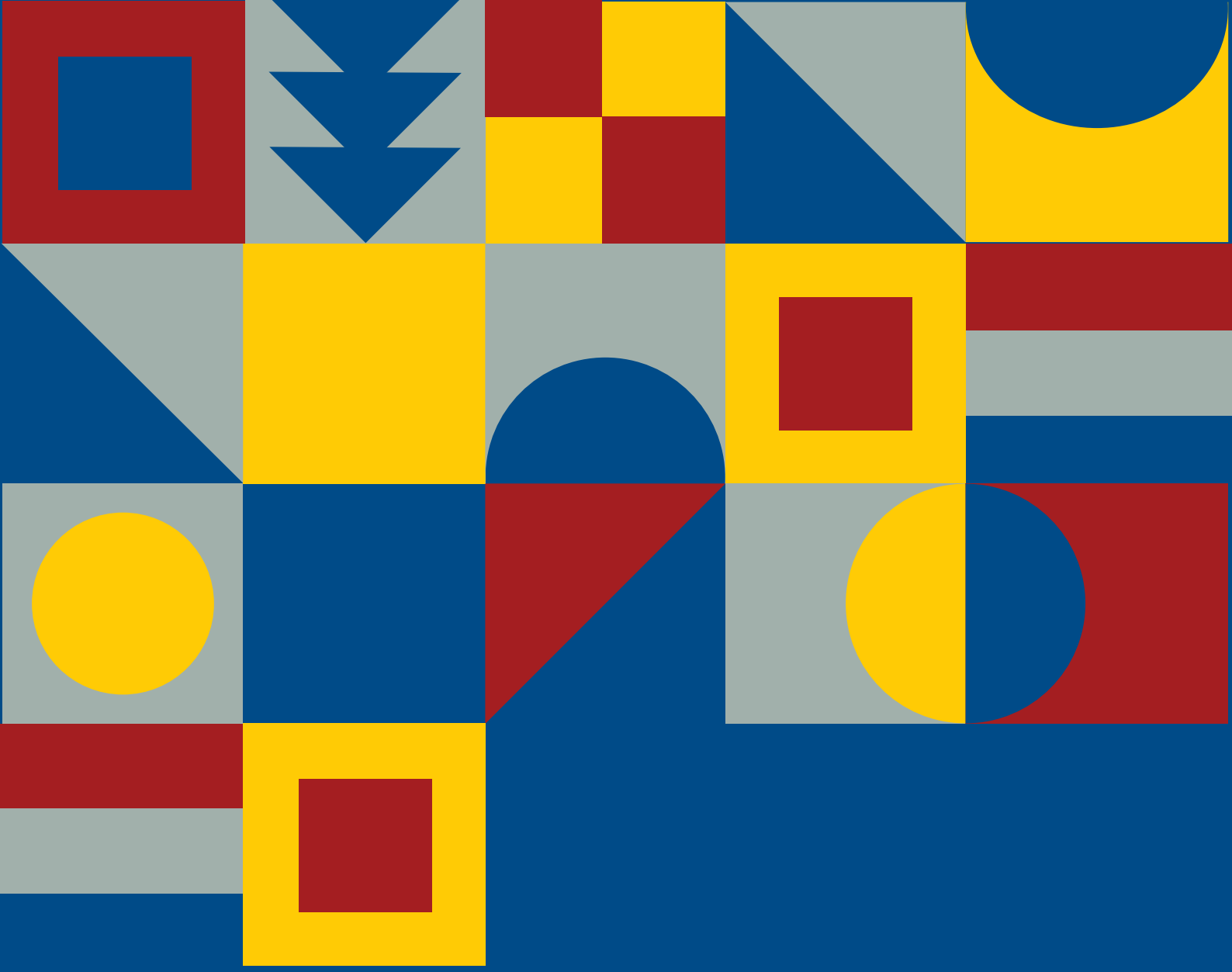


RESPONSES TO

RESEARCH & INNOVATION

PART 1

MESSAGE FROM THE ACTING VICE-CHANCELLOR AND PRINCIPAL

For the year 2019, the theme, *"Reimagining Central University of Technology, Free State (CUT): Living our values"*, was aimed at being true to the university brand by living the values we subscribe to in undertaking research, innovation and engagement that are beneficial to the communities that we serve.

The university has aligned itself with the most pressing priorities for higher education in South Africa, namely science and technology, which include, inter alia, the readiness of the CUT for the Fourth Industrial Revolution. This is accomplished by aligning academic and applied research programmes and ensuring that our graduates are ready for the future world of work; enhancing our innovation ecosystems that should impact on the socio-economic development of our country; and addressing deep socio-economic inequalities and the national social justice agenda through teaching, research and innovation.

It is with great pride that I look back on research and innovation achievements in 2019.

The culmination of research, innovation and other collaborations has broadened our footprint in Africa and globally, and embraced comprehensive internationalisation, with eighty active international agreements across the globe.

Our steady increase in financial investment by the university and grants from agencies such as the National Research Foundation (NRF) and the Department of Higher Education and Training (DHET) towards research has contributed to an increasing trend in the research and innovation portfolio. Most significantly, the Department of Science and Innovation (DSI) approved the establishment of a multimillion-rand Medical Device Additive Manufacturing Demonstrator (MedAdd) at the CUT during 2019 and 2020.

The university, through the Centre for Rapid Prototyping and Manufacturing (CRPM), won the Innovation Award: Corporate organisation for innovations and research and/or development at the 21st Annual National Science and Technology (NST) 2018/2019 National Science and Technology Forum (NSTF)-South 32 Awards, also known as the "Science Oscars" of South Africa. Through this, the University will continue to provide its partners with exceptional tools and solutions to maintain the lead in 3-D printing technology, and to bring about social and technological innovations in the country.

Furthermore, the CRPM was awarded the prize for the best performing and best managed project at the Fuchs Foundation 50 Golden Years Gala Awards.

The university continues to excel through various innovations such as the ITIKI, which is a solution for drought challenges, and the various product solutions for problems in South Africa's healthcare system, including the Sensory Integration (SI) roller, SI swing, SI ramp and scooter board, patient transfer device, multifunctional walking frame, and sustainable wheelchair. The Qbell Care Bed Management System was successfully launched at the Spinal Unit of the Pelonomi Hospital in Bloemfontein.

As a university, we are determined to play a prominent role in the socio-economic transformation of our region. The CUT is committed to improving the lives of our people and making an impact in the region, the province, our country and the African continent. To this end, we have a role to fulfil in addressing the challenges of society through education, research, innovation and skills development, the commercialisation of business ideas, and community engagement.

Professor David Ngidi
Vice-Chancellor and
Principal (Acting)

MESSAGE FROM THE DEPUTY VICE-CHANCELLOR RESEARCH, INNOVATION AND ENGAGEMENT

The year 2019 was indeed another successful period for the Central University of Technology, Free State (CUT). The annual report presents an opportunity to share with the university community, relevant stakeholders, broader communities and networks, the performance within the research and innovation space.

A number of activities to enhance research, innovation, and engagement practices at the university were recorded. These included measures to strengthen partnerships and funding opportunities for the CUT – with eighty active international agreements across the globe.

We have seen our university continuing to reflect a steady 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 75,9% growth in publication outputs in 2019 compared to the previous year. The CUT also achieved the highest per capita research publication output (normalised by head count of permanent academic staff) of all of the universities of technology (UoTs), at 0.58 and against a sector target of 0.97.

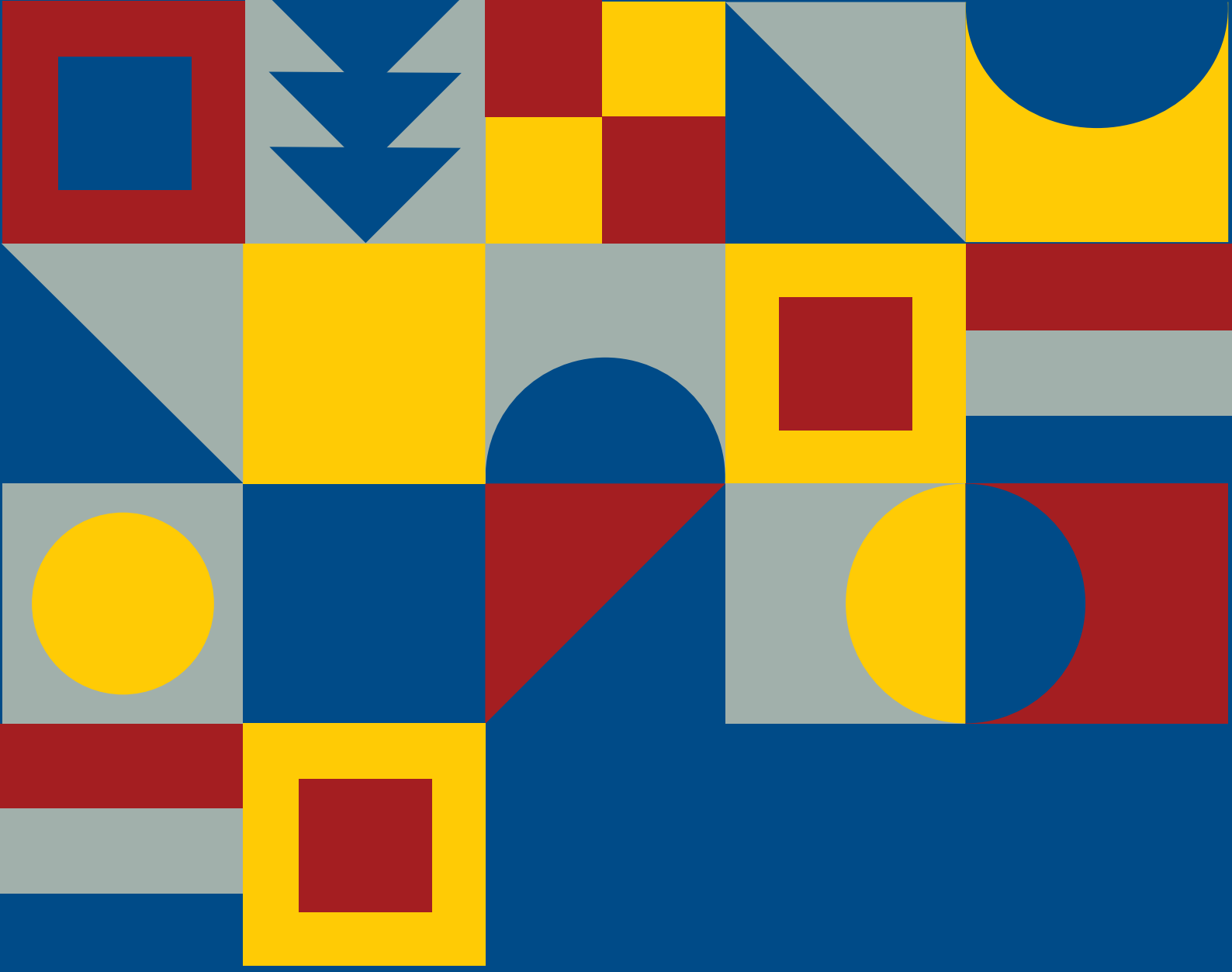
For 2018, 40% of our academic staff members have doctorates, and during the year under review a total of 64 staff members were supported in improving their qualifications – an opportunity to grow the research outputs dramatically with the increase of staff participating in research.

Most significantly, the university analysed all research activities during the past two years 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 Senate approved the following research centres at its meeting of 25 February 2019:

- 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.

As a university we are highly indebted to our researchers, support staff, and stakeholders in carrying out this role, and we will continue to be committed to providing excellence in research, innovation and engagement!

Prof. Afred Ngowi
Deputy Vice-Chancellor:
Research, Innovation
and Engagement



INSTITUTIONAL PERFORMANCE

HIGHLIGHTS & ACHIEVEMENTS

PART 2

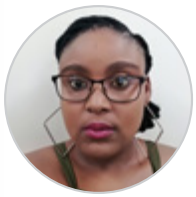
RESEARCH DEVELOPMENT AND POSTGRADUATE STUDIES SUPPORT

Under the newly-established Research, Innovation and Engagement Portfolio and the Research Development and Postgraduate Studies (RD and PGS) Section, the RD and PGS office is constituted of the following staff members:

The Research Development and Postgraduate Office:

Professor Laetus Lategan
Senior Director: Research Development & Postgraduate Studies
llategan@cut.ac.za

Ms Edith Sempe
Deputy Director: Research Development & Postgraduate Studies
ksempe@cut.ac.za



Ms Disebo Modise
Research Officer: NRF Activities
modised@cut.ac.za

Ms Eleanor Nel
Research Officer: Postgraduate Studies
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Ms Somari van Heerden
Administrative Officer: Research Development & Postgraduate Studies
svheerden@cut.ac.za

Ms Mary Mokhoa
DST/NRF: Intern
lmokua@cut.ac.za

Ms Cecile Olivier
Research Assistant: Administration Projects
olivierc@cut.ac.za

Mr Lebogang Matlaletsa
DST/NRF Intern
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Ms Samantha-Leigh Marupen
Research Assistant: DHET UCDG and Special Projects
smarupen@cut.ac.za

Ms Clementine Lekgetho
Research Officer: Administration
clekgetho@cut.ac.za

Core Functions

- *Postgraduate & Researchers' Grants & Scholarships*
- *National Research Foundation (NRF) Support*
- *Workshops & Mentorships*
- *Analysis of Institutional Performance*
- *Research Ethics & Integrity*
- *Research information management system*

The Research Development and Postgraduate Office Staff

Faculty Support

Research

Innovation

Engagement

Research and innovation is further strengthened at faculty level by the Assistant Deans: RIE

Professor Crispen Chipunza
Faculty of
Management Sciences
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Professor Michael Mhlolo
Faculty of Humanities
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Professor Yali Woyessa
Faculty of Engineering and
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Dr Tshepiso Makhafola
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RESEARCH DEVELOPMENT AND POSTGRADUATE STUDIES PLAN, 2014 – 2020

Research is 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:

Focus	Objective	Activity
Scholarly development through research and innovation training	Scholarly engagement with the research process and research cycle	• 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	• 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	• Student retention and throughput • Publications • Conference attendance • Patents • Rated researchers • Research funding

The aim of the plan is to contribute to:

REVIEW OF THE 2019 RESEARCH DEVELOPMENT ACHIEVEMENTS

Research funding and support

The R & D section had a total budget of R 52 585 304 available for research activities supported by different funding sources as reflected below.

Agency	Funding objective	Amount
CUT	RD & PGS institutional grants	R 17 000 000
CUT	New M & D grants	R 7 000 000
DHET R & D Grant	Support research capacity building	R 4 682 000
NRF	Support research projects and student training	R 23 903 304
Total		R 52 585 304

University Capacity Development Programme Grant Research and Development Support

The UCDP R & D Grant for 2019 was awarded (R 4 620 000) out of a total award of R 13 428 000 = 34.40% of total award.

The following progress can be reported:

- Awarded: R 4 620 000
- Budget allocated to approved projects: R 4 682 776
- Commitments from 2018: R 189 366.67
- Total expenditure: R 5 034 183

Below is detailed progress per project and activity for the period January – December 2019.

Note 1: Comprehensive management, monitoring and evaluation systems have been completed and implemented.

The following projects were identified for the UCDP Research Grant:

Next Generation Researchers' Development	Focus
Activity 1: Training and development workshops for next generation researchers and postgraduate studies	The focus of this programme is to train and mentor the new generation of researchers and postgraduate students in doing research.
Activity 2: Staff Development: Postgraduate study support programme	This programme is in line with the main objective of the DHET grant allocation, namely for staff to improve their qualifications.
Activity 3: Enhancing mobility and access to research resources	The University took the initiative to promote active participation with Cluster A and B universities that will deliver on joint postgraduate supervision and joint publications. The programme will enhance existing expertise and will support identified networks and collaboration with other universities.

Research Development Support towards improving global citizenship and research capacities	Focus
Activity 1: Research career development of early and mid-career researchers programme	The focus of this programme is to build the capacity of researchers.
Activity 2: Supplementation for NRF rated researchers	Support of researchers for expansion of research capabilities through application and NRF rating
Activity 3: Management/Administration of the Research Development Grant	Building of research administrative capacity

NATIONAL RESEARCH FOUNDATION (NRF) – FUNDING

The NRF national development agency for the support, promotion and advancement of research and human capacity development through funding and the provision of the necessary research infrastructure, in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including humanities, social sciences and indigenous knowledge.

For the period January – December 2019, the university continued to benefit from the following allocations made from NRF awards:

Grant	Amount
Staff awards: A total of 40 awards were granted (26 to males and 14 to females) (32.95% of total NRF funding)	R 6 135 124,17
Student awards – A total of 283 awards were granted (130 to males and 153 to females) (73.19% of total funding)	R 7 655 385,00
Total:	**R 17 215 380,00**

NRF – Funding Policy Amendments Consultation

The NRF visited the Central University of Technology on 26 June 2019. NRF representatives' Dr Romilla Maharaj and Dr Mbulelo Ncango elucidated that the visit was part of their annual visits to all institutions in the country that benefit from the funding provided by the organisation. The aim of the visit was to discuss changes taking place in the organisation, more specifically the change in their funding policy. Invitations to attend were extended to Deans, Assistant Deans, the Finance Office and the Research Office.

The NRF has made some radical changes to the funding policy in pursuit of realising its goal of contributing to the knowledge economy in South Africa by attaining at least 1% of the global research and development output. As a result, the NRF will no longer fund undergraduate qualifications, postgraduate certificates or diplomas, master's by coursework, or professional master's and doctoral degrees. In addition, they have also reduced the age of completion for doctoral degrees, whilst improving success rates, and facilitating high retention of exceptional postgraduate talent in the academic and research fields.

From (left) standing Mr Lebohang Matlaletsa, Prof. Laetus Lategan, Dr Mbulelo Ncango (NRF), Dr Romilla Maharaj (NRF), Prof Rene Haarhoff, Prof Muthoni Masinde, Ms Cecile Olivier. Sitting from left, Ms Samantha Marupen, Ms Disebo Seooe, Ms Mary Mokhoa and Ms Edith Sempe after presentation on the NRF funding policy amendments

National Research Foundation Rating

For the period January – December 2019 the following researchers were rated:

The NRF rating categories:

A	B	C	L	Y
Leading international researcher	Internationally acclaimed researcher	Established researcher	Late entrant into research	Promising young researcher

Prof. D De Beer
Field: Engineering **Rating Categories:** C
Specialty: Computer Integrated Manufacturing, Rapid prototypes – Engineering, Rapid product development, Rapid tooling, Rapid manufacturing, Additive manufacturing

Prof. F Emuze
Field: Built Environment **Rating Categories:** C
Specialty: Construction – Project management, Construction Engineering and Management (CEM), Construction industry – Safety measures, Construction management, Construction site – Management, Construction Occupational Health and Safety

Prof. K Kusakana
Field: Engineering **Rating Categories:** Y
Specialty: Energy management; Renewable and sustainable energy; Electrical Engineering

Prof. LOK Lategan
Field: Philosophy **Rating Categories:** C
Specialty: Applied ethics

Prof. JFR Lues
Field: Environmental Health **Rating Categories:** C
Specialty: Food safety, Food microbiology, Food safety – Behaviours

Dr. TJ Makhafola
Field: Clinical Technology **Rating Categories:** Y
Specilaity: Vitro genotoxicology, In vitro toxicology

Prof. M Mhlolo
Field: Education **Rating Categories:** C
Specilaity: Mathematics education, Mathematics education – Classroom discourse, Mathematics education – Curriculum Studies, Mathematics education – Professional development, Mathematics education – Large scale reform, Mathematics education – Children, Gifted children – Education

Prof. D Ngidi
Field: Humanities **Rating Categories:** C
Specilaity: Educational Research, Educational psychology, Teacher education

Prof. A Ngowi
Field: Engineering **Rating Categories:** C
Specilaity: Construction Engineering and Management (CEM)

Prof. I Ntshoe
Field: Education **Rating Categories:** C
Specilaity: Curriculum, Education policy, Sociology of knowledge, Economics education

Prof. P Rambe
Field: Management Sciences **Rating Categories:** C
Specilaity: Education, Information technology – Education, Information technology – Applications, Information and communication technology – Education, Educational technology, Governance and public management, Politics and government – Africa

Prof. J Swart
Field: Engineering **Rating Categories:** Y
Specilaity: Radio frequency, Engineering education, Electronic communications, Electronic Measurements

Dr. I Yadroitsava
Field: Engineering **Rating Categories:** C
Specilaity: Laser metal additive manufacturing, Advanced materials, Numerical modelling

Prof. H Vermaak
Field: Engineering **Rating Categories:** C
Specilaity: Automation, System Control, Vision Systems, Robotics, Renewable Energy Technologies

Prof. I Yadroitsau
Field: Engineering **Rating Categories:** C
Specilaity: Additive manufacturing, Laser matter interaction, Powder metallurgy, Optical measurements, Laser materials processing, Laser metal additive manufacturing

NRF CUSTOMISED PROGRAMME IN ENABLING THE RATING OF FEMALE ACADEMICS

The NRF approved this application and will support an initiative aimed at enabling the rating of female researchers. The Research Office engaged the faculties in a first approach to obtain (a) the names of all female employees with doctorates, and (b) to identify the black female employees with doctorates. Based on the feedback received, the Research Office noted that the university has 47 female employees with doctorates, of whom 14 are black female employees. Amongst these, no black female employee with a doctorate holds an NRF rating.

As a next step, the Research Office identified black female employees with doctorates in the academic professional services who are also active in research. As a result, two more black female employees with doctorates were identified. This bring the total of the cohort of early to mid-career black female academic employees with doctorates to 16.

The university has 47 female employees with doctorates (out of 132 employees with doctorates as per institutional data at the end of March 2019) in the academic portfolio. The target cohort of black female academic employees with doctorates represents 36.6% of the female academic employees with doctorates.

The University Research and Innovation Committee supported the proposal to grow the number of NRF-rated researchers amongst black female academic employees with doctorates. Sixteen (16) black female academics with doctorates have been identified to participate in this project. The approach to grow the number of rated researchers is well aligned with the university's Research and Development Plan, 2014-2020, which is in line with the institutional Vision 2020. One of the

objectives in this plan is to grow the seniority of academic employees. Rated researchers contribute towards the seniority of academic employees.

Based on this information the Senior Director: Research Development & Postgraduate Studies, Prof. Laetus OK Lategan, applied to the NRF's Customised Programme to support a diagnostic report on the capacity building of black female rated researchers. The diagnostic report will reflect on the following contents:

- Overview of research development support available in general and black female academics with doctorates in particular.
- A developmental plan for each individual researcher to reach a state of readiness to submit an NRF rating application.
- Faculty and Research Office programmes to support these employees.
- Strategic plan to grow female academics with doctorates in general and black female academics with doctorates to become NRF-rated researchers.

POSTGRADUATE STUDENTS' ENROLMENT AND FUNDING SUPPORT

As a drive for the university to grow its research outputs via the completion of master's and doctoral degrees, the university opens two calls annually in support of master's and doctoral degree students. The aim of these calls is to support students in the successful completion of their studies. These calls are meant as basic support for students and have no intention of fully funding the cost associated with research. Supplemental funding is encouraged via Departmental Funding, Grant Agency Funding and Competitive Funding. These calls are directed at full-time and part-time master's and doctoral students.

For 2019, the following grants were awarded to M (162 students) and D (43 students) degree students and post-doctoral fellows:

Scholarships, 2019			
Year	M students	D students	Post-docs
2019	R 8 466 230	R 2 761 860	R 1 010 000
TOTAL			R 12 238 090

This can be compared to the period 2014 to 2018, during which R38684 684 was awarded to M and D degree students and post-doctoral fellows:

Scholarships, 2014 – 2018			
Year	M students	D students	Post-docs
2014	R 957 880	R 628 494	R 880 000
2015	R 1 972 340	R 1 147 030	R 1 000 000

2016	R 5 229 930	R 3 205 660	R 600 000
2017	R 6 547 880	R 3 337 380	R 940 000
2018	R 8 466 230	R 2 761 860	R 1 010 000
Sub-total	R 14 708 030	R 8 318 564	R 3 420 000
GRAND TOTAL	R 23 174 260	R 11 080 424	R 4 430 000

The following 2019 enrolment figures compared to those of 2018 and 2017 can be reported:

Qualification type – level description	2017	% column	2018	% column	2019	% column
Doctoral	156	0,86	191	0,98	217	1,02
Master's	380	2,09	414	2,13	437	2,06
Other	185	1,02	172	0,88	66	0,31
PG to master's	417	2,29	399	2,05	602	2,84
Undergraduate	17 047	93,74	18 288	93,96	19 903	93,77
Grand total	18 185	100,00	19 464	100,00	21 225	100,00
Total percentage of enrolments (doctoral, master's and postgraduate to master's)	1 138	6,26	1 176	6,04	1 322	6,23

In 2019, the following numbers of students graduated with postgraduate qualifications relative to 2018:

- D graduates 2017 = 16 (target = 16) 2018 = 22 (target = 19) 2019 = 18 (target = 19)
- M graduates 2017 = 47 (target = 45) 2018 = 47 (target = 48) 2019 = 40 (target 48)

For the period 2001-2019 the trend in M and D graduates is reflected below:

Completed postgraduate studies 2001-2019																				
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
M degrees	11	16	19	19	13	17	31	22	25	27	17	35	29	37	29	53	47	47	40	494
D degrees	1	2	6	5	5	8	4	11	5	6	3	6	3	13	13	19	16	22	18	148
M course work	-	-	-	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	5

Note 1: Course work programme discontinued.

Department of Higher Education Training (DHET) Publication Submissions 2018 (n-1) and 2019(n)

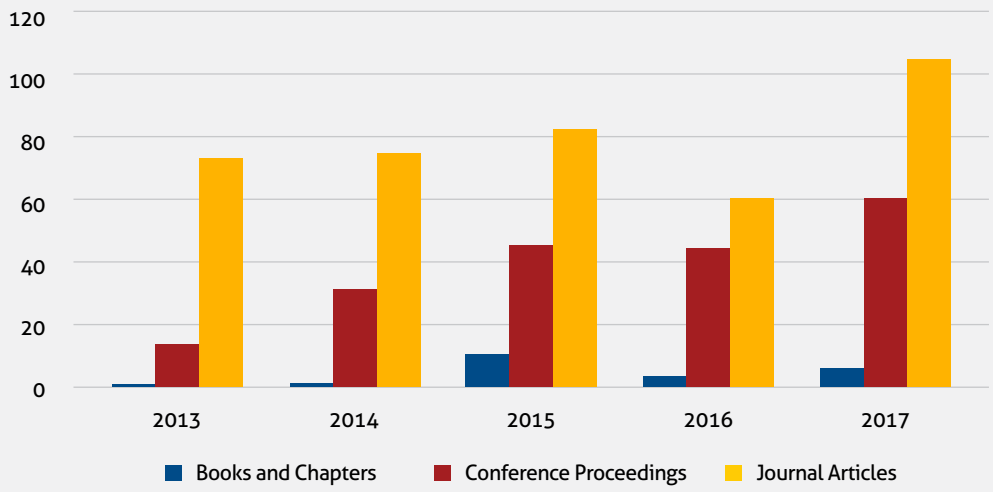
It is worth noting that in the year 2018, the CUT submitted the highest number of research outputs since the implementation of the research output policy in 2005.

Within the entire higher education system, CUT performance can be summarised as follows:

- In 2018, the CUT achieved a 0,90 weighted research output against a sector average of 1.91. This indicator combines the publication output with two categories of graduate production: research master's and doctoral graduates (weighted by a factor of 3) and is normalized by dividing the total units by total headcount of academic staff.
- The CUT also achieved the highest per capita research publication output (normalized by head count of permanent academic staff) within the UoTs at 0.58 and against a sector target of 0.97.
- The average percentage of staff members with doctorates is 40% of staff against a sector average of 48%.

CUT institutional performance analysis

The Figure reflects the increasing trend of the university research output over a period of five years.



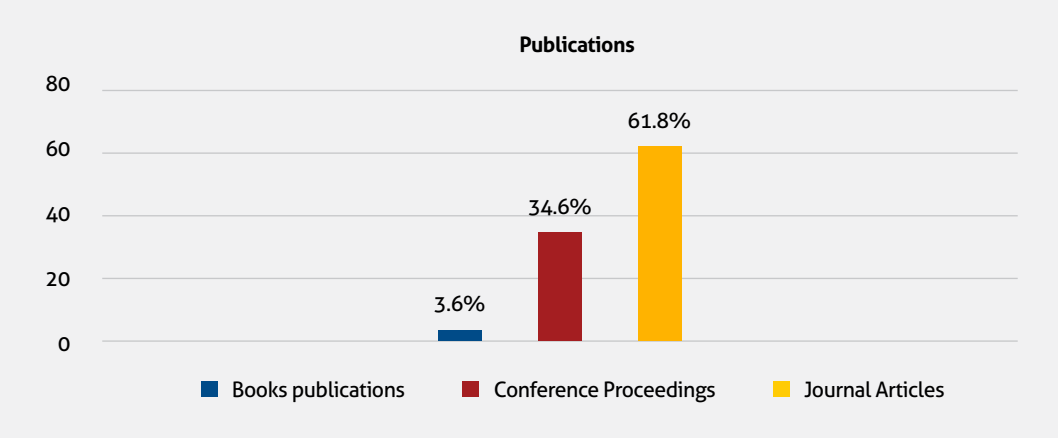
	2014	2015	2016	2017	2018
Books and Chapters	0.69	1.11	10.39	3.21	6.19
Conference Proceedings	13.65	30.85	44.89	44.23	58.88
Journal Articles	72.83	74.52	82.14	59.78	105.12

Figure: CUT total research output units by type of publication, 2014-2018

In May 2018 a claim for published research outputs amounting to 201.622 units was submitted.

Units submitted	Units awardes
201.622	107.2043

It is evident that the largest proportion of the university output remains in the form of:



UNIVERSITY PUBLICATIONS

The university publishes two journals: the INTERIM, an in-house journal to promote writing skills, and the Journal for New Generation Sciences, a DHET accredited journal.

INTERIM

The INTERIM is the university's developmental journal to assist (a) novice researchers and postgraduate students to publish their research papers and by doing so, to grow their publication writing skills and (b) for mid-term and established researchers to publish preliminary research results. Very often doctoral students will also submit a paper after the completion of their studies to meet the requirements for graduation.

In 2017 it was decided to recruit the services of an external expert in publication writing to comment on papers, to provide some suggestions for publishing papers in the INTERIM and generally to advise on publication writing. In 2019 four papers were received and submitted to review. It was also decided first to rethink the scope of the journa before the edition will be finalised. The following information on the INTERIM can be presented:

First edition	Number of editions up to 2019	Number of papers published	Number of participating authors
2002	26	426	282

JOURNAL FOR NEW GENERATION SCIENCES (JNGS)

The Journal for New Generation Sciences (JNGS) publishes original research-based papers in the technological sciences. Technological science refers to the development of knowledge through application and goes beyond disciplinary borders and subject specific issues. The JNGS aims to develop use-oriented research. Use-oriented research is a combination of applied research and use-inspired basic research. The objective is for business, industry and government, as well as social communities (known as the "quadruple helix") to benefit from the application of the research results. Used-oriented research should be executed in the context of Gibbons's Mode 2 Knowledge Production. This mode of knowledge production implies that knowledge is produced in the context of application, is transdisciplinary in nature and is reflective of and responsive to societal needs. The following information for the JNGS in 2019 can be presented.

First edition	Number of editions up to 2018	Number of papers published
2003	39	414

Number of participating authors	Participation (SA): public universities
722	20/26

The JNGS focuses on papers which reflect the scientific results of:

- science, technology, engineering, mathematics and arts (STEAM) and the management of STEAM research (Arts covers humanities and social sciences.)
- applied research informed by problems and challenges as faced by industry, business, government and social communities
- partnerships with industry, business, government and social communities (the "quadruple helix").
- knowledge creation in the context of Mode 2 Knowledge Production
- scholarship in teaching and research
- research projects leading to SET+A and management qualifications
- income generation through research
- entrepreneurship through innovation

RESEARCH BREAKAWAY

Attendees having a discussion during the breakaway session

The 2019 Research Breakaway was dedicated to discussing the first draft of the doctoral self-assessment report. The Council on Higher Education started a project some time ago to review doctoral standards. This project has now been scoped with supportive material and guidelines. The university was requested to submit its self-assessment report by the end of March 2020.

