Central University of Technology, Free State

RESEARCH AND **INNOVATION** REPORT

2018

SIGNIFICANT ACHIEVEMENTS

2018

PROFESSORS

RESEARCH

INFLUENCE

INNOVATION

Tel: +27 51 507 3336 | Fax: +27 51 507 3275
E-mail: llategan@cut.ac.za
Central University of Technology, Free State (CUT)
Private Bag X20539, Bloemfontein, 9300, South Africa

Design and production by SUN MeDIA Bloemfontein | sunmedia@sunbloem.co.za

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PART ONE #1

TRANSFORMATION

ENHANCE

Responses to Research and Innovation 2018

ESPONSES

MESSAGE FROM THE VICE-CHANCELLOR AND PRINCIPAL

The Central University of Technology, Free State (CUT) has made great strides in 2018 to enhance our strategic intent of *"Reimagining CUT as a transformative, transformational and entrepreneurial University and 'model' University of Technology in Africa, impacting on the socio-economic development of the Central region of South Africa and beyond"*. Two of the ten focus areas founded on the transformation drive and institutional change are *"Pockets of world-class research programmes"* and "*Model, vibrant innovation ecosystem in Africa"*.

In support of this strategic intent, we were delighted by the numerous collaborations and participation of our researchers on the nationally, continentally and global platforms. Of particular significance is the prestigious Gold award for Scholarly Impact in Advanced Manufacturing for the work done by the Centre for Rapid Prototyping and Manufacturing. In addition, contributions made by other research and innovation entities in applying technologies and innovations that foster and promote sustainable development, quality of health and living and socio-economic entrepreneurship have not gone unnoticed, as are highlighted in this Research Report.

Significant strides have also been made in positioning the university to take a proactive step in driving the Fourth Industrial Revolution (4IR) and Circular Economy (CE) agenda. Our university envisages that its research and innovation will be informed by the 4IR and CE and align ourselves with the 2030 United Nations Sustainable Development Goals (SDG) and technologies.

Our steady increase in financial investment during 2018, both by the university and through grants towards research from the National Research Foundation (NRF) and the Department of Higher Education and Training (DHET), has contributed to an increasing trend in master's and doctoral enrolment, research outputs, and a steady growth in the academic development of staff members – which serves as justifiable evidence of our commitment to enhance research and the innovation ecosystem at CUT.

I wish to express my sincere gratitude towards the CUT Council, members of Executive and Senior Management, the Section for Research Development and Postgraduate Studies, staff, students, and local and international partners, who all worked tirelessly during 2018 to achieve outstanding research and innovation contributions. The support to CUT and the contributions of the DST, NRF, Technology Innovation Agency (TIA), Science Councils, the DHET, Sector Education and Training Authorities (SETAs), industry, business and many others during 2018 are acknowledged with profound sincerity.

I look ahead, very positively, to great accomplishments during 2019!

Prof. Henk de Jager
Vice-Chancellor
and Principal

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

It is a pleasure for me to introduce the 2018 Annual Research and Innovation Report. The report serves as an illustration of the university's shared commitment to advancing excellence in research and innovation.

During the year 2018, the university continued with the repositioning of the research and innovation agenda. Although the advances in research and innovation were mainly guided and aligned to our University's Vision 2020 Strategy, Research Development and Technology and Innovation Plans, the university found itself having to take advantage of the exciting opportunity presented by the Fourth Industrial Revolution (4IR) – an opportunity which can potentially transform and impact positively on our research and innovation agenda. For this reason, a task force was launched to prepare the institution for the 4th Industrial Revolution. The task force will specifically focus on identifying areas that should be addressed to prepare for 4IR and the Circular Economy, develop a roadmap of broad issues and timelines, develop a budget and mobilise funds.

In addition, we also see our university continuing to reflect a steady increase in its research and innovation footprint with positive scientific and societal impacts for the communities we serve. Over the years we have witnessed an increase in both internal and external financial investment in research and innovation.

The continued effort to foster a research culture was supported by numerous policies, grants, incentives and capacity building initiatives. Most significant is the capacity development funding allocated towards growing women in research and grants for postgraduate students. This allocation, together with initiatives such as the CUT and University of Free State (UFS) Joint Research Collaboration Programme, has contributed towards making an impact in growing our research capacity and towards an increased research impact on regional development.

This annual report documents our development and achievements over the 2018 academic year. I invite you to take a look and see what our university has achieved and how it has progressed over the year!

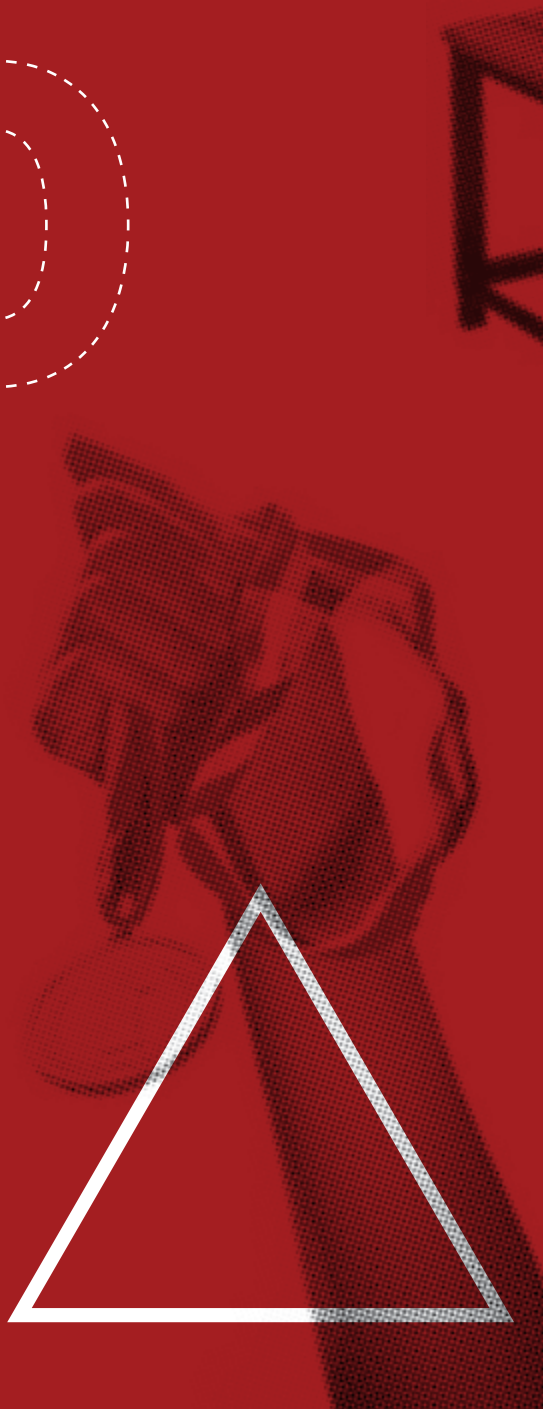
Prof. Afred Ngowi
Deputy Vice-Chancellor:
Research, Innovation
and Engagement

HIGH

SUSTAINABILITY

PART TWO

#2



LIGHTS

DEVELOP

Research Institutional Performance Highlights and Achievements

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
enel@cut.ac.za

Ms Samantha-Leigh Marupen
Research Assistant: DHET UCDG and Special Projects
smarupen@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
lmatlaletsa@cut.ac.za

Acknowledging our retired colleagues:

Ms Riana Dessels
Research Officer: Administration

Ms Sandra Nel
Administrative Officer: Research Development and Postgraduate Studies

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

Professor Crispen Chipunza
Faculty of
Management Sciences
cchipunza@cut.ac.za

Professor Michael Mhlolo
Faculty of Humanities
mmhlolo@cut.ac.za

Professor Herman Vermaak
Faculty of Engineering and
Information Technology
hvermaak@cut.ac.za

Professor Carlu van Westhuizen
Faculty of Health and
Environmental Sciences
cvdwesthuizen@cut.ac.za

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:

The objectives of this plan are:

- to grow "seniority" of the academic staff profile
- to grow the publication profile – 75% of DHET norm of 1.1 credit unit per full-time academic staff
- to grow postgraduate enrolment – 5% of student body
- to grow the number of completed M and D projects
- to grow the external funding basis
- to grow the number of rated researchers
- to grow multi-, inter- and transdisciplinary research.

The university's R & D Plan 2014 – 2020 emphasises the following ten strategic research programmes:

1. Undergraduate to Graduate Programme
2. Master's Programme
3. Doctoral Programme
4. Next Generation Researchers Programme
5. Postdoctoral Fellowship Programme
6. Early Career Researchers Programme
7. Mid-Career Researchers Programme
8. Established Researchers Programme
9. Women in Research Programme
10. Rated Researchers Programme

The following additional strategic programmes and projects have also been introduced in support of the R & D Plan:

- CUT and UFS Joint Research Programme (optimising capacity and sharing of resources)
- Research Entities (Centres, Units and Groups Projects)
- Sabbatical Leave Programme
- SARChI Programme (nationally funded Research Chairs)
- DHET University Capacity Development Programme
- Establishment of the IR 4.0 and Circular Economy Taskforce

REVIEW OF THE 2018 RESEARCH DEVELOPMENT ACHIEVEMENTS

Research funding and support

The R & D section had a total budget of R 50 943 000 available for research activities supported by different funding sources as reflected below.