One of the discussions was on the role of the Research Centres in research and postgraduate studies.

Prof. Alfred Ngowi DVC: Research Innovation and Engagement made an interesting presentation on "Aligning Our Research Effort with Global Trends" *and commented also on the 4IR Revolution. Prof. Lategan provided a comprehensive background on the RD & PGS Five Core Functions as well as the generic activities of the School embedded in administration, monitoring and evaluation of internal and external staff and postgraduate students grants, scholarships and awards, the development of research skills for employees and postgraduate students through workshops and mentorships, and the analysis of the institutional RD & PGS performance.*

RESEARCH EDUCATION TRAINING PROGRAMME

The RD & PGS section offers a detailed research education training programme in support of the university's researchers, academic supervisors and postgraduate studies. The focus of research programmes is multi-, inter- and trans-disciplinary of nature, with an emphasis on sustainable development, answering especially questions such as: *What kind of research is done? What are the objectives?* and *What impact will the research have?* At the university, research, postgraduate studies, research development, technology transfer, innovation and commercialisation activities are understood to be complementary. These activities form part of what is commonly known as the *research cycle*. The RD & PGS section also offered seven training sessions to 580 prospective applicants on how to apply online to the NRF for these grants.

Number of workshops	Number of staff attending workshops	Number of students attending workshops	Number of unclassified attendees at workshops
19	26	426	282

ACADEMIC WRITING WORKSHOP HELD IN PURSUIT OF A CUT WRITING SCHOOL

The Research Development and Postgraduate Studies Office presented yet another successful Academic Writing Mentorship Seminar in the week of 12 – 16 August 2019. A full day workshop, intended for authors or prospective authors who needed to be reminded about the broad guidelines on how to write a scholarly article, was facilitated by Prof. Eli Bitzer, Emeritus Professor at Stellenbosch University on 12 August 2019.

Topics such as targeting an appropriate journal for an article, the criteria for scholarly writing, the writing process argumentation, how to conclude an article, the writing of an abstract, formulating the article title and dealing with reviewer feedback, were covered.

Sixty-one postgraduate students and staff attended the seminar. The second workshop took place on 15 August 2019, and was facilitated by Prof. Rodrigo Lozano and Dr Maria Barreiro-Gen, University of Gävle, Sweden. This half-day workshop was aimed at authors or prospective authors who needed to be reminded about guidelines on how to write a scholarly article for high impact factor journal publications. The workshop covered information and activities related to the need to publish research findings in high impact factor journals, the structure of an article and the research methodology. Fifty-eight participants attended the workshop. Seventeen papers were submitted from colleagues from both the Bloemfontein and Welkom campuses.

Professor Lategan expresses his gratitude to Dr Maria Barreiro-Gen and Prof. Rodrigo Lozano, from University of Gävle, Sweden

Professor Lozano addressing the attendees

Prof. Rodrigo Lozano and Dr Maria Barreiro-Gen with Dr Prosper Hoeyi, during one of their one-on-one sessions

Prof. Bitzer, Prof. Lozano and Dr Maria Barreiro-Gen held individual sessions with the authors who needed assistance with their research papers for submission or review. Many researchers pounced on this opportunity and set appointments with the three experts to guide them in working through the corrections. The week was a productive one for both novice and experienced researchers. The approach taken to implement the Academic Writing Mentorship Seminar has differed from any programme rolled out previously. This initiative was in line with the CUT's institutional aspirations to increase the visibility of the research being conducted at the university and the researchers in the international research community through the publication of research articles in high-impact factor, peer-reviewed publications in different fields. Participants submitted a draft article well in advance. The panel will continue to guide the authors until the eventual publication of their manuscript.

The use of such a comprehensive programme with pre- and post-workshop support and accountability, rather than merely a workshop approach, has been a first. The overall feedback received for the workshops suggests that the institution is well underway in creating a positive and competitive environment for research at the CUT.

ACADEMIC WRITING PROGRAMME FOR DOCTORAL CANDIDATES

The Graduate School presented a Doctoral Academic Writing Programme aimed at doctoral students in various fields of study. The objective of the pilot programme, hosted from 11 October 2019 to 22 November 2019, was to assist doctoral students in improving their academic writing skills. The programme covered aspects of the writing process, coherence and cohesion, academic writing style, the literature review, paragraphing, paraphrasing, referencing techniques, and other skills essential in academic writing. The facilitator was an experienced senior lecturer at the institution, Dr Brendon Fredericks.

At the end of the programme an accredited language practitioner advised participants on how to edit their writing. Twenty-six (eighteen female and eight male) candidates enrolled for the programme. The participants strongly agreed that they were personally motivated to join the programme, that the course material and the environment was appropriate, that the programme assisted them in improving their ability to better understand academic writing, that the presenter had knowledge of the subject matter and responded fully – with relevant examples - to their questions. The programme was not just about the presentations and practical evaluations; it was about a community of scholars who had the ability and the willingness to enhance their academic writing to become better academic authors. The Graduate School will be holding another session to continue assisting emerging researchers with academic writing.

SPSS WORKSHOPS HELD FOR CUT RESEARCHERS

The Introductory and Advanced SPSS Workshops that were presented in November 2019 were very successful and were attended by a total of 73 researchers and postgraduate students. Attendees were very receptive and were eager to complete the various learning activities that formed part of the training. Attendees found the introductory workshop very helpful to perform basic, time saving data analysing procedures in SPSS. The advanced SPSS training was offered for the first time and was very beneficial as attendees were exposed to advanced data analysis that can be used in the analysis of their own data.

Supervisors also expressed their gratitude for the workshops as it empowered them to be able to assist their postgraduate students more effectively. By the end of the workshops, attendees that attended both workshops were able to use SPSS very efficiently, so that offering the advanced workshop directly after the introductory workshop proved to be a very good strategic decision.

It was noticed that attendees who did not have a basic statistics background did experience the training as more challenging. The IT stats team also experienced that the morning and afternoon sessions worked very well as staff members and postgraduate students were able to attend the session that suited them best. More workshops of this nature will be organised in the new academic year to assist researchers in acquiring more knowledge regarding stataitistics.

Staff members and post graduate students during the SPSS workshops

SCIENCE COMMUNICATION – FAMELAB COMPETITION

At the request of the British Council, the CUT hosted the FameLab Free State Province science communication training and heat/competition on 11 & 12 March 2019. This followed the successful hosting of the 2018 Free State Famelab competition, which saw one of the Free State winners representing South Africa in the global competition hosted in London, UK. For 2019, a total number of 16 postgraduate students from the CUT participated in the event.

These students set the standard very high in terms of their science communication skills as well as the content of their presentations. Therefore, the competition was tough. Mr Goitsemang Dikane, master's student in the Faculty of Health and Environmental Science, specialising in Plant Breeding and Genetics (Agriculture) succeeded as the Free State winner for 2019. The first runner up was Mr Lubabalo Bila (Agriculture) and the second runner up was Mr Burger Lübbe (Electrical Engineering). Mr Dikane represented the Province at the National FameLab master's training and competition. According to Mr Dikane, this was an experience that improved his science communication skills immensely and that contributed to his development as a researcher. Our appreciation goes to all staff and students who were involved in the planning and hosting of this successful event.

Mr Goitsemang Dikane (1st prize winner), Mr Burger Lubbe (2nd runner-up) and Mr Lubabalo Bila (1st runner-up). The trio was delighted to have been part of a competition of this magnitude.

POSTGRADUATE SUPERVISION SEMINAR

The RD & PGS office hosted a four-day Supervision Seminar for supervisors on both Bloemfontein and Welkom campuses. Prof. Eli Bitzer was the main presenter for the seminar. He is an emeritus professor at Stellenbosch University. "Developing the scholarly identity of the postgraduate supervisor" was the topic on Day 1. Research communities, scholarships and research productivity were discussed, to reframe thoughts around postgraduate supervision and factors that support the development of a scholarly identity.

On day 2 of the seminar, the theme for the day was on promoting quality and relevance of the PhD. The seminar was well attended by Deans, Assistant Deans: RIE and Heads of Academic Departments. Over the last century, the doctorate has established itself as the standard qualification for entry into higher education as a profession. It has also been repositioned as an important qualification for other labour markets such as commerce. What remains crucial is that this highest qualification awarded by universities must give evidence of scientific quality and relevance for the workplace. Bearing this in mind, the seminar provided a thinking and discussion space to map the elements that need consideration when contemplating enrolling PhDs at the Central University of Technology, Free State. The seminar was well attended and elicited positive feedback.

RESEARCH ETHICS AND INTEGRITY COMMITTEE

A Research Ethics and Integrity Policy Framework, together with a Constitution for the Research Ethics and Integrity Committee as a sub-committee of the URIC, was approved by Senate in November 2016. The Policy Framework was implemented in 2017.

For 2018 a total of 110 protocols were approved by the FRICs from EIT, Health and Environmental Sciences, and Management Sciences. A total of 25 protocols required ethical clearance letters and these were issued. For twelve (12) protocols, ethical clearance was awarded through the UFS Clinical Ethics Committee collaborative initiative. The university is a participating partner in this committee.

A training workshop on Research Ethics took place on 8 November 2018, which was attended by 33 participants. The workshop was divided into two sessions, with session one focusing on the development of the current ethics approval system, and session two on plagiarism policy development and anti-plagiarism tools.

From the above engagement, the following decisions are to be implemented for 2019:

- A Policy on Plagiarism and other Research Misconduct was drafted, to be submitted for approval by Senate early in 2019.
- Initiate a process to develop SoPs and have an accredited Ethics Committee for Humanities.

PARTNERSHIPS AND RESEARCH COLLABORATIONS

Strategic partnerships and research collaborations have become an important mechanism for building the university's research profile. The partnerships are undertaken across various disciplines with other universities, industry and the community.

Some of key partnership initiatives are highlighted below.

Joint CUT and UFS research programme

The call for the 4th CUT and UFS Joint Research Programme collaboration and the call for progress reports for the 3rd CUT and UFS Joint Research Programme were published on 8 May 2018 and closed in June 2018. The call for the 4th Programme was for:

- Track 1: Four hundred thousand rand (R400000) per research collaboration project. Track 1 will be limited to two (2) projects.
- Track 2: One hundred thousand rand (R100000) per research collaboration project. Track 2 will be limited to six (6) projects.
- A total of 12 applications were received and reviewed in July 2018.
- Six projects were funded to the value of R310000.

The following new projects were funded:

- Radiation Protection Improvement in South Africa (RAPISA) Project.
- Proposal for a study of the state and ownership patterns of the Food and Beverages processing sub-sector (agro-processing) in the Free State and the linkages with other economic sectors in the province.
- Community-University partnerships in fostering the wellbeing and career prospects of learners in educational contexts beset with gang violence in South Africa.
- Unravelling the microbiome of Sesotho (sorghum beer) through targeted metagenomics.
- Social innovation through regional community engagement.
- Investigating the production of polypropylene powder suitable for processing through laser sinter additive manufacturing.

THE 4TH ANNUAL FREE STATE PROVINCE RESEARCH COLLOQUIUM

The Central University of Technology, Free State (CUT), in partnership with the Free State Provincial Government, co-hosted the 4th Annual Research Colloquium on 18 and 19 September 2019. The colloquium is one of the CUT's efforts to bring government, private sector, higher education institutions and the community together to create a platform where challenging issues and viable research solutions can be discussed to bring sustainable economic development and growth in the province and the country. It also aims to bridge the gap between research, practitioner's law and policymakers. The colloquium convened under the theme "Good governance practices with special focus on ICT, service delivery and youth empowerment."

In his welcoming address, Prof. Henk de Jager, Vice-Chancellor and Principal, said that the CUT is honoured to partner and take hands with Free State Provincial Government in the colloquium to enhance the research agenda in the province and bring solutions to the socio-economic challenges faced. He further said that youth as future leaders of the country should be empowered and offered an environment that will allow them to unlock their creativity. "I am grateful for this partnership to develop an innovation hub that will make a difference in the lives of our young people and ensure that they develop proper and viable businesses for job creation in the country. There was a tendency that research would be done on the community instead of doing it with them and for us as a university, the impact of what we are doing should be noticeable on the society."

The Acting Premier (then) and MEC for Agriculture, Mr Kwekwe William Bulwane, said that good governance needs to be understood and managed, and should lead change efficiently. "We need to see all of you gathered here participating not only on your academic work but also in public debates and tackling topics such as expropriation of land without compensation and the National Health Insurance. Research has the potential to address and develop a scientific approach to deal with social ills, including a better and efficient approach to service delivery."

"Interdisciplinary research remains the cornerstone of more collaboration work and allows you, as scientists, to work together and exchange knowledge. We stand on the brink of a technological revolution that changes the way we work, live and relate to each other and we must observe and explore the fourth phase of this industrial revolution."

"We are living on borrowed time, and you as scholars, scientists and researchers have the potential to steer and drive our communities to live better with your discoveries. We wish you all fruitful deliberations that will impact positively in our province and the country at large. Let's all build the Free State we want."

Ambassador Vincent Karega from Rwanda said that he was inspired and impressed by the leadership, patriotism and the willingness to be different and to do things differently, as well as to have an impact in the province. "I heard that South Africans are good in self-actualisation, undermining and complaining as if tomorrow is the end of the world. I want to reassure you that this country is beautiful and has more than what it needs. The people of this country, especially those in leadership, need to do more differently and rapidly to correct the problems of inequality, unemployment, and poverty in this sea of wealth."

He said that Rwanda was the worst country 25 years ago. It was the poorest, small and highly populated with very hilly difficult terrains and no petrol or platinum, "but as I stand here, I am proud when I hear everybody talking about clean and growing Rwanda. Let's change and account for what we do, let's cut on expenditure, and focus on the real things, let us use the 4th Industrial Revolution to come up with viable solutions that will bring change to this country. I don't like to see South Africa cry because it is not a small country; it is a beautiful country with resources."

Partners, researchers, law and policymakers at the 4th Annual Free State Research Colloquium. From left: Free State MEC for Education, Mr Tate Makgoe; Rwanda's Ambassador to SA, Mr Vincent Karega; MMC for Finance of the Moqhaka Municipality, Mr Rachere Moletsane; Executive Mayor of Phumelela Local Municipality, Cllr Tlokotsi John Motaung; MEC for Finance, Ms Gadija Brown; Executive Mayor of Ngwathe Local Municipality Cllr Joey Mochela; Prof. Alfred Ngowi, Deputy Vice-Chancellor: Research, Innovation, and Engagement; and MEC for Agriculture, Mr Kwekwe Bulwane.

CUT PARTNERSHIP WITH MASSACHUSETTS INSTITUTE OF TECHNOLOGY (MIT)

On 15 & 16 July 2019, the CUT hosted Prof. Hazel Sive of the Massachusetts Institute of Technology (MIT), who led a workshop on Educating with Problem-Solving Approaches under the auspices of MIT-Africa Initiative. This initiative is part of the collaborative projects between the CUT and Massachusetts Institute of Technology in the USA that will ensue from this workshop. Her presentation focused on pivotal aspects of the higher education curriculum that contribute to student success and promote problem-solving skills. She spoke about how students can solve problems and use knowledge to address real-life challenges and learn from failure while working across various fields, and be ready for employment in the changing world of work.

As the result of the disruptions caused by the 4th Industrial Revolution (4IR), the 21st century is in need of students that are confident, entrepreneurial problem solvers who have tools to form a career, have resiliency across the changing face of work, and power to contribute to economic growth. Within the landscape of developing educational approaches and technologies, educators are challenged to devise new, productive curricula that will motivate students and promote achievements and success. The workshop followed a visit by Prof. Alfred Ngowi, Deputy Vice-Chancellor of Research, Innovation and Engagement, and Mr Glarington Quvile, CEO: CUT Innovation Services (CUTis) to MIT in April 2019, that was aimed at establishing collaboration with MIT in a number of areas including innovation, entrepreneurship, research, and new approaches in education (including open learning) under the auspices of MIT-Africa and MIT-South Africa Initiatives.

MIT is a highly ranked institution globally, established in 1876 with the motto "Mens et manus" (Mind and Hands) upon which it is founded. Unlike other universities that focus on classical education, MIT places emphasis on practical education as they believe that innovation and entrepreneurship are the must-have skills, thus practice should be infused in the curriculum to emphasise learning by doing.

Front row from left: Prof. Alfred Ngowi, Deputy Vice-Chancellor of Research, Innovation and Engagement, Mr Glarington Quvile, CEO: CUT Innovation Services (CUTis), Prof. Hazel Sive, Professor of Biology at MIT, Founding Director of J-WEL Higher Education and MIT-Africa initiative, Ms Michelle Huang, MIT graduate, Alice Lin, senior student at MIT and Prof. David Ngidi, Deputy Vice-Chancellor: Teaching and Learning. They are flanked by other CUT staff members from different departments who formed part of the discussions.

The workshop formed the first step of the envisaged CUT-MIT collaboration that will be anchored by membership of the Abdul Latif Jameel World Education Lab (J-WEL Higher Education), which convenes a global community to promote excellence and transformation in education. The workshops conducted by MIT J-WEL include: Curriculum Design; High Impact Research; A University Entrepreneurship Ecosystem; University Leadership & Governance; and Technology Licencing.

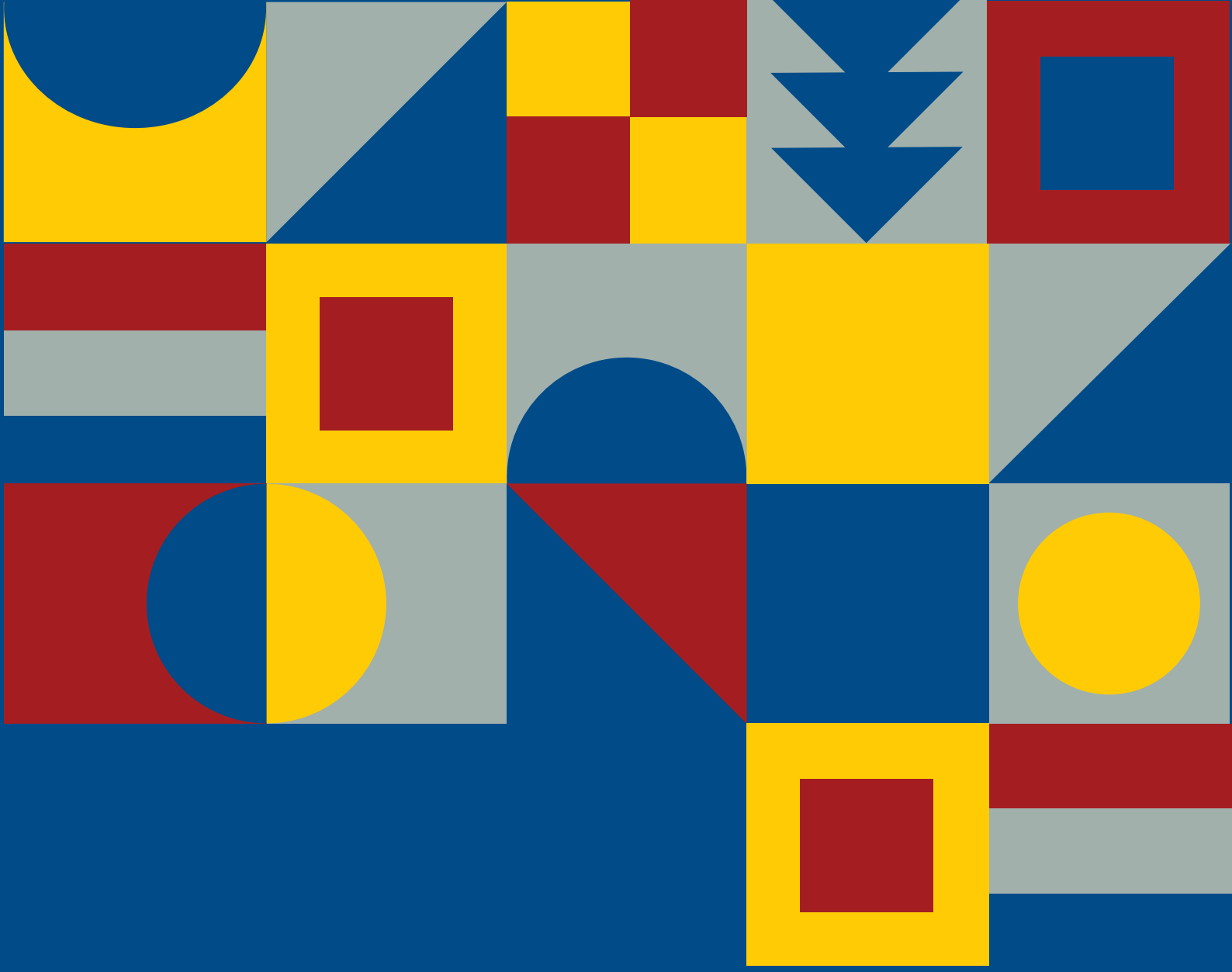
SWEDEN'S TOP-RANKED RESEARCH AND EDUCATION UNIVERSITY UPPSALA VISITS THE CUT

Delegates from Uppsala University, Sweden (UU) visited the Central University of Technology, Free State (CUT) on 7 May 2019, to strengthen the already existing partnership.

The CUT and UU have been partners for four years, and to date, the two institutions have collaborated on two Erasmus+ programmes, including staff and student exchange.

The latest collaboration is Erasmus+ YEBO, International Credit Mobility as well as an Erasmus+ Capacity Building of Higher Education project called YEBO, Internationalisation of Doctoral Studies in South Africa and South Africa – Sweden University Forum (SASUF). Through this partnership, participants will be given a once in a lifetime opportunity to shadow a female VC of Prof. Eva Âkesson's calibre. Prof. Âkesson is Vice-Chancellor at Uppsala University.

Back row, from left: Prof. David Ngidi, Deputy Vice-Chancellor: Teaching and Learning; Prof. Henk de Jager, Vice-Chancellor and Principal; Dr Gary Paul, Deputy Vice-Chancellor: Resources and Operations, and Prof. Alfred Ngowi, Deputy Vice-Chancellor: Research Innovation and Engagement.
Front row: Ms Erika Dabhilkar, from Uppsala University with the CUT Woman in Leadership programme candidates. Ms Laurika van Straaten, Manager: Language Services; Ms Helene Kotze, Deputy Director: HR Operations; Prof. Wendy Setlalentoa, Associate Professor: Teacher Education, Prof. Eva Âkesson, Vice-Chancellor: Uppsala University; Ms Reynell van der Ross, Talent Management Specialist; Ms Edith Sempe, Deputy Director: Research and Development Support and Ms Ntokozo Dlamini, Deputy Registrar: Academic Administration.



CELEBRATING

RESEARCH EXCELLENCE & INNOVATION

PART 3

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 of rain or drought. Prof. Masinde 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. 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 Build 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.

Prof. Masinde said that the tool is a unique innovation that will help farmers deal with and adapt to 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. ITIKI 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.

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

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.

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.

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

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 laricinus*, *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 these plant extracts, and demonstrated their safety using current and classical cell biology techniques. She also discovered that *Asparagus laricinus* 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 drug to the liver), *Asparagus laricinus* 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 researches, 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 laricinus* 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.

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 undergone 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 Booyens, representative from 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 for 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 Moshoane 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

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 Moshoane, 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.

Stakeholders who have 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. 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."

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.

PDTS INNOVATES TO IMPROVE CARE FOR PATIENTS AT PELONOMI HOSPITAL

The Chief Executive Officer (CEO) of Pelonomi Hospital, Ms Baesi Ramodula and her team launched 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 towards 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.

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.

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 opportunity 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 export of opportunity, 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."

CRPM WINS FUCHS GOLDEN YEARS ANNIVERSARY PROJECT

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 Booysen (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.

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 form a consortium between doctors and the CUT's product development centres to drive development.

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 on short notice, he is 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 will 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.

Research Group winners in the Innovation Award category: Mr Thabo Ngobeni, Prof. Dillip Das and Mr James Honiball (middle) received a R30 000 cash cheque to advance their research endeavours. The award was presented by the Vice-Chancellor and Principal, Prof. Henk de Jager (left) and Prof. Alfred Ngowi, Deputy Vice-Chancellor: Research and Engagements. DVC: Research Innovation and Engagement.

EMPLOYEES CELEBRATED AT THE 4TH ANNUAL VICE-CHANCELLOR'S EXELLENCE AWARDS

The annual Vice-Chancellor's Excellence Awards aim to celebrate and acknowledge the outstanding performance of staff members who walk the extra mile in their field of work to achieve incomparable performance for their constant and exceptional achievement in research and innovation, teaching, community engagement and support services, which are aligned with the university's vision. They are also meant to sustain the spirit of excellence in delivering quality education in the higher education landscape. The annual event was held on 30 October 2019.

In acknowledging the recipients, Prof. Henk de Jager, Vice-Chancellor and Principal, said "Excellence is a continuously moving target, and these awards should encourage you to do better in 2020 and beyond. As the CUT, we have embraced the human project which focuses on valuing people who are prepared to walk the extra mile. These accolades are a symbol to recognise your hard work and dedication, and it is only through people like you that we can create an exceptional university. As we celebrate you tonight, we also want to thank you for bringing credit to this university. Without your tireless efforts, this institution is nothing."

In conclusion, Prof. De Jager extended his appreciation to the families and spouses of recipients for the undying support they have provided to their loved ones. "You are a safe haven for our employees. It is through your love and support that we have gathered here tonight."

The recipients not only received certificates of excellence but were also awarded with cash cheques to advance their research endeavours. The nominees received awards in the following categories: teaching, research and innovation, scholarship in community engagement and support staff.

L-R: Prof. Herman Vermark, Dean: Faculty of Engineering, Built Environment and Information Technology, Dr Nothemba Mrwetyana, Registrar, man of the moment and newly inducted Professor Fidelis Emuze and Prof. Henk de Jager, Vice-Chancellor and Principal

INAUGURAL LECTURE – PROFESSOR FIDELIS EMUZE

Professor Fidelis Emuze, Head of Built Environment and Head of the Unit for Lean Construction and Sustainability, was inducted into the 'academic hall of fame' when he was inaugurated as a full professor on 7 November 2019. His address was a summation of his expertise as a distinguished scholar in the field of construction.

In his professorial address, Prof. Emuze delivered a lecture titled 'Respect for persons'– a Kantian approach to respect for persons in construction in which he spoke about the respect-for-persons (RfP) and its implications for ethical thinking and practice in the construction industry, especially in relation to workers on project sites.

He said that RfP requires management to provide safe and healthy worksites with zero harm. "People in construction are exposed to a lot of unpleasant circumstances. They need to be treated with human dignity, respect, authentic care and justice. RfP demands the integration of thought, feeling, and knowledge of the contextual networks in an environment."

He also stated that people in construction are current students who will become real people in construction like he did, and he believes that they must be empowered to use their reason. "A curriculum of teaching and learning must embed the ethos of respect for people. Together let us leave a legacy of critical thinkers, problem solvers, safe and healthy PiC and enriched society." His research focus is influenced by his lived experience on construction sites, both in Nigeria and South Africa. "My work experience as a construction engineer and document controller inspired me to produce a supply chain management research treatise in 2010. Further studies thereof, provided me with the opportunity to examine performance and inefficiency issues on project sites. Such inefficiencies are synonymous with waste classification in the domain of lean construction. Lean construction is not about technology, it's about valuing people in construction and how they can make changes to the world."

Prof. Emuze acknowledged all role players who contributed to his academic success. "I am grateful to everyone who has been supportive to what I have done in the last seven years. The CUT has provided with the platform to explore what I can become without restricting me to what I must research and what I must teach. It has enabled me to become a thinker."

Prof. Herman Vermaak, Dean of Engineering, Built Environment and Information Technology, thanked Prof. Fidelis Emuze for his contribution to the faculty. He said, "Your work offers an opportunity to examine issues facing the built environment and to look for solutions and ideas that will carry us into the future. This is a huge achievement and it shows our commitment in the faculty to expand research undertaking in the built environment so that we develop solutions that are sustainable and adaptable for the global stage. We salute you for the sterling job you have done in the academia and industry, and we want to draw lessons from your work as an intellectual and a humanist."

Graduations

Dr Joel Johannes de Lange
Doctor of Education)

Promoter: Dr Luzaan Schlebusch, PhD (CUT),
Co-promoter: Prof. Shiela Matoti, PhD (CUT)

Dr Joel Johannes de Lange's topic: "School management teams' impact on educators' job satisfaction in the Free State province"

His studies focused on the impact of school management teams (SMT) on educators' job satisfaction levels in the Free State province. The research findings indicated that participant educators experienced substantial job dissatisfaction that inhibited their job fulfilment, and which puts quality education in schools at risk.

Dr Mpofokaze Bokhatsi Maope
Doctor of Education

Promoter: Dr Awelani Rambuda, PhD (UP)
Co-promoter: Prof. Gawie Schlebusch, PhD (Vista University)

Dr Mpofokaze Bokhatsi Maope's research topic: "Towards a development of a quality external support framework for the Further Education and Training (FET) phase physical sciences teachers in Lejweleputswa district"

The research revealed that teachers attended subject-specific workshops and have managed to form collaborations with peers where they planned lessons together. However, teachers felt challenged by a lack of funds to buy science equipment, inadequate supply of science textbooks, and low learner interest in the subject.

Dr Stephen Kgano Sebeela
Doctor of Education

Promoter: Dr Awelani Rambuda, PhD (UP)
Co-promoter: Dr Clement Moreku, PhD (CUT)

Dr Stephen Kgano Sebeela's topic: "The relationship between the leadership of the school and the performance of Grade 12 learners in the North West province"

Dr Sebeela's study explored the association between the performance of grade 12 learners and the nature of leadership at schools. The results revealed that in secondary schools, transactional leadership was the most implemented leadership style, followed by distributed leadership, transformational and capacity-building leadership. The least implemented leadership style was strategic leadership.

Dr Evodia Maisaiah Phakisi
Doctor of Education

Promoter: Dr R Bhagwandeen, PhD (Jabalpur, India)
Co-promoter: Dr Awelani Rambuda, PhD (UP)

Dr Phakisi Evodia Maisaiah's topic "Evaluating the primary school science teachers' pedagogical practice in multi-grade classrooms in Lesotho"

Dr Maisaiah explored problems associated with the teaching of primary school science in multi-grade classrooms. The research revealed that teachers adopt a quasi-monograde strategy when they teach. Teaching in a multi-grade classroom demands a well-trained and innovative teacher who can meet the challenges associated with multi-grade teaching. The study recommended retraining and reskilling of multi-grade teachers, and that the Lesotho curriculum should include multi-grade teaching.

Dr Mosebekoa
Doctor of Education

Promoter: Dr JR Maimane, PhD (Vista)
Co-promoter: Dr MP Rankhumise, DEd (UniZulu)

Dr Mosebekoa's topic: "The Technical and Vocational Education and Training as the basis for societal development: The comparative study of the Republic of South Africa and Lesotho"

His doctoral study investigated technical vocational education and training (TVET) as a basis for societal development from the perspective of lecturers of the Polytechnic College in Lesotho, and the Motheo TVET College in South Africa. It was found that both institutions raise career awareness, but with a focus on prospective secondary school students, disregarding their current students. Furthermore, education and training are provided in curricula responsive to both countries' societal and national development goals. It is recommended that institutions under the control of both governments and the private sector should improve infrastructural developments and recruit more lecturers. Instructional technology should be a priority for TVET colleges. Furthermore, both colleges should formulate an integrated policy that will be beneficial for both countries.

Dr Sandile Phillip Koko is congratulated by his Promoter, Prof. Kanzumba Kusakana (left) and Prof. Herman Vermaak (right)
Doctor of Electrical Engineering

Promoter: Prof. Kanzumba Kusakana, DTech (CUT)
Co-promoter: Prof. Herman Vermaak, PhD (Twente)

Dr Koko's topic: "Optimal energy manage-ment modelling of a grid-connected micro-hydrokinetic with pumped hydro storage"

His doctoral study focused on energy optimisation modelling for both the grid-interactive and non-grid-interactive micro-hydrokinetic pumped-hydro-storage systems, aimed at minimising electricity bills and maximising the return on energy sales. He developed a control algorithm that led to the effective management of disturbances caused by load demand uncertainties. The external examiners commented that the results of this ground-breaking research contribute substantially to technological-scientific knowledge in engineering. Four accredited journal articles, six international and national conference papers, and a book chapter were published from the findings of the research.

Dr Ikechukwu Frank Aneke with Dr Pinky Nothemba Mrwetyana at the graduations
Doctor of Civil Engineering

Promoter: Prof. MMH Mostafa, PhD (Liverpool),
Co-promoter: Dr A Moubarak, PhD (PSU)

Dr Aneke's topic: "Behaviour of unsaturated soils for road pavement structure under cyclic loading"

In his doctoral study, Dr Aneke investigated the geotechnical behaviour of unsaturated soils for road pavement structure under cyclic loading on South African pavements using the application of unsaturated soil mechanics, which is an entirely new area of geotechnical engineering. The findings revealed that subgrade soils with a high plasticity index and swelling potential pose uncommon challenges to engineers, and trigger pavement failure. The findings were published in peer-reviewed conference proceedings and accredited journals. His study is well researched, with a novelty contribution to the body of knowledge.

Dr Eltony Mugomeri
draped by the Registrar, Dr Pinky Nothemba Mrwetyana at the graduation ceremony
Doctor of Health Sciences in
Biomedical Technology

Promoter: Prof. WMJ van den Heever-Kriek, PhD (UFS), Co-promoter: Dr D Olivier, DTech (CUT)

Dr Mugomeri's topic: "Isoniazid preventive therapy for tuberculosis occurrence in HIV-positive patients in Lesotho"

His doctoral study evaluated the effectiveness of isoniazid preventive therapy (IPT), and the durability of such effectiveness for tuberculosis occurrence in HIV-positive patients in Lesotho. His major finding was that IPT was effective when administered within one year of commencing antiretroviral therapy, with efficacy declining after four years, highlighting the need for IPT-booster doses. Challenges affecting the implementation of IPT were linked to health system factors, emphasising the need for a comprehensive health systems approach to the implementation of IPT in Lesotho. His work accrued three publications in reputable journals, was presented at the International AIDS Society Conference in the Netherlands (AIDS 2018), and informed the Southern African regional policy on TB prevention in people living with HIV.

Dr Hermanus Lukas Jordaan (L) and Dr Lukas Chipfupa (R)

Doctor Technologiae: Agriculture

Promoter: Prof. Peter Fourie, DTech (CUT), Co-promoter: Prof. Ryk Lues, PhD (UFS)

Dr Hermanus Lukas Jordaan's topic: "Development of a rhino anti-poaching model for game farms and nature reserves in the Free State province of South Africa"

In his doctoral research, he developed a rhino anti-poaching model for game farms and nature reserves in the Free State, South Africa. In order to protect rhinos in the Free State, there is a need to manage the risk of poaching through a practical model that can assist in the effective protection of rhinos. Factors contributing to rhino poaching were identified, and Free State rhino breeders' preparedness for the poaching onslaught was measured. The Rhino Anti-Poaching Model determines current poaching risk, identifies weaknesses on rhino sites, addresses problem areas, enables efficient monitoring, and predicts possible future poaching risks. The study enhances rhino breeders' understanding of the risk of rhino poaching, and the need to enhance their security measures through the effective use of the Rhino Anti-poaching Model. The research findings were submitted to various scientific journals.

Promoter: Dr FV Nherera-Chokuda, PhD (Cornell University),
Co-promoter: Prof. Peter Fourie, DTech (CUT)

Dr Lukas Chipfupa's topic "Vegetation gradients, soil microbial pools and carbon sequestration in cactus-invaded semi-arid rangelands of the Western Free State"

In his doctoral research, he investigated the dynamics of herbaceous and browse forages, soil microbial pools and carbon sequestration in creeping prickly pear (Opuntia humifusa)-invaded western Free State rangelands. These rangelands contribute significantly to red meat production and ecotourism. However, invasive species accelerate rangeland degradation. Although displacement of herbaceous forage species was notable, with higher depletion of soil micro-fauna relative to grass- and shrub-covered areas, organic matter under prickly pears improved, and phosphorus and magnesium levels were higher. Continued decline in rangeland-carrying capacity will negatively impact red meat production in the western zone. The study generates knowledge and creates awareness of invasive species and promotes the rehabilitation of degraded rangelands affected by invasive alien species. The research outputs were published and presented locally and internationally, amongst others at the Australian Rangeland Conference.

Dr Sara Mohammed Hassan Abdalla with her co-promoter, Prof. SS Mashele
Doctor of Health Sciences in Biomedical Technology

Promoter: Prof. K Syed, PhD (SKU), Co-promoter: Prof. SS Mashele, PhD (Medunsa)

Topic: Genome scanning of basidiomycete fungi for cytochrome P450 monooxygenases involved in steroids hydroxylation

In her doctoral research, Dr Sara Mohammed Hassan Abdalla carried out genome data mining and the identification of P450s in 19 basidiomycete species belonging to three different categories. In total, 3 033 P450s were identified in 19 basidiomycete species. The identified P450s were subjected to annotation, phylogenetic analysis and functional analysis to identify endocrine-disrupting P450s in the basidiomycetes.

The study results clearly demonstrated that relatively many P450s were duplicated, suggesting the possible role of these P450 families in the adaptation of fungal species in different ecological niches, as previously hypothesised.

The results were published in two high-impact accredited journals. It is envisaged that her work will have a significant biotechnological application.

Dr Polo-Ma-Abiele Hilda Mfengwana with her promoter: Prof. SS Mashele

Doctor of Health Sciences in Biomedical Technology

Topic: Evaluation of pharmacological properties of traditional medicinal plants used for the treatment of cancer by South African and Lesotho communities

Dr Hilda Mfengwana's doctoral research evaluated the pharmacological properties of *Asparagus laricinus, Gunnera perpensa* and *Senecio asperulus* for the treatment of prostate and breast cancer.

Her study provides insight into the antibacterial and anti-inflammatory activities of these plant extracts, and demonstrated their safety using current and classical cell biology techniques. She also discovered that *Asparagus laricinus* is a suitable aspirant for future breast cancer chemotherapeutic drug development, due to the selective cytotoxicity thereof on cancer cells.

The research findings were presented at national and international conferences, and two articles were published in accredited journals. It is envisaged that her work will have a significant impact in the pharmaceutical industry.

Dr Ernestine Atangana, with her Promoter, Dr TT Chiweshe, (left) and Co-promoter, Dr HA Roberts (right)

Doctor of Philosophy in Environmental Health

Topic: Development of modified biopolymer adsorbents from natural polysaccharides for renewal of abattoir wastewater

Dr Ernestine Atangana's research made a significant contribution to the field of Environmental Health as she developed a novel technique for separating heavy metals from abattoir wastewater using modified biopolymer adsorbents.

Results from this study revealed a high adsorption capacity of alkali and alkaline earth metals using modified shrimp chitosan products, which can be beneficial to the lithium industry.

The method also proved to be specific and effective for the removal of heavy metals from abattoir wastewater, depending on the type of adsorbent used. At least two papers from the research work have already been published in high-impact, reputable international journals.

Dr Mariëtte Fourie with her Promoter, Dr D Selaledi (right) and Co-promoter, Prof. G Schlebusch (left)

Doctor of Education

Topic: Simultaneous impact of juxtaposed learning theories on learner information processing ability for cognitive growth and development

In her doctoral study, a quantitative non-experimental survey method was employed to select samples of learners and teachers from whom information on the dependent variables of the study was collected.

Data collection was administered through questionnaires for learners and teachers, respectively. Data analyses employed inferential statistics using the hierarchical linear model (HLM) and structural equation model (SEM). HLM accounted for variation at multiple levels. SEM provided a holistic understanding of how the four dependent variables are casually connected and mapped.

Dr Mariëtte Fourie then designed a comprehensive and integrated model, MEIPAC, which serves as a valuable depiction of the underlying debates of the study. Four journal articles were extracted from the study for submission, review, and publication in high-impact and accredited national and international journals.

Dr Eben Proos with Promoter, Dr JL Hattingh (right) and Co-promoter, Prof. D Kokt (left)

Doctor of Business Administration

Topic: A tourism development plan for the South African War Battlefields Route in the central Karoo

In his doctoral research, Dr Eben Proos constructed a tourism development plan for the South African War Battlefields Route in the central Karoo. Based on the findings of the study, he identified the need for the development of the route and the establishment of a South African War Battlefields Route Destination Marketing Organisation (DMO).

External assessors indicated that the research is ground-breaking and has the potential to renew academic and private historians' interest.

Furthermore, it was highlighted that the study was an interesting topic, well researched, presented professionally, and contributes substantially to the field of dark tourism and route tourism development in the central Karoo in particular, and in South Africa overall.

Dr Terry Wohlers, CUT Alumnus, keynote speaker and President of Wohlers Associates in the USA, sharing his 30 years' experience in additive manufacturing with the audience at the RAPDASA conference held from 6-8 November 2019.

CUT HOSTS WORLD-RENOWNED GUESTS AT THE 20TH ANNUAL RAPDASA CONFERENCE

From 6-8 November 2019, the Central University of Technology, Free State's (CUT) Centre for Rapid Prototyping and Manufacturing (CRPM) brought together renowned experts in the field of additive manufacturing from around the globe to network and share their knowledge on the technology at the 20thinternational RAPDASA conference in innovation, themed'Creating the Future of Manufacturing – Layer by Layer'.

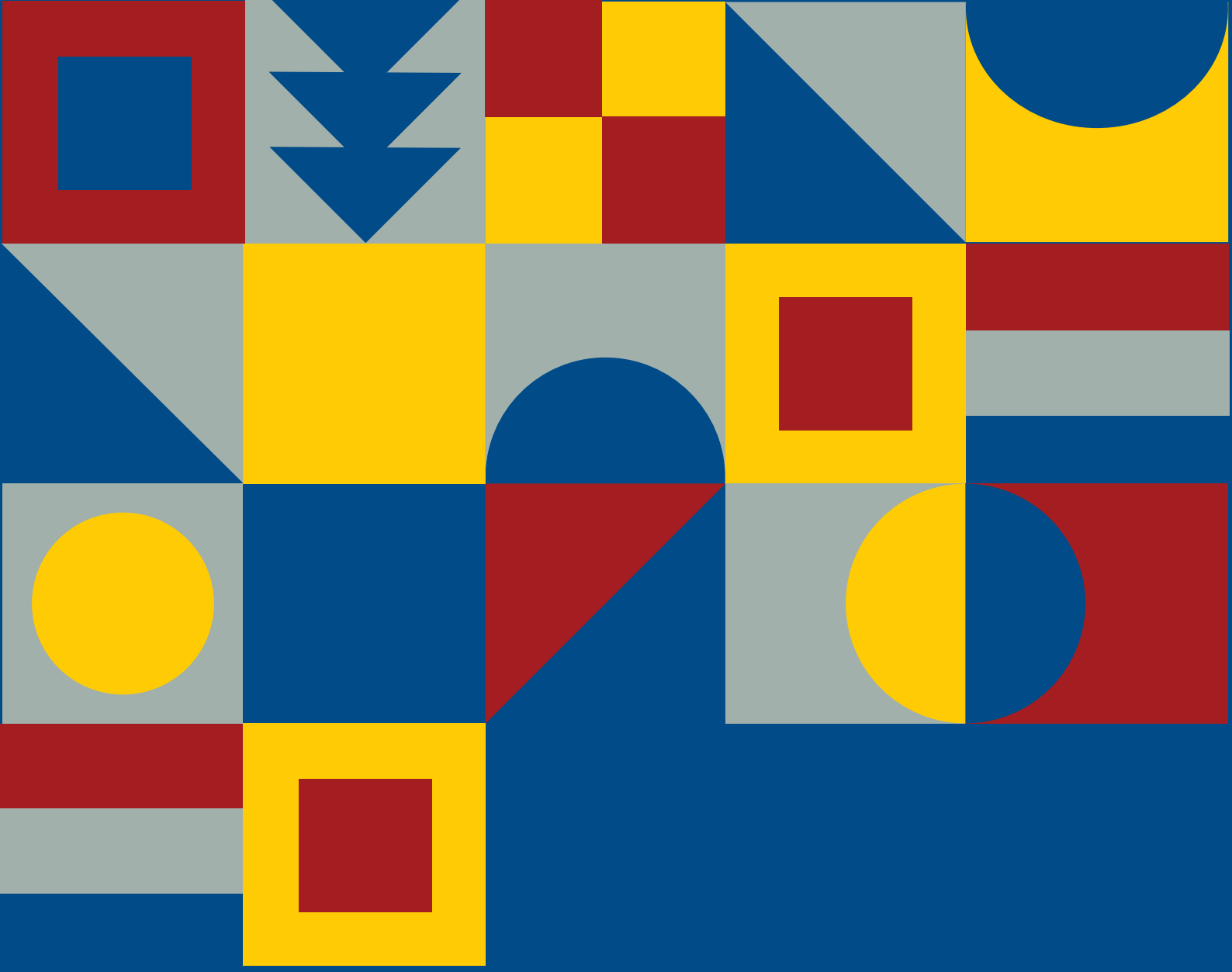
Additive manufacturing (AM) has been active in South Africa for 21 years, and the market has grown significantly over the years. The technology has matured from a prototyping technology into the fully-fledged manufacturing technology and has proved itself in aiding designers and engineers to achieve complexity in design and manufacturing. The conference covered sectors such as Aerospace, Medical and Bio-medical, Automotive, Sport & Leisure and Architecture.

Keynote speaker, Dr Terry Wohlers, President of Wohlers Associates in the USA and CUT Alumnus, said that he started with 3D printing more than 30 years ago and has therefore had the time to learn how to make models, prototype parts and some forms of tooling. "The next frontier is to use it for actual manufacturing, and we have seen a few cases of that in aerospace, medical, power generation, dental, jewellery and some consumer products. The next opportunity in the future is to drive cost out of the machines, drive the speed up and make more types of material but most importantly, lower the cost. If you are not adding value to the product developed, then you probably shouldn't 3D print it because it is going to cost more. You have to add value somehow to justify some of the things you do."

Dr Wohlers is the President of Wohlers Associates, Inc., an independent consulting firm that has been in existence for 31 years. Through this company, Wohlers has provided consulting assistance to more than 260 organisations in 26 countries.

In 2016, he became an adjunct professor at RMIT University in Melbourne, Australia. Wohlers was elected to the SME College of Fellows in 2005 and in 2004, received an Honorary Doctoral Degree in Mechanical Engineering from the Central University of Technology, Free State (CUT).

Other international speakers included Prof. Eric MacDonald from Youngstown State University, who spoke about 3D Printed Bionics: Electronics in Additive Manufacturing Structure, Prof. Alain Bernard from Centrale Nantes, France, Dr Chris Broeckhoven from the University of Antwerp in Netherlands, Mr Ravi Kunji from Altaic USA, Prof. Markus Glasser, Senior Vice president of EOS, Mr Olivier Diegerick, Portfolio Development Executive at Siemens PLM, Prof. Amir Zadpoor from Delft University of Technology, Netherlands, Prof. Frank Bruckner from Technische Universitat, Dresden, Germany, Prof. Nataliya Kazantseva from the Russian Academy of Sciences, Russia, and Mr Arno Held from AM Ventures. The company provides technical and strategic consulting services on new developments and trends in rapid product development, additive manufacturing and 3D printing.



RESEARCH IN

TECHNOLOGY & INNOVATION

PART 4

MESSAGE FROM THE CEO: CENTRAL UNIVERSITY OF TECHNOLOGY INNOVATION SERVICES (CUTIS)

During 2019, the CUT filed two provisional patent applications along with one South African complete patent application. One design application and two trademark applications were also filed as a way of broadening the university's protection of intellectual property emanating from research activities.

Getting closer to commercialisation are two projects, one a board game (VALU-E) for entrepreneurship education, developed by the Faculty of Management Sciences and Aalen University (Germany), and the other a beer fermentation technology developed by the Centre for Applied Food Security and Biotechnology (CAFSaB), a centre that has been developing a range of award-winning beer brewing recipes over the last few years. A developed commercialisation plan recommended the licensing of the intellectual property as the optimal route for commercialisation and a local potential licensee has been identified.

CUTis is also assisting with commercialisation of several projects that have huge potential to change the social and economic wellbeing of people. These include the 3D printing of medical devices (implants and patient-specific surgical guides for medical, dental and spinal applications), the local manufacturing of affordable rugby wheelchairs by disabled people, and a hospital bed with a wireless, radio communication and reporting system particularly for the disabled patients.

As universities across the world are envisioned to generate greater social and economic impact, CUTis is driving the institution's application to become an accredited entrepreneurial and engaged university with the Accreditation Council for Entrepreneurial and Engaged Universities (ACEEU).

The Innovation & Technology Transfer section of CUT Innovation Services (CUTis) comprises of the following functions that support the university's research and academic community:

- Idea Generator (iGYM) – promotes a culture of innovation and entrepreneurship amongst the university community, and creates a platform for identification and nurturing of student entrepreneurs.
- Fabrication Lab (FabLab) – offers prototyping equipment services to enable anyone at any age to turn their idea into reality using digital design, 3D printers, laser cutting and other advanced technological means.
- Technology Transfer Office (TTO) – promotes the identification, management and commercialisation of intellectual property emanating from CUT research and development activities.
- Incubation Support – provides start-up businesses with entrepreneurial support, infrastructure, mentorship, advice, and resources to help the startups succeed and grow.

Mr Gcobane Quvile
CEO
Central University of Technology
Innovation Services (CUTis)

Key highlights for the 2019 academic year

THE 2019 INNOVATION WEEK

Eighteen Welkom CUT students presented seven ideas on 15 August and the top ones were invited to the main Student Day Challenge of Innovation Week at the Bloemfontein campus on 3 September 2019, where eighteen ideas were pitched by 35 students.

On 4 September, the Staff Day Challenge of Innovation Week was held, and twelve ideas were pitched by nine staff members. The Innovation Week Finale was held on 5 September, when the three finalists of each of challenge competed for the grand prize of R15 000.

In the student category, Mr Gareth Gericke was the overall winner for his innovative idea of an Internet of Things (IoT) Water Monitor. He walked away with the R15 000 cash prize to further develop his idea, plus a fully paid trip to SLUSH 2019. SLUSH is the world's biggest start-up event held in Finland every year, bringing together about 25,000 curious minds, including 4,000 start-ups and 2,000 investors from all around the globe. At SLUSH, Gareth's project attracted the interest of a Dutch agency, which is willing to assist in creating the start-up company in the Netherlands, and also a US technology incubator, which encouraged him to apply for a start-up programme to accelerate the technology development.

Mr Jared McIntyre, wheelchair rugby (seated front row), Back row from left: Dr Kerry Faul, Head of NIPMO, Prof. Henk de Jager, Vice-Chancellor and Principal, Ms Thamaray Govender, TIA, and Mr Teboho Steven Oupa Mohoje, Toyota Cheetahs and Springbok rugby player

THE 2019 WORLD IP DAY (NATIONAL ANNUAL CELEBRATIONS)

CUTis hosted the 2019 WIPO IP Day in partnership with the Companies and Intellectual Property Commission (CIPC), the Department of Science and Technology (DST), the Department of Trade and Industry (Dti), the Small Enterprise Development Agency (SEDA) and the Technology Innovation Agency (TIA). The CUT hosted the media launch on 15 April 2019, at the Hotel School where several local media houses were present. Acting VC (Professor Ngidi) officially opened the media launch. Executives from all the partner institutions offered messages of support for the event. On 25 April, the CUT and its partners held a roadshow at Bloem Plaza Mall to promote the role of intellectual property in the sports industry. This roadshow was an effort to reach out to the community of Mangaung. On 26 April, the CUT hosted the World IP Day event at the Boet Troskie Hall. The 2019 theme was *"IP in Sports – Going for Gold"*. The theme explored how innovation, creativity and the IP rights that encourage and protect them support the development and enjoyment of sports across the world. VIPs that graced the occasion included Teboho Oupa Mohoje (Toyota Cheetahs and Springbok rugby player). The target audience included high school learners, CUT and UFS students, university researchers, SMEs, innovators and the general public.

NIPMO INCENTIVES FOR INTELLECTUAL PROPERTY (IP) CREATORS

In March 2019, NIPMO launched an incentives programme for intellectual property (IP) creators in an effort to promote the translation of R & D outputs into products, processes and services that are of benefit to society. Professor Ihar Yadroitsau was recognised as the top IP creator from the CUT and received a certificate of acknowledgement at the Awards evening that was held on 28 March 2019 in Midrand. The TTO has received a financial award to advance his IP along the innovation value chain.

INNOVATION COACH TRAINING WITH JAMK UNIVERSITY OF APPLIED SCIENCES

CUTis organised a training for innovation coaches from 8-12 April as a staff development activity with facilitators from JAMK University of Applied Sciences (Finland). This teacher-to-coach training covered the innovation process, design thinking tools, creativity in organisations, entrepreneurial skills and how pedagogical solutions can help the learner, value creation pedagogy, value creation as educational practice, basic pedagogical tools etc. Check-in meetings have been going on since then to ensure that there is implementation of what participants learned in their faculties and departments. A pathway was developed as a guide for innovation coaches to ensure there is a clear pathway for development of ideas before they are channelled to the Idea Generator for validation.

STUDENT ENTREPRENEURSHIP TRAINING IN IRELAND

CUTis facilitated the participation of Ms Mudau Mukonanyi to attend the *Skills Training for Emerging Entrepreneurs* from 13-17 May 2019 in Ireland. This training was organised by SATN through grant funding acquired from TIA. The training was an effort to recognise the top student entrepreneurs across the universities and afford them an opportunity to hone their entrepreneurship skills through a SAQA credit bearing entrepreneurship course.

INNOVATION COACH TRAINING WITH LAPLAND UNIVERSITY OF APPLIED SCIENCES

The following four innovation coaches were selected, one from each faculty, to attend further training at Lapland University of Applied Sciences (Rovaniemi), Finland: Mr Shola Ojo – Design & Studio Department (Faculty of Humanities), Mr Lebogang Mogongoa – Biometrics Department (Faculty of Health & Environmental Sciences), Ms Mpho Mbele – IT Department (Faculty of Engineering, Built Environment and IT) and Mr Jacques Ras – Tourism Department (Faculty of Management Sciences). The training took place from 28 October to 1 November 2019 and covered the following: pre-training analysis, general look at the philosophy behind Finnish UAS education, entrepreneurial education in Finnish UAS (policy and practices), entrepreneurial education in Lapland UAS (practices and framework), benchmarks and how to implement Lapland UAS's entrepreneurial model in the CUT context.

WIPO SOUTH AFRICA ADVANCED SUMMER SCHOOL ON INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER

For the second consecutive year, CUTis partnered with the World Intellectual Property Organization (WIPO), the National Intellectual Property Management Office (NIPMO) and the Companies and Intellectual Property Commission (CIPC) to run the 2-week Summer School on Intellectual Property & Technology Transfer from 25 November to 6 December 2019. The objective of the Summer School was to provide an opportunity for professionals from across the globe to attain deeper knowledge about intellectual property, and to gain an appreciation of intellectual property as a tool for economic, social, cultural and technological development. This was the 11th Summer School in SA, and the second time that it was being hosted in the central region of South Africa. So, this was a remarkable activity as it ties in well with our university's vision to be an engaged university. Over 100 applications were received but the eventual attendance was 43 due to many applicants not being able to attend due to various reasons e.g. late issuance of visas, and fearfulness brought about by the xenophobic attacks that took place in last quarter of 2019.

SATN ENTREPRENEURSHIP TRAINING

SATN provides various training platforms for studentpreneurs across the world for its South African partner universities. These annual training platforms are aimed at upskilling the student entrepreneurs with the necessary tools to venture into the world of entrepreneurship well prepared. During the week of 13-17 May 2019, our studentpreneur, Ms Mudau Mukonanyi, was sent to Ireland on *Skills Training for Emerging Entrepreneurs*, accompanied by Prof. Dzansi. Continuing with these efforts, SATN organised another Skills Training for Emerging Entrepreneurs which took place from 7- 11 October 2019, at the Maharani Hotel. Seven of our students and one lecturer attended this training: from FEBIT: Mr Sibulele Tyala, Mr Junior Khumalo, Mr Lesedi Kubatsi, Mr Elton Mokoduwe, Ms Fumane Phuthi, Ms Tseleng Matlokotsi and from FMS: Ms Masello Mokhoro, and lecturer, Mr Ephraim Tshobeka.

EDHE ENTREPRENEURSHIP INTERVARSITY COMPETITION

CUTis in partnership with the Centre for Innovation in Learning and Teaching (CILT) drove this initiative. Thirty-three applications were received and internal round selections were done to select those students who will participate in the final rounds. Four CUT students qualified for the regionals. The CUT hosted the regional Intervarsity Competition on 8 August 2019, and four finalists from the region emerged from this process including our own Mr Sibulele Tyala. Sibulele then attended the finals (nationals) at Southern Sun, OR Tambo Int. Airport on 18-19 Sep 2019.

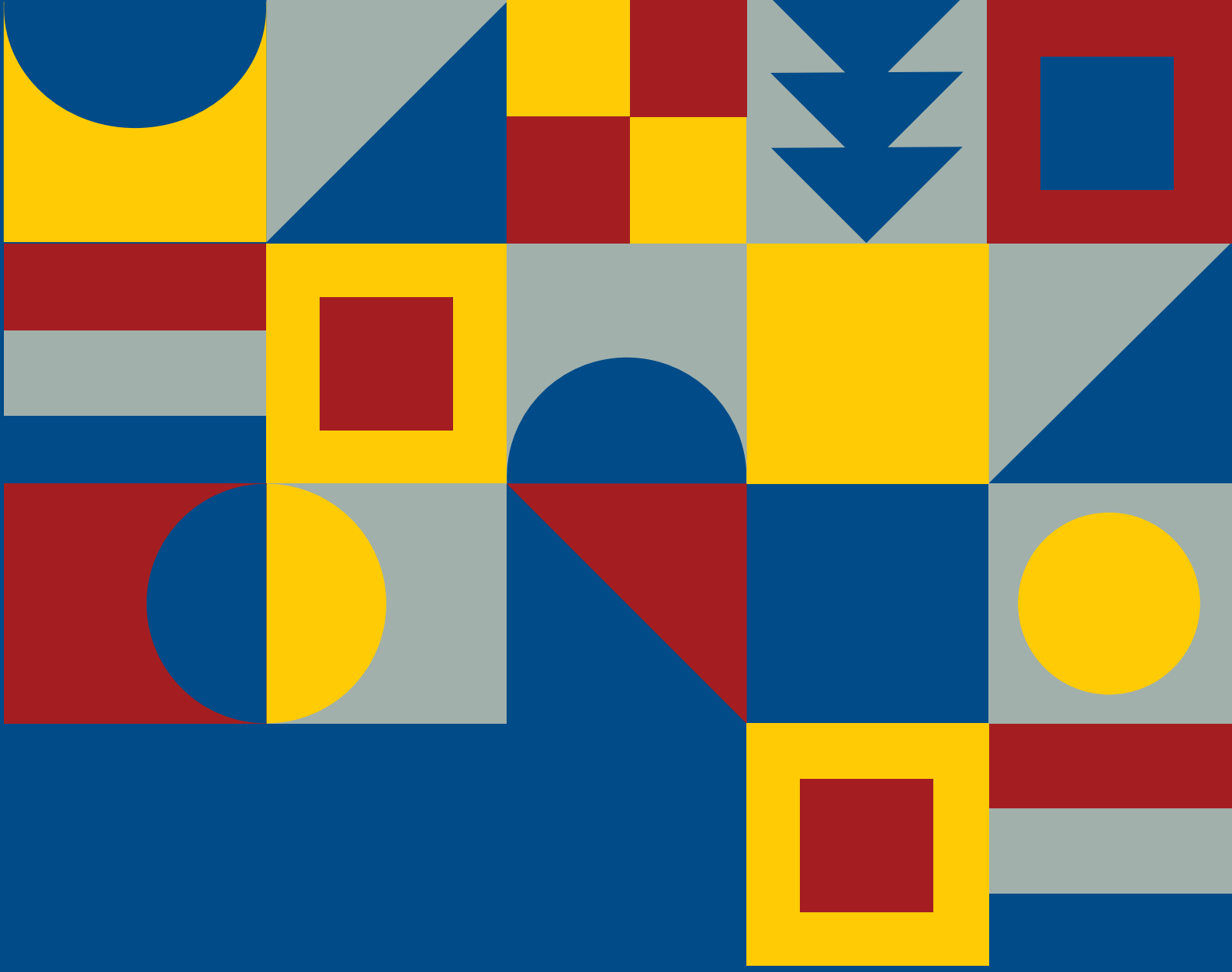
2019 INNOVATION BRIDGE TECHNOLOGY MATCHMAKING AND SHOWCASING EVENT

The CUTis participated in the 2019 Innovation Bridge Technology Matching and Showcasing Event which took place at the CSIR International Convention Centre from the 4-6 December 2019.

The aim of the event was to encourage and accelerate the utilisation and commercialisation of existing and new knowledge and technologies that have been developed by publicly funded South African research and technology development institutions. For CUTis, this event provided an opportunity to showcase our CUT-developed technologies and seek technology development partners, licensing and investment opportunities. The three technologies exhibited were:

- Mary Loo/Multiwalking Frame
- DONNER Carbon Fibre Reinforced Nylon Drumsticks
- Wall Socket

The walking frame attracted the most interest with some enquiries on when it will be available on the market. TTO will follow up on the contacts obtained.



FACULTY

ENGINEERING & NFORMATION TECHNOLOGY

PART 5

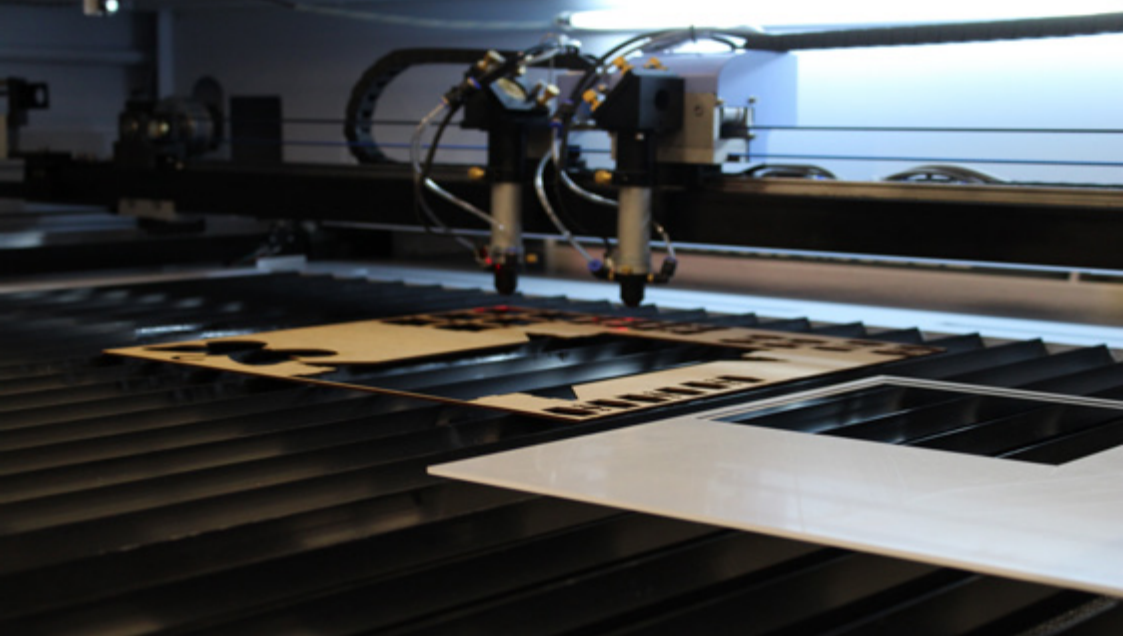
A MESSAGE FROM THE DEAN – PROF. H VERMAAK

The vision of the Central University of Technology, Free State (CUT) places a significant emphasis on socio-technological innovations, primarily in the central region of South Africa. The faculty is working towards the Global and National Sustainability Development Goals. In particular, but not limited to the harvesting, storage and management of clean water, to search for alternative and renewable energy sources and using green and sustainable infrastructure. FEBIT, in collaboration with international universities, is currently focusing on the implementation and challenges of Industry 4.0 and already has a number of projects within this environment. The vibrant research culture, with more staff involved, is bearing fruit, and several joint multi-departmental and even multi-faculty projects have been initiated. The challenge however is to build capacity for study supervision and to enrol more full-time postgraduate students.