Agency	Funding objective	Amount
CUT	Operational research funds	R 16 000 000
CUT	Postgraduate students' new grants	R 6 500 000
DHET R & D Grant	Support research capacity building	R 4 443 000
NRF	Support research projects and student training	R 24 000 000
Total		R 50 943 000

Annual research breakaway

The 6th Annual University Research and Development Breakaway was held on 10 August 2018 with the theme of "The fourth industrial revolution: are we ready?"

The aim of the breakaway was to engage on the concept of research and development within the context of the fourth industrial revolution (IR 4.0). The following concepts relating to research and development were identified and discussed within the context of the IR 4.0.

- Increasing of research outputs
- Postgraduate studies
- Partnership
- Increasing third stream income
- Monitoring and evaluation

The breakaway resulted in the establishment of the IR 4.0 + Circular Economy (4IR +CE) Taskforce.

CAPACITY DEVELOPMENT ACTIVITIES SUPPORTED BY THE DHET RESEARCH AND DEVELOPMENT GRANT

DHET R & D programme

This programme ended in 2017. Based on the unqualified audit report received, the following financial statistics can be presented:

- Total amount available: R 9 941 466,07.
- Total expenditure including committed funds: R 9 092 797,40.

- Total unspent funds: R 848 668.67.
- The total accrued interest: R 719 830.
- According to DHET the unspent funds of R 848 668.67 will form part of the UCDP Grant 2019.
- Part of the interest was used to supplement the shortfall on the UCDP Grant R & D Programme.

UCDP GRANT R & D programme

The UCDP R & D Grant for 2018 was awarded (R 4 443 000) out of a total award of R 12 744 900 = 34.86% of total award.

The following progress can be reported:

- Awarded: R 4 443 000
- Budget allocated to approved projects: R 4 443 000
- Budget spent: R 4 443 000 (of allocated budget) + R 171 586,90 of the interest earned.
- Participated in the development of an M & E Framework for the UCDP 2018-2020 facilitated by CREST.

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

- **Mentorship/Supervisor training programme:** The focus of this programme is to train the new generation of researchers and students in doing research. A series of either university-wide or discipline-specific workshops were held, focusing on the following research development themes: research process, doctoral education, statistical methods, analytical tools training, grant proposal writing, thesis proposal and article writing. Total number of 37 training events were held and cumulatively 661 staff and postgraduate students from both the Bloemfontein and Welkom campuses participated in the research development workshops.
- **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. The funding was used to support a total of sixty-six (66) staff members comprising 15 master's (7 females and 8 males) and 49 doctoral (21 females and 28 males) students.
- **Enhancing mobility and access to research resources:** The programme enhanced existing expertise and supported identified networks and collaborations with universities, both locally and internationally. The university allocated funding to six (6) Regional Focus Joint Collaboration Research Programmes to promote active participation with Cluster A and B universities that will deliver on joint postgraduate supervision and joint publications. In addition, seven (7) researchers were funded to participate in South Africa and Sweden under the National Mobility Collaborative Research Programme and three (3) in international mobility with the CUT/Montpellier Erasmus + programme, the UK British Council Travel Grant–Research Mobility DHET initiative and the South Africa and Nordic Countries initiative.
- **Research career development of early and mid-career researchers programme:** The focus of this programme is to build research capacity in the faculties through supporting staff at different levels of their research careers. Thirty-three (33) researchers were supported through different initiatives to development their research competencies.
- **Topping up of NRF funds:** NRF projects were supplemented through this programme. The funding of ten (10) rated researchers was supplemented.
- **Management/Administration of the Research Development Grant:** A project facilitator was appointed to assist with the capacity building of grant holders. The UCDP R & D Grant is supported through a detailed administrative and management support system that is used for accountability and report-back to the DHET.

SUPPORT TO POSTGRADUATE STUDENTS

For 2018 the following grants were awarded to M (162 students) and D (43 students) degree students and post-doctoral fellows:

Scholarships, 2018			
Year	M students	D students	Post-docs
2018	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 2017 during which R 38 684 684 was awarded to M and D degree students and post-doctoral fellows:

Scholarships, 2014 – 2017			
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
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

NRF FUNDING 2018

For the period January – December 2018 the university continued to benefit from the following allocations made from NRF awards:

- 53 staff members were funded in 12 different NRF calls/grants, with a total funding of R 7 655 385.
- 13 masters' and 13 doctoral students were funded, with a total of R 2 650 000.
- 144 B.Tech students were funded, with a total of R 7 303 0000.

The awards are reflected below:

Staff awards: 53 (39 males and 14 female) (32.95% of total NRF funding)		
Grant	TOTAL	AMOUNT
Competitive support for unrated research (1 M)	1	R 365 077,00
Incentive funding for rated researchers (10 M)	10	R 300 000,00
DST-NRF Fellowship for early career researchers from the UK (1 M)	1	R 220 000,00
Indigenous Knowledge Systems (1 F)	1	R 786 262,00
International science and technology agreements (1 M)	1	R 560 006,00
IRG - UK / South Africa researcher links grants for travel (1 M)	1	R 374 850,00
Knowledge interchange and collaboration (14 M & 7 F)	21	R 433 000,00
National equipment (1 M)	1	R 620 000,00
Sabbatical grants to complete doctoral degrees (1 M)	1	R 215 357,00
S & F - Research career awards (1 F)	1	R 508 368,00
Sa Research Chairs – open (1 M)	1	R 1 664 249,00
Thuthuka (excluding institutional commitment) (8 M & 5 F)	13	R 1 608 216,00

Student awards - 273 (73.19% of total funding)		R 7655 385
S & F - Innovation doctoral scholarships (9 M & 6 F)	15	R 1 881 004,00
S & F - Innovation master's scholarships (6 M & 10 F)	16	R 1 440 000,00
S & F - NRF free-standing postdoctoral fellowships	1	R 250 000,00
S & F - NRF -TWAS postdoctoral fellowship programme (1 M)	1	R 400 150,00
S & F Part-time doctoral scholarships (1 F)	1	R 20 000,00
S & F - Scholarships & fellowships programme (1 M)	1	R 70 000,00
S & F Innovation honours grants (39 M & 57 F)	96	R 5 430 000,00
S & F Scarce skills development fund (Honours) (28 M & 33 F)	61	R 4 370 000,00
S & F - Scholarships (honours) (18 M & 22 F)	40	R 1 095 000,00
S & F - Scholarships (master's) (23 M & 18 F)	41	R 2 050 000,00

DHET PUBLICATION SUBMISSIONS 2017 (N-1) IN 2018(N)

Correction: research output units 2016

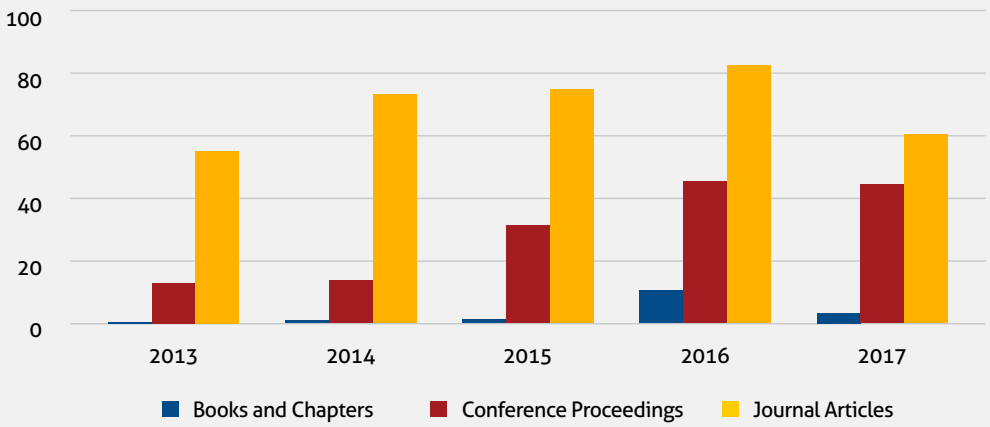
The university submitted a claim for 82.14 units and was awarded all 66.81 units for publications in accredited journals. A total of 15.33 units were rejected for articles published in predatory journals. DHET has now decided to allocate these units to the university. In addition, corrections were also made to the 2016 allocation by the DHET. As a result, the university has now been awarded 137.42 output units for 2016 (see figure below).

Consequently, the allocated 2017 research output units must be analysed in the context of the adjusted credit units for 2016.

Overall research output units accrued – 2017

In May 2018, the Central University of Technology (CUT) submitted a claim for 2017 research publications amounting to 142.12 units for books, conference proceedings and journals. Based on the DHET assessment report of December 2018, CUT attained a total of 107.22 units with 34.9 credit units rejected. This is a decrease of 30.20 units (21.98%) from the 137.42 units awarded for 2016 publications (updated).

The institutional publication trend for all publications (books, journals and conference proceedings) over the past five years (2013-2017) is shown in the figure below.



	2013	2014	2015	2016	2017
Books and Chapters	0.44	0.69	1.11	10.39	3.21
Conference Proceedings	13.02	13.65	30.85	44.89	44.23
Journal Articles	55.02	72.83	74.52	82.14	59.78

CUT total research output units by type of publication, 2013 – 2017

From the figure above the following is evident:

Journal publications

- In 2017, relative to 2016, there was a decline of 27.22% (22.36 units) in journal publications. This decline is also negative when seen in relation to the 49.3% growth experienced between 2013 and 2016. The decline was mainly as a result of a significant reduction in contribution of article publications and a preference towards conference proceedings as a research output outlet.
- The university submitted a claim for 63.06 units but was awarded 59.78 units for publications in accredited journals. A total of 3.28 units were rejected due to the fact that:
  - The subsidy had already been claimed and awarded in the previous year, and
  - the same submissions were made by other universities where the staff member was/is affiliated.