The increase in the research outputs of the faculty is consistent and is a testament to the evolving positive inquiring culture where established scholars mentor early career academics in the faculty. The research culture in the faculty thus facilitates the coming together of new ideas addressing the needs of the society and global challenges. The positive collegial atmosphere in the faculty supports the realisation that the quest for knowledge is a frontal attack on industrial and societal problems, thereby ensuring the relevance of research, innovation and engagement activities in the faculty. The CRPM and Sustainable SMART City Research Centres in the faculty are adeptly responding to socio-technical needs of today through pragmatism, which is about solving problems with all available tools in various disciplinary spaces.

FEBIT has shown what is possible with hard work and commitment in its research outputs and performance. The faculty has exceeded all expectations and produced more research outputs of higher quality than ever before. The research of FEBIT staff has made a global impact and postgraduate students have outstanding research experience. Staff are provided with the opportunity for a lifelong engagement with research, thereby improving their research productivity.

Prof. H.J. Vermaak
Dean
Faculty of Engineering
and Tnformation
Technology (FEIT)



A MESSAGE FROM THE ASSISTANT DEAN – PROF. Y WOYESSA

The Faculty of Engineering, Built Environment and Information Technology has gone from strength to strength in meeting its strategic goals and in the implementation of the University's Vision 2020. In 2019, the Faculty registered significant achievements in terms of publications and postgraduate throughput. Staff participation in research has also increased significantly. The faculty, through its six departments, has adopted a strategy of encouraging young and upcoming staff members to get involved in research through mentorship by senior members of the faculty.

The year 2019 has also been the year of realignment of research entities and establishment of a new research centre. In the wake of the establishment of the Centre for Sustainable SMART Cities (CSSC) in 2019, the old research entities, namely research groups and research units, were dissolved, paving the way for the emergence of the new centre. In 2019, there was an increased effort to identify projects that fit with the main aims of the CSSC. Those projects. which were identified to be aligned with the main aims of the CSSC, were approved for seed funding from the faculty and are showing significant progress. It is believed that the establishment the CSSC together with the research arm of the CRPM will give the faculty an edge in its endeavour to solve societal problems and to produce graduates with enhanced problem-solving skills.

Prof. Y Woyessa
Assistant Dean: RIE
Faculty of Engineering
and Tnformation
Technology (FEIT)

SARCHI CHAIR: PROF. I YADROITSAU

Prof. Ihar Yadroitsau (Igor Yadroitsev) was appointed Research Professor at the Central University of Technology, Free State (CUT) on 1 January 2014. His background includes PhD and MSc degrees in laser physics and optics along with 30 years of academic experience in applied optics and laser technologies (selective laser melting/sintering, laser cladding, interferometry and optical monitoring systems, materials science). Prof. Yadroitsau has a strong interdisciplinary background and broad experience in the fields of Physics and Engineering which allows him to comprehend thoroughly scientific and technical problems with the purpose of finding original solutions in different fields of laser applications. It should be specially mentioned that Prof. Yadroitsau has produced more than 200 scientific publications (1 book, 3 chapters in books, over 200 manuscripts in peer-reviewed journals and conference proceedings and 11 patents). His *H*-index of citation is 24 (cited 3419) in Scopus and 31 (cited 5378) in Google scholar, as well as i10-index – 57 and i100-index – 16, respectively. Prof. Yadroitsau is an NRF-rated researcher (C1). In August 2015, the CUT was awarded a Research Chair under the NRF South African Research Chairs Initiative (SARChI). The goal was to increase research output and innovation in areas that are considered essential to the country's strategic growth and development. Prof. Yadroitsau was appointed to the SARChI Chair in Medical Product Development through Additive Manufacturing. At the end of 2019, according to the results of the successful completion of the first cycle, the SARChI grant was renewed for another 5-year cycle (2020-2024).

Under the Research Chair initiative, a metallographic laboratory for the study of material properties was created in 2015 and was moved to a new building in 2016. In addition to already purchased equipment from 2014-2018, the following equipment was added in 2019: a Vision Research High-Speed camera PHANTOM VEO- E 310L. Licenses for Mimics and COMSOL Multiphysics software were purchased. Mimics is software specially developed by Materialise for medical image processing. COMSOL Multiphysics is a general-purpose simulation software for modelling designs, devices, and processes in all fields of engineering, manufacturing, and scientific research.

Prof. Yadroitsau has supervised twenty-one masters' and four doctoral students as well as three postdoctoral fellows in Engineering. Their studies were devoted to additive manufacturing, selective laser melting, residual stresses, heat treatment and mechanical properties of additive manufacturing objects, non-destructive testing and medical devices.

In 2019 Prof. Yadroitsau, in cooperation with other researchers from the RSA, Sweden, France, USA, Australia and Russia, published one chapter of the book *Titanium for Consumer Applications. Review of the use of Titanium within the Consumer Industry*, 8 articles indexed in Scopus, and 13 conference proceedings. Prof. Yadroitsau participated in a number of scientific seminars in South Africa, Russia, USA and Canada.

Prof. I Yadroitsau
SARCHI chair
Faculty of Engineering
and Tnformation
Technology (FEIT)

CPAM (THE COLLABORATIVE PROGRAMME IN ADDITIVE MANUFACTURING) CHAIR: PROF. WB DU PREEZ

Additive manufacturing (AM) is globally accepted as a key technology in the 4th Industrial Revolution. The Central University of Technology, Free State (CUT), through its Centre for Rapid Prototyping and Manufacturing (CRPM), has established itself as the leading South African university in the research, innovation and commercialisation of AM of customised medical implants and surgical guides. To a large extent, this research has been made possible through the funding support of the Department of Science and Innovation (DSI) for the national Collaborative Programme in Additive Manufacturing (CPAM). From 2015 to 2020, DSI supported the CUT with R17.1 million for its role in the national CPAM programme. The CPAM is the primary implementation programme of the national South African Additive Manufacturing Strategy (published in 2016 at www.rapdasa.org). CPAM has four sub-programmes and the CUT-CRPM contributes to all of these.

A key aim of CPAM is to achieve full acceptance of AM by the South African manufacturing industry as technology that can improve productivity and competitiveness. To achieve this, the reliability, reproducibility and sustainability of AM must be proven to industry. Credible research data must be generated and published to prove that parts produced through AM can fully comply with the accepted international standards for material, physical, chemical and mechanical properties of such parts. The two sub-programmes of the CPAM on *Qualification of Additive Manufacturing of Ti6Al4V for Medical Implants and Aerospace Components* and *Polymer Additive Manufacturing*, are designed to reach these goals. Through AM process control and control of qualified post-AM processes, a qualified process chain for production of titanium medical implants, supported by validation data generated through research on these processes and products, has been established since 2015. In 2019 two peer-reviewed journal articles and one peer-reviewed conference paper were published on the qualification of medical implants produced through AM in a titanium alloy. Under the ISO 13485:2016 quality management system of the CRPM, qualified and certified customised medical implants are now produced. On-going research is aimed at further improving the in-depth insight in the performance of the AM produced parts under more severe dynamic operational conditions, which would enable qualification of structural aerospace components. Towards achieving this goal, research by three doctoral and one master's student was initiated in 2019.

In addition, the CPAM research is aimed at demonstrating the benefits that can be derived from the characteristics of AM. This research is focused on establishing approaches and procedures that will substantiate the key benefits of AM, namely design freedom, more productive and faster product development, improved efficiency over conventional manufacturing, AM as green technology and empowerment of small and medium enterprises. These outcomes are pursued by the *Design for Additive Manufacturing* sub-programme of the CPAM.

Cowries printed in platinum by CRPM

The fourth sub-programme of the CPAM, *Industry Development*, focuses on creating awareness in industry and with the general public, of the power of AM. It provides the platform for close collaboration with the South African industry in transferring the AM technology to industry, thereby contributing to its competitiveness in the 4th Industrial Revolution. During 2018, funding support of R2 million was secured from the DSI for the establishment of a *Chair in Innovation and Commercialisation of Additive Manufacturing* at the CUT. This chair complements the existing CUT chair in *Medical Product Development through Additive Manufacturing* and the CPAM by specifically focusing on the so-called "Valley of Death" in the product development cycle and by developing and implementing approaches, procedures and tools to span the "innovation chasm". Insights gained through the work of this chair and its deliverables are of value not only to the CUT, but also to the wider South African AM community and to various industry sectors. Collaborators that are supporting this chair are the Manufacturing, Engineering and Related Services Sector Education and Training Authority (merSETA) with R6 million over three years, and Vaal University of Technology with R800000 per year. Prof. Deon de Beer, the chair holder since September 2018, has been leading this focus area. An exciting initiative in this area is the research aimed at adding value to South Africa's abundant natural resource of platinum group metals (PGMs) through additive manufacturing of platinum and PGM alloys. The CUT is a shareholder with Vaal University of Technology and North-West University in PlatForum (Pty) Ltd. The commercial player in this venture is the mining company Sibanye-Stillwater. Following on the initial demonstration of the CUT's ability to develop process parameters for AM of platinum jewellery, PlatForum is now exploring AM of PGM-based industrial products.

Outputs delivered by CPAM in 2019 were 12 peer reviewed journal articles, 22 peer reviewed conference papers, and 2 technology demonstrators. This research programme supported 20 masters' and 11 doctoral students, as well as a postdoctoral fellow, with a further 6 master's students who graduated with MEng degrees in 2019.

CPAM NATIONAL WORKSHOP

The aim of this national workshop was to engage with stakeholders, especially private companies, on the proposal to the Department of Science and Innovation (DSI), requesting further funding for the CPAM for 2020 to 2023. A total of 72 people, of whom 37% were from South African small enterprises, participated enthusiastically in this hands-on workshop. Participants had the opportunity to make inputs on improvements to the current focus areas of the CPAM, as well as to suggest areas that should be added to improve the impact of the programme. A general conclusion was that, while there was much that was going well in CPAM, there were also areas for improvement, notably the need to more efficiently convert R & D into commercial products, to be more effective with marketing and communicating the programme, and to find ways to better expose students to industry. It was also concluded that the impact of CPAM in industry could be improved by enabling stronger industry leadership, introducing new education and training approaches (to improve student exposure to industry), improving communication with the industry, and supporting industry-wide interventions which strengthen and develop the industry. Consensus was reached on five potential additions to the CPAM programme. The funding proposal was submitted to the DSI at the beginning of 2020.

Prof. Laetus Lategan, Senior Director: Research and Postgraduate Studies, addressing academics on the importance of responsive research that will make impact on communities

22ND ANNUAL RESEARCH SEMINAR: ACADEMICS, BUSINESS AND INDUSTRY SHARE IDEAS ON HOW THEY CAN BE RELEVANT IN THE 4TH INDUSTRIAL REVOLUTION

The Faculty of Engineering Built Environment and Information Technology (FEBIT) hosted its 22nd Annual Research Seminar on 17 October 2019. The seminar brought together researchers, engineers and scientists from academia and industry under one roof to exchange ideas on the latest developments in engineering and information technology. This year, FEBIT launched the Centre for Sustainable SMART Cities (CSSC).

Speaking about the 4th Industrial Revolution (4IR), Prof. Fidelis Emuze, Acting Dean of FEBIT at the time, emphasised that as a university of technology, the CUT does not want to fall behind. He indicated that even though the engineering faculty has its traditional disciplines, it has gradually moved beyond them to advance into the 4IR.

He further mentioned that this move is making borders between certain disciplines unclear and that is why the Centre for Sustainable Smart Cities (CSSC) has been developed, which will focus not only on one social development goal, but on all seventeen of them to avoid future challenges. He encouraged the industry members to have an open mind so they can appeal to their reason, which is the motor of enlightenment.

Prof. Yali Woyessa, Assistant Dean for Research Innovation and Engagement (RIE), explained that, if they are to remain relevant, academics and industry members should take a leading role in transforming the world by developing knowledge and skills by adapting themselves to the 4th Industrial Revolution.

He also touched on the country's burning issues such as population increase, energy crisis, food shortage and water scarcity.

"The demand and supply ratio of resources is out of balance and without innovations, we are going to deplete the planet faster that we can imagine. As engineers, we are best positioned to bring solutions to our societal issues." said Prof. Woyessa.

In his address, Prof. Laetus Lategan, Senior Director: Research and Postgraduate Studies, said that industry members, students and academics need to be responsive to what is happening in the world of business and industry and to know the research agenda of the government and the country, because ultimately, there is an end user for the products or services they offer.

He mentioned the CUT's six new centres with commonalities, highlighting that "although the respective centres are accommodated in different faculties, the idea is to work across faculties because the societal issues are far too complex for one discipline to have all solutions. Involving other professions in research will help broaden the respective professions which, as a result, will make graduates more employable and competitive in the job market." He appealed to researchers to be competitive in the South African research environment.

6TH FEBIT RESEARCH CULTURE WORKSHOP HELD TO ENCOURAGE APPLIED RESEARCH FOR RELEVANCE AND SOCIETAL IMPACT

Applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. With the Fourth Industrial Revolution (4IR) already upon us, we need to align our research to the Sustainable Development Goals (SDGs), and use the right technologies to solve the modern world's practical problems.

In terms of academic research outputs, and as a university of technology, the Central University of Technology, Free State (CUT) contributes significantly in this regard. All research programmes are aimed at solving problems in business, industry and government, in order to contribute to the socio-economic development of the region.

From left: Prof. Laetus Lategan, Senior Director: Research and Postgraduate Studies; Dr Mlungisi Cele, Acting CEO: National Advisory Council on Innovation (NACI); Prof. Muthoni Masinde, Head of the Department of Information Technology; Prof. Alfred Ngowi, Deputy Vice-Chancellor: Research Innovation and Engagement; Prof. Yali Woyessa, Assistant Dean: Research Innovation and Engagement and Prof. Herman Vermaak, Dean of the Faculty of Engineering, Built Environment and Information Technology

On 2 October 2019, FEBIT held its 6th Annual Research Culture Workshop themed "Steering research for relevance and societal impact". The main objective is to instil a culture of research amongst academic researchers, with much emphasis on applied research, to find solutions and develop innovative technologies that will impact on the economic development of the city, the region, and beyond.

Prof. Alfred Ngowi, Deputy Vice-Chancellor (DVC): Research Innovation and Engagement, said that he would like to see pockets of world-class research with national and international partners taking place at the CUT. He also spoke about three avenues for the CUT's research impact, including a balance between basic and applied research, high-impact journals, and multidisciplinary research centres. "We cannot avoid basic research, but we need to focus more on applied research if we want to tackle real issues. Excellent research leads to a better society and the economy. By leveraging the 4IR, we can come up with multidisciplinary research methods that will benefit this region."

In his keynote address, Dr Mlungisi Cele from the National Advisory Council on Innovation (NACI) discussed the South African Innovation System and the role of universities. He focused on the context in which knowledge production occurs, identifying matters that require a sense of urgency to ensure that South Africa does not lag behind. He said that South Africa is characterised by unequal development, as well as an increasing demand for improving the quality of life and well-being of South Africans. In this broader context, he mentioned multiple societal challenges – a concept that is now used globally in the Science, Technology and Information (STI) policy discourse.

He also said that non-governmental organisations and civil society had not been included in research or innovation practices in the past, but that now they cannot be excluded. "As academics, we can no longer set research agendas without the inclusion of the beneficiaries or the users. At the heart of an innovation policy, it must be what humanity needs, and not what we traditionally did to come up with solutions, and thereafter go to societies and present them with solutions for their problems."

"It is important for us to think what innovations or technological solutions we should be developing to transform the situation of our people. As a country, we need to have more Research and Development-led industries that may help us to stimulate or generate more resources of economic growth. We also need to improve the competitiveness of industries and firms, and I was happy to see that the CUT is doing well in 3-D printing."

Dr Cele also indicated that South Africa is not doing well in terms of the global innovation competitive index. "Our firms are not competitive, and part of the reason is that they are not innovative. The question is: What is it that the CUT can do to address these challenges related to manufacturing? We need to use our innovation to support small, micro and medium enterprises (SMMEs), as the future of our economic growth depends on them to properly function and ultimately produce. We need to improve and upscale the grassroots of innovations, and if you want to be relevant as the CUT, you need to have initiatives that are aimed at supporting these innovations, which are those found in townships, rural areas and informal settlements. We need to support government's decision making, so that we are not always criticised", he concluded.

POST-DOCTORAL FELLOWS

Dr MO Oladokun

Dr Michael Oladokun is a post-doctoral research fellow in the Department of Built Environment, Faculty of Engineering and Information Technology, Central University of Technology, Free State, Republic of South Africa and also a senior lecturer in the Department of Building, Faculty of Environmental Studies, University of Uyo, Nigeria.

The aim of his study is to develop a model of energy consumption and carbon emissions in South African dwellings with a view to improving the understanding of the complex nature of energy consumption and carbon emissions in dwelling by providing a system dynamics model to policy makers for testing different energy policy strategies in South Africa. The following specific objectives are set in order to fulfil the aim of this research: 1. To identify the variables influencing energy consumption and carbon emissions in South African dwellings. 2. To establish the causal relationships among the variables influencing energy consumption and carbon emissions in South African dwellings. 3. To develop a model of energy consumption and carbon emissions within the South African dwellings. 4. To use the developed model to evaluate the effects of energy policies on energy consumption and carbon emissions within the South African dwellings.

Dr LT Stephen

Dr Stephen is a post-doctoral fellow in the Department of Electrical, Electronic and Computer Engineering, Faculty of Engineering, Built Environment and Information Technology.

His research project is undertaken in the field of smart energy conversion systems with a special focus on energy efficiency and renewable energy technology in the domain of sanitary hot water heating. The research will employ the design and installation of an innovative residential hybrid solar assisted air source heat pump water heater. A remote communication data acquisition system will be designed to monitor the operational performance of the proposed technology. Furthermore, both a thermo-fluid physics-based model and a machine learning (artificial neural network) model will developed and used to predict the energy performance of the proposed design technology. Finally, a conservative measurement and verification protocol guideline that adheres to the IMPVP standard will be proposed and developed. The proposed measurement and verification guideline will be implemented in a bid to quantify the electricity saving from sanitary hot water production with reference to the electric hot water heater (geyser), standalone solar water heater and residential (split type) air source heat pump water heater.

Dr OM Adeola (Adisa)

Dr Adeola is a post-doctoral fellow in the Department of Information Technology, but hosted by the South African Weather Service (SAWS). She was appointed in September 2019. She recently submitted her first manuscript for a journal article. The article is still under review. She is also in charge of the implementation of the ITIKI Project in Limpopo as well as the integration of ITIKI within SAWS systems.

Dr T Dzogbewu

Dr Thywill Cephas Dzogbewu is a materials physicist in the mechanical field, who has explored the possibility of producing biomedical objects of suitable mechanical properties with antibacterial properties for replacing damaged bone tissue in the human body with significant success. He is a post-doctoral research fellow in the Department of Mechanical and Mechatronics Engineering, Faculty of Engineering, Built Environment and Information Technology, Central University of Technology, Free State, Republic of South Africa. Dr Dzogbewu is currently researching the in-situ allying of different elemental powders for biomedical and engineering applications, surface modification of biomedical objects with nano-fibers and essential oils to enhance osseointegration and to prevent implant infections, financial and marketing models for the commercialisation of 3D products. He published a paper in an accredited journal in 2019 and submitted three additional papers in 2020 which are currently under review. He also co-authored four papers which were published in conference proceedings in 2019. Dr Dzogbewu is co/supervising five master's students and three PhD students

Dr L Mugwagwa

Dr Mugwagwa is a post-doctoral fellow in the Department of Mechanical and Mechatronic Engineering. His post-doctoral study focuses on in situ stress relief for laser powder bed fusion. He published a paper in an accredited journal in 2019 and also submitted a second paper to a journal. He also had a paper published in the RAPDASA 2019 conference proceedings. Dr Mugwagwa assists postgraduate students with their research.

Dr PR Stott

Dr Philip Stott is a post-doctoral fellow in the Department of Civil Engineering, Faculty of Engineering, Built Environment and Information Technology. Dr Stott's post-doctoral research project aims to determine probability density functions for as broad a range of soils as possible and to search for patterns which can lead to better estimation of soil properties for engineering design. The project has now started to look at other kinds of tests for soil properties, and testing procedures have been developed for assessing shear strength and Atterberg Limits. Relatively few different soils have been tested, but the techniques are reaching the stage where a wide range of different soils can be tested with confidence. So far these tests have tended to confirm the suction tests in the general form of probability density function displayed. Three papers on the research covered by this project have been accepted for presentation and publication in the proceedings of the 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering. One paper has been submitted to an international journal and a second is in preparation. A paper dealing with the method being used for this research project was awarded the J.E. Jennings Award for best research paper for 2018.

Research Centres

CENTRE FOR SUSTAINABLE SMART CITIES

As part of the drive in the restructuring of the research activities at the CUT, the Centre for Sustainable SMART Cities was established and officially launched in 2019. 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. This research will be done utilising and exploring the possibilities of the 4th Industrial Revolution. This will provide a platform for multi-, inter- and transdisciplinary (MIT) research that will assist in the preparation of graduates for the 4th Industrial Revolution and the future world of work and will also contribute to the national STI initiatives. Furthermore, the main aim of the centre is in line with the UN's Sustainable Development Goal No. 7 (ensuring environmental sustainability) and by extension, also Goals No. 9 (industry, innovation and infrastructure) and No. 11 (ensuring sustainable cities and communities) of the UN's Sustainable Development Goals. Sustainable development implies economic growth that protects the environment, each reinforcing the other. In the same analogy, sustainable technology is a technology that provides for our current needs without sacrificing the ability of future populations to sustain themselves.

As part of the re-alignment of the existing research activities in the faculty and the drive to generate new ideas for research and innovation, funding opportunities for MIT projects were devised and implemented. In this regard, several new and existing projects have been evaluated, registered and funded by the centre. The following table presents a summary of research projects that are recorded under the centre in 2019.

Prof. Lategan (left) and Prof. Emuze (right) at the official unveiling of the Centre's Logo

Project name	Project description	Project leader	Field
SMART Farm	Development and Implementation of SMART technologies as Technology Demonstration on the CUT Farm	Dr B Kotze	Electrical Engineering
SMART Manufacturing	Design and Development of SMART manufacturing systems implementing new technology and methodology for the 4IR Environment	Prof. H Vermaak	Electrical Engineering
Renewable Energy and Energy Monitoring	Investigation and design of Renewable Hybrid system as well as Energy Monitoring and Optimization systems	Prof. K Kusakana	Electrical Engineering
Assistive Mobility	Design, development and cooperative control of multiple robotic systems to assist patients with mobility impairments	Dr E Markus	Electrical Engineering
Pico solar systems	Performance of Pico solar systems to enhance sustainability	Prof. AJ Swart	Electrical Engineering
Sustainable Aquaponics	Aquaponics to enhance sustainability in food production	Prof. P Hertzog	Electrical Engineering
ITIKI Drought Prediction	Application of Artificial Intelligence in predicting climatic variations	Prof. EM Masinde	Information Technology
Additive manufacturing for organic rankine cycle systems	The development of additive manufactured components for applications in organic rankine cycle systems	Dr G Jacobs	Mechanical Engineering
SMART Soil Engineering	Development of simple, rapid and economic methods to supplement or replace current, unreliable methods of assessing heaving clay, and development of more reliable foundation design procedures	Prof. E Theron	Civil Engineering
Smart Water Leakage project	Implementation strategy for monitoring water leakages in real time by connecting IoT enabled controllers onto the water main lines and automatically/remotely control the water main lines to limit the amount of water wastage	Dr R Kuriakose	Electrical Engineering

Project name	Project description	Project leader	Field
3D printed Humanoid base for smart city research	A humanoid robot is a robot with its body shape built to resemble the human body. The design may be for functional purposes, such as interacting with human tools and environments, for experimental purposes, such as the study of bipedal locomotion, or for other purposes. In general, humanoid robots have a torso, a head, two arms, and two legs, though some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robots also have heads designed to replicate human facial features such as eyes and mouths. Androids are humanoid robots built to aesthetically resemble humans.	Dr N Luwes	Electrical Engineering
Quasi-Isothermal Compressor Development	Renewable energy has become a prominent and viable alternative to conventional fossil fuel based power technologies. One disadvantage of renewable energy is its intermittent nature. Effective and efficient energy storage technologies can help to increase the reliability of renewable energy. One such technology is compressed air storage and liquid air storage systems. Both of these technologies rely on compressors.	Dr G Jacobs	Mechanical Engineering
Electro-hydraulic control system for a collaborative humanoid robot	The project involves the design and implementation of an energy efficient hydraulic-based robotic arm that will be applied in collaborative smart city environment.	Dr E Markus	Electrical Engineering
Waste energy recovery and solar thermal technology	The project involves the design of a smart combined water heating system composed of a solar water heater and an air source heat pump water heater, and the implementation of a remote communication data acquisition system to monitor the performance of the integrated solar assisted air source heat pump water heater. Finally, to develop a modelling methodology to evaluate the performance of the technology via thermofluid and artificial neural network models.	Prof. K Kusakana	Electrical engineering

Project name	Project description	Project leader	Field
Energy management at University campus with emphasize on water heating	The project involves development of measurement and verification methodology and building of simulation application to evaluate the techno-economic viability of retrofitting existing boilers with hybrid solar assisted air source heat pumps.	Prof. K Kusakana	Electrical engineering
SMART Bin	The design and development of a smart monitoring system for waste management.	Prof. B Awuzie	Built Environment
Development of an Adaptive Environmental Management System	Developing air quality monitoring system using WSN and local knowledge for Lejweleputswa District.	Ms Mbele	Information Technology

RESEARCH CENTRE FOR RAPID PROTOTYPING AND MANUFACTURING

The Research Centre for Rapid Prototyping and Manufacturing has continued to grow in national and international stature during 2019, going from strength to strength with most outputs committed to for 2019 surpassed. Increased interest in the field of additive manufacturing ensures a steady flow of postgraduate students approaching the Centre not only from South Africa but also from other countries in Africa.

The CRPM conducts research and development in the following focus areas:

- Additive manufacturing of medical implants and devices, using titanium alloy powders and polymers powders;
- Additive manufacturing of aerospace and renewable energy components;
- Additive manufacturing of platinum group metal powders;
- Additive manufacturing of advanced tooling;
- Additive manufacturing for direct end-use by companies;
- Design for additive manufacturing as cross-cutting enabling competence;
- Commercialisation of additive manufacturing.

The research and development activities in these focus areas align with the DSI funded national *Collaborative Programme in Additive Manufacturing (CPAM),* the NRF/DST SARChI research chair in *Medical Product Development through Additive Manufacturing* and the DSI/merSETA *Chair in Innovation and Commercialisation of Additive Manufacturing.* Following an NRF commissioned review of the achievements of the SARChI Chair in *Medical Product Development through Additive Manufacturing* over the past five years and a site visit, the NRF extended the period of support of the Chair by another five years.

Third stream income secured by the CRPM Research Centre:

- DSI Collaborative Programme in Additive Manufacturing (CPAM). Cumulative income since February 2015: R 16213300 (excl VAT).
- NRF SARChI research chair on Medical Product Development through Additive Manufacturing. Cumulative income since 2016: R 6680000.
- DSI/merSETA Chair in Innovation and Commercialisation of Additive Manufacturing.
  - DSI once-off contribution: R 2000000
  - merSETA contribution: R 6000000 for 2019 to 2021
  - VUT contribution: R 800 000 per year for 5 years, from 2019 to 2023.
- NRF Mexico/South Africa Joint Science and Technology Research Collaboration: R 742127.

Sixteen master's and seven doctoral students were registered for studies in the CRPM Research Centre in 2019. Four of the seven doctoral students were staff members (J Nsengimana, D Kouprianoff, G Moletsane and K Thejane). Six master's degrees were awarded in 2019 to students who completed their studies through the Centre. Dr Ina Yadroitsava and Prof. Willie du Preez both received C2 ratings from the NRF. Prof. Du Preez's rating is effective from 2020.

Prof. Igor Yadroitsev received the Intellectual Property Creators Award. He was identified as the *Top Intellectual Property Creator in Central University of Technology, Free State* for the period 1 April 2011 to 31 March 2018. The Minister of the Department of Science and Technology, Ms Mmamoloko Kubayi-Ngubane, handed over a Certificate of Acknowledgement to Prof. Yadroitsev for his obvious passion in ensuring that his research has practical application and seeks to result in an innovation which can be of benefit to the people of our Republic. In addition, the Office of Technology Transfer at the CUT received a monetary contribution of R 605 000 to assist in driving technologies from intellectual property creation to innovation as a product, process or service with impact.

Prof. Willie du Preez was a finalist of the 2018/2019 NSTF-South32 Awards, in the categories *Lifetime Award* and *Special Annual Theme Award.*

A short course on *Introduction to Materials Science* was presented from 25 to 29 March 2019 to 12 master's students from the CUT. The course covered topics such as Materials for Additive Manufacturing, Material Properties and Microstructures, Phases, and Factors Influencing Mechanical Properties.

In 2019 the CRPM Research Centre hosted the following international researchers:

- Prof. P Krakhmalev, from Karlstad University in Sweden, visited the CUT in May 2019 and delivered a lecture on *Materials engineering and additive manufacturing of titanium alloys.*
- Prof. Nataliya Kazantseva, from the Russian Academy of Sciences in Russia, visited the CUT in November 2019. She participated as keynote speaker in the 20th Annual RAPDASA International Conference and delivered two lectures at the CUT on *Planar defects in TEM images* and *Phase transitions in TRIP steel* after the conference on 11 and 12 November 2019.

Dr Terry Wohlers, internationally renowned expert on additive manufacturing, has attended all twenty RAPDASA annual conferences, with the Vice-Chancellor of CUT, Prof. Henk de Jager (left) and Prof. Deon de Beer, the RAPDASA 2019 Conference chairperson (right)

RAPDASA 2019 PRE-CONFERENCE SEMINAR ON *DESIGN AND ADDITIVE MANUFACTURING OF TITANIUM PARTS*

A record number of just over 80 postgraduate students, researchers and other delegates participated in this seminar on 5 November 2019, hosted by the CUT in the Japie van Lill Auditorium, and organised by the CRPM. Five of the seven student papers were fully peer reviewed, giving the students their first experience of submitting and presenting papers to an international conference. Apart from the questions to the students, the presentations by the three invited speakers evoked some lively discussions. It was clear that the theme of this seminar remains relevant for the research community and industry.

RAPDASA 2019 INTERNATIONAL CONFERENCE

This 20th Annual International RAPDASA (Rapid Product Development Association of South Africa) Conference with its theme: *The future of manufacturing layer by layer – establishing the 3D process chain*, was highly successful and rated among the largest and best attended of its kind over the past 20 years. Under the leadership of Prof. Deon de Beer, the CRPM hosted this event from 6-8 November 2019 at Emoya Estate in Bloemfontein. The conference brought together renowned experts in the field of additive manufacturing from around the globe to network and share their knowledge on the latest technology in this field. Nine international and two local keynote speakers presented stimulating and challenging talks on a broad range of topics within the ambit of the conference theme. Other speakers presented their papers in three parallel streams, drawing good audiences right up to the last session of the conference. One of the key threads throughout the conference was the imperative of positioning to participate efficiently in the 4th Industrial Revolution. The general feedback from most delegates was that they found the technical content of the conference of a high standard and that they thoroughly enjoyed the interaction with their peers.