Conference proceedings

- In 2017, a claim amounting to 67.81 units was submitted for publications in conference proceedings and 44.23 units were awarded. A total of 23.58 units were declined for not meeting the Research Outputs Policy requirements – primarily the absence of sufficient evidence of the peer review process.

- Conference proceedings continue to be regarded as a sustainable research output for the university and make up 41.25% of the total university outputs for 2017. An incremental growth from 2016-2017 took place in the Faculty of Engineering and Information Technology, where outputs grew by 24%, and by 32% in 2015-2016. It is evident that the Faculty of Engineering and Information Technology continues to benefit from this research outlet.

Books and chapters

- In 2017, a claim amounting to 11.25 units was submitted for book publications, and 3.21 units were awarded. A total of 8.04 units were declined for not meeting the Research Outputs Policy requirements – primarily the lack of sufficient evidence of the peer review process.

Analysis

The DHET updated the 2016 research publication outputs from 117.09 credit units to 137.42 units. This was an increase of 20.33 credit units. For 2017 a total of 107.22 credit units were awarded, which was a decline of 30.2 credit units.

The decline is due to:

(a) a decline in accredited articles in 2017 compared to 2016;

(b) a decline of 23.58 credit units for conference proceedings not meeting the DHET criteria for subsidised conferences;

(c) only 44 out of 105 (41%) senior academics (academic staff with doctorates) in 2016 who could have participated in the research outputs for 2016 compared to 59 out of 126 (47 %) senior academics (academic staff with doctorates) in 2017 who could have participated in the 2017 research outputs.

A similar trend can be identified with students:

In 2016 there were 37 student co-authors from the 457 students enrolled. In 2017 there were 43 student authors from the 562 postgraduate students enrolled, and

It should be noted that more participating authors did not result in more outputs. A desktop analysis suggests (a) a once-off high outset by an author; (b) that established authors contribute to less credit units per outputs; and (c) that there may be more authors for a single paper.

Policy on evaluation of creative outputs and innovations

The university should benefit from the DHET promulgated *Policy on Evaluation of Creative Outputs and Innovations produced by South African Higher Education Institutions*. The policy will be implemented with effect from January 2019 on creative outputs of 2018.

POSTGRADUATE STUDIES

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

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

In 2018, the following numbers of students graduated with postgraduate qualifications relative to 2017:

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

For the period 2001-2018 the trend in M and D graduates is reflected below:

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

Note: Course work programme discontinued.

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 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.

The following summative information can be presented:

Number of workshops	33	**Number of unclassified attendees at workshops**	15
Number of staff attending workshops	244	**Number of NRF training events**	7
Number of students attending workshops	109	**Number of students attending training events**	580

DOCTORAL SUMMER SCHOOL

The Research Development and Postgraduate Studies (RD & PGS) Section presented its second Doctoral Education Summer School on 8 & 9 November 2018. This Summer School followed the first successful Summer School in 2017 – "Taking the next step."

This Summer School coincided with a national discussion on doctoral standards. What is the scope of the doctorate? How can the doctorate contribute towards new knowledge creation? What is expected from the doctorate? What should be part of a doctoral programme?

The purpose of the Summer School is (a) to make doctoral studies more competitive in the context of a global knowledge base; (b) to identify academic and research support required to support doctoral students; and (c) offering doctoral education as part of the research and innovation value chain.

Typical topics for discussions were on access and admission, research support, university support, roles and responsibilities of the student and the supervisor, outputs as part of doctoral training, assessment, including the viva, research funding, research uptake and research ethics and integrity. Part of the deliberations was an informed discussion linked to a community of practitioners.

During the Summer School a "three-minute competition" for presenting doctoral candidates' research was also hosted.

The Summer School had three parts:

- 8 November (Hotel School): two different workshops addressing different topics:
  - Postgraduate supervision (developing research skills and respectful research)
  - Research ethics and integrity (ethics approval system and anti-plagiarism)
- 9 November (Japie van Lill Auditorium): Informed discussion on doctoral education
- 9 November (Japie van Lill Auditorium): "Three-minute competition" for doctoral candidates.

The invitation was extended to doctoral supervisors, doctoral students and staff supporting doctoral studies.

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 was for Track 1: Four hundred thousand rand (R400 000) 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.

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.

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. During 2018 the following opportunities were presented in support of staff and students' writing competencies.

First edition	Number of editions up to 2018	Number of papers published	Number of participating authors
2002	31	429	282

JOURNAL FOR NEW GENERATION SCIENCES

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.

First edition
2003

Number of editions up to 2018
37

Number of papers published
403

Number of participating authors
680

Participation (SA): public universities
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

SUMMATIVE PROGRESS

The following summative progress can be reported.

Programme / Project	Target	R & D Support	Output
Undergraduate to graduate programme	Grow total postgraduate student enrolment by 5% of overall student enrolment (5% x 16 000 = 800)	Funding support Training support Publication support	197 B.Tech students were funded with R10 977000 through NRF Block Grant. 8 x workshops
Master's programme	Grow total postgraduate student enrolment by 5% of overall student enrolment (5% x 16 000 = 800)	Funding support Training support Publication support	R 11956230,00 awarded 21 x workshops 386 student enrolments 47 master's students graduated
Doctoral programme	Grow total postgraduate student enrolment by 5% of overall student enrolment (5% x 16 000 = 800)	Funding support Training support Publication support	R 4 556 860 awarded 11 x workshops 178 student enrolments 22 doctoral students graduated
Next Generation Researchers programme	50% of staff with doctorates by 2020	Funding support Training support Publication support	R 1843448 funding support available 66 staff members benefitted from DHET R & D Grant to promote qualifications 126 staff members with doctorates
Postdoctoral Fellowship programme	5	Funding support Training support Publication support	Track 1 (4) and Track 2 (6) = R 1010 000
Women in Research programme	Grow number of female researchers	Funding support Training support Publication support	DHET grant recipients to improve qualifications = 28 CUT awards to postgraduate students = 151 NRF grant holders = 35 CUT and UFS grants = 5 Early and mid-career researchers participated in calls = 8
Rated Researchers programme	12	11 rated researchers	R 300 000 awarded to the researchers
CUT and UFS Joint Research programme	5	Funding support	8 applications funded = R 245 000
Sabbatical programme	Grow annual staff qualifications by 10%	Funding support Training support Publication support	10 x awards
SARChI Chair	1 SARChI Chair	Funding support	NRF-approved SARChI chair in medical product development

PART #3

THREE

UNITS

CENTRES

GROUPS

Building Research Structure and Capacity

RESEARCH CENTRES, UNITS AND GROUPS

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

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

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

In 2018, the university commenced with a process of reposition its current research entities (two Research Centres, twelve Research Units and two Research Groups) into consolidated, streamlined and competitive research centres which will be operational in 2019.

THE COLLABORATIVE PROGRAMME IN ADDITIVE MANUFACTURING CHAIR

Professor WB du Preez

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 and implementation of additive manufacturing (AM) for the production of customised medical implants and surgical guides. This research has, to a large extent, been made possible through the funding support of the Department of Science and Technology (DST) since 2015 for the national Collaborative Programme in Additive Manufacturing (CPAM). From 2015 to 2017 DST supported CUT with an amount of R5.5 million for the CPAM and with a further R11.6 million for this programme for the period 2018 to 2020.

Additive Manufacturing is globally accepted as one of the key technologies in the 4th Industrial Revolution. The CPAM is the primary implementation programme of the national South African Additive Manufacturing Strategy (published at www.rapdasa.org). It has four sub-programmes and CUT-CRPM contributes to all of these.

A key part of the overall aim of the 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 have to be proven. Sufficient research data must be produced 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, supported by validation data generated through research on these processes and products, has been established since 2015. 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.

The CPAM research is aimed at demonstrating the benefits that can be derived from the characteristics of AM. This implies research 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 individuals (the "maker" community). These outcomes are pursued by the *Design for Additive Manufacturing* sub-programme of the CPAM.

The fourth sub-programme of the CPAM, *Industry Development*, focuses on creating awareness in industry and among 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 DST for the establishment of a *Chair in Innovation and*

Commercialisation of Additive Manufacturing at 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" 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 will be 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 was appointed as the chair holder and started in this new role in September 2018.

RESEARCH CHAIR IN MEDICAL PRODUCT DEVELOPMENT THROUGH ADDITIVE MANUFACTURING (AM) AND NRF-RATED RESEARCHER

Professor Ihar Yadroitsau (Igor Yadroitsev) was appointed Research Professor at the Central University of Technology, Free State (CUT) on 1 January 2014. In August 2015, CUT was awarded a Research Chair in Medical Product Development grant with Prof. Yadroitsau as the grant holder. 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, and material science). Prof. Yadroitsau has a strong interdisciplinary background and broad experience in the fields of Physics and Engineering which allow 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 170 scientific publications. His H-index of citation is 22 (cited 2573) in Scopus and 27 (cited 3958) in Google Scholar. Prof Yadroitsau is a C NRF rated researcher.

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 between 2014 and 2016, the following equipment was added: Smartzoom 5 Digital Microscope (Carl Zeiss) and LectroPol-5 (Struers ApS). Licenses for Mimics and Structures Module software was purchased. Mimics is software specially developed by Materialise for medical image processing. The Materialise Magics Structures Module enables the transfer of a solid 3D model into a lightweight version. A lattice structure can be applied to reduce the weight of the design or to reinforce it.