COMPLETED DEGREES

Master's degrees

Adam, I. (2019). *Design Rules for Conformal Cooling Channels in Plastic Injection Moulds Produced through Direct Metal Laser Sintering of Maraging Steel.* Central University of Technology, Free State.

Allnut, C. (2019). *Estimation of time parameter proportionally ratios in large catchments: case study of the Modder-Riet River Catchment, South Africa.* Central University of Technology, Free State.

Botha, E. (2019). *Establishment of a Database and Knowledge Base for Cables as Possible Input to an Expert System for Electrical Equipment.* Central University of Technology, Free State.

Fondjo, A. (2019). *Characterization of swelling stress and soil moisture deficiency relationship for expansive unsaturated soils.* Central University of Technology, Free State.

Jordan, E.A. (2019). *Modelling of an architecture for local energy generation and distribution with peer-to-peer electricity sharing in a South African context.* Central University of Technology, Free State.

Mafunda, B. (2019). *Developing an Integrated Model for Mobile Learning Usability Evaluation.* Central University of Technology, Free State.

Malefane, L.B. (2019). *Determination of the fatigue properties of Ti6Al4V (ELI) parts built by a Direct Metal Laser Sintering system with standard process parameters followed by post-processing treatments.* Central University of Technology, Free State.

Masana, N. (2019). *Investigation of the viability of an Integrated Cloud-Based Electronic Medical Record (EMR) for Health Clinics in Free State, South Africa.* Central University of Technology, Free State.

Mbele, L.N. (2019) *Utilization of small conduit hydropower generation for domestic loads. Cum Laude.* Central University of Technology, Free State.

Moloabi, T.E.M. (2019). *A tool to assess the success of business intelligence implementation within Free State government departments: Task technology fit perspective.* Central University of Technology, Free State.

Muiruri, A.M. (2019). *Investigation of the high strain rate behaviour and impact toughness of Ti6Al4V (ELI) parts built by the EOS M280 DMLS system with standard process parameters; as built and stress relieved. Cum Laude.* Central University of Technology, Free State.

Newby, E. (2019). *Investigation of in-situ alloying grade 23 titanium with copper by selective laser melting process for biomedical applications. Cum Laude.* Central University of Technology, Free State.

Nkhasi, N.P. (2019). *Effectiveness of Prime Cast® and Poly (methyl methacrylate) additive manufacturing processes to produce patterns for investment casting.* Central University of Technology, Free State.

Pawson, A. (2019). *Establishment of a Wireless Charging Systems for a Battery Operated Automatic Guided Vehicle.* Central University of Technology, Free State.

Pretorius, H. (2019). *Evaluation of pedestrian sidewalk utilisation in residential areas of Bloemfontein City, South Africa.* Central University of Technology, Free State.

Rogers, L. (2019). *Development of an intelligent self-learning product assembly system using visual identification. Cum Laude.* Central University of Technology, Free State.

Shoman, A. (2019). *Internet of Things Based Framework for Public Transportation Fleet Management in Free State.* Central University of Technology, Free State.

Van As, B. (2019). *Tooling through Laser Sintering in Maraging steel for High Volume Plastic Injection Moulding.* Central University of Technology, Free State.

Van der Merwe, C.J. (2019). *Design and development of a low voltage DC domestic power supply* system. *Cum Laude.* Central University of Technology, Free State.

Van Der Walt, A. (2019). *A heuristic usability evaluation of electronic input devices with regard to recording class attendance at universities: case of Central University of Technology.* Central University of Technology, Free State.

Completed doctoral degrees

Koko, S.P. (2019). *Optimal Energy Management Modelling of a Grid-Connected Micro-Hydrokinetic with Pumped Hydro Storage.* Central University of Technology, Free State.

Okorafor, C. (2019). *Retrofitting to reduce carbon emissions from existing buildings in Bloemfontein, South Africa.* Central University of Technology, Free State.

List of national conference papers

Arogunjo E.O., Olatunbosun A. and Markus, E.D. (2019). *Optimal Design of an Energy-efficient Natural Gas Transmission Mainline.* Proceedings of the 27th Domestic use of Energy Conference Cape Town, South Africa March 25-27, 2019, pp. 95-100.

Azege, I.S., Das, D.K. and Awuzie, B.O. (2019). *Identification of Planning and Design Factors Influencing Stakeholders' Acceptance of Public Transport Facility.* Proceedings of the 11th CIDB Postgraduate Conference, University of Johannesburg, 29-30 July 2019. Springer. Cham. ISBN: 978-3-030-26527-4.

Baloyi, N.M., Mendonidis, P., Du Preez, W.B. and Popoola, A.P.I. (2019). *Microstructural influence of tensile and fatigue properties of TI6AL4V ELI direct metal laser sintering produced.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Das, D. (2019). *Appraisal of Construction Site Safety in Building Projects in Indian Cities.* Proceedings of the ARCOSH 2019, Cape Town, South Africa.

Das, D. (2019). *Developing Safety Archetypes for Construction Industry in India by Using System Dynamics.* Proceedings of ARCOSH 2019, Cape Town, South Africa.

Das, D. (2019). *Non-Motorised Transportation for Revitalising the City Centres of South Africa.* Proceedings of the Southern African Transport Conference 2019, Pretoria, South Africa.

Das, D. and Woyessa Y.E. (2019). *Exploring the Relevance of Problem Based Learning in the Universities of Technology in South Africa.* The 13th Multi-Conference on Society, Cybernetics and Informatics, pp. 62-67, ISBH 978-1-950492-13-8.

Emuze, F.A. and Oladokun, M.G. (2019). *Exploring the quality management methods adopted by contractors in fast-track construction projects in Eastern Cape.* Proceedings of the 11th Construction Industry Development Board Postgraduate Research Conference, pp. 337–344, ISBN: 978-3-030-26528-1.

Erasmus, D. and Gopinath, R. (2019). *A review of durability modelling of reinforced concrete structures towards carbonation induced corrosion.* Proceedings of the 13th Built Environment Conference Structures Conference (ASOCSA). Durban, RSA.

Gopinath, R. (2019). *An overview of the influence of shrinkage reducing admixture on the properties of concrete*. Proceedings of the 13th Built Environment Conference Structures Conference (ASOCSA). Durban, RSA.

Honiball, J.E. (2019). *The four determinant factors of vibrant and sustainable public parks*. Proceedings of the 22nd Annual FEBIT Research Seminar. Bloemfontein, RSA.

Kazantseva, N., Krachmalev, P., Yadroitsev, I., Ezhov, I., Merkushev, A. and Davidov, D. (2019). *Comparative analysis of the structure and properties of titanium and cobalt medical alloys manufacturing by 3D printing.* Conference of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Kouprianoff, D., Yadroitsava, I. and Yadroitsev I. (2019). *Acoustic emission for LPBF single track formation at different layer thickness.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Kusakana, M.N., Coetzee, M. and Oke, S.A. (2019). *A Proposed Innovative Framework to Explore the Communication Challenges Between Bloemwater and the Mangaung Municipality*. Proceedings of the IEEE Open Innovation Conference. 2-4 October 2019. Cape Town, RSA. ISBN: 978-1-7281-3463-5.

Langroudi, A.A. and Theron, E. (2019). *Gaps in particulate matters: formation, mechanisms, implications*. Proceedings of the 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering. Cape Town, RSA.

Lesia, R., Gopinath, R. and Kiliswa, M. (2019). *Properties of waste tyre rubber aggregate concrete with cement extenders and geopolymer binders – A review*. Proceedings of 13th Built Environment Conference Structures Conference (ASOCSA*)*. Durban, RSA.

Liphoto, T., and Masinde, M. (2019). *Road Traffic Optimization for Mid-Sized African Cities – Application Fuzzy Algorithms and Computer Vision*. Proceeding of the Open Innovations Conference. Cape Town, South Africa, 2-4 October 2019 (OI). pp. 1-8. IEEE.

Marais, S., Kusakana K. and Koko S.P. (2019). *Techno-economic feasibility analysis of a grid-connected solar PV system for South African residential load*. Proceedings of the International Conference on the Domestic Use of Energy (DUE 2019).

Masana, N. and Muriithi, G.M. (2019). *Adoption of an Integrated Cloud-Based Electronic Medical Record System at Public Healthcare Facilities in Free-State, South Africa*. Proceedings of the ICTAS, Durban, South Africa, 6-8 March 2019. Available on IEEE Xplore Digital Library.

Masinde, M. (2019). *Internet of Things Research & Development: What Will Work for the African Continent?* Proceedings of the Open Innovations Conference, held in Cape Town, South Africa, from 2-4 October 2019 (OI). pp. 1-6. IEEE.

Matete, R., Emuze, F. and Smallwood, J. (2019). *Hazardous Environmental and Occupational Exposures among Mobile Plant Operators in the South African Construction Industry*. Proceedings of the 1st Association of Researchers in Construction Safety, Health, and Well-Being (ARCOSH) Conference. 3-4 June 2019, Cape Town, South Africa, pp. 102-114.

Mbele, L., Kusakana, K. and Koko, S.P. (2019). *Experimental analysis of small conduit pressure hydropower systems*. Proceedings of the International Conference on the Domestic Use of Energy (DUE 2019).

Molefi, M., Markus, E.D. and Abu-Mahfouz, A. (2019). *Wireless Power Transfer for LoRa Low-Power wide-area Networks (LPWANs*). Proceedings of the SAUPEC/RobMech/PRASA Conference, Bloemfontein, South Africa, January 28-30, 2019. pp. 105-110. DOI: 978-1-7281-0368-6/19/$31.00 ©2019 IEEE.

Moleko, T.C., Maringa, M. and Du Preez, W.B. (2019). *Wrought Ti-6Al-4V as an Alloy for High Velocity Impact Applications.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Pre-conference Seminar on Additive Manufacturing and Design of Titanium Parts, CUT, Japie van Lill Auditorium, Bloemfontein, Free State, Central University of Technology, 5 November 2019, South Africa.

Mollo, L., Emuze, F., and Smallwood, J. (2019). *A Review of Construction Accident Causality Model.* Proceedings of the 1st Association of Researchers in Construction Safety, Health, and Well-Being (ARCOSH) Conference. 3-4 June 2019, Cape Town, South Africa, pp. 212-220.

Mollo, L.G., Emuze, F. and Smallwood, J.J. (2019). *Developing a framework for deploying unmanned aerial vehicles (UAVs) to improve construction safety management.* Proceedings of the 11th Construction Industry Development Board Postgraduate Research Conference, pp. 497–504. ISBN: 978-3-030-26528-1.

Monyane, T.G. and Awuzie, B.O. (2019). *Performance Indicators for Lean Implementation in Construction: Free State perspectives.* Proceedings of the 13th Built Environment Conference, Hilton Hotel, Durban, South Africa, 2 -4 September, ISBN: 978-0-620-71904-9.

Monyane, T.G., Emuze, F.A. and Crafford, G. (2019). *Challenges to lean construction implementation in South Africa.* Proceedings of the 11th Construction Industry Development Board Postgraduate Research Conference, pp. 337-344. ISBN: 978-3-030-26528-1.

Mpelo, N. and Hertzog, P.E. (2019). *An Investigation into the effect of aging components on the medium voltage network configurations in the semi-urban areas.* Proceedings of the SAUPEC/RobMech/PRASA 2019, Bloemfontein, 2019.

Muiruri A.M., Maringa, M. and Du Preez, W.B. (2019). *Constitutive Numerical Modelling in Additive Manufacturing: Challenges in Predicting the Yield Strength and Flow Properties of Alloys.* Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, Free State, Central University of Technology, 6-8 November 2019, South Africa.

Muiruri, A., Maringa, M., Du Preez, W.B. and Masu, L.M. (2019*). Effect of Stress Relieving Heat Treatment on High Strain Rate Tensile Properties of Direct Melting Laser Sintered (DMLS) Parts.* Proceedings of the International Conference on Competitive Manufacturing - COMA 2019, 30.01-01.02.2109 Stellenbosch, South Africa.

Mvusi, M., Das, D. and Hassan M.M. (2019). *Integration of Information & Communication Technologies for Sustainable Road Traffic Movement in Mthatha.* Proceedings of the Southern African Transport Conference 2019, Pretoria, South Africa.

Mwagha M. and Masinde, M. (2019). Complementary Methods for Human Visual Perception of Visual Weather Lore Sky Objects Using Machine Learning Methods. Proceedings of 2019 Open Innovations Conference, held in Cape Town South Africa, 2-4 October 2019 (OI). pp. 1-8. IEEE.

Mwania, F.M., Maringa, M. and Van der Walt, J.G. (2019). *Recycling of Polypropylene Powder Used in Laser Sinter Additive Manufacturing – A Literature Review.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Nhlapo, N. and Dzogbewu, T.C. (2019). *Osseointegrative capacity of Ti-based implants and related properties: A review.* Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Nsengimana J., Van der Walt J.G., Langner E. and De Beer D.J. (2019). *Determining optimal scanning speed for laser sintering of CP75 polypropylene powder.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Odendaal, W. and Janse van Vuuren, A. (2019). *Places of belonging or discomfort: Framing South Africa through a filmic lens.* Proceedings of the 5th Annual Regional History Studies Conference: Reflecting on Identities. 28-29 November 2019. Johannesburg, South Africa.

Oke, S.A., Alowo, R. and Masinde, M. (2019). *Using Internet of Things for sustainable groundwater drought management in the Modder River catchment of South Africa.* Proceedings of the Open Innovations Conference (OI). IEEE. 2-4 October 2019. Cape Town, RSA. pp. 63-70. ISBN: 978-1-7281-3463-5.Okorafor, C., Emuze, F. and Das, D.K. (2019*). Using case study design to investigate the delivery of building energy retrofit projects.* In Proceedings of the 11th Construction Industry Development Board Postgraduate Research Conference, pp. 485-496. ISBN: 978-3-030-26528-1.

Ramafalo, R.B., Awuzie, B. and Aigbavboa, C. (2019*). Probable Challenges Facing Servitization Adoption in Construction: Lessons from the Manufacturing Sector.* Proceedings of the 11th Construction Industry Development Board (CIDB) Postgraduate Research Conference, 28-30 July 2019, Johannesburg, South Africa. ISBN: 978-3-030-26527-4.

Ramosena, L.A., Dzogbewu, T.C., Du Preez, W.B., Parker, B.S. and Blaine, D.C. (2019). *Metal additive manufacturing of TI6AL4V from a Ti-10(60Al:40V) powder blend.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Shange, M., Yadroitsava, I., Pityana, S., Yadroitsev, I. and Du Plessis, A. (2019). *The effect of inclinations of LPBF parts on the porosity and surface roughness.* Proceedings of the Rapid Product Development Association of South Africa (RAPDASA) 20th Annual International Conference, Emoya Estate, Bloemfontein, 6-8 November 2019, RAPDASA 2019 Conference Proceedings.

Shirinda, K., Kusakana, K. and Koko, S.P. (2019). *Techno-economic analysis of PV with groundwater pumped hydro storage system.* Proceedings of the International Conference on the Domestic Use of Energy (DUE 2019).

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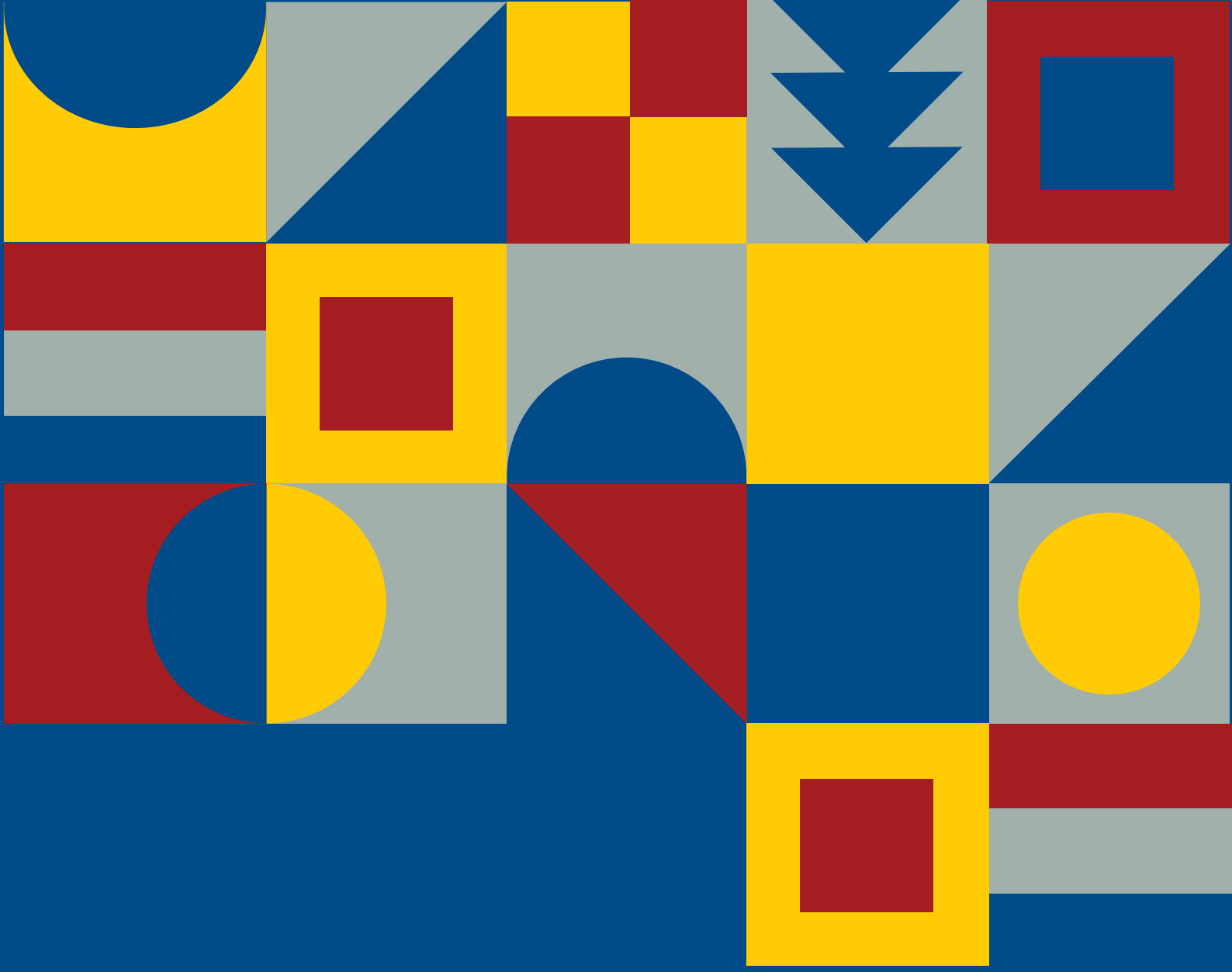


FACULTY OF

HEALTH & ENVIRONMENTAL SCIENCES

PART 6

A MESSAGE FROM THE DEAN

I am struck by the passion that our faculty and students have for discovery and problem solving; and the dedication of our hard-working staff in keeping the faculty on the cutting edge of research. We must address the most pressing problems facing society – problems with water, food, health, and the environment – and do it in a sustainable, ethical, and humane way.

One of the noteworthy events to occur in the year under review was the significant increase of full-time postgraduate students and publications in high impact factor journals. In fact, our faculty has the highest number of full-time postgraduate students. We will expand our research enterprise to address our nation's most difficult and pressing technological problems. The challenge is to continue creating an enabling environment that inspires researchers to achieve their ambitions, and that attracts the most talented academics and scholars. I am certainly proud of our achievements in 2019 and wish to thank all researchers, managers and staff, for their support, dedication and hard work.

Prof. S.S. Mashele
Dean: Faculty Health and Enviromental Sciences

A MESSAGE FROM THE ASSISTANT DEAN

I want to take this opportunity to thank my predecessor, Prof. Carlu van der Westhuizen, for the great work done during his period as Assistant Dean RIE (FHES). I hope that the coming years will be equally and more productive as I continue where he left off. Going forward, success will be measured not by any personal achievements of mine, but rather by our ability to unite all parts of our faculty's research community in a common effort to achieve important goals.

The faculty is blessed with dedicated, hardworking researchers, as evident from the research activities indicated in this report. We celebrate a significant increase in 2019 of enrolled full-time postgraduate students and also an increased number of articles published in high impact factor journals, a clear indication of our footprint. The faculty prides itself in using research for the benefit of humanity by conducting cutting edge research to address the most pressing problems facing society. We plan to expand our research enterprise by enhancing our laboratories with more state of the art equipment, promoting national and international collaborations, and fostering and facilitating postgraduate student and staff exchange programmes, all in an effort to ensure that more research focused on addressing South Africa's health and socioeconomic challenges is conducted. I am certainly proud of the faculty's achievements in 2019 and wish to thank all researchers, managers and staff, for their dedication and hard work.

Dr TJ Makhafola
Assistant Dean: RIE
Faculty Health and
Enviromental Sciences

FHES 2019 RESEARCH AND INNOVATION HIGHLIGHTS

There were 195 registered postgraduate students in the FHES in 2019, 10 more than in 2018. Most of these students received financial support from the CUT. Supervisors need to ensure proper progress of these students and that progress reports be periodically submitted to the research office so as to ensure continued funding. Actual spending of the allocated funds is also vital.

CUT URIC grants to the value of R 12,25m were granted to FHES postgraduate students for continuation of their studies. The NRF and DST also contributed significantly (R 3 790 000) via BTech Block Grants, NSFAS grants, DST-Innovation Block grants, and NRF Freestanding Block grants in 2019, while a further R1 260 000 for master's and R840 000 for doctoral students were provided. UCDP grants to staff to the value of R240,000 were also awarded by the DHET. Much other external research funding was also obtained from private and public sources. The total amount of research funding for faculty staff and students for 2019 adds up to an estimated R20m.

Sixty-two new research projects were approved by FRIC and the LS262a forms were forwarded to the examination department for further administration.

Thirty-eight (38) accredited articles were published in accredited scientific journals during 2019, while six (6) published proceedings of national and international conferences will be submitted to DHET for accredited subsidy.

During the graduation ceremonies, 6 doctorates and 14 master's degrees were awarded.

Several staff members presented papers and posters at local and international conferences and workshops. Twenty-three LS25 applications were accordingly approved by FRIC. Proper feedback of these visits to FRIC should be a priority, to ensure that collaboration with external experts are appropriately documented to guide and focus future liaisons.

Dr Lewtak resigned as postdoctoral fellow, bringing the total number of remaining postdoctoral fellows in the faculty to four. Many research outputs are expected from and delivered by these researchers.

The faculty's Prestige Research Day (PRD) took place on 3 October 2019 (under the chairpersonship of Dr IT Manduna) and several staff and students made presentations reflecting their research foci. The faculty also successfully presented a Public Lecture on 16 October 2019. The main speaker was Ms Mariaan Maartens (Director: Cornerstone Coaching) with the topic "The 4th Industrial Revolution: Does an algorithm-reliant future need IQ or EQ?".

Several innovation activities took place during the year. Prof. Ryk Lues, as Chairperson of RIMS, played a major and creative role in these initiatives/activities. Commercialisation of our research will further strengthen our financial position and contribute to the establishment of entrepreneurs who will improve the quality of life of the community.

FHES PRESTIGE RESEARCH AND PUBLIC LECTURE SEMINARS

The FHES successfully hosted the Prestige Research Day (PRD) and Public Lecture on 3 and 16 October respectively. The Prestige Research day was held on 3 October 2019 with the theme; "Food Science, Behaviours and Entrepreneurship for the 21st Century: A Balancing Act." The keynote speaker was Mrs Linda Jackson (Food Focus, South Africa) and we had guest presentations by Mrs Keates (John Paul College, Australia) and a representative from Colgate. The DVC Research Innovation and Engagement also spoke about the 4th Industrial Revolution. There were 34 presentations by staff and students from our faculty. All presenters in the programme were awarded certificates and the best presenters received prizes.

PRD 3 OCTOBER 2019: MRS LINDA JACKSON, PARTICIPANTS AND DEAN WITH ONE OF THE PRESENTERS, DR GUMEDE

Sponsorship for the event was received in cash and kind from the Research Innovation and Engagement office, the Dean's office, the Somatology programme and our esteemed sponsors from industry (Colgate, Anatech, The Scientific Group, Labotec, Inqaba Biotec, Ascendis Medical, ThermoFisher and Satorius). The sponsors as well as staff and students from Somatology, the CUT Indigenous Knowledge Systems (CUTIKS) and the CAFSaB Craft Brewery showcased their products and services in a vibrant exhibition during the event.

PUBLIC LECTURE

The Public Lecture on 16 October 2019 was presented by Mrs Mariaan Maartens (of Cornerstone Coaching) with the title "The 4th Industrial Revolution: Does an algorithm-reliant future need IQ or EQ?". The event was well attended by the University community and external stakeholders.

Mrs Mariaan Maartens, Guest Speaker at our Public Lecture held on 16 October 2019

CENTRE FOR APPLIED FOOD SECURITY AND BIOTECHNOLOGY

The centre has grown substantially in 2019, with 73 postgraduate students reported in the annual report of 2019 compared to 61 postgraduate students reported for 2018. Together with the 13 professional members as listed who conduct their primary research under the centre, this brings the human resource cohort participating in centre research to 86.

The centre led the organising and guest lectureship at the 2019 PRD and also hosted a public institutional lecture. At the event members displayed some of our products to be commercialised, including flavoured bath salts and craft beer.

Preparation of products for exhibition at our 2019 PRD

The centre sponsored hole 9 at the Annual CUT Golf Day, and also displayed a range of its products.

Following the BAFA event, Mr Anton Erasmus, chief brewer of SAB, labelled it the best national event he had ever attended. At the intervarsity, the centre won the awards for winter warmer and people's choice, following its various awards in previous years. SAB and the CUT management have already agreed that the CUT will again be facilitating the beer and food pairing affair, as well as the intervarsity craft brewing competition 2020 in collaboration with the CUT hotel school.

SAB INTERVARSITY CHALLENGE

- The appointment of Prof. Lucia Anelich as Adjunct at the centre has been finalised. Prof. Anelich is currently immediate past president of SAAFoST, the leading association in the field nationally, as well as president of the IUFoST, the International Union for Food Science and Technology. Prof. Anelich is widely acknowledged as the leading authority on SA-International food safety matters.
- Prof. Lues was nominated as president elect for the SA Association of Food Science and Technology, SAAFoST for the 2020-2022 term. This follows his previous tenure as vice-president.
- For a second time around, CAFSaB nominated a speaker for a CUT public lecture, Mrs Maartens. She spoke on the 4th IR and its broader consequences.
- CAFSaB hosted the guest speaker at the annual PRD event of the faculty: Mrs Linda Jackson spoke on food safety and women entrepreneurs.
- The Phehla brewery has initiated its commercialisation processes by applying for a liquor licence as well as a COA. Possible take-off in collaboration with CUTis includes the CUT Suite, hotel school, on-campus events and others. Two postgraduate students are currently doing their projects on aspects of brewing and distilling.

CENTRE FOR QUALITY OF HEALTH AND LIVING

The Centre for Quality of Health and Living saw an increase in research activities in 2019, as evident in published research articles, conference attendance, workshops, and training attendance. The range and scope of our members' research interests and our scientists' expertise position our centre as a highly translational research institute which rapidly deploys the basic science and clinical discoveries into changes in health care practices in the clinic and community, and into improved social and health policies that impact positively on the health of the community. The centre's scientists collaborate with colleagues across South Africa, Africa and the rest of the world. A meeting with members of the Department of Health Sciences was held to discuss research activities within the centre and possible approaches for collaborations. Members of the centre attended conferences, participated in workshops and published articles.

DR P KENDREKAR'S VISIT TO UCLan, DECEMBER 2019

Mr Asive Methuse, Dr Chika Chukwuma and Dr Tshepiso Makhafola attended the first internship funded by the SA-NRF and BELSPO at Sciensano (Brussels, Belgium) from 20-29 November 2019. The internship was coupled with attendance of the Belgian Society for Toxicology (Beltox) on a toxicology-related topic. The topic of this year's meeting was 'Innovative tools for 3Rs testing' which fitted perfectly within the scope of the IN-NATAL project. This was followed by a training course and workshop on *in vitro* and *in silico* methodologies for human toxicology and risk assessment. In the afternoon session, 3R approaches in ecotoxicology and the use of artificial intelligence in risk assessment were presented.

Sciensano (Brussels) visit November 2019. Dr Makhafola, Dr Chikwuma and Mr Methuse

RESEARCH ACTIVITIES

Prof. Mashele and Dr Makhafola attended the kick-off meeting of the project Innovative Non-Animal strategies to assess the Toxicity and (biological) activity of candidate drugs derived from medicinal plants (IN-NATAL), from 9-11 September 2019, at SCIENSANO, Brussels. In the meeting, Dr B. Mertens presented the projects and activities on innovative non-animal methods and approaches for toxicity testing of the Service Risk and Health Impact Assessment. The different projects and activities of the CUT relevant to the IN-NATAL project were presented by Dr T. Makhafola.

Dr Pravin Kendreka visited the University of Central Lancashire (UCLan), in Preston, UK, for research, conference attendance and participation in workshops in December 2019.

Synthesis time

Lipid formulation

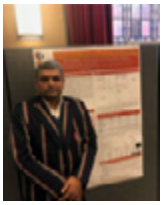
NMR Discussion on Lipis

Dr. Sergey Zlatogorsky

Prof. Singh lab visit

Lipid formulation

SMC Centre at UCLan



MERCIA Meeting

SMC Centre at UCLan

MRSA Discussion at DDD Centre at UCLan

Dr. George at University of Leeds

EXPERIMENTAL FARM

The CUT farm provided excellent opportunities for the presenting of practical and hands-on training. We were honoured by the visits of the CUT council member for Agriculture, Counsellor Mokosi, Dr Paul and Prof. Mashele during 2019.

The following activities took place during 2019.

WIL students: Five Agriculture students did their WIL on the farm from February 2019. Miss G. Gaapare departed for the USA on 22 July 2019, and Miss B. Mokoko was placed on the CUT farm in her place. First-year visit to farm: On 6 February 2019, a welcoming ceremony and a practical session were held. Groups rotated among department members, with both livestock and crops being demonstrated.

- Pecan nuts: The orchard is one-year-old now and the trees are growing well.
- Prickly pears: The prickly pears were pruned, and the first yield has been sold.
- The farm house: Four students occupied the farm house, 2 women and 2 men.
- Tractors and equipment: Maintenance has been done, and a feed mixer on wheels (1 ton) and a bale fork have been purchased.
- Water supply: Works very well, although electrical challenges occurred (load shedding, lightning damage).
- Sheep Shearing Day was held on 1 August 2019 for Agricultural students, where the students had the opportunity to shear sheep themselves. Wool classing was also part of the day. In addition, several other livestock practicals were also conducted on the farm.
- Sheep: A total of 104 sheep were bought during 2019. Many practicals were conducted using these animals. The sheep were fed and sold at an average price of R1 801.26 (VAT incl). The Agriculture students visited the abattoir and experienced the process of beef cattle being processed.
- Cattle: Twenty-one steers were backgrounded (raised from 180kg-260kg) of which 16 were intensively fed for 50 days and then slaughtered. They obtained an average price of R12 162.19. The other five were sold back to the auctioneers.
- Eragrostis Teff: Fifty-seven big bales were sold, weighing on average 260kg @ R380/bale; 464 small bales were also produced and weighed approximately 26kg each, with an estimated value of R55/bale. An average of 2.6 ton/ha was recorded. Sixteen big bales and 78 small bales were kept for use by the CUT farm animals.

- Oats: The bales weighed approximately 30kg each, and 78 bales were used by CUT farm animals, with 19 bales of oats being sold for R60/bale.
- Vegetables: The season continued into 2019 and sales are stated below.
- Spinach and beetroot: A new plot (0.3ha) was planted in February. The produce was sold at the Bloemfontein market and to staff.