Prof. Yadroitsau has supervised eleven master's and three doctoral students in Engineering. Their studies were devoted to selective laser melting, residual stresses, heat treatment and mechanical properties of additive manufacturing objects, and non-destructive testing.

In 2018 Prof. Yadroitsau, in cooperation with other researchers from RSA, Brazil, Sweden, France, USA, Australia and Russia, published twelve articles indexed in Scopus and ten conference proceedings. Prof. Yadroitsau participated in a number of scientific seminars at the South Africa, Russia, and the USA.

RATED RESEARCHERS

Dr Ina Yadroitsava is Senior Researcher in the Department of Mechanical and Mechatronics Engineering. Dr Yadroitsava received her M.Sc. in Physics from Belarus State University and PhD in Biology from Vitebsk State Academy of Veterinary Medicine (Belarus). Her early research projects were focused on numerical simulations, experimental designs and statistical analysis of biological and medical data. After moving to Saint-Etienne Engineering School (France) in 2010, her specific areas of research interest turned to additive manufacturing and advanced materials. She was a post-doc fellow for 3 years at the Department of Mechanical and Mechatronics Engineering of the Central University of Technology and in 2018 she was appointed as Senior Researcher. She manages the Metallographic Laboratory and teaches students in microscopy and material science. Dr Yadroitsava is co-author of 65 papers on laser powder based fusion, optimisation process-parameters and material characterisation, and biomedical applications of additively manufactured parts. In 2019, she was recognized by the NRF as an Established researcher (C) in such areas as laser metal additive manufacturing, advanced materials and numerical modelling.

Professor David P Ngidi is a Category C NRF-rated researcher, currently occupying the position of Deputy Vice Chancellor: Teaching and Learning at the Central University of Technology, Free State. His specialisation is in the field of Psychology of Education and key research focus areas are in teacher education, curriculum, attitudes, and personality dimensions. Over his research career, Prof. Ngidi has contributed more than twenty publications, supervised seven master's and doctoral postgraduate students and presented more than thirty papers at national and international conferences and seminars.

Additional responsibilities related to his research work and career are, amongst others:

- National editorial board member: South African Journal of Education (SAJE) (2006 – 2010)
- Consulting editor: Journal of Educational Review (JER), Nigeria (2008 – date)
- National editorial board member: International Journal of Educational Development in Africa (IJEDA) (2013 – date)
- Editorial committee member: Southern African Journal of Research and Innovation (2014 – date).
- International editorial board member: African Journal of Pedagogy and Curriculum (2014 – date).
- General Secretary and Treasurer: Southern African Society for Education (SASE) (2006 – date).

Professor Alfred Beati Ngowi is a C NRF-rated researcher currently occupying the position of Acting Deputy Vice Chancellor: Research, Innovation and Engagement at the Central University of Technology, Free State. He is a registered professional construction project manager (Pr. CPM); a member of the Botswana Institute of Engineers (BIE); a member of the Institution of Engineers, Tanzania (MIET); a member of the Chartered Institute of Building (MCIOB); and member of the International Association of Housing Sciences (IAHS). His research interests are multi-disciplinary and they include engineering, the built environment, human capital, strategic management and performance management with an extensive record in human capacity development, having produced technicians and degree graduates as well as supervising 21 master's and doctoral students. Some of these students have proceeded with doctoral studies at leading universities such as MIT and Princeton in the USA and Cambridge in the UK. He has published over 100 papers in journals, proceedings and book chapters.

He is also a co-chief editor of the Journal of Construction in Developing Countries (JCDC); an associate editor of the Journal of Built Environment and Asset Management (BEPAM); and a reviews editor of the Botswana Journal of Technology (BJT). Currently Prof. Ngowi's research effort is geared towards embedding sustainability in all construction activities, starting from planning and procurement, to execution on project sites. Specifically, work has been carried out regarding how construction firms could benefit from the sustainable development goals (SDGs) in general, and how firms could create competitive advantage by embracing sustainable construction in particular. Future work will ensure that the approach used in developing construction firms takes cognisance of creating an environment that shows the firms embracing the attributes of sustainability, particularly sustainable construction leading to a competitive advantage.

Professor Laetus O.K. Lategan is currently the Senior Director: Research Development and Postgraduate Studies at Central University of Technology, Free State. His research outputs have been commended with a C Rating from the National Research Foundation (NRF) and the awarding of an extraordinary professorship in research and professional ethics at the University of the Free State (2007 – 2010). His research contribution goes beyond own research activities. He is the founding editor of the Journal for New Generation Sciences, a Department of Higher Education and Training accredited research journal. His current research interests centre around four themes: Public health ethics, Medical humanities, Research ethics and integrity and How to educate a new generation of researchers.

As a researcher he has an extensive research publication list comprising almost 200 publications as author or co-author (ranging from accredited articles, chapters in books, published conference papers, monographs, books, chapters in books and public intellectual comments) in various fields of study (philosophy, ethics, higher education, research education and research management). His professional qualifications are at doctoral level in philosophy and theology. His most recent books include Get ready, Get set, Go! Preparing for your doctoral studies and doctoral education [2017,

L.O.K. Lategan (editor), SUN MeDIA: Bloemfontein], Healthcare ethics for healthcare practitioners [2017, L.O.K. Lategan and G.J. van Zyl (editors), SUN MeDIA: Bloemfontein] and Vulnerable responsibility: small vices for caregivers [2019, L. Vanlaere, R. Burggraeve and L.O.K. Lategan, SUN MeDIA: Bloemfontein].

Professor Deon de Beer is an NRF C-rated researcher and is the incoming DSTMerSETA Chair: Innovation and Commercialisation of Additive Manufacturing (AM) at the Centre for Rapid Prototyping and Manufacturing (CRPM) at the Central University of Technology, Free State (CUT). Prof. De Beer spent 10 years (industrial R&D) at the Atomic Energy Corporation, followed by 31 years in Higher Education (teaching, research and management). He has published widely on topics in product development, technology transfer, innovation, research development and commercialisation, is a rated researcher with the NRF, and a member of ASSAF. Deon founded the CRPM, PDTS and Fablab at the Central University of Technology; he established the VUT Southern Gauteng Science Park and the Advanced Manufacturing Precinct at Vaal University of Technology, and founded the Idea 2 Product Lab concept (currently more than 30 platforms active internationally).

During his tenure as Chief Director: Technology Transfer and Innovation Support, he also started AM activities at North West University, which focus on applications in engineering, biomaterials and health sciences. Deon leads the Design for AM and Polymer AM programmes within the Collaborative Programme for AM (CPAM) – a national consortium funded by the Department of Science and Technology (DST). He received several local and international awards, and during 2015, he received the NSTF Award for his contribution to make AM available to industry in SA. Deon is also a founding member of the Rapid Product Development Association of SA (RAPDASA), and has served on the RAPDASA management committee since inception for 18 years.

He was part of the team that initiated the Innovation Highway™ – a regional development initiative, which amongst other things, led to the establishment of PLATFORUM, an innovation and incubation initiative that promotes value addition to the PGM-group metals, through additive manufacturing. Deon believes in empowering others while maintaining personal excellence and leading by example. One of his personal objectives is continuous promotion and education of AM in SA and beyond.

Professor Ryk Lues is an NRF C-rated researcher and is currently Full Professor in Food Safety in the Faculty of Health and Environmental Sciences at the Central University of Technology (CUT), Free State, South Africa. He is the Director of the Centre for Applied Food Sustainability and -Biotechnology (CAFSaB) and Coordinator of the Regional Innovation Forum for the Free State Province, an entity mandated to facilitate discourse amongst various academic, business and regulatory stakeholders in the regional innovation value chain. He holds an MSc. (Microbiology) and a

PhD (Food Science) from the University of the Free State and his field of specialisation comprises social-behavioural aspects impacting on food microbiology and hygiene. He also has an interest in organic acid preservatives and microbial acid tolerance. His research into food safety behaviour has seen him being invited to a number of industries both within and outside the food sector to speak on issues related to risk, organisational culture and motivation, and he serves on a number of national and international advisory bodies and expert panels. This includes an Erasmus Mundus tenure at University of Uppsala in Sweden. He has, to date, authored and co-authored 69 articles in accredited journals, 3 book chapters and 1 book on topics related to research methodology, food preservation, food safety culture and food hygiene systems management, and has promoted numerous master's, doctoral and post-doctoral candidates. He is a lecturer of selected postgraduate courses in the Faculty of Health and Environmental Sciences as well as some Spring and Fall modules of the online Food Safety Programme at the Michigan State University. He is a previous Vice-President of the SA Association of Food Science and Technology.

Professor Isaac Ntshoe is a NRF C-rated researcher currently occupying the position of Research Professor in Academic Development and Support and the leader of the Unit of Research in Scholarship of Teaching and Learning. His research extends and complements the research area on curriculum design, higher education policy and planning, the sociology of knowledge and the economics of education. Prof. Ntshoe has numerous publications and has supervised several master's and doctoral postgraduate students. His research focuses on investigation into curricula design and pedagogical practices in the professional and sectoral fields of practice offered by traditional universities and universities of technology, and by technical and vocational education and training (TVET) institutions.

Professor Patient Rambe is a C rated researcher and holds a PhD in Educational Technology from the University of Cape Town, South Africa. He is an Associate Research Professor in the Faculty of Management Sciences at the Central University of Technology, Free State in South Africa. He is the 2017 Winner of the Vice Chancellor's Excellence Award (Established Researcher category) in the Faculty of Management Sciences. Prof. Rambe is a co-leader of the Centre for Enterprise and Entrepreneurship Studies. He is also a German DAAD Dies ProGrant Certified Trainer of academics in research grant proposal writing. Prof. Rambe is also a Faculty Convener of the Master's and Doctoral Programme Streams at the same university. He has previously served as an Assistant Director in the Office of International Academic Projects in the Vice Chancellor's Office at the University of the Free State, South Africa. He has published over 120 research publication outputs comprising book chapters, accredited journal articles and conferences papers. He has also been invited to speak and deliver seminars at several universities in South Africa, Ghana and Zimbabwe. His main area of research interest interfaces entrepreneurship, business management

and application of emerging technologies. He also occasionally conducts scholarly research on the appropriation of educational technology (e.g. social media, mobile instant messaging and mobile handhelds) in Higher Education.

Professor Fidelis A. Emuze is Professor and Head of the Department of Built Environment and Head of the Unit for Lean Construction and Sustainability at the Central University of Technology, Free State (CUT), South Africa. Lean construction, health, safety, and well-being and sustainability constitute the primary research interest of Dr Emuze, who is a National Research Foundation (NRF) funded researcher who has published over 200 research outputs over the past seven years. Dr Emuze is a member of several editorial advisory boards of international journals including the ISI indexed Proceedings of the Institution of Civil Engineering – Municipal Engineers. He is a member of the Association of Researchers in Construction Management, the Lean Construction Institute and the Board of Directors of the Engineering, Project, and Production Management Association (EPPM-Association). Dr Emuze is the International Coordinator of CIB TG59 – People in Construction task group.

Professor Herman Vermaak is a C-rated professor and currently the Dean: Faculty of Engineering, Built Environment and Information Technology. His research focus is on Flexible Manufacturing, Automation and Robotics as well as Renewable Energy Technologies. He was head of department for eleven years and acting dean of the faculty for fourteen months. He has presented numerous papers at international conferences, published widely in international journals, and supervised more than thirty completed postgraduate studies. He has also produced two technical reports for the Council for Scientific and Industrial Research (CSIR) on Reconfigurable Assembly Systems. Prof. Vermaak was inaugurated as a full Professor on 7 September 2016. His address was a summation of his prowess as a scholar of note in the field of engineering. In his address, he presented Design-for-Testability: the solution to improved test engineering and product quality as a tribute of his work of many years as artisan, technologist and engineer.

Professor Michael Mhlolo is an NRF C-rated researcher who holds a PhD in Mathematics Education from the University of the Witwatersrand in Johannesburg, South Africa. His research interests are in Giftedness in general and in Mathematical Giftedness in particular. He has received extensive training on Grants Proposal Writing, thanks to the DAAD Dies Programme. As a result of that extensive training he holds a research grant on Giftedness from the National Research Foundation. Hi interest in research mathematical giftedness is driven by a global discourse that

positions mathematical competence as the key to the welfare of a nation in the Fourth Industrial Revolution (4IR). Mathematically gifted students have been hailed as the hope for the future because of their potential to generate the knowledge and skills that are needed in the 4IR. He is an Associate Professor and currently the Assistant Dean responsible for Research Innovation and Engagement in the Faculty of Humanities at the Central University of Technology, Free State. Regionally, he is a member of the Association of Mathematics Educators of South Africa (AMESA) and recently completed his 3-year term as an executive committee member of the Southern Africa Association for Research in Mathematics, Science & Technology Education (SAARMSTE). Internationally, he is a member of the World Council for Gifted & Talented Children and an executive committee member (President Elect) for the Mathematical Creativity & Giftedness (MCG) group.

Professor Arthur James Swart is a Y-rated researcher currently occupying the position of Associate Professor in the Department of Electrical, Electronic and Computer Engineering. His key performance areas include teaching Electrical Engineering and research into Engineering Education and Energy Monitoring. His Energy Monitoring research focuses on monitoring the energy yield from solar modules exposed to various environmental conditions using the Internet of Things. The purpose of this research is to determine the feasibility and viability of these solar modules under varying environmental conditions. Most of his recent research in this field has been done with Prof. Pierre Hertzog, a colleague in the department. His Engineering Education research focuses mainly on the use of educational technology to promote student engagement with the course content. One key aspect of engagement relates to helping engineering students fuse theory with practice. Throughput rates remain low in higher education, which mandates academics to search for innovative methods to improve student learning so that students may demonstrate graduate attributes that are required by industry today. He considers himself privileged to be a mentor in a research group for Engineering Education (called ARGEE) within the faculty; this group has published 15 accredited journal articles and presented 72 international conference papers over the past five years.

Professor Kanzumba Kusakana has a BSc Eng. in Electromechanical Engineering, as well as an MTech and a DTech in Electrical Engineering. His research interests are electrical power and energy systems, energy management, renewable and alternative energies. Professor Kusakana is a member of the South African Institute of Electrical Engineers (SAIEE); he is a Professional Engineer registered with the Engineering Council of South Africa (ECSA), a Certified Energy Manager (CEM) and is currently an NRF Y2-rated researcher. Prof. Kusakana has supervised seven master's and one doctoral student to completion. He has produced more than 100 publications including accredited DHET journal articles, book chapters as well as conference papers. He is currently an Associate Professor and Head of the Electrical, Electronic and Computer Engineering Department at the CUT.

POST-DOCTORAL FELLOWS

Dr Arc Evelyn Lami Ashelo Allu

Dr Arc Evelyn Lami Ashelo Allu (Fnia) obtained her PhD in Sustainable Architecture and Climate Change from De Montfort University (DMU), Leicester UK in December, 2014. Dr Allu is a Senior Lecturer at the University of Jos, Nigeria, where she is an academic staff member of the Department of Architecture. Dr Allu's research interest includes climate change and buildings, traditional architecture, sustainable design and construction and sustainability of the built environment. Dr Allu is also a Fellow of the Nigerian Institute of Architects, and member of the following: the Nigerian Institute of Architects (NIA), the Architects Registration Council of Nigeria (ARCON), the Association of Architectural Educators (AARCHES), the Association of Researchers in Construction Management UK, the Network for Comfort and Energy Use in Buildings (NCEUB) UK, the Co-operative Network for Building Researchers and the International Society for Development and Sustainability.

Dr Allu is currently a post-doctoral research fellow at the Department of Built Environment, Central University of Technology, Free State (CUT), South Africa. She has published 19 journal research papers, and 11 conferences papers on national and international platforms. She has recently published a book chapter.

Dr Allu has been involved in teaching, research, architectural design studio mentorship and student supervision since 2006, with undergraduate and postgraduate students, after her confirmation as an academic staff member at the University of Jos. She has supervised more than 30 undergraduates' projects, 13 master's students and currently supervises three PhD students. Dr Allu is an external examiner of the Department of Architecture, Ahmadu Bello University, Zaria-Nigeria. She also serves as a reviewer for journals and conferences both nationally and internationally.

Dr Michael Oladokun

Dr Michael Oladokun is a post-doctoral research fellow in the Department of Built of 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 post-doctoral research is to develop a model of energy consumption and carbon emissions in dwellings with a view to improving the understanding of the complex nature of energy consumption and carbon emissions of buildings. This is done by providing a model for policy makers to test different energy policy strategies in South Africa. The research will provide a new model that can be used to describe future energy use and carbon emissions resulting from the housing sector of South Africa. The project will outline how energy use and housing-related carbon emissions will change in South Africa in the future. The research is still ongoing.

During the year under review, Dr Oladokun participated in a number of activities. His post-doctoral research produced four conference papers as outputs that were published in the proceedings of three different international conferences. There were three other articles that were published during the year under review from other projects in which he was involved at the Department of Built Environment. Furthermore, he was part of the team that won a research project from the Free State Department of Human Settlements. The project was successfully executed and delivered.

Dr Thywill Dzogbewu

Dr Thywill Cephas Dzogbewu is a materials physicist in the mechanical field, who has with significant success explored the possibility of producing biomedical objects of suitable mechanical properties with antibacterial properties for replacing damaged bone tissue in the human body. 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 completed his doctoral degree in March 2018 at the Central University of Technology, Free State, in the Department of Mechanical and Mechatronics Engineering. His doctoral research focused on additive manufacturing of titanium alloys for biomedical and engineering applications. Prior to his doctoral studies, Dr Dzogbewu had graduated with a BSc. (Hons) Physics and MSc. Physics (*Materials Physics*) degree from Kwame Nkrumah University of Science and Technology, Ghana.

Dr Dzogbewu is currently researching the in-situ alloying of different elemental powders for biomedical and engineering applications, surface modification of biomedical objects with nano-fibers and essential oils to enhance osseo-integration and to prevent implant infections, as well as financial and marketing models for the commercialisation of 3D products.

His research outputs are published in academic journals and refereed conference proceedings. He is a registered member of the South African Council for Natural Scientific Professions. He is currently co/supervising four master's students and two PhD students.