COLLABORATIONS

National

- Mr Khetsha is collaborating with Prof. Khayalethu Ntushelo (UNISA) and Dr Denise Olivier (Seobi) on metabolomics studies.
- Dr Pretorius is collaborating with peers at the NWU on maize insects.
- Prof. Fourie has established research collaboration with the Nguni, Meatmaster and Dorper Breeders' Societies.
- Dr Pretorius established collaboration on pecan nut research with Prof. Hannalene du Plessis from the University of the North-West in Potchefstroom.
- Prof. Sedibe is the chairperson of the Taung College of Agriculture Advisory Council.
- Prof. Fourie serves as the vice president of the South African Meatmaster Breeders' society.

International

- Dr Pretorius was elected to serve as the International Branch Representative on the P-IE Nomination Committee for the Entomological Society of America (ESA).

COMPLETED MASTER'S DEGREES

Direko, P.I. (2019). *Evaluation of effects of extracts of Eschscholzia californica on angiogenesis by determining inhibitory activity against COX-1 and COX-2 enzymes.* Central University of Technology, Free State.

Fourie, K. (2019). *Radiation protection practice in digital radiography in Eastern Cape government hospitals.* Central University of Technology, Free State.

Khasapane, N.G. (2019). *MasMicrobial analysis of raw milk from small-scale farmers around Maluti-a-phofung, Free State, using molecular techniques.* Central University of Technology, Free State.

Letuka, P.L. (2019). *Microbial profiling of street vended foods.* Central University of Technology, Free State.

Mboneni, E. (2019). *Bioethanol production from brewers' spent grain.* Central University of Technology, Free State.

Moleko, K.A. (2019). *Evaluation of municipal waste services in Matjhabeng Local Municipality, Free State Province.* Central University of Technology, Free State.

Nel, C. (2019). *Radiographic image recording techniques when using computed radiography imaging systems in the Eastern Cape Province.* Central University of Technology, Free State.

Nyakane, N.E. (2019). *Use of Magnetic field nutrient solution amended with mycorrhizal and ratio of calcium to magnesium on yield and oil quality of rose geranium (Pelargonium graveolens L.).* Central University of Technology, Free State.

Rautenbach, J.J. (2019). *Classification of PM10 and fall out dust sampling in the iron ore mining industry, Northern Cape province of South Africa.* Central University of Technology, Free State.

Sebate, S.L.I. (2019). *Evaluation and application of molecular and immunological serotyping techniques for selected avian and human E. coli strains.* Central University of Technology, Free State.

Sheik, R.A. (2019). *Evaluation of disinfectant efficacy on yeast species and biofilm associated microorganisms from a beverage facility.* Central University of Technology, Free State.

Venter, Y. (2019). Investigation into the precision feeding of Nguni steers under feedlot conditions. Central University of Technology, Free State.

Wessels, S.K. (2019). *Assessment of the T-reflex in adult patients with early Guillain-Barré Syndrome at Groote Schuur Hospital.* Central University of Technology, Free State.

Completed doctoral degrees

Abdalla, S.M.H. (2019). *Genome scanning of basidiomycete fungi for cytochrome P450 monooxygenases involved in steroids hydroxylation.* Central University of Technology, Free State.

Atangana, E. (2019). *Development of modified biopolymer adsorbents from natural polysaccharides for renewal of abttoir wastewater.* Central University of Technology, Free State.

Chipfupa, L. (2019). *Vegetation gradients, soil microbial pools and carbon sequestration in cactus invaded semi-arid rangelands.* Central University of Technology, Free State.

Jordaan, H.L. (2019). *Development of an anti poach rhino model for game farms and nature reserves in the Free State Province of South Africa.* Central University of Technology, Free State.

Mfengwana, P.H. (2019). *Biomedical Technology Evaluation of pharmacological properties of traditional medicinal plants used for the treatment of cancer by South African and Lesotho communities.* Central University of Technology, Free State.

Mugomeri, E. (2019). *Isoniazid preventive therapy on tuberculosis occurence in HIV-positive patients in Lesotho.* Central University of Technology, Free State.

LIST OF CONFERENCE PAPERS/POSTERS

Bila, L. and Fourie, P.J. (2019). *Using pelvic area measurements in the selection for reduced dystocia rates in Sussex heifers – preliminary results.* Proceedings of the 51st Annual Congress of the South African Society of Animal Sciences, Bloemfontein, 10-12 June.

Boaduo, N.A.A. and Malebo, N.J. (2019). *Hygiene and microbial hazards associated with childcare facilities in the Free State.* Proceedings of the 3rd International Federation of Environmental Health (IFEH) World Academic and 16th Makerere University of Environmental Health Students' Association (MUEHSA) Scientific Conference in Kampala, Uganda, 9-11 April 2019.

Botes, L., Van Den Heever, J., Laker, L., Bester, D., Dohmen, P. and Smit, F. (2019). *Tissue engineering of bovine pericardial tissue in the circulatory system of a young ovine model: commercial versus in-house decellularization.* Oral Presentation at SATIBA congress.

Du Plessis, J and Slabbert, R. (2019). *Peer-assistant learning as a strategy to improve educational performance in radiography training.* Proceedings of the ECR Conference, Vienna Austria, 27 February – 03 March 2019.

Du Plessis, J. (2019). *A Peer-assisted Learning action research project to assist at-risk students in radiography training.* Proceedings of Röntgenveckan 17-20 September.2019, Jönköping, Sweden.

Du Plessis, J. (2019). *Curricular modalities to prepare a new generation of professionals.* Proceedings of USAF Conference. 2-4 October 2019, CSIR's International Convention Centre, Pretoria.

Du Plessis, J. (2019). *Development and assessment of peer-assisted learning activities to assist student learning in radiography training.* Proceedings of RSSA-SORSA Conference 15-18 August 2019, Cape Town.

Du Plessis, J. (2019). *Sustainable development through community engagement.* Proceedings of the SASUF Innovation Initiative. 8-10 May 2019. University of Stellenbosch, Stellenbosch.

Friedrich-Nel, H. (2019). *The South African Radiographer: Button pusher or creative thinker?* Proceedings of the ECR Conference, Vienna Austria, 27 February – 3 March 2019.

Horn-Lodewyk, J., Van Der Merwe, B. and Van Der Linde, B. (2019). *Using Roleplay for the Understanding of Ethics as Part of a Development Approach to an Appropriate Research Methodology.* Proceedings of the 18th European Conference on Research Methodology for Business and Management Studies, 20-21 June 2019, Johannesburg.

Horn-Lodewyk, J., Zeewart, J., WagenaaR, J. and Engelbrecht, G. (2019). *Comparative evaluation of in-house-prepared 99mTc- ethylene-dicysteine-deoxyglucose and 18F-fluorodeoxyglucose in breast cancer.* Proceedings of the ECR Conference, Vienna Austria, 27 February – 03 March 2019.

Jacobz, J. and Fourie, P.J. (2019). *Pelvimetry and other selected factors causing dystocia in young Dorper and Dohne Merino ewes – preliminary results.* Proceedings of the 51st Annual Congress of the South African Society of Animal Sciences, Bloemfontein, 10-12 June.

Kendrekar, P., Mashele, S. and Salunke, D. (2019). *Pharmacokinetic Evaluation of a Novel Synthesis Anti-malarial Compound.* Proceedings of the 6th Asian Network for Natural & Unnatural Materials 27-28 July 2018 Gifu, Japan.

Makhafola, T.J., Elgorashi, E.E., Mcgaw, L.J., Verschaeve, L. and Eloff, J.N. (2019). *Combretum microphyllum and Leucospermum erubescens inhibit the genotoxic effects of 4-NQO, MMC and EMS in vitro.* Proceedings of the Joint Symposium of BelTox, IC-3R's & INVITROM. 21-22 November 2019. VUB Brussels.

Makhoahle, P. and Mokgawa, S.D. (2019). Attended the 6th Innovation in Learning and Teaching Conference, 20-21 June 2019.

Mfengwana, P.H., Verschaeve, L, Anthonissen, R., Mashele, S.S. and Manduna, I.T. (2019*). In vitro Investigation of Genotoxic and Antigenotoxic Properties of Gunnera perpensa Roots Extracts.* Presentation of e-poster (international*):* The 2nd World Academy of Science, Engineering and Technology Conference, 14-15 February 2019, London, United Kingdom.

Mohlomi, M.O., Lenetha, G.G., Magunga, B.T. and Malebo, N.J. (2019). *Antimicrobial activity of essential oils against foodborne pathogens, causing diarrhoea.* Proceedings of the South African Association for Food Science and Technology 23rd Biennial International Congress, 1-4 September 2019.

Muller, H., Rae, W.I.D. and Friedrich-Nel, H. (2019). *Dose distribution for vascular procedures at a tertiary training hospital in South Africa.* Proceedings of the ECR Conference, Vienna Austria, 27 February – 03 March 2019.

Nkwana, A.T., Fourie, P.J. and Hoon, J.H. (2019). *Effect of dietary inclusion levels of diatomaceous earth on production, carcass characteristics and faecal egg count of lambs.* Proceedings of the 51st Annual Congress of the South African Society of Animal Sciences, Bloemfontein, 10-12 June.

Ntho, T.C., Manduna, I. and Malebo, N.J. (2019). *Assessment of nutritional and microbial content of indigenous vegetables used by the Basotho people of Southern Africa.* Oral presentation at the 3rd International Federation of Environmental Health (IFEH) World Academic and 16th Makerere University of Environmental Health Students' Association (MUEHSA) Scientific Conference in Kampala, Uganda, 9-11 April 2019.

Nwafor, I.C., Roberts, H.A. and Fourie, P.J. (2019). *Growth performance and faecal egg count reduction in naturally parasitized pigs fed graded levels of dry chicory (Cichorium intybus) roots.* Proceedings of the 51st Annual Congress of the South African Society of Animal Sciences, Bloemfontein, 10-12 June.

Perkins, J., Van Den Heever-Kriek, W.M.J. and Van Der Byl, A. (2019). *Evaluation of accurate tidal volume as displayed on the Avea™ ventilator using predetermined neonatal ventilator settings.* Proceedings of the 7th Annual Free State Provincial Health Research Day, Bloemfontein, South Africa. (Best paper)

Phahlamohlaka, N.P. (2019). *Design-Based Learning: A Creative Approach to Innovation in Radiography.* Proceedings of the 6th Innovation in Learning and Teaching Conference, 20-21 June 2019, Bloemfontein.

Roberts, H. (2019). *Environmental, Health and Social Impacts of Dumping and Burning of Municipal Solid Waste in South Africa.* Oral presentation at the Thirty Fourth International Conference on Solid Waste Technology and Management Conference in Annapolis, MD, U.S.A, 31 March – 4 April 2019.

Sebelego, I.K. (2019). *Experience in planning and executing a continuous professional development programme among radiography students.* Proceedings of the RSSA-SORSA Conference 18 August 2019, Cape Town.

Sebelego, I.K. (2019). *Addressing neonatal chest image quality at an undergraduate level.* SAAHE, 25-27 June 2019, Bloemfontein (poster presentation on behalf of Van der Linde, B).

Sebelego, I.K. (2019). *Experience in planning and executing a continuous professional development programme among radiography students.* Proceedings of SAAHE, 27 June 2019

Sebelego, I.K. (2019). *The use of anatomical lead markers: who is responsible?* Proceedings of RSSASORSA. 18 August 2019, Cape Town.

Sedikelo, G.K.M., Lenetha, G.G. and Malebo, N.J. (2019). *Microbial species associated with cockroaches found in Mangaung food markets.* Proceedings of the South African Association for Food Science and Technology 23rd Biennial International Congress, 1-4 September 2019.

Sejake, M., Lues, J.F.R. and Nkhebenyane, S.J. (2019). *Evaluation of WASH risk factors and foodborne pathogens in Lesotho prisons.* Oral presentation at the Water Sanitation and Hygiene Conference in Colorado Boulder USA, 4-6 March 2019.

Seshoka, M.L., Malebana, I.M.M., Fourie, P.J., Kanengoni, A.T. and Nkosi, B.D. (2019). *Dietary inclusion of ensiled avocado (Persia Americana) oil cake on pig growth performance.* Presented at the 70th Conference of the European Association of Animal Production held in Ghent, Belgium, 26-30 August.

Smit, F.E., Gwila, T., Jansen Van Vuuren, M., Botes, L. and Mestres, C.A. (2019). *Infective endocarditis in Central South Africa in the HIV era – A Surgical Perspective.* Proceeding of the International Society for cardiovascular and Infectious Diseases Conference, Lausanne, Switzerland, 24 June 2019.

Van Der Merwe, B. (2019). *Flexible learning off-campus for radiography students in clinical practice.* ECR conference, Vienna Austria, 27 February – 3 March 2019.

Van Der Merwe, B. 2019. *Empower students for the operating theatre. Challenge to change healthcare for 2030.* SAAHE Conference, 26-28 June 2019, Bloemfontein.

Van Der Merwe, B. 2019. *Interdepartmental simulation to enhance teaching and learning by promoting university values in diverse environments.* 6th Innovation in Learning and Teaching Conference, 20-21 June 2019, Bloemfontein.

Van Der Merwe, B., Sebelego, I.K. and Perkins, J. (2019). *Interdepartmental simulation to enhance teaching and learning by promoting university values in diverse environments.* Proceedings of the 6th Innovation in Learning and Teaching Conference, Bloemfontein.

Van Der Westhuizen, C. (2019). *Apps in Agriculture.* Oral presentation at the 4IR summit on 28-29 November 2019. Bloemfontein, South Africa.

LIST OF JOURNALS/ARTICLES (DHET SUBSIDISED)

Atangana, E., Chiweshe, T. and Roberts, H. (2019). Modification of Novel ChitosanStarch Cross-Linked Derivatives Polymers: Synthesis and Characterization. *Journal of Polymers and the Environment*, 27 (5), pp. 979-995. DOI: 10.1007/s10924-019-01407-0.

Bhagat, D.S., Pande, S.G., Katariya, M.V., Pawar, R.P. and Kendrekar, P.S. (2019). Microwave Assisted One Pot Synthesis of 3,4-Dihydropyrano[c]chromene Derivatives using [Emim]OH Ionic Liquid as Novel Catalyst. *Asian Journal of Chemistry*, 31(4): 829-833.

Bhagat, D.S., Tekale, S.U., Dhas, A.K., Deshmukh, S.U., Pawar R.P. and Kendrekar, P.S. (2019). A Rapid and Convenient Synthesis of Acridine Derivatives Using Camphor Sulfonic Acid Catalyst. *The New Journal for Organic Synthesis*, Vol 51, 2019 - Issue 1. pp. 96-101. https://doi.org/10.1080/00304948.2018.1549907.

Bhale, S.P., Yadav, A.R., Tekale, S.U., Nawale, R.B., Marathe, R.P., Kendrekar P.S. and Pawar, R.P. (2019). Synthesis, Characterization and Antimicrobial Screening of Novel Hydrazide Ligand & It's Transition Metal Complexes. *Asian Journal of Chemistry* 2019, 31(4): 938-942.

Chukwuma, C.I., Matsabisa, M.G., Rautenbach, F., Rademan, S., Oyedemi, S.O., Chaudhary, S.K. and Javu, M. (2019). Evaluation of the nutritional composition of Myrothamnus flabellifolius (Welw.) herbal tea and its protective effect against oxidative hepatic cell injury. *Journal of Food Biochemistry*, 43: 1-11. DOI: 10.1111/jfbc.13026.

Claassen, F.M., Mutambirwa, S.B.A., Potgieter, L., Botes, L., Kotze, H.F. and Smit, F.E. (2019). Outcome determinants of urethroplasty in the management of inflammatory anterior urethral strictures. *South African Medical Journal*, 109(12): 947-951.

Corbett, K.M. and De Smidt, O. (2019). Culture-dependent diversity profiling of spoilage yeasts species by PCR-RFLP comparative analysis. *Journal of Food Science and Technology International.* https://doi.org/10.1177/1082013219856779.

Dellar, R., Madiba, T.E. and Moodley, Y. (2019). Knowledge of cardiovascular disease in South African HIV-positive surgical patients – A pilot survey. *SAHeart*, 16:128-131.

Dikhoba, P.M., Mongalo, N.I., Elgorashi, E.E. and Makhafola, T.J. (2019). Antifungal and anti-mycotoxigenic activity of selected South African medicinal plants species. *Heliyon,* Volume 5 (10). 10.1016/j.heliyon.2019.e02668.

Direko, P.I., Mfengwana, P.H., Mashele, S.S. and Sekhoacha, M.P. (2019). Investigating the angiogenic modulating properties of Spirostachys Africana in MCF-7 breast cancer cell line. *International Journal of Pharmacology*, 18:970-977.

Du Plessis, J. and Bezuidenhout, J. (2019). Areas of good practice and areas for improvement in work-integrated learning for radiography training in South Africa. *African Journal of Health Professions Education.* https://doi.org/10.7196/AJHPE.2019.v11i3.1043.

Erukainure, O.L., Chukwuma, C.I. and Islam, M. (2019). Raffia palm (*Raphia hookeri*) wine: Qualitative sugar profile, functional chemistry, and antidiabetic properties. *Food Bioscience,* 30 (2019) 100423.

Fadeyi, O.A., Igene, L., Sedibe, MM., Solomon, O. and Van Der Westhuizen, C. (2019). Financial Crisis and the South African Agricultural Sector: A CGE analysis. *African Journal of Business and Economic Research* 14(3), 71- 90.

Foster, L.A., Fourie, P.J. and Neser, F.W.C. (2019). Effect of different levels of supplementation after weaning on beef heifer development. *SA J. Anim. Sci.* In print [ISSN 0375-1586 (print) and ISSN 221-4062 (online)].

Gumede, T.P., Luyt, A.S., Tercjak, A. and Müller, A.J. (2019). The influence of polycarbonate/MWCNTs masterbatch on the morphology and isothermal crystallization kinetics of double crystalline PCL/PBS blends. *Journal of Polymers* 11(4)

Gunn, C., O'Brien, K., Fosså, K., Tonkopi, E., Lancae, L., Martins, C.T., Muller, H. Friedrich-Nel, H., Abdolell, L. and Johansen, S. (2019). A multi institutional comparison of imaging dose and technique protocols for neonatal chest radiography. *Radiography.* doi: https://doi.org/10.1016/j.radi.2019.10.013.

Jordaan, H.L., Fourie, P.J. and Lues, J.F.R. (2019). Occurrence of rhinoceros in the Free State, South Africa: a reassessment. *Pachyderm Journal*, No 60, July 2018-June 2019, pp. 67-77.

Katikati, A. and Fourie, P.J. (2019). The production and management practices of emerging cattle farmers in the Amathole and Chris Hani districts of Eastern Cape Province. *South African Journal of Agricultural Extension*, 47 (1), pp. 92-102. ISBN 2413-3221.

Khattab, M.S. and Moodley, Y. (2019). Perioperative blood loss in South African primary hip arthroplasty patients. *UTMJ*, 96 (3): 29-34.

Kujane, K. Sedibe, M.M. and Mofokeng, A. 2019. Genetic diversity analysis of soybean (*Glycine max* (L.) Merr.) genotypes making use of SSR markers. *Austr. J. Crop Sc.* 13(07): pp. 1113-1119. doi: 10.21475/ajcs.19.13.07. p1638 0.33.

Lewtak, J.P., Koszarna, B., Charyton, M.K. and Gryko, D.T. (2019). Extending a porphyrin chromophore via fusion with naphthalene and indole. *Journal of Porphyrins and Phthalocyanines.*

Manduna, I. and Vibrans, H. (2019). Consumption of Wild-Growing Vegetables in the Honde Valley, Zimbabwe. *Economic Botany*, pp.1-14. DOI: 10.1007/s12231-019-9441-y. Department of Botany, Colegio de Postgraduados.

Mfengwana, P.H., Mashele, S.S. and Manduna I.T. (2019). In vitro Antibacterial, Antioxidant and Anti-Inflammatory effects of Senecio asperulus and Gunnera perpensa from Mohale's Hoek, Lesotho. *Journal of Pharmacognosy*, 11(4):730-739.

Mfengwana, P.H., Mashele, S.S. and Manduna, I.T. (2019). Cytotoxicity and cell cycle analysis of Asparagus laricinus Burch. and Senecio asperulus DC. on breast and prostate cancer cell lines. *Heliyon*, 5(5), p. e01666.

Mfengwana, P.H., Mashele, S.S., and Manduna, I.T. (2019). In vitro Antibacterial, Antioxidant and Anti-Inflammatory Effects of Senecio asperulus and Gunnera perpensa from Mohale's Hoek, Lesotho. *Pharmacog* J., 11(4): 730-9.

Mochane, M.J., Motsoeneng, T.S., Sadiku, E.R., Mokhena, T.C. and Sefadi J.S. (2019). Morphology and Properties of Electrospun PCL and Its Composites for Medical Applications: A Mini Review. *Applied Sciences* (MDPI), 2019 :9; 2205 (1-17). Doi:10.3390/app9112205.

Mugomeri, O.D. and Van Der Heever, W.M.J. 2019. Tracking the rate of initiation and retention on isoniazid preventive therapy in a high human immodeficiency virus and tuberculosis burden setting of Lesotho. *Southern African Journal of Infectious Diseases*, 34(1). https://doi.org/10.4102/sajid.v34i1.10.

Nwafor, I.C., Roberts, H. and Fourie, P. (2019). Prevalence of gastrointestinal helminths and parasites in smallholder pigs reared in the central Free State Province. *Onderstepoort Journal of Veterinary Research,* 86(1), a1687. https://doi. org/10.4102/ojvr.v86i1.1687.

Nwafor, I.C., Roberts, H.A. and Fourie, P.J. (2019). Awareness of porcine helminthiasis and the prevalent farm management operations among smallholder pig farmers in the Free State. *SA J. Agric. Ext.,* 47(3): 61-69.

Nyakane, N.E., Markus, E.D. and Sedibe, M.M. 2019. The effects of magnetic fields on plants growth: A comprehensive review, *International Journal of Food Engineering*, Vol. 5, No. 1, pp. 79-87, March 2019. doi: 10.18178/ijfe.5.1.79-87. Proceedings of the 4th International Conference on Food and Agricultural Engineering, Lisbon Portugal.

Nyakane, N.E., Sedibe, M.M. and Markus, E. (2019). Growth response of Rose Geranium (Pelargonium graveolens L.) to Calcium and Magnesium Ratios Exposed to Magnetic Field and Mycorrhizal. *Hortscience,* 54(n): 1-7. 2019. https://doi.org/10.21273/HORTSCI14248.

Rathebe, P., Weyers, C. and Raphela, F. (2019). A health and safety model for occupational exposure to radiofrequency fields and static magnetic fields from 1.5 and 3 T MRI scanners. *Health and Technology*. https://doi.org/10.1007/S12553-019-00379-4.

Sadiku, E.R., Fasiku, V., Agboola, O., Ibrahim, I.D., Daramola, O.O., Olajide, J.L., Kupolati, W.K., Sanni, S. and Mochane, M.J. (2019). Overcoming Antimicrobial Resistance: New Strategies, Expections: Greater Hope: Mini Review. *Biomedical Journal of Scientific & Technical Research,* 2019; pp. 1-5. ISSN: 2574-1241; DOI: 10.26717/BJSTR.2019.13.002353.

Sebelego, I. (2019). The use of clickers to evaluate radiographer's knowledge of shoulder images. *Health SA Gesondheid*. https://doi.org/10.4102/hsag.v24i0.1053.

Sebelego, I., Van Der Merwe, B. and Du Plessis J. (2019). A radiographic criteria checklist to determine reasons for errors resulting in suboptimal routine shoulder projections. *Health SA Gesondheid*. ISSN: 1025-9848, E-ISSN: 2071-9736.

Steyn, M., Oberholster, P.J., Botha, A.M., Genthe, B., Van Den Heever-Kriek, P.E. and Weyers, C. (2019). Treated acid mine drainage and stream recovery: Downstream impacts on benthic macroinvertebrate communities in relation to multispecies toxicity. *Journal of Environmental Management*, 235: 377-388.

Van Der Merwe, B. (2019). Design-based research for the development of a flexible learning environment. *Health SA Gesondheid*, 24 (0), a1050. doi:https://doi.org/10.4102/hsag.v24i0.1050. ISSN: (Online) 2071-9736, (Print) 1025-9848.

Wium, E., Jordaan, C.J., Botes, L. and Smit, F.E. (2019). Alternative mechanical heart valves for the developing world. *Asian Cardiovascular and Thoracic Annals*.

Yogesh, W., More, Y.R., Tekale, S.U., Kaminwar, N.S., Kótai, L., Pasinszki, T., Kendrekar, P.S., Bhosale, S.V. and Pawar, R.P. 2019. Synthesis of 3,4dihydropyrano[c]c, hromenes using a carbon microsphere supported copper nanoparticles (Cu-NP/C) catalyst prepared from a Cu-loaded iminodiacetate-functionalized styrenedivinylbenzene copolymer. *Current Organic Synthesis*, 2019, 16, 8, 288-29.

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Bhagat, D.S., Pawar, R.P. and Kendrekar, P.S. (2019). A Rapid and Convenient Synthesis of Acridine Derivatives Using Camphor Sulfonic Acid Catalyst. *Organic Preparations and Procedures International*, 2019, Vol.28, No.4, pp. 1-6.

Bharad, J.V., Kendrekar, P.S. Gayakwad, D.R., Sarda, S.R., Nawale, R.B. and Marathe, R.P. (2019). Synthesis and characterization of some metal complexes of bisimines of vanillin. *Journal of Emerging Technologies and Innovative Research*, 2019, 6, 6, 878.

Botes L, 2019. Decellularized Sterile-Stabilized Bovine Pericardial (DSBP) Scaffolds: Recullularization, Comparative Strength and Calcification compared to Glutaraldehyde Crosslinked Pericardial Patches in the Juvenile Ovine Mode. *Journal Structural Heart,* Volume 3 (1) 10.1080/24748706.2019.1589332.

Fourie, P.J. and Becker, S,J. (2019). Relationship between body weight and certain body measurements of Meatmaster rams – preliminary results. *Annual Journal of the SA Meatmaster Breeders' Society.*

Friedrich-Nel, H. and Munro, L. (2019). Will the patient benefit from the radiographers' attendance of ethics presentations at continuous professional development (CPD) events? *The South African Radiographer*, 55 (2), November 2017.

Jacobsz, J. and Fourie P.J. (2019). Pelvimitry and other selected measurements in young Dohne Merino ewes. *Annual Journal of the SA Dohne Merino Breeders' Society.*

Kendrekar, P.S. and Pawar, R.P. (2019). Sulphated tin oxide: An efficient catalyst for the synthesis of quinoxaline derivatives. *Journal of Current Pharma Research (JCPR),* Volume 9 Issue 4, July-Sep 2019 (*Special Issue).*

Sedibe, M.M. and Nyakane, N.E. 2019. Growth Response of Rose Geranium (Pelargonium graveolens L) to Calcium Magnesium Ratio, Magnetic Field, and Mycorrhizae. *Hort Science Journal,* Volume 54 (10), 10.21273HORTSCI4248-19.

BOOKS AND CHAPTERS IN BOOKS

Horn-Lodewyk, J., Van Der Merwe, B. and Van Der Linde, B. (2019). Using roleplay to understand ethics as part of a development approach to an appropriate research methodology. In: Remenyi D (ed). (2019). *Innovation in the Teaching of Research Methodology Excellence Awards: An Anthology of Case Histories.* Reading, UK: Academic Conferences and Publishing International Limited. pp. 77-88.

Mfengwana, P.H. and Mashele, S.S. (2019). Medicinal Properties of Selected Asparagus Species: A Review. In: Venketeshwer Rao, Dennis R, Mans A and L Rao *Phytochemicals in Human Health.* Intechopen. ISBN 9781-78985-588-3. DOI: 10.5772/intechopen.87048.

Mochane, M.J., Mokhena, T.C., Sadiku, E.R., Ray, S.S. and Mofokeng, T.G. (2019). Chapter 2: Green Polymer Composites Based on Polylactic Acid (PLA) and Fibers. In: Dr. Dhorali Gnanasekaran. *Green Biopolymers and their Nanocomposites.* Singapore: Springer Nature. pp. 29-54. https://doi.org/10.1007/978-981-13-8063-1_2 .

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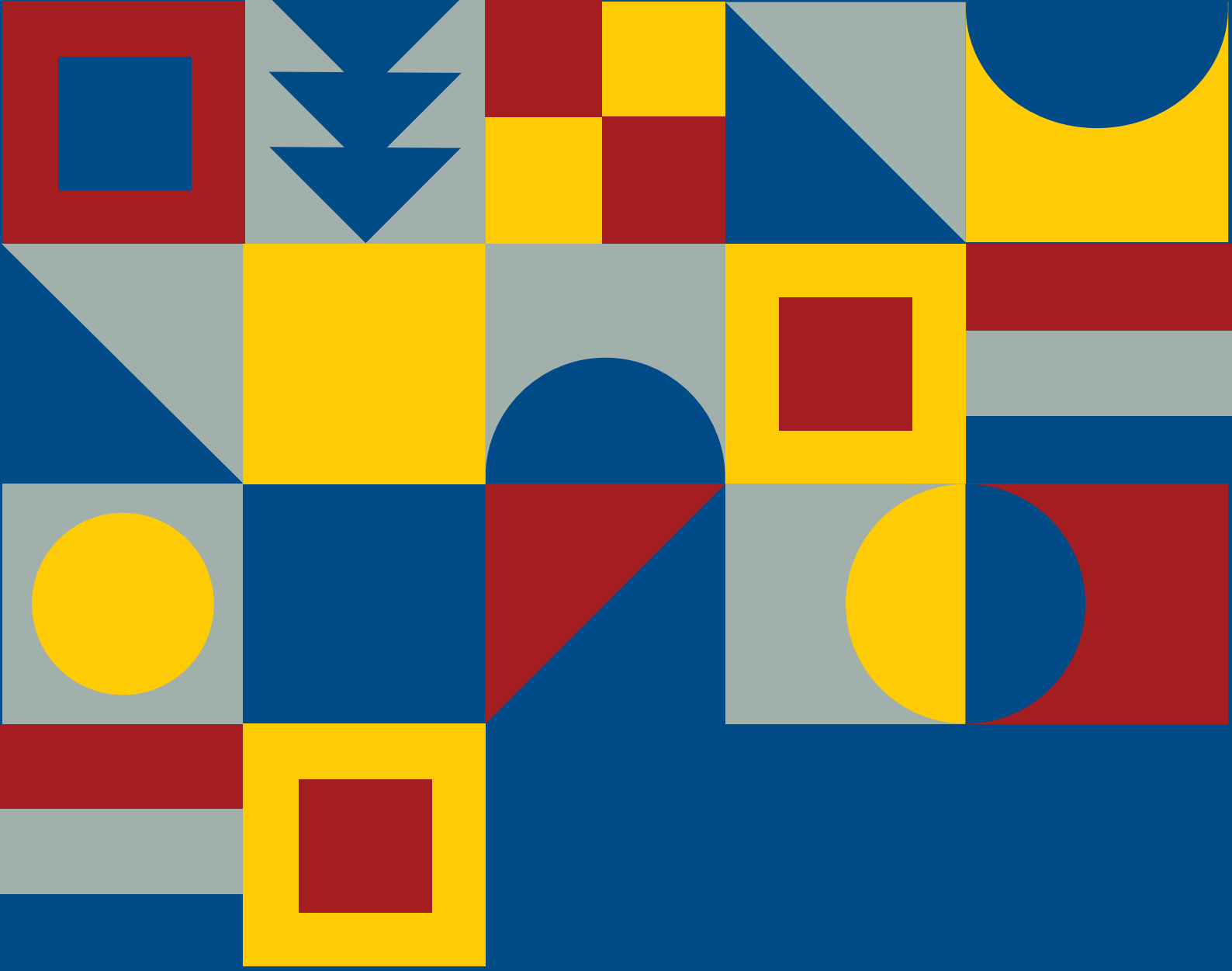


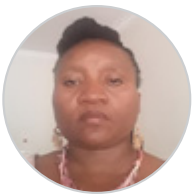
FACULTY OF

HUMANITIES

PART 7

A MESSAGE FROM THE DEAN – PROF. NOSISI FEZA

In the Faculty of Humanities, we pride ourselves on leading in creative outputs that are new in South Africa. Our research is strongly influenced by the challenges in our society and diverse communities. The faculty uses its Art experts in leading community engagement projects that empower members of the communities living with disabilities, by making jewellery using recycled material. This is a very good example of applied research, which is a focus of the Central University of Technology. Our research highlights the use of indigenous languages as capital for development. Inclusivity is at the heart of our research, which emphasises that everyone should be empowered by proficiency in knowledge, skills and language. Our research reflects innovative teaching strategies needed in the education system globally. At the heart of our research the theme is "Every learner counts".



Prof. N.N. Feza
Dean: Faculty of Humanities

A MESSAGE FROM THE ASSISTANT DEAN RESEARCH INNOVATION & ENGAGEMENT (RIE)

It is my pleasure once more to present to you the 2019 Annual Research Report for the Faculty of Humanities.

Humanities graduates the majority of post-graduate candidates. This is as a direct result of the support we give our students such as writing workshops and research seminars. This indicates potential for research outputs that can be aligned with the graduation rate. The faculty reflects on its low performance on journal publications that is low, however it has to acknowledge the low motivation of staff members to high teaching workloads. The faculty then commits to use relevant motivation strategies that will improve the quality of outputs.

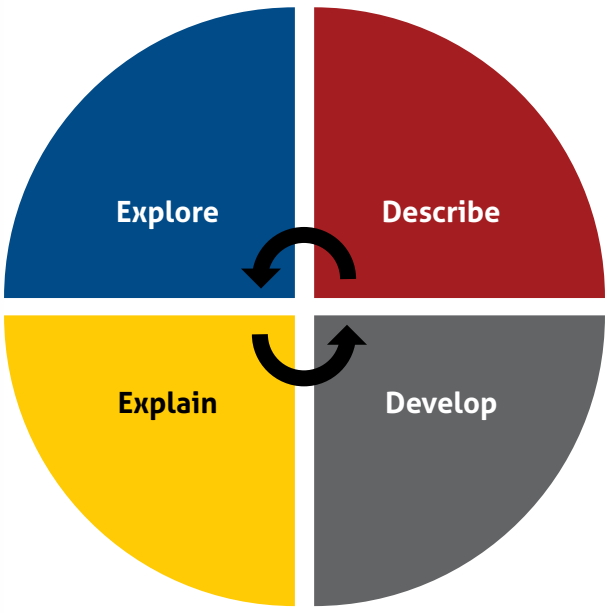
Now let me take you through the faculty's research related activities for the period under review.

Prof. M.K. Mhlolo
Assistant Dean: RIE
Faculty of Humanities

Prof. Johannes Cronjé, Dean of Informatics and Design at the Cape Peninsula University of Technology shared with the audience a couple of shortcuts and tools to develop a research proposal in a quick way.

FACULTY OF HUMANITIES PRESTIGE RESEARCH SEMINAR: EXPLORING THE 'WHAT, HOW, WHY AND WHEN' OF SOCIAL SCIENCE RESEARCH

This year's guest speaker at our annual prestige seminar was Prof. Johan Cronjé. In his presentation, Prof. Cronjé argued that research (that he has supervised) can be divided into four types. There are exploratory studies that explore the possibilities of new technologies, or that try and discover who is doing what, and why. Then there are studies that attempt to understand what solutions work best, and why. The third category of studies tries to determine why a certain teaching and learning problem exists, and then attempts to figure out how best to develop a solution. Finally, there are studies that evaluate a given situation in order to describe what is going on, and how it can be represented, copied, or scaled up. The problem is that often students spend a great deal of time figuring out which of these types of studies they wish to undertake, and often drift aimlessly from one to the other, wasting valuable time in the process. The greatest cause of the delay is often that they either know what they want to achieve, but not how, or they know what they want to do, but not why.



I Research aims and research questions

Briefly, Cronjé's presentation described an application of Burrell and Morgan's four paradigms of social science research from which a set of research questions can be derived that will ensure that what a student sets out to do is aligned with the research questions, so that the research methodology can be derived from that. Cronjé's tool has also been very useful in assisting students recover from devastating reports by external examiners whose main criticism is that the research is incoherent. Prof. Cronjé's tool is presented here in the hope that it will help other students and supervisors to explore the possibilities that it offers in the development of a clear research focus.

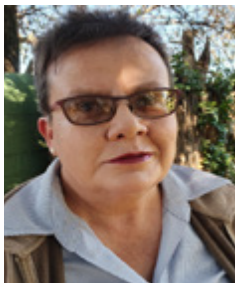
The figure shows how the four research aims can be achieved by the four research questions. If the research aim is to develop a solution, then the researcher needs to ask, "Why is this not working?" and "How should it be fixed?" If the researcher wishes to explain, then the questions are "How does this work?" and "Why is it working?" If the purpose is to explore, the questions are "What is going on here?" and "How does it affect those involved?" Finally, if the aim is to describe, then the questions are "What are the elements of this model?" and "How should they be combined or related?"

Post-doctoral fellows

MESSAGE FROM DR LEPHEANA ALICE MAMOTSHEARE – A POST-DOC FELLOW WORKING WITH PROF. GREGG ALEXANDER

The road started in 2018 in Humanities and a lot has happened since then. My focus will basically be on 2019, which was the second year of my journey under the mentorship of Prof. Alexander and the leadership of Prof. Mhlolo. I attended numerous presentations that were organised by the institution, such as how to apply for NRF assistance, VVOB, and mixed methods in research, to mention but a few. I learned to be independent, and also realised that there is a funding body in the form of the NRF that finances the research population. Even though I was not successful in obtaining funding, I was at least exposed to the processes and requirements. The highlight of 2019 for me was when my paper was accepted for a conference at Khon-Kaen University, Thailand. The paper was later successfully published for the CUT in the proceedings of the conference at Khon-Kaen University, Thailand, under the heading: *Elucidating the components of a psycho-social support framework for child-headed household learners for sustainable learning*. This motivated me strongly, especially when I was presented with a certificate from Khon-Kaen, acknowledging my short paper. Furthermore, I realised how committed the team of CUT is in everything they do as a university. I am still looking forward to learning much more: it is true that learning is not a cul-de-sac.

MESSAGE FROM DR ANNARI MILNE – A POST-DOC FELLOW WORKING WITH PROF. MIKE MHLOLO



The exposure to the academic world is a thought-provoking, though challenging experience. To learn at the feet of a master is a privilege. My first article, which resulted from a presentation at an international conference, will be published in the South African Journal of Education, February 2020 edition. The next article is already in the pipeline and is an investigation into how the clients of gifted education are experiencing the system. My experience as a post-doc fellow has made me even more curious to know and to learn more about gifted education that is in need of serious attention in our country. As a result of the exposure I have had, I have been doing workshops with teachers in different phases on how to differentiate their teaching in Mathematics, amongst other things. One thing that I have realised is that one can never stop learning, and I am looking forward to being able to obtain my qualification in gifted education. A successful 2-day Maths indaba was held for 125 people (teachers from different phases, departmental officials, and final year Mathematics education students from the CUT). CUT staff members also supported the project. The whole idea behind the project was to look holistically at Mathematics education. A project that was initiated in the district between the Elits department, an IT specialist and myself, was to increase the reading with understanding skills of the learners and to measure the influence of the process against their performance in Mathematics.

Research Centre

CENTRE FOR DIVERSITY IN HIGHER EDUCATION: STUDY VISIT TO THE WORLD COUNCIL FOR GIFTED & TALENTED CHILDREN (WCGTC) AT THE WESTERN KENTUCKY UNIVERSITY (USA)

The project on Gifted Education operates under the wing of our Centre for Diversity in Higher Education. In terms of national alignment of our centre's aims and objectives, we subscribe to the National Development Plan – Vision 2030, in which the preamble states that a South Africa is envisaged where "we participate fully in efforts to liberate ourselves from the conditions that hinder the flowering of our talents" (Vision 2030). As an institution that trains teachers, our view is that the CUT has a corporate social responsibility to be proactive in pursuit of implementation of such recommendations. Today more and more universities around the world are integrating social responsibility into their mission statements, including their research, and teaching missions, arguing that higher education is better off when it gives back to the society that is responsible for funding it.It is against this background that Prof. Mhlolo decided to embark on research into gifted education, with a particular focus on Mathematics education. Although we kicked off with this specific focus, giftedness allows diversity in that it can be researched across different disciplines both in education and otherwise.

Left to Right: Mr Thomas Clark Tyler (Administrative Officer – WCGTC), Dr Annari Milne, Mrs Gertrude Motshidisi van Wyk, Dr Lukanda Kalobo, Prof. Julia Roberts (Director of the Headquarters), Prof. Mike Mhlolo, Ms Sister Mapiyeye, Mr Jack Mathoga Marumo

Given our interest in research into the topic of gifted children, and the fact that we have built up relevant networks over time, we were invited to the Western Kentucky University for their 21-day Annual Summer Program for (1) Verbally and Mathematically Precocious Youth (VAMPY) in Grades 7 – 10, and (2) Camp Innovate – a minds-on, hands-on day camp open to Grade 3 to Grade 5 learners with advanced ability and high interest in learning.

Even though the WKU is way ahead of CUT in terms of their work on gifted education, we were informed of the struggles they went through before getting to where they are now. This gives us hope that we can also achieve something if our minds are set on the target. It is clear that the CUT can learn a lot from this university. Partnering with the WKU could yield great benefits for the education system in the Free State province. The WKU could not have been a better choice for this study visit.

The office of the World Council is located in a $35 million College of Education and Behavioural Sciences building on the WKU campus, which was named after WKU's ninth president (equivalent to Vice Chancellor), Gary A. Ransdell.

Prof. Alexander (Chairperson of the Internationalisation Committee)

FACULTY OF HUMANITIES: INTERNATIONALISATION

This report is presented by the Chairperson of the Internationalisation Committee in the Faculty of Humanities. Pertaining to various outbound activities (staff travelling abroad to partner universities and other institutions), the following activities were realised. Dr Tebogo Matlho, Mr M Letuka and Mr Paseka Mollo visited the Faculty of Education, Khon Kaen University in Thailand, for the period 25-27 September 2019, to participate in the International Conference on Educational Research (ICER), at which the CUT is a co-host. Dr Matlho delivered a keynote address on behalf of the CUT. In total, 8 papers were presented at the ICER, which were also published in the official conference proceedings book/CD. The expectation amongst ICER partner universities is that CUT should host ICER in 2022.

In terms of inbound activities, Prof. Gregg Alexander (as part of his funded NRF Thuthuka project), invited Dr Prasong Saihong (Faculty of Education, Mahasarakham University, Thailand) to South Africa as a visiting scholar for the period 11-18 February 2019. Dr Saihong and Prof. Alexander engaged with lecturers, teacher education students, primary school teachers and primary schools (with the assistance of Dr Lukanda Kalobo) on the topic of *Storytelling*. It should be noted that Mahasarakham University has an official MoU with the Central University of Technology. Three workshop seminars and school presentations on storytelling activities were held at the University of the Free State, Sol Plaatje University, the Central University of Technology and two primary schools in Bloemfontein. The Dean of the Faculty, Prof. Feza, also hosted the faculty's first ever *lekgotla* on 18-19 April 2019, where Prof. Aridam Bose, Associate Professor, Centre for Education Innovation and Action Research (CEIAR), Tata Institute of Social Sciences, Mumbai, made a presentation titled: *Fostering meaning making in Mathematics Classrooms: Valuing Tri/Multilingual registers and spaces of learning.* It should be noted that a faculty delegation visited the Tata Institute in 2018 and that an MoU with this institution is in draft form.

Professors Ermelinda Moutinho Pataca and Agnaldo Arroio from the University of Sao Paulo, Brazil, were hosted by Prof. Wendy Setlalentoa, HoD, Department of Maths, Science & Technology Education on 21 February 2020. Both colleagues from Brazil made presentations to faculty staff. Issues pertaining to research, cultural exchange programmes (for staff and students), teaching, knowledge sharing and funding applications for common projects were explored as future collaborative initiatives. On 4 March 2020, Dr Lekgopane Tladi (Acting Dean of the School of Science and Technology) and Prof. Sonny Ayuk (School of Science and Technology) from the Botswana Open University (BOE) were hosted by the Department of Maths, Science & Technology Education, CUT. Critical areas of interest such as curriculum programmes between CUT and BOE, benchmarking on common programmes such as Computer Science and ICT, external moderators for exit modules for undergraduate studies and external examiners for postgraduate studies were discussed as initiatives for future collaboration between the two institutions.

Student and staff engagements between CUT and Thomas More University College (Belgium), Aelen University (Germany) and Mittweida University (Germany) take place on a continuous basis. Prof. Alfred Makura also undertook a courtesy visit to Great Zimbabwe University, where he engaged with Prof. Rose Mugweni (Dean of Education, RG Mugabe School of Education) in December 2019. Prof. Mugweni expressed willingness to work with CUT on initiatives pertaining to research collaboration, lecturer exchange and supervision. Prof. Jonathan Chitiyo (Assistant professor in special education) at the University of Pittsburgh, USA, extended an invitation to the faculty to collaborate on issues relating to lecturer and student exchange, supervision, external moderation and joint research project funding.

At international level, Prof. Gregg Alexander interacted with staff attached to Mahasarakham TVET College, Thailand, while Dr Charles Masoabi had engagements with Ngee-Ann TVET College in Singapore. Prof. Alexander and Dr Masoabi were especially impressed at the workshop arrangements and learning spaces provided to students to acquire certain skills in a very practical and interactive manner. The level of social interaction between lecturers and students during the teaching process was built on cooperation, practical demonstration, active learning, enthusiasm, pride and respect. Ngee-Ann offers the best Engineering programmes in south-east Asia – these developments can support internal processes of the Department of Postgraduate Studies in Education's envisaged Advanced Diploma in TVET education as well as providing exposure to training for lecturing staff.

Seven staff members (Prof. Gregg Alexander, Prof. Alfred Makura, Prof. Jo Badenhorst, Dr Motshidisi Lekhu, Dr Charles Masoabi, Dr June Palmer and Dr Brenton Fredericks) from the faculty's Internationalisation Committee participated in the Masterclass workshop (Managing Higher Education Internationalisation) held on 27-29 August 2019, which was facilitated by Dr Nico Jooste. Masterclass colleagues are now part of a core group working closely with the CUT International Affairs Office and advising on issues pertaining to the CUT Internationalisation Policy and institutional directives in the internationalisation of higher education.

As part of its community engagement outreach, the faculty's RDI (Research Development Initiative) created opportunities for prospective master's and doctoral students to present their research intentions to staff on two occasions in 2019. On 12 September 2019 and 1 & 3 October 2019, Ms Rola Yu and Mr Marvin Gabriel met with Prof. Feza, HoD members of the Internationalisation Committee and students (Bloemfontein and Welkom campuses), to discuss the Chinese Intercultural Educational Exchange Programme, which is aimed at recruiting final year BEd and PGCE students to teach in China. Through these platforms, Ms Yu and Mr Gabriel engaged with students to discuss the objectives, benefits, processes, criteria and recruitment procedures attached to the programme initiative.

COMPLETED MASTER'S DEGREES

Challenor, R.M. (2019). *Playing games pedagogy in the 21st century.* Central University of Technology, Free State.

Drude, N.C. (2019). *Exploring the resilience of grade 7 progressed learners in the Lejweleputswa district of the Free State province.* Central University of Technology, Free State.

Lephatsoe, M.A. (2019). *Teacher role in the promotion of mastery learning: Perspective on strategy and performance in the FET phase.* Central University of Technology, Free State

Marumo, J.M. (2019). *Strategies used by teachers for supporting mathematically gifted learners in ten selected high schools around Bloemfontein.* Central University of Technology, Free State.

Mokodutlo, B.M. (2019). *The exposure of township secondary school learners to career education in Lejweleputswa district.* Central University of Technology, Free State.

Muomezie, S.I. (2019). *Teachers' efficacy in teaching physical education in primary schools in the Motheo District, Free State province of South Africa.* Central University of Technology, Free State.

Nel, L. (2019). *Revaluing commodity fetishism to facilitate fashion sustainability.* Central University of Technology, Free State.

Oldjohn, P. (2019). *Exploring workplace adversity and resilience among teachers in the Lejweleputswa district.* Central University of Technology, Free State.

Qhobosheane, M.E. (2019). *An investigation into the levels of English proficiency of grade 4 learners in township and rural schools.* Central University of Technology, Free State.

Tadi, M.E. (2019*). Exploring performance appraisal policy (IQMS) and educational outcomes in selected secondary schools in the Lejweleputswa education district.* Central University of Technology, Free State.

Van Wyk, M.G. (2019). *Teachers' perceptions on mathematically gifted: A survey of mathematics teachers in Motheo and Xhariep Districts' primary schools of Free State Province.* Central University of Technology, Free State.

COMPLETED DOCTORAL DEGREES

De Lange, J.J. (2019). *School management teams' impact on educators' job satisfaction in the Free State province.* Central University of Technology, Free State.

Fourie, M. (2019). *Simultaneous impact of juxtaposed learning theories on learner information processing ability for cognitive growth and development.* Central University of Technology, Free State.

Maope, M.B. (2019). *Towards a development of a quality external support framework for the Further Education and Training (FET) phase physical sciences teachers in Lejweleputswa district.* Central University of Technology, Free State.

Mlambo, S. (2019). *South African educators' beliefs and cognitive orientations towards educational technology integration in classrooms: A comparative study of Gauteng and North-West provinces.* Central University of Technology, Free State.

Mosebekoa, M.J. (2019). *The Technical and Vocational Education and Training as the basis for societal development: The comparative study of the Republic of South Africa and Lesotho.* Central University of Technology, Free State.

Phakisi, E.M. (2019). *Evaluating the primary school science teachers' pedagogical practice in multi-grade classrooms in Lesotho.* Central University of Technology, Free State.

Sebeela, S.K. (2019). *The relationship between the leadership of the school and the performance of Grade 12 learners in the North West province.* Central University of Technology, Free State.

LIST OF CONFERENCE PROCEEDINGS

Alexander, G. and Lepheana., A. (2019). *Proposing a Psychosocial Framework for Assisting Learners from Child-Headed Households.* In S.Chaijaroen, N.Srisawasdi, C.Samat (Eds). Proceedings of the 12th International Conference on Education Research), Thailand, Faculty of Education, Khon Kaen University. pp. 157-161. ISBN 978-616-438-422-4.

Beukes, J.A.G (2019). *4th IR-Implications For Higher Education.* In J.Holmanova (Ed.). Proceedings of the 50th International Academic Conference, Paris. pp. 40-51, ISBN 978-80-87927-84-7.

Kalobo, L. (2019). *Ascertain Mathematics Teachers Subject Experiences in Understanding their Perceptions in Developing Statistical Learning Outcomes in South Africa High School Contexts.* In N.Srisawasdi and C.Samat (Eds). Proccedings of the 12th International Conference on Education Research, Thailand, Facutly of Education, Khon Kaen University, pp. 183-189. ISBN 978-616-438-422-4.

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Kalobo, L. and Mhlolo, M.K. (2019). *Mathematics education pre-service teachers awareness of gifted students' characteristics.* In M. Nolte (Ed.). Proceedings of the 11th International Mathematical Creativity & Giftedness (MCG) Conference, Germany, University of Hamburg, pp. 277-283. ISBN 978-3-95987-132-5.

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Kimanzi, M.K. (2019). *Assessing SMEs' Awareness Level about sustainability issues: A Case of Pitermaritzburg (South Africa) – based SMEs.* In O. Sam (Ed.). Proceedings of the 7th International Conference on embracing capacity building opportunities in the modern-day dispensation, CPUT, Cape Town, South Africa. pp. 273- 278, ISBN 421-0341-9040-030.

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Letuka, M. (2019). *Student Teachers' Perception of Lecturer Feedback on Their Teaching Competence During Teaching Practice.* In S. Chaijaroen, N. Srisawasdi, and C. Samat (Eds). Proceedings of the 12th International Conference on Education Research), Thailand, Faculty of Education, Khon Kaen University. pp. 151-155. ISBN 978-616-438-422-4.

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Mokhampanyane, M.C. and Modise, A.M. (2019). *Accounting student life adjustment at the university in South Africa.* In C. Yu; T. Hung and C. Li (Eds). Proceedings of the International Symposium on Education and Psychology (ISEP) Fakuoka Japan. pp. 13-18. ISBN 2226-6275.

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Mollo, P.P. (2019). *Gamification in Education using Information Communication Technology: What Student Teachers In South Africa Need to Know.* In N. Srisawasdi (Eds). Proceedings of the 12th International Conference on Education Research, Thailand, Facutly of Education, Khon Kaen University, pp. 144-149. ISBN 978-616-438-422-4.

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Setlalentoa, W.N. (2019). *Towards Enhancing Reflective Practice and Nurturing Communities of Practice Amongst Natural Sciences Student Teachers at a University of Technology.* In J. Holmanova (Eds). Proccedings of the 50th International Academic Conference, Paris, pp. 206-213, ISBN 978-80-87927-84-7.

Thabane, R.W. (2019). *Negotiating Transition from High School Mathematics to Teacher Education Mathematics at a University of Technology in South Africa: Perceptions of Students and Lecturers.* In S. Chairjaroen, N. Srisawasdi, C. Samat (Eds). Proceedings of the 12th International Conference on Education Research, Thailand, Faculty of Education, Khon Kaen University, pp. 163-170. ISBN 978-616-438-422-4.

Thabane, R.W. (2019). *Enhancing Micro Teaching Through The Incorporation of Lesson Study at Central University of Technology.* In M. Carmo (Ed.). Proceedings of the Education and New Developments (END), In Science Press. pp. 163-167. ISBN 978-989-543-1267.

Van Wyk, M.G. and Mhlolo, M.K. (2019). *Examining Primary School Teachers' support towards Mathematically Gifted Learners in South Africa.* In M. Nolte (Ed.) Proceedings of the 11th International Mathematical Creativity & Giftedness (MCG) Conference, Germany, University of Hamburg, pp. 209-214. ISBN 978-3-95987-132-5.

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Kimanzi, M.K. (2019). Education for sustainable development – economics students' perspectives at an institution of higher learning in South Africa. *International Journal of eBusiness and e-Government Studies,* 11(1) ISSN 2146 – 0744.

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Makura, A.H. and Kalobo, L. (2019). Reliability and equity of subject delivery competencies: Perspectives of pre-service teachers. *Journal of Psychology in Africa,* 29(5) pp. 511- 515 ISSN 1433-0237 EISSN 1815 – 5626.

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Moyo, R.M. (2019). Adoption of information and communication technologies in teaching and learning at a university. *South African Journal of Higher Education,* 33(5) pp. 42-60.

Ngidi, D.P. and Ngidi, S.A. (2019). Determination of factors influencing pre-service teachers' sense of self-efficacy. *South African Journal of Higher Education*, 33(5), pp. 98-111. eISSN 1753 – 5913.

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Tondi, P. (2019). The concept of good governance and the King IV Principle of Ethical and Effective leadership as absolutes for effective and efficient South African Higher Education setting. *Gender & Behaviour,* 17(1), pp. 12671-12683. ISSN 1596 – 9231.

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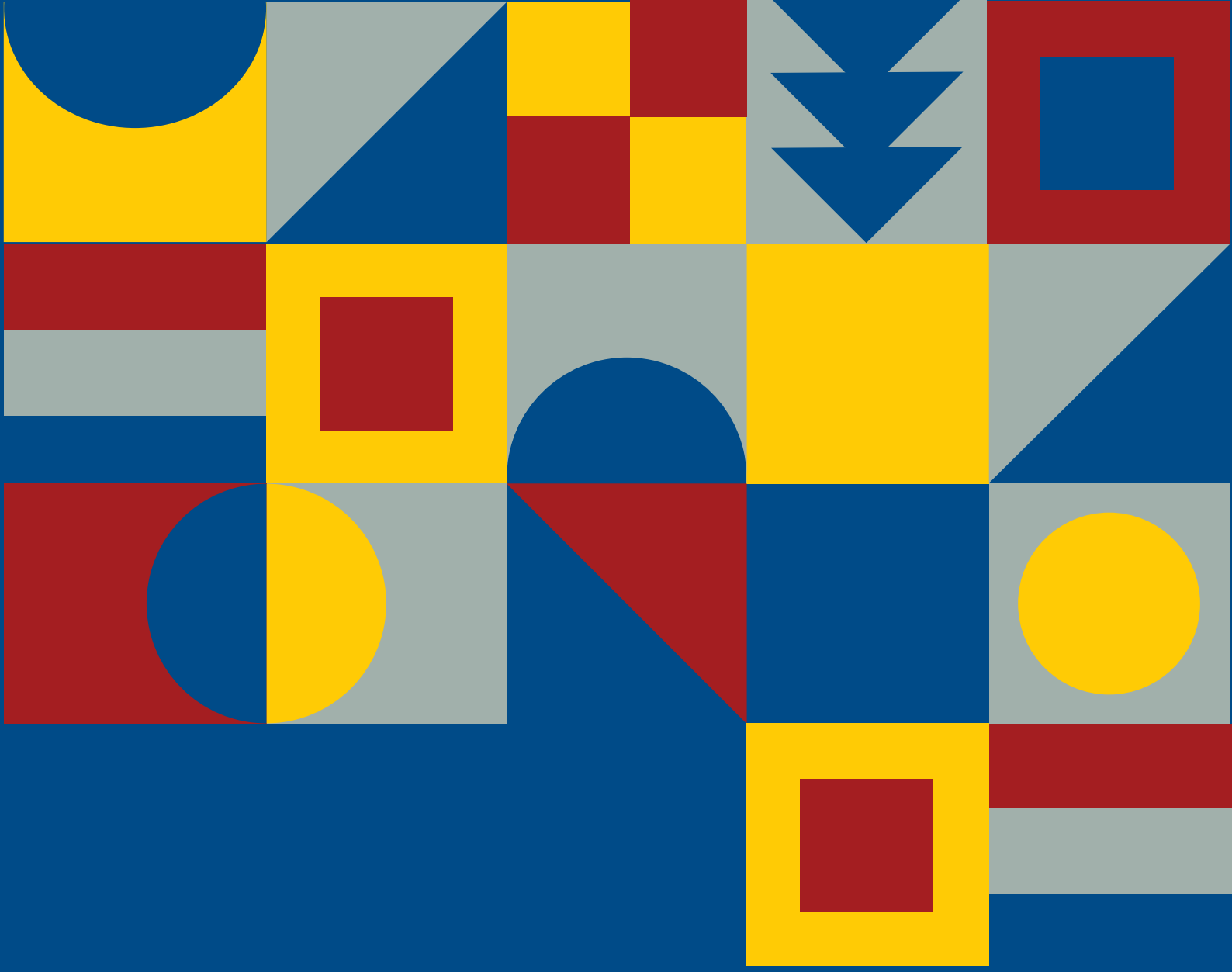
Feza, N. (2019). Black students' rich mathematical experiences: Mathematics concepts and Xhosa cultural games for Reception class. In Donna Farland-Smith (Ed.) *Early Childhood Education,* pp. 151-163. ISBN: 978-1-78985-521-0.

Feza, N. (2019). Self-Regulation in Early Years of Learning Mathematics: Grade R observed Self-Efficacy Skills Shared and Aligned. In N. Feza (Ed.) *Metacognition in Learning* pp. 83- 95. ISBN: 978-1-78985-521-0.



FACULTY OF

MANAGEMENT SCIENCES

PART 8

A MESSAGE FROM THE DEAN

Engagement in applied research activities is a major priority in the Faculty of Management Sciences and 2019 was no exception. We experienced a growth of more than 20% in publications in accredited journals compared to 2018, and we also produced our fair share of master's and doctoral graduates. I am also very proud of our international footprint – especially in Africa through active research partnerships with the Ho Technical University in Ghana and the Greater Zimbabwe University. We are also very excited by the fact that we received confirmation of SAQA registration for a new structured master's in management sciences, in Entrepreneurial Management – a first for the CUT! Equally exciting is the fact that the CUT's Senate has approved a new research centre for the faculty, namely the Centre for Entrepreneurship and Enterprise Studies (CEES). In future, all research in the faculty will revolve around the themes of entrepreneurship and enterprise studies. This will help us to be focused and to become specialists in an area very relevant to economic growth and development – not only in central South Africa but also beyond our borders. We also appointed a full-time Senior Researcher in Entrepreneurship from 1 September 2019.

I want to thank our Assistant Dean, Research, Innovation and Engagement, as well as all HODs and colleagues who contributed to the successes of 2019. May all colleagues come on board soon to take the faculty to the next level in the research arena!

Prof. A.J Strydom
Dean: Faculty of
Management Sciences

A MESSAGE FROM THE ASSISTANT DEAN

One of the faculty's focus areas in 2019 was on filling the vacant posts of Professor in Entrepreneurship, and Statistician, as a strategy to further improve our research output and footprint within the university and outside. A senior researcher in entrepreneurship was duly appointed, but not a statistician. The faculty however identified some staff members in the faculty to be trained in some statistical analysis techniques, with the proviso being that they help all other researchers in the faculty. In addition, staff had the liberty to continue engaging with outside faculty expertise in doing their research, in order to gain as much knowledge and understanding in statistics as possible.

On the internationalisation front, the further implementation of the Ho Technical University and Great Zimbabwe MoUs was earmarked, as well the increase in the pool of partners, with a focus on collaborative research, staff and student exchange. To this end, the faculty successfully hosted the biennial ICED 2019 conference on 3-5 April, during which more than 40 papers were presented by local and international attendees, and a special issue of selected papers from the conference was published before the end of the year (2019). The Prestige Seminar was also successfully held on 16 September. The guest speaker was Professor Joan Lockyer, Director of Education, International Centre for Transformational Entrepreneurship (ICTE) at Coventry University. A total of five CUT papers were presented, from across the faculty. In addition, on 17 September 2019, a workshop was held by the Centre for Entrepreneurship and Enterprise Studies, to benchmark and learn best practices from Prof. J Lockyer, who is part of a similar centre in the United Kingdom. Other notable international footprints were made by Prof. M.N. Naong, who visited Sweden on an exchange programme under Erasmus + in October, while Prof. C Chipunza visited the University of Montpellier in France during the same period, to explore the establishment of a joint doctoral programme. Prof. Strydom visited China on a study tour, while Prof. Dzansi visited Ireland and Finland. One postgraduate student (doctoral student) was selected for an exchange programme in Sweden at Uppsala 2020.

To highlight the need for increased participation in research by every staff member during 2019, the faculty research office organised an open discussion with all staff members on 8 March 2019 to discuss ways of improving research. Several issues were identified, including the need to have focused training in article writing, ensuring quality in statistical analysis of M & D studies, the identification of two staff members good at statistics to be further capacitated, and cross-supervision of students in departments.

Workshops on proposal writing were held by Prof. P Rambe for prospective M & D students, at both the Bloemfontein and Welkom campuses. The faculty continued to be inundated with prospective postgraduate students, especially in HR and Business Administration. The issue of supervision workload per each supervisor and lack of adequate supervision capacity in the faculty was raised throughout the year at FRIC meetings. To find a possible solution on supervision workload, a benchmarking exercise was done by the faculty research office. Based on the benchmarking, FRIC recommended that each department/HoD should deal with the issue of supervision workload in line with the workload model of the university. Regarding lack of supervision capacity in the faculty, FRIC recommended that HoDs should budget for experienced external supervisors for 2020, with the help of the faculty research office. In addition, the faculty will have to work with international partners in this regard, where possible.

A total of 13 students graduated, one (1) doctorate and 12 masters', while 25 postgraduate proposals were approved in the faculty for the 2019 academic year. External funding is still confined to NRF, and the set target for 2019 was reached. A total of 29.83 units were generated through publications, compared to 22.72 in 2018.