Dr Philip Robert Stott

Dr Philip Stott obtained his Dr Eng in Civil Engineering at the Central University of Technology in May 2018. He also holds BSc. (Honours) and MSc. (Eng) degrees from Manchester University, England, and has been a registered professional engineer in South Africa since 1984. He lectured in Civil Engineering at Ahmadu Bello University in Nigeria from 1966 to 1969 and at the University of the Witwatersrand from 1970 to 1972. The focus of research for his Dr Eng was the problem of widespread damage to light structures, particularly RDP housing, caused by swelling clay. This

research led to ten papers being published in conference proceedings and four published journal papers, two of which received the annual J.E. Jennings award for best geotechnical paper (in 2017 and 2018). Two further papers are being prepared for journal submission.

The research currently being undertaken in the post-doctoral fellowship programme has broadened the above focus to include a major problem revealed by the doctoral research, namely, that of variability of engineering properties in soil, of apparently uniform and consistent nature, from a single soil stratum. This problem has been found to extend to a wide range of soils. It is believed that this work has yielded the first ever probability density functions of engineering soils properties to a precision suitable for geotechnical engineering design. Abstracts for three international conference papers on this work have been accepted, and a geotechnical journal has expressed interest in a paper which is in the drafting stage.

Philip Stott has, over the past three years, supervised three master's students who have been awarded master's degrees, two with distinction. Three master's students are currently being supervised. One of the previous master's students is preparing an application for doctoral study, and another is considering applying for doctoral studies.

Research report Dr P. Kendrekar

Dr Kendrekar and his research group are currently working on the development of novel drugs for resistance to breast cancer. The main aim of the project was to find a novel drug or inhibitor which can be used to stop proliferation and also to discover methods that can be used to overcome the anti-cancer drug resistance in the form of RB1 mutations and also CDK4\6 phosphorylation, thus finding new methods to try and develop a drug that overcomes resistance and patients don't relapse after taking the molecule for receptor positive breast cancer. Microarray technology can be used to analyse the expression levels of the regions and areas in the retinoblastoma and also CDK4\6 protein complexes in cancer cell lines and also in normal cells to look at the expression levels of the genes and areas which can help analyse what causes the resistance to the anticancer drugs. There are currently five master'sstudents working on this project, some of whom received NRF funding for their master's studies).

Furthermore, two students in our research group are busy with novel drug development for resistance to malaria. These two students will soon be going to the UK for the further research work. Ms Mercy Khala is busy working on novel drug development in resistance to tuberculosis, in collaboration with Stellenbosch University and the University of the Free State.

The same amino acids that are interacting with Palbociclib were also interacting with GPK044

Lipid-formulation of novel drug for resistance to malaria

Liposomes are one of the most popular carrier systems and have been well exploited for various drug delivery applications, to date. There are, however, more elegant lipid systems which have emerged in recent years based on self-assembled lipid nanostructures. Lipids bearing an amphiphilic character self-assemble into remarkable morphologies in aqueous media. In order to expand their application arena these self-assemblies are further dispersed into colloidal emulsions, usually retaining the original nanostructure.

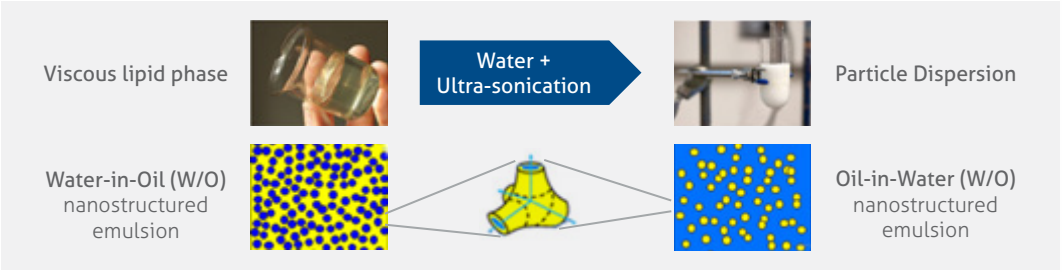
Our work in exploiting such nanostructured emulsions is to develop a range of formulations for pharmacological therapies. Preparation, characterisation and fine-tuning properties of nanostructured emulsions have already been established. There are certain advantages of nanostructured emulsions over liposomes, e.g. these emulsions contain a large hydrophobic surface area, facilitating the solubilisation of drugs that are poorly soluble in water. Moreover, their properties can be applied over a wide range which could be useful for optimising them for efficient loading and altering their physical forms for various routes of administration e.g. oral or topical.

The main idea of a project fabricated from nanostructured lipid particles and polysaccharide based hydrogel, is for sustained release applications. Lipid particles were prepared by kinetically stabilising self-assembled lipid nanostructures whereas the hydrogel was obtained by dissolving kappa-carrageenan (KC) in water. The drug was incorporated in native as well as lipid particle loaded hydrogels, which, upon dehydration, formed thin films. The kinetics of drug release from these films was monitored by UV–Vis spectroscopy while the films were characterised by Fourier transform infra-red (FTIR) spectroscopy and small angle X-ray scattering techniques. Pre-encapsulation of a drug into lipid particles is demonstrably advantageous in certain ways: for instance, direct interactions between KC and drug molecules are prohibited due to the mediation of hydrophobic forces generated by lipid tails. Rapid diffusion of small drug molecules from a porous hydrogel network is interrupted by their encapsulation into rather large sized lipid particles. The drug release from the lipid-hydrogel matrix was sustained by an order of magnitude timescale with respect to the release from native hydrogel films. These studies form a strong platform for the development of combined carrier systems for controlled therapeutic applications.

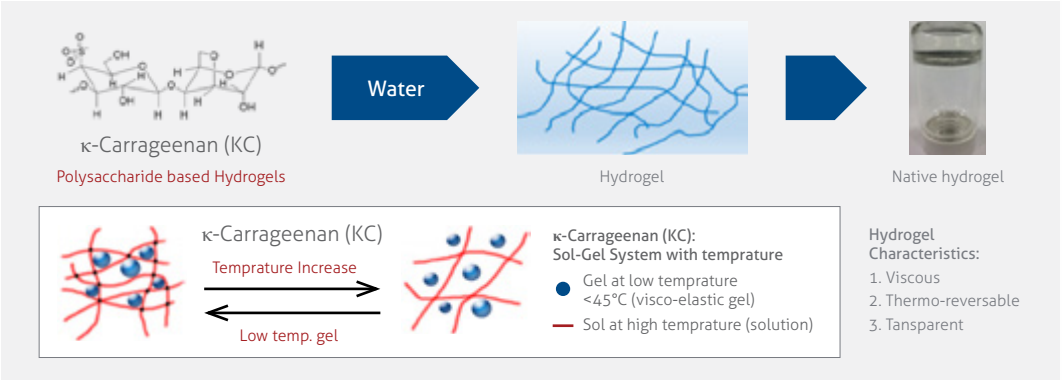
The Unit for Drug Discovery Research group.

This group is busy encapsulating newly synthesized hydrophobic drugs and developing formulations which can be used for therapies against resistance to malaria drugs. This work includes the comparison of the above formulations with existing drug carriers and their testing on affected cells. Small Angle X-ray Scattering, Dynamic Light Scattering and UV-Vis Spectroscopy comprise major characterisation techniques. This work is highly interdisciplinary benefiting pharmaceutical as well as biomedical disciplines. We will send the samples for characterisation to the collaborators at UcLan with Dr Kulkarni.

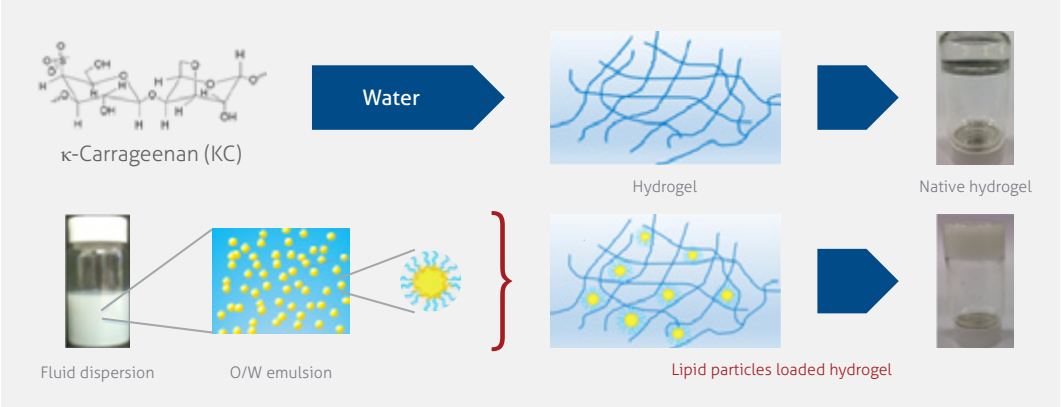
Dispersion/Emulsion



Polysaccharide based Hydrogels



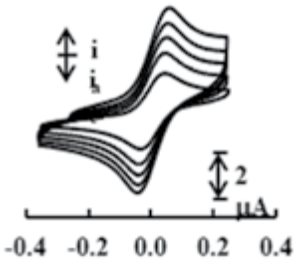
Encapsulating lipid Particlesin Hydrogels



Dr J.P. Lewtak

Dr Lewtak is currently working on four different projects namely:

- Food safety assessment and microbiological analysis of Kombucha Tea prepared from Rooibos (*Aspalathus linearis*). A Kombucha tea sample was prepared using a symbiotic culture of bacteria and yeast. pH, antioxidant properties, DPPH, conductivity and LC-MS analyses were obtained. A manuscript for publication is in the process of being written by J.P. Lewtak, O. De Smidt, and I.T. Manduna, to be submitted in 2018 to the *Food Microbiology* Journal.
- Comparison of 4-Ferrocenylmethenyloxo-, thio, aza and carbophthalonitriles: the synthesis, spectroscopical characterisation, crystal structure and electrochemical studies of novel precursors for the synthesis of phthalocyanines, metallocene phthalonitriles with oxo-, thio, aza and carbo- linkages have been synthesised, characterised spectroscopically and studied electrochemically. A manuscript is in the final stages of being written, by J.P. Lewtak, E. Langner and J.C. Swarts, to be submitted in 2018 to a journal of Inorganic Chemistry.
- Electrochemical studies of series of 3 and 4-Ferrocenylalkylthiophthalonitriles. Progress made has been that a series of eight ferrocenylalkylthiophthalonitriles, 3-Fc$(CH_2)_n$SPn and 4-Fc$(CH_2)_n$SPn where n = 1 through 4, Fc = ferrocenyl and Pn = $C_6H_3(CN)_2$ were synthesized. Electrochemical measurements of the series of compounds were performed. The phthalonitriles have not been reported in the literature to date. A manuscript is in the process of being written by J.P. Lewtak and J.C. Swarts, and will be submitted in 2018 to the *Journal of Organometallic Chemistry*.