Professor C.C. Chipunza
Assistant Dean: RIE
Faculty of
Management Sciences

REPORTS FROM RESEARCH PROFESSORS

Prof. Patient Rambe is a Research Professor of Entrepreneurship. His research interests are in the appropriation of emerging digital technologies to leverage entrepreneurship, business management and higher education imperatives. In 2019, Prof. Rambe was appointed as a co-director of the Centre of Enterprise and Entrepreneurship Studies. Patient is the leader of the Entrepreneurship and Innovation cluster on the Higher Education Regional Development Initiative of Central South Africa (HERDIC-SA), a consortium of central region SA universities and TVET colleges collaborating on entrepreneurship research and economic development in the Free State Region. He served as the guest editor-in-chief of the Entrepreneurship Development Special Issue of the African Journal of Hospitality, Tourism and Leisure (AJHTL) 2019. He also serves as the assistant editor of AJHTL for the years 2019-2020. He reviewed a chapter titled *Positive Tourism in Africa: Resisting Afro-pessimism*, by M. Mkono, published in Positive *Tourism in Africa* (edited by M. Mkono). Prof. Rambe is the supervisor of Dr Takawira Ndofirepi's research on entrepreneurial intentions of higher education students in emerging economies. In 2019, he co-authored four publications in DHET accredited journals and presented one paper at an international conference in Barcelona. He also represented the Faculty of Management Sciences at the South Africa-Sweden University Forum and presented a research paper titled *Student demographics and perceptions of usefulness of technologies for learning* in May 2019. Moreover, he presented a research proposal titled *Understanding factors affecting technology entrepreneurship of university-based technology-based firms* in the Faculty of Economics and Management Sciences at University of the Free State, September 2019.

VISITING PROFESSORS

Prof. Ulrich Holzbaur, our Extraordinary Professor from Aalen University of Applied Sciences in Germany, visited the Faculty of Management Sciences during February 2019. The main purpose of his visit was to finalise our jointly developed entrepreneurial game, called VALU-E. He also had discussions on cooperation options regarding sustainable and geo-tourism, joint degree offerings and the continuation of our active programme of student and staff exchanges.

HO TECHNICAL UNIVERSITY AND CUT PROJECT

In 2017, CUT and HTU signed an MOU to collaborate in mutually beneficial research projects. As an offshoot, CUT has registered over 40 staff members for various CUT doctoral and master's programmes. The first intake was in 2018, with majority of the students registered in programmes in the Faculty of Management Sciences.

MACCAUVLEI PROJECT

The Department of Business Management, through its flagship 3rd stream Maccauvlei project, persists in making a positive impact on the South African economy. For the 2020 academic year, the project successfully recruited a total of 54 students for the Advanced Diploma: HRM programme, an apt replacement for the now defunct B.Tech: HRM programme. The programme continues to recruit across diverse sectors of the SA economy, and is offered in a flexible, blended and block release mode.

COMPLETED MASTER'S DEGREES

Bester, J.C. (2019). *The influence of transactional data quality improvements on monetary savings of Eskom distribution, Free State.* Central University of Technology, Free State.

Chamboko, M. (2019). *Demographics and consumer behaviour of visitors to the WEGRY/DRIVE OUT Bull Run Motorsport Event.* Central University of Technology, Free State.

Dzansi, M.S. (2019). *Soft skills training needs of owner/ managers of emerging construction firms in the Mangaung Metro.* Central University of Technology, Free State.

Khori, L.T. (2019). *Assessing the implementation of the King III internal auditing reporting guidelines at Universities of Technology in South Africa.* Central University of Technology, Free State.

Lefera, M. (2019). *Sexual diversity management by SMME owner-managers in Mangaung Metropolitan Area.* Central University of Technology, Free State.

Mabope, C. (2019). *Strategies and practices for effective talent management in Mangaung Metropolitan Municipality.* Central University of Technology, Free State.

Magagula, S. (2019). *An evaluation of the implementation of monitoring and evaluation systems in the Office of the Premier, Free State Provincial Government.* Central University of Technology, Free State.

Mbambo, E.M. (2019). *Perceptions and challenges of service delivery in the Department of Home Affairs, Welkom Regional Office, South Africa: A TQM perspective.* Central University of Technology, Free State.

Mokhesi, G.L. (2019). *Assessing the Level of Compliance with ISO 9001:2008 Quality Management Systems at Eskom Distribution Project Execution and Plant.* Central University of Technology, Free State.

Monyaki, L. (2019). *The impact of selected individual and organisational factors on intention to quit among employees. Case of B&B establishments in Thabo Mofutsanyane District, Free State.* Central University of Technology, Free State.

Sealome, P. (2019). *The impact of employees' perception of diversity management practices on psychological capital. Case of B&B establishments in Matjabeng Local Municipality in the Free State.* Central University of Technology, Free State.

COMPLETED DOCTORAL DEGREES

Proos, E. (2019) *A development plan for establishing a South African War battlefields route for the Central Karoo.* Central University of Technology, Free State.

LIST OF CONFERENCE PAPERS

Coughlin, LM. (2019). *Taste the Free State – The quest to ascertain a food identity for the Free State province, South Africa.* Vancouver, Canada, 21-25 September 2019.

De Klerk, B. (2019). *The management and operations of ungraded small accommodation establishments situated in small towns of the Free State platteland.* Vandebijlpark, South Africa, 3-5 September 2019.

Haarhoff, R. (2019). *Environmental perceptions of Global tourists.* Havana, Cuba, 5-7 March 2019.

Hattingh, J. (2019). *Agri-tourism in the eastern Free State: What are the critical success factors?* Cape Town, South Africa, 22-25 September 2019.

Hlalele, BM. (2019). *Probabilistic flood risk analysis and modelling: an external project risk factor, Bloemfontein, South Africa.* Durban, South Africa, 17-20 September 2019.

Kokt, D. (2019). *Suggestions to prepare the South African youth for the fourth industrial revolution.* Bloemfontein, South Africa, 9-11 October 2019.

Kokt, D. & Seqhobane, M. (2019). *To what extent can job characteristics motivate millennial hospitality employees?* Cape Town, South Africa, 22-25 September 2019.

Makwara, T. (2019). *Practices fueling the spread of HIV/AIDS in the South African construction industry.* Cape Town, South Africa, 2-3 June 2019.

Masilo, T.G.G. (2019). *The perceived impact of integrated development planning (IDP) on the social and economic development of communities: the case of the Magareng Local Municipality (Northern Cape).* Nelspruit, South Africa, 14-17 May 2019.

Mokoena, L.G. (2019). *Cultural tourism: Cultural Presentation at the Basotho Cultural Village, Free State, South Africa.* Portsmouth, United Kingdom, 9-12 July 2019.

Molomo, P. (2019). *Differentiation in the curriculum in developing innovative and engaged graduates: The case of a University of Technology, South Africa.* Bloemfontein, South Africa, 9-11 October 2019.

Motsumi, O.L. (2019) *Assessing the impact of the Mandela-Castro medical collaboration programme in promoting health care service delivery in the Frances Baard district hospitals, Northern Cape province.* Nelspruit, South Africa, 14-17 May 2019.

Mphirime, B.G. (2019). *Psychological Contract, Psychological Capital and employee commitment in accommodation establishments.* Durban, South Africa, 17-20 September 2019.

Naidoo, A. (2019). *Xenophobia at Higher Education Institutions in South Africa.* Bloemfontein, South Africa, 9-11 October 2019.

Proos, E. (2019). *Dark Tourism: Unlocking the niche tourism potential of the Free State Province.* Port Elizabeth, South Africa, 8-11 September 2019.

Sebakamotse, J.K.T and Van Niekerk, T. *The Constitution, 1996 as a guideline to ensure oversight and accountability for public officials in the Free State local municipalities.* South Africa, 25-27 September 2019.

Sempe, L. (2019). *Examining the Mediating Effect of Word-of-Mouth on the Relationship between Customer Experience, Effort Expectancy and Customer Trust in E-Commerce.* Cape Town, South Africa, 2019.

Van Der Walt, F., Nkoyi, A., Masupa, A. and Rambe, P. (2019). *Factors influencing internet banking adoption decisions of rural dwellers in a developing country.* Madrid, Spain, 21-22 August 2019.

Van Niekerk, T. (2019). *Corruption undermines the rule of law: the case of state capture in South Africa.* Lisbon, Portugal, 22-26 July 2019.

LIST OF CONFERENCE PROCEEDINGS

Sempe, L. (2019*). Examining the Mediating Effect of Word-of-Mouth on the Relationship between Customer Experience, Effort Expectancy and Customer Trust in E-Commerce.* In Suresh, P. (Ed.). Proceedings of the International Conference on Management, Economics & Social Science (ICMESS) 24 -25 June 2019 held in Cape Town, South Africa, pp. 1-6. ISBN 978-93-87405-18-9.

Steenkamp, L., Smidt, L., Ahmi, A., Lubbe, D.S. and Van Der Nest, D.P. (2019). *An assessment of the maturity of the use of Generalised Audit Software: A Survey of Internal Audit Functions in the Federal Government of Canada.* In Proceedings of the SAAA/IAAER International Accountancy Conference, Johannesburg, South Africa, 26-28 June 2019.

Steenkamp, L., Smidt, L., Ahmi, A., Lubbe, D.S. and Van Der Nest, D.P. (2019). *An assessment of the maturity of the use of Generalised Audit Software: A Survey of Internal Audit Functions in the Federal Government of Canada.* In Proceedings of the SAAA/IAAER International Accountancy Conference, Johannesburg, South Africa, 26-28 June 2019.

LIST OF JOURNALS/ARTICLES (DHET SUBSIDISED)

Agbobli, A., Mosweunyane, L. and Okyere, F. (2019). Surviving the Competition: A South African Case Study of Quality of Record Keeping and Economic Performance of Hairdressing Salons. *International Journal of Management Sciences and Business Research, 8(6), 100-114.*

Chamboko, M. and Hattingh, J. (2019). Demographics and consumer behaviour of visitors to the WEGRY/DRIVE OUT Bull Run Motorsport Event. *African Journal of Hospitality, Tourism and Leisure*, 8(3) 2019, 1-18.

Chipunza, C. and Phalatsi, B.C. (2019). The influence of selected demographic factors on the choice of marketing communication tools: Comparison of foreign and local spaza shop owners in South Africa. *Acta Commercii,* 19(1), 2-14.

Chipunza, L.T. (2019). Does firm size matter in innovation in small accommodation businesses in developing economies? *African Journal of Hospitality, Tourism and Leisure*, Vol 8 (special edition), 1-12.

Haarhoff, R. and De Klerk, B. (2019). Destination South Africa: Analysis of Destination Awareness and Image by International Visitors. *GeoJournal of Tourism and Geosites,* 1(24).

Haarhoff, R. and Hass, AB. (2019). Destination South Africa: Analysis of Destination Awareness and Image by International Visitors. *African Journal of Hospitality, Tourism and Leisure* 8(1).

Hlalele, B.M. (2019). A multi-dimensional drought risk analysis in the Free State drought-hit municipalities, South Africa. *Ecology, Environment. & Conservation, 25*(2), 968-974.

Hlalele, B.M. (2019). Application of the force-field technique to drought vulnerability analysis: a phenomenological approach. *Journal of Disaster Risk Studies*, 11(1), 1996-1421.

Hlalele, B.M. (2019). Iyengar-Sudarshan method application to drought social vulnerability: Free State province, South Africa. *Environment and Conservation,* 25(3). ISSN: 0971-765X.

Hlalele, B.M. (2019). Spatio-temporal climate change risk assessment: Mangaung Metropolitan Municipality, South Africa. *Environment and Conservation*, 25(3). ISSN: 0971-765X.

Hlalele, M. (2019). Bi-hazard assessment for timely and effective disaster management: Free State disaster area 2015. *Ecology, Environment and Conservation*, 25.

Hlalele, M. (2019). Stochastic soil erosion risk modelling and simulation using Fournier index. *Ecology, Environment and Conservation*, 25.

Iwuchukwu, E.I., Amoakoh, E. and Chipunza, C. (2019). A theoretical analysis on the impact of relationship marketing practices on customer retention: A case of transformed small grocery retail shops in Mangaung Municipality area in South Africa. *African Journal of Hospitality, Tourism and Leisure*, Vol 8 (special edition), 1-12.

Jonck, P. and Van Der Walt, F. (2019). Demographic predictors of work ethics in a South African sample. *African and Asian Studies*, 18, 325-341.

Kokt, D. and Palmer E.P. (2019). Strategic priorities for cultivating commitment amongst academic staff: the militating effect of workplace spirituality. *South African Journal for Human Resource Management,* 17(0), 1-8.

Lategan, L.O.K. (2019). Caring for the elderly – a care ethics approach. *Journal for Christian Scholarship* 55(3): 85-105.

Makoni, J., Naong, M.N. and Onojaefe, D.P. (2019). Corporate Community Engagement Framework on Stakeholder Relations in the Extractive Sector in the Western Cape, South Africa. *Interdisciplinary Journal of Economics and Business Law*, Vol. 8 (Special Issue).

Makwara, T. (2019). Taking on the challenge: small, micro and medium enterprises (SMMEs) and socioeconomic development in South Africa. *Journal of Hospitality, Tourism and Leisure,* Volume 8 (Special Edition CUT) – 1-21. (2019) ISSN: 2223-814X.

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Mashavira, N., Chipunza, C. and Dzansi DY. (2019). Managerial interpersonal competencies and the performance of family- and non-family-owned small and medium-sized enterprises in Zimbabwe and South Africa. *SA Journal of Human Resource Management,* 17(0), a1130. https://doi.org/ 10.4102/sajhrm.v17i0.1130.

Mokoena, L.G. (2019). Cultural tourism: cultural presentation at the Basotho cultural village, Free State, South Africa. *Journal of Tourism and Cultural Change.* DOI:10.1080/14766825.2019.1609488.

Mokoena, L.G. (2019). Ethical tourism: should businesses be concerned? *Africa Journal of Hospitality, Tourism and Leisure,* 8(1), 1-14.

Mosweunyane, L., Rambe, P. and Dzansi, D. (2019). Use of social media in Free State tourism SMMEs to widen business networks for competitiveness. *South African Journal of Economic and Management Sciences,* 22(1), a2780. https://doi.org/10.4102/ sajems.v22i1.2780.

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Ndofirepi, T. (2019). Gender-based dichotomies in various psychographic attributes for environmentally friendly products, *Acta Commercii*, 19(1), 1-10.

Nkoyi, A., Tait, M. and Van Der Walt, F. 2019, Predicting the attitude towards electronic banking continued usage intentions among rural banking customers in South Africa, South African. *Journal of Information Management*. https://doi.org/10.4102/sajim.v21i1.1016

Nnamdi, O., Madichie, N., Mpiti, N. and Rambe, P. (2019). Impact assessment of funding on technology acquisition by small businesses: A case study of hair salons in a South African municipality. *Journal of Enterprising Communities: People and Places in the Global Economy,* 13 (1/2): 145-166. https://doi.org/10.1108/JEC-09-2018-0058.

Nyamubarwa, W. and Chipunza, C. (2019). Debunking the one-size-fits-all approach to human resource management: A review of human resource practices in small and medium-sized enterprise firms. *South African Journal of Human Resource Management,* Vol 17, a1108. DOI: https://doi.org/10.4102/sajhrm.v17i0.1108.

Proos, E. and Hattingh, J. (2019). Advancing Heritage tourism in the Central Karoo: The South African War Battlefields Route. *Development Southern Africa,* Online Dec. 2019.

Rambe, P. and Ndofirepi, T. (2019). Explaining Social Entrepreneurial Intentions among College Students in Zimbabwe. *Journal of Social Entrepreneurship*, 1-22. https://doi.org/10.1080/19420676.2019.1683878 9.

Smidt, L., Ahmi, A., Steenkamp, L., Van Der Nest, D. P. and Lubbe, D.S. (2019). A Maturity-level Assessment of Generalised Audit Software: Internal Audit Functions in Australia. *Australian Accounting Review*, 2019, 29(3) :516-531.

Strydom, A.J., Mangope, D. and Henama, U.S. (2019). Making community-based tourism sustainable: evidence from the Free State Province, South Africa. *GeoJournal of Tourism and Geosites,* 24(1).

Strydom, A.J., Mangope, D. and Henama, U.S. (2019). A critique of the interface between tourism, sustainable development and sustantiable tourism in community-based tourism theory. *African Journal of Hospitality, Tourism and Leisure*, 8(5), 1-12.

Swart, A.J., Coughlan, L.M. and Joannou, N. (2019). Student perspectives of a peer mentorship programme introduced at a university of technology in South Africa. *Global Journal of Engineering Education*, 21(3).

Van Der Walt, F. and Steyn, P. (2019). Workplace spirituality and the ethical behaviour of project managers. *SA Journal of Industrial Psychology*, 45(0), a1687. https://doi.org/ 10.4102/sajip.v45i0.1687.

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Kokt, D. (2019). The major human resource challenges associated with the Fourth Industrial Revolution. *HR Voice.* Available from: http://sabpp.co.za/the-major-human-resource-challenges-associated-with-the-fourth-industrial-revolution-by-desere-kokt/.

Kokt, D. (2019). The role of human resource professionals in navigating the new world of work. *HR Voice.* Available from: https://sabpp.co.za/the-role-of-human-resource-professionals-in-navigating-the-new-world-of-work-by-desere-kokt/.

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Atiase, V. and Dzansi, D. (2019). Microfinance and Necessity Entrepreneurship: The Ghanaian Experience. In Dana, L. and Ratten, V. (Eds). *Societal Entrepreneurship and Competitiveness.* Emerald Publishing Limited, pp.155-170.https://doi.org/10.1108/978-1-83867-471-720191011.

Lategan, L.O.K. and Van Zyl, G. (2019). Healthcare for the vulnerable and its meaning and contribution towards peace leadership. In Van Zyl, E. and Campbell, A. *Peace leadership: self-transformation to peace.* Randburg: KR Publishing.

Van Der Walt, F. and Lezar, L.W.P. (2019). Flourishing and thriving for well-being. In M Coetzee (Ed.). *Thriving in digital workspaces.* Springer International: Switzerland.

Vanlaere, L., Burggraeve, R. and Lategan, L.O.K. (2019). Vulnerable responsibility: Small vices for caregivers. Bloemfontein: Sun Press.

NEW PROFESSORS APPOINTED

Three associate professors were promoted to full professors in 2019. These are: Prof. A.J. Strydom, Prof. N.M. Naong, and Prof. P. Rambe.

POST-DOCTORAL FELLOWS

Three out of four post-docs had their appointments renewed based on the performance targets set by their mentors in collaboration with the faculty. The three are: Dr T. Ndofirepi, Dr L.T. Chipunza, and Dr V. Atiase. In addition, one full-time post-doc (Dr R. Manyevere) was appointed in the Tourism and Event Management Department.

FOSTERING STRATEGIC PARTNERSHIPS

Project title	Network Testing and Fuzzing for a Reliable and Secure Internet of Things
Collaborative parties	(SASUF) [Dr Ntima Mabanza (Central University of Technology, Free State); Prof. Konstantinos Sagonas (Uppsala University); Dr Gardner Mwansa (Walter Sisulu University); Prof. Cyrille Artho (KTH Royal Institute of Technology); Prof. Bernd Fischer (Stellenbosch University)]
Description	Internet of Things (IoT) involves data flow and exchange between different kinds of devices interconnected through a network. IoT network is known to be an open environment and does not provide adequate security. This makes IoT devices operate in such an environment to be vulnerable to various security issues and different kinds of attacks. Hence, the current project brings together Information Technology researchers in the areas of networking, programming, and security at South African and Swedish Universities who will work together to find innovative techniques and tools that can improve the security of IoT systems and applications; also, to educate students and professionals on recent techniques and tools for securing IoT network and its applications. Some specific goals of this project include: Upgrading of technological capabilities and innovation, and enhancing of scientific research, both for developing and developed countries, Establishing new connections and developing medium-term joint research projects for postgraduate students (honours/master's, PhDs) under the guidance of the involved senior researchers.
Project title	On-line monitoring of Laser Powder Bed Fusion Processes
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Dr B Lane at the Engineering Laboratory, National Institute of Standards and Technology, Gaithersburg, USA
Description	Strategically important collaboration with this internationally leading institute.
Project title	Materials for biomedical applications
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Prof. P Krakhmalev Karlstad University, Department of Engineering and Physics, Sweden
Description	On-going collaboration that has resulted in various joint publications.
Project title	Lattice structures by LPBF
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Prof. M Kobashi at the Department of Materials Process Engineering, Graduate School of Engineering, Nagoya University, Japan
Description	Lattice structures and microstructure characterisation of in-situ alloyed materials by laser powder bed fusion. This is an important emerging research field.
Project title	Titanium alloys
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Prof. Ma Qian at the Department of Manufacturing, Materials and Mechatronics, RMIT University, Australia
Description	The research group under Prof. Ma Qian at RMIT University is internationally recognised as a leader in titanium alloys and metal additive manufacturing.

Project title	Medical Product Development through Additive Manufacturing
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Prof. A. Kabanova at the Vitebsk State Medical University Medical Product Development through Additive Manufacturing
Description	This collaboration is strategically important for the focus of the SARChI chair.
Project title	Residual stress of SLM objects
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Nelson Mandela Metropolitan University
Description	NMU are national leaders in the determination of residual stresses in metals.
Project title	Quality control of AM parts; lattice structures and biomimicry
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with Stellenbosch University
Description	SU is a collaborator in the Collaborative Programme in Additive Manufacturing.
Project title	In-line monitoring of laser processing and qualification of AM materials; design and residual stresses after high speed selective laser melting
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with CSIR and National Laser Centre
Description	The National Laser Centre is a key player in laser applications, such as additive manufacturing, and is also the national coordinator of the Collaborative Programme in Additive Manufacturing.
Project title	AM Ti6Al4V- Zr oxide in-situ alloying for biomedical applications
Collaborative parties	Prof. I Yadroitsau and Dr I Yadroitsava with University of Witwatersrand, School of Mining, Metallurgy and Chemical Engineering
Description	
Project title	3D Printing educational pre-operative planning and patient-specific medical device fabrication. Co-supervision of research students.
Collaborative parties	Prof. W du Preez with University of Botswana
Description	A leading example of CUT collaboration with an African country.
Project title	The relationship among design, material and processing parameters in SLM Additive Manufacturing of metals.
Collaborative parties	Prof. W du Preez and Prof. D de Beer with Universidad Nacional Autónoma de México
Description	An emerging collaboration opportunity funded by the NRF.
Project title	Powder bed additive manufacturing using Ti-based alloys for biomedical applications: Optimization of mechanical and bio-compatibility properties
Collaborative parties	Prof. W du Preez and Prof. D de Beer with CIDESI, CIATEQ A.C., Mexican National Laboratory of Thermal Spray (CENAPROT), School of Engineering and science at Tecnológico de Monterrey, Mexico
Description	An emerging collaboration opportunity funded by the NRF.
Project title	Research on materials science and, engineering analysis Characterisation of Ti6Al4V powder for AM, AM patterns for investment casting and mechanical testing of AM parts
Collaborative parties	Prof. W du Preez with University of the Witwatersrand Prof. W du Preez with CSIR Materials Science and Manufacturing division
Description	Co-supervision of postgraduate students. Collaborator in the Collaborative Programme in Additive Manufacturing.

Project title	Characterisation of Ti6Al4V powder for AM, AM patterns for investment casting and mechanical testing of AM parts
Collaborative parties	Prof. W du Preez with CSIR Materials Science and Manufacturing division
Description	This CSIR team has years of experience of processing of titanium alloys.
Project title	Characterisation of Ti6Al4V powder, spheroidisation of powder and AM of plasma system components
Collaborative parties	Prof. W du Preez with Nuclear Energy Corporation of South Africa (Necsa)
Description	Necsa has processing facilities and analytical laboratories that are relatively unique in South Africa.
Project title	Physical metallurgy of titanium alloys produced through AM
Collaborative parties	Prof. W du Preez with University of Cape Town
Description	UCT's Centre for Materials Engineering is a nationally leading unit in physical metallurgy of titanium alloys.
Project title	Qualification of the AHRLAC nose wheel fork for additive manufacturing in Ti6Al4V(ELI)
Collaborative parties	Prof. W du Preez with ADC Aeroswift (Pty) Ltd
Description	The locally designed and produced AHRLAC aircraft provides opportunities for applying additive manufacturing in aerospace
Project title	Utilisation of micro-CT scanning in research on additive manufacturing of titanium alloys and polymers
Collaborative parties	Prof. W du Preez with Stellenbosch University
Description	SU is a collaborator in the Collaborative Programme in Additive Manufacturing.
Project title	The development of a quasi-isothermal compressor for application in compressed air and liquid air energy storage systems
Collaborative parties	Dr G Jacobs is with the Nanyang Technological University (NTU), Singapore
Description	Design advice to NTU by Dr Jacobs
Project title	Arrangement of winter school at CUT
Collaborative parties	Dr M Maringa with Dr Birgit Welt of Aalen University
Description	Agreed to schedule the next course in the month of January 2021.
Project title	Additive manufacturing for Kenya
Collaborative parties	Dr M Maringa and Prof. Willie du Preez with Dr Thomas Mbuya of the University of Nairobi, Kenya
Description	Awaiting return of draft MoU from UoN to move on a partnership.
Project title	THRIP Fire Engineering Project
Collaborative parties	Dr J Combrinck with the Fire Engineering Research Unit (FireSUN) from the Civil Engineering Department of Stellenbosch University
Description	Fire testing and prototype development of a novel steel building system

Project title	THRIP Fire Engineering Project
Collaborative parties	Dr J Combrinck with the South African Institute of Steel Construction (SAISC)
Description	Fire testing and prototype development of a novel steel building system
Project title	Laser sinter additive manufacturing powder from SASOL polypropylene pellets
Collaborative parties	Dr K van der Walt with Dr Ernst Langner at the Department of Chemistry UFS
Description	Investigating the feasibility of producing polypropylene powder suitable for the laser sinter additive manufacturing process from polypropylene pellets as produced by SASOL.
Project title	Craft beer fermentation
Collaborative parties	Luwes (Electrical/Electronic/Comp Eng) De Smith H&E Sciences
Description	Construction of Craft beer fermentator
Project title	Augmented realty labelling
Collaborative parties	Luwes (Electrical/Electronic/Comp Eng) Lues Environmental Health
Description	Augmented realty label for intervarsity beer and food event
Project title	WRC K5/2923
Collaborative parties	Dr OJ Gericke and Stellenbosch University (SU)
Description	The applicability of the use of Radar Data to develop Areal Reduction Factors in South Africa
Project title	WRC K5/2924
Collaborative parties	Dr OJ Gericke and UKZN & SU
Description	Development of a regionalised approach to estimate areal reduction factors and catchment response time parameters for improved design flood estimation in South Africa.
Project title	Industry Academia Partnership Programme (IAPP18-19\94)
Collaborative parties	Dr OJ Gericke and Royal Academy of Engineering, University of Bath, SANCOLD, University of Pretoria, UKZN & SU
Description	Development of multi-institutional research collaboration and capacity development for modernizing flood risk assessment practice in South Africa
Project title	Impact of Bloemfontein landfills on the environment (UFS Interdisciplinary research funding)
Collaborative parties	Centre for Environmental Management UFS
Description	Landfills have the capacity to store large volumes of MSW but can pose a serious threat to air, water and soil (land) degradation through the production of leachate and greenhouse gases. Hence it is important that the environmental impacts of these landfills are investigated. Critical to this investigation are the management aspects influencing the pollution of air, water and soil resources.

Project title	Attenuation capacity of the Matsopa bentonite and shale
Collaborative parties	Dr S Oke and Geology Department UFS, Council for Geoscience (CGS)
Description	Determination of the bentonite and shale mineralogical and trace metals exchangeable potentials for acid and mine drainage and other mining pollutants.
Project title	The vegetation cover dynamics and the biodiversity conservation in the Free State National Botanical Garden. (SANBI Funding)
Collaborative parties	Dr S Oke and South Africa National Biodiversity Institute (SANBI), FHES-CUT
Description	The application of remote sensing techniques at ensuring the environmental sustainability of the Free State Botanical Garden vegetation and biodiversity.
Project title	The vegetation cover dynamics and the biodiversity conservation in the Free State National Botanical Garden. (SANBI Funding)
Collaborative parties	Dr S Oke and South Africa National Biodiversity Institute (SANBI), FHES-CUT
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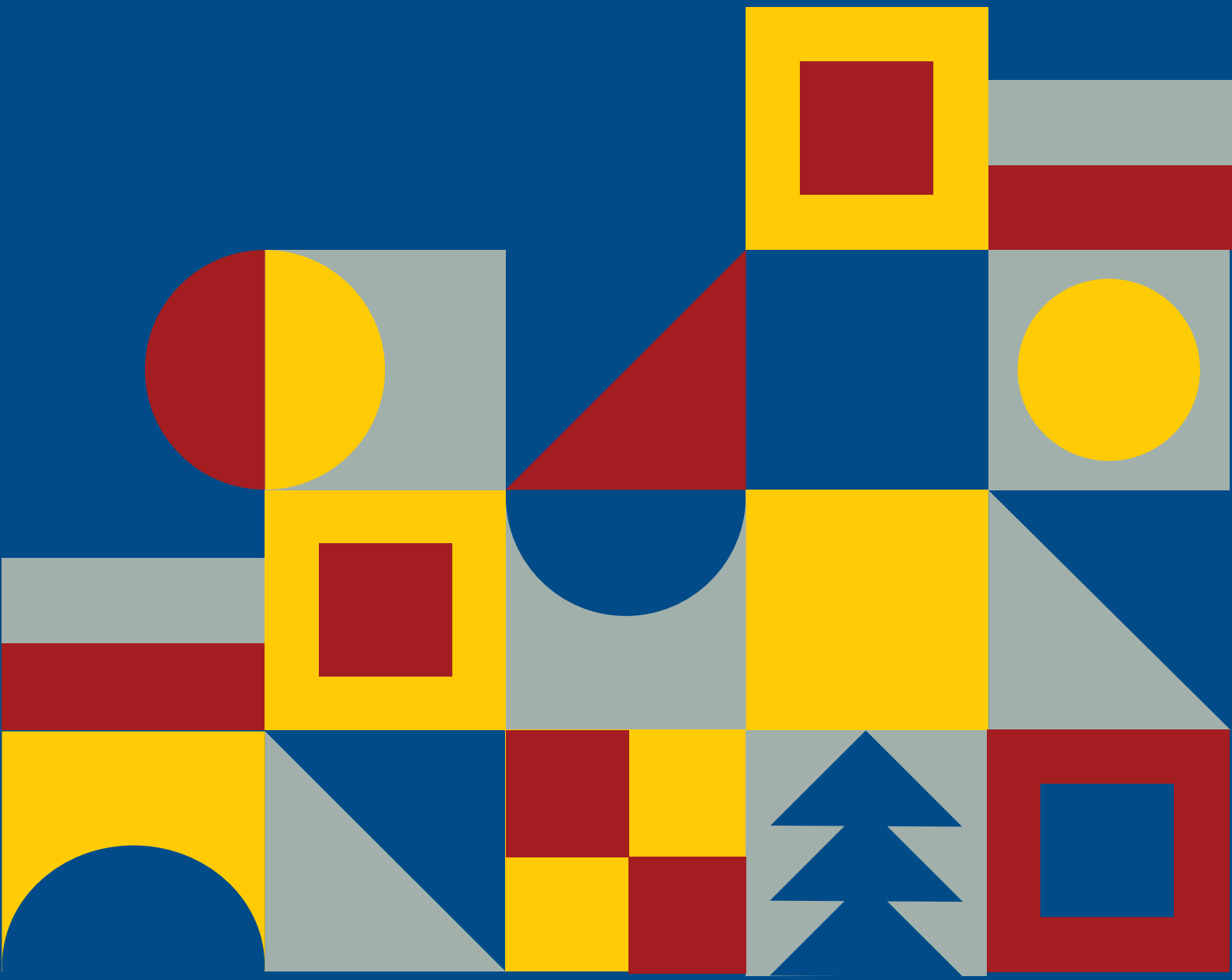

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