- The composition of hard resins of Humulus Lupulus of South African origin and their potential role in medical nutrition therapy.

Dr G.G. Setlhare

"Essential Oils, An Alternative Approach in Fighting Bacterial Antibiotic Resistance"

Dr Setlhare is currently working on four different projects namely:

Morphological and chemical changes induced by *Thymus vulgaris* essential oil on *Staphylococcus aureus* cell wall was done. A research publication written by G.G. Setlhare, N.J. Malebo, and J. Nkhebenyane, was submitted to the *BMC Complementary and Alternative Medicine Journal* (under review).

Analyses were performed on the inhibitory effect of *Thymus vulgaris* essential oil on different concentrations of *S. aureus* and *B. cereus* isolates, after which further analyses regarding changes in cell morphology (e.g. cell damage) were done using scanning electron microscopy (SEM) at the University of Free State.

An interfaculty collaboration was established with Dr T.C. Dzogbewu (researcher at the Department of Mechanical Engineering – FEIT, Central University of Technology, Free State, Bloemfontein) on the topic: Potential application of different essential oils (*Thymus vulgaris*, *Mentha × piperita*, *Eucalyptus globulus*, *Rosmarinus officinalis*, *Artemisia afra*, *Erythrina lysistemon*, *Psidium guajava* and Helichrysum essential oil) for control of biofilm formation on medical implants. The aim is to assess whether essential oils can target/inhibit bacterial colonization on medical implants.

A research publication was submitted to the Health SA Gesondheid Journal on the topic: Potential applications of essential oils for infection control. This was a Review article in partnership with Dr T.C. Dzogbewu of the Faculty of Engineering.

In the project, new information was provided on the diverse mechanisms of action of *Thymus vulgaris* essential oil against antibiotic-resistant bacteria. The project contributes to the field of food safety by providing alternative options to address the antibiotic-resistance challenge. Furthermore, as growers can potentially benefit from deriving antimicrobial products from essential oils, the project makes a socio-economic contribution in the long term. For the project to continue to expand, there are currently four master'sstudents working on it under the supervision of Dr Setlhare and Dr Malebo of the Department of Life Sciences.

The overall assessment of her research development over the period has been very satisfactory. She has developed core skills in data analysis, seminar/conference presentations (oral paper presented at the IAFP: International Association for Food Protection, Salt Lake City, Utah, 8-11 July 2018), journal submissions and general research capacity. She has also built a research network particularly with in the Department of Mechanical Engineering, Central University of Technology, Free State, where her research outputs are discussed for feedback and improvement. She has also commenced supervising students under the guidance of her mentor, Dr N.J. Malebo. She won the Best Presentation by a staff member at the Prestige Research Day (PRD) at the Central University of Technology (CUT), on 30 October 2018. Lastly, she was also invited by the research office to present at the institutional postdoctoral forum.

The university also appointed six post-doctoral fellows under Track 2 for the Faculty of Humanities and Management Sciences:

Dr Milne holds a PhD in Mathematics Education from the University of the Free State. Her mentor is Prof. M.K. Mhlolo and the focus of her proposed research project is on strategies for curbing dropping out of at-risk mathematically gifted students in the Bloemfontein area.

Dr Lepheana holds a PhD in Educational Psychology from the University of the Free State. Her mentor is Prof. G. Alexander and the focus of her proposed research project is on teachers' understanding of life sciences and challenges faced by diverse learners especially those from child-headed households.

The faculty renewed the contracts of the four part-time post-docs (Dr L.T. Chipunza; Dr T. Ndofirepi; Dr V. Atiase; and Dr F. Okyere) for the academic period August 2018 to July 2019, with specific expected deliverables for each one of them.

IMPACT

PARTOUR

#4

PROFESSORS

EXCEL

INFLUENCE

Research Impact and Excellence

LENCE

APPOINTMENT OF PROFESSORS

The following new associate professors were appointed as from 1 July 2018.

Professor M. Sedibe

Prof. Moosa Sedibe is an Associate Professor at the Central University of Technology, Free State South Africa. He has experience in lecturing and conducting research. Prof. Sedibe holds a PhD (agronomy) degree and is a registered with SACNASP as a Professional Scientist. He is a member of the Southern African Society for Horticultural Science and the American Society for Horticultural Science. Additionally, Prof. Sedibe is a member and chairperson of the Advisory Council of Taung College of Agriculture. He has been a grant holder for many years, mostly obtained from the National Research Foundation. He is an NRF-Thuthuka Post-Doc Track (2018 – 2020) grant holder. His research interest is on genetic diversity and population structure of genotype polymorphism of indigenous plants collected from different geographic origins, using the DArTseq method, genotype by sequencing technique and SSR's markers, and using Crispr Cas9 technology to develop variety resistant. He is also involved in studying the effect of nutrition on vegetables and essential oil plants. He is currently supervising doctorates and master's students.

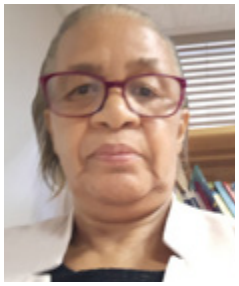
Professor R. Haarhoff

Prof. René Haarhoff is the HOD: Tourism & Event Management and has been employed at the CUT since 1997. Her qualifications include a B.IURIS degree, a B.Tech degree in Tourism Management, a master's degree in Tourism Marketing and a doctoral degree in Business Administration focusing on price competitiveness. She also completed short courses Guesthouse Management and Project Management, and holds a certificate in Doctoral Supervision. Her industry experience includes an eight-year career at South African Airways, a stint as a senior travel consultant at Magic Travel and being the proud owner of a successful guest house in Bloemfontein from 2000 – 2004. In 2010 she received the award for the Best Research at the Prestige Research Seminar FMS, CUT. In 2012 she received the Vice Chancellor's Award of Excellence for the category "Community Engagement" for her involvement in the five-year STRONGBOW project in Ethiopia, of which she was also the South African project leader. This project was aimed at research capacity building and gender equity of university staff members. In 2015, she was a national finalist in the ASATA Diners Club Awards for Exceptional Commitment to Industry and was nominated for the Vice Chancellor's Excellence Award: Advanced Teaching, FMS, CUT. In 2016 she was a nominee for The HSRC Medal for Social Sciences and Humanities. She has also been a board member of LARASA (Leisure and Recreation Association of South Africa) since 2017. In 2018 she received the Vice-Chancellor's Excellence Award: Mid-Career Researcher, FMS, CUT. Prof. Haarhoff's research has a strong focus on Tourism and Destination Management, covering aspects such as responsible tourism, medical tourism, tourism marketing and price and airline competiveness.

Professor F.E. Emuze

Fidelis A. Emuze holds a PhD and is Professor and Head of the Department of Built Environment and Head of the Unit for Lean Construction and Sustainability at the Central University of Technology, Free State (CUT), South Africa. Lean construction, health, safety, and well-being and sustainability constitute the primary research interests of Dr Emuze, who is a National Research Foundation (NRF)-funded researcher who has published over 200 research outputs over the past seven years. Dr Emuze is a member of editorial advisory boards of international journals including the ISI indexed Proceedings of the Institution of Civil Engineering – Municipal Engineers. He is a member of the Association of Researchers in Construction Management, the Lean Construction Institute and the Board of Directors of the Engineering, Project, and Production Management association (EPPM-Association). Dr Emuze is the International Coordinator of CIB TG59 – People in Construction task group.

The following new professor was appointed:



Professor S.N. Matoti

Professor Sheila Nokuthula Matoti obtained a Bachelor of Science (BSc.), University Education Diploma (UED) and Bachelor of Education (BEd.) from the University of Fort Hare, a Bachelor of Science (Hons) from Potchefstroom University (now NWU), and a Master of Education (MEd.) degree in Science Education from Rhodes University. She later obtained a Doctor of Education degree (Ed.D) in Teacher Education and Educational Management from the University of Bristol in the United Kingdom. She has taught Biology and Physical Science at Senior Secondary School and College level. She joined the University of Transkei (now Walter Sisulu University) and taught Educational Management and Research Methodology to postgraduate students. She joined the Technikon Free State (now Central University of Technology, Free State) in 2002 as a Senior Lecturer in Educational Management. She was requested by the late Dr R. Litheko to start a Science Programme and also serve as a Programme Head for Science. Once the programme had taken off, and also due to restructuring, she focused on Educational Management and Research Methodology. She has supervised and co-supervised master's and doctoral students in Teacher Education and Educational Management. Her research areas include teaching and learning in the Sciences, teaching efficacy of practising teachers and of pre-service teachers, and leadership efficacy of school managers. She is involved in the Scholarship of Teaching and Learning (SoTL) where she mentors six staff members in two research clusters, namely, Classroom Practice and Student Experiences. She has presented papers at both international and national conferences, and has published articles in accredited journals and conference proceedings.

STAFF GRADUATION: DOCTORATES

Dalene Crowther
Qualification obtained:
Doctor of Business Administration
Central University of Technology, Free State

- **Thesis:** Formulation of a sustainable financial management strategy for South African Universities' Hotel Schools

Motalenyane Alfred Modise
Doctor of Education
Central University of Technology, Free State

- **Thesis:** English as the language of learning for limited English proficiency grade 10 accounting learners in the Free State province

Logan Munsamy
D.Tech
Central University of Technology, Free State

Thesis: Development of an integrated disaster risk management model for the municipalities in the Free State province

Joel Timire
Doctor of Philosophy
University of the Free State

- **Thesis:** Mechanical Technology Teacher Education Curriculum Alignment to practice: Towards a conceptual framework

Jane Nkhebenyane
PhD (Environmental Health)
Central University of Technology, Free State

- **Thesis:** Food Hygiene Risks and Related Practices in Central South African HIV/AIDS Hospices: a qualitative assessment

EP Palmer
Doctor Human Resources
Central University of Technology, Free State

- **Thesis:** The impact of workplace spirituality on organisational commitment: The case of the Central University of Technology, Free State (CUT)

L Matlho
Doctor in Education
University of the Free State

- **Thesis:** A Sustainable Learning Environment model in a Foundation Phase Multigrade Classroom

THE 4TH INDUSTRIAL REVOLUTION AND CIRCULAR ECONOMY TASKFORCE LAUNCHED

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

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

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

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

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

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

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

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

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

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

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

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

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

CUT HOSTS ASTRONAUT CANDIDATE FOR THE 100 MARS ONE PROJECT

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

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

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

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

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

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

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

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

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

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

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

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

INTELLECTUAL PROPERTY AND TRANSFER OF TECHNOLOGY: SUMMER SCHOOL

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

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

The two-week training, which will be divided into nine interactive sections, is a world-wide event that will be attended by speakers from all over the world. A broader scope on various topics will be covered and about 20 renowned experts and specialists from academia, government and industry will be presenting and debating on the issues.

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

The programme consists of lectures, case studies, simulation exercises and group discussions on selected IP topics, with an orientation towards the interface between IP and other disciplines. A certificate of participation will be awarded to participants who successfully complete the programme requirements.

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

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

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

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

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

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

INAUGURAL AFRICAN ADVANCED MANUFACTURING INNOVATION AWARDS: CUT ACKNOWLEDGED

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

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

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

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

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

Mr Johan Perkins (middle) is congratulated by Prof. Carlu Van der Westhuizen, Professor: Environmental Health (left) and Prof. Samson Mashele, Dean: Health and Environmental Sciences.

CUT LECTURER WINS BEST PAPER AWARD

One of CUT's lecturers in Clinical Technology and researcher Mr Johan Perkins won the "Best Paper" award for his master's research paper at the 7th Annual Free State Provincial Health Research Day, hosted jointly by the Free State Department of Health and the University of the Free State on 8 and 9 November 2018. This year's theme was "*Unifying the public and private sectors through research: dream or reality?*"

Research day allows for enlightening and critical engagement about research findings and recommendations between researchers and the broader health community, including provincial, district and facility managers, health care professionals, academia, students, and others interested in health and health care in the province.

Abstracts were invited for research that addresses health policies and means towards unification of the healthcare system in the province. Mr Perkins entered his research paper titled "Evaluation of accurate tidal volume as displayed on the Avea™ ventilator using predetermined neonatal ventilator settings" and came up tops, beating approximately 60 papers that were submitted and presented during the two days. Out of the study, a quality control kit was developed and can be used to test the accuracy of the ventilator and the proximal hotwire flow sensor at the bedside of the patient. He was supervised and mentored by Prof. Elmien van der Heever-Kriek, Dr Arina van der Byl and Prof. Hoek.

Mr Perkins said that he was happy to have received the award and he was grateful for the recognition. "This was most unexpected, but I am extremely grateful for the recognition and for this award. It is indeed a great honour and motivation for me to continue doing well in my research."

Prof. Carlu Van der Westhuizen, Professor: Environmental Health, said that the award indicates that the work done by Mr Perkins as a CUT staff member is contributing to solving the community's problems by developing high-tech solutions that will enhance the quality of life of many South Africans. "As far as I know, this is the first quality control kit for this specific ventilator and flow sensor. We are very proud of his achievements."

Prof. Mashele, Dean: Health and Environmental Sciences, said that their faculty believes in impact research that challenges the status quo. "We do research not only to publish papers but to develop technological innovations for socio-economic development. Mr Perkins' research resulted in the development of the first quality control kit for ventilators and flow sensors. I am proud to say that this innovation speaks volumes in terms of our vision 2020."

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

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

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

SAIS 2 Call for Proposals (2018/1/CN) will fund projects under three thematic areas, namely stronger ecosystems, scaling enterprises and inclusive innovations. The consortium of three institutions, the CUT, BITRI and UB, was successful in jointly securing € 150 000 (R2 550 000) under the stronger ecosystems thematic area.

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

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

Prof. Henk de Jager, Vice-Chancellor and Principal and Dr Daniel Tau, Vice-Chancellor of Botswana Open University (BOU) signing towards their brighter future.

BOU AND CUT FORMALISE RELATIONS

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

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

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

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

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

He also mentioned that he was impressed by the CUT as a university of technology, and by the staff members who showed passion and enthusiasm in their work. "There is something attractive about this institution; there are many impressive projects that we have seen and heard about. I have noticed the passion, creativity, innovations and the quality of staff members you have. What we saw in the Faculty of Engineering and Information Technology will definitely take this institution

to greater heights. There are many universities that have been around for a long time, but are not as innovative and creative as you are, and do not exude the passion and enthusiasm that we have witnessed here. Keep up with the good work."

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

CUT AND NHLS VENTURES INTO UMBRELLA PARTNERSHIP

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

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

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

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

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

NUIST AND CUT DECLARE TO FORM STRONG COOPERATION

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

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

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

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

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

Profs. Fanny Poujol, from the University of Montpellier, France, Liezel Frick, from Stellenbosch University and Stephanie Giljohann, from the Technical University of Berlin, Germany, facilitated the workshop.

ERASMUS YEBO TRAINING HELD

The CUT International Office hosted a training session on intercultural competencies and managing multicultural research groups from 22-25 October 2018. The session targeted academics that supervise students who have intercultural competences with an international flavour. This event aims to improve and support the modernisation, accessibility and internationalisation of higher education in partner countries. The project further addresses the problems and challenges facing the higher education sector, with specific reference to postgraduate management systems.

The Yebo Project is an international collaborative project involving seven South African and five European universities. Participating universities in South Africa are the University of the Western Cape, Tshwane University of Technology, Cape Peninsula University of Technology, University of Pretoria, University of Stellenbosch, University of Cape Town and Central University of Technology, Free State participating as co-leaders in the Erasmus+ Capacity Building of Higher Education (CBHE) YEBO! Project.

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

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

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

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

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

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

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

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

He further mentioned that the centre had been awarded an international certification (ISO13485) in 2016 and is the only manufacturer of titanium implants on the African continent, as well as the South Africa Research Chair Initiative (SARChI) for medical product development through additive manufacturing. "I am really excited about our growth, the team efforts and dedication, support from our management and council, and our incredible partners and sponsors for making us realise this dream. All these achievements will open the doors for commercial manufacturing of medical devices here in South Africa and also offer us global export opportunities."

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

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

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

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

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

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

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

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

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

He also thanked the CUT, NRF, DST, THRIP, industry and corporate sponsors for making this dream come true. Other partners include Pelonomi Hospital, EOS, Materialise, the Department of Science and Technology (CPAM project), the National Research Foundation (SARChi Chair), the Technology Innovation Agency (TIA), the Fuchs Foundation, the Council for Scientific and Industrial Research (CSIR), the Central Analytical Facilities (CAF), PDTS, CUTis, Medical Professionals, the Life Healthcare group, the FS Provincial government, the FS Department of Education, the FS Department of Health, DESTEA, the FS Department of Public Works, the Department of Trade and Industry, the IDC, Botswana International University of Science and Technology, Botswana Institute for Technology, Research and Innovation, Rapid 3D, Metal Heart, LHA, FDC, MRC, Universitas Hospital, SEDA, SqwidNET, Sefako Makgatho University, the UFS, VUT, NW University, the University of Johannesburg, the University of Pretoria, Stellenbosch University, the University of Namibia, the National University of Singapore, SABS, SAAB, Grintek Defence, Denel, Bloemfontein Chamber of Commerce and Industry, SAMTI, South African Airways, Gauteng Tooling Initiative, UV Tooling, CSAR, Gold Yard, Rapdasa, Phatsoane Henney Attorneys and the media houses.

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

CUT CRPM SCOOPS THE MOST INNOVATIVE LOCAL BUSINESS AWARD

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

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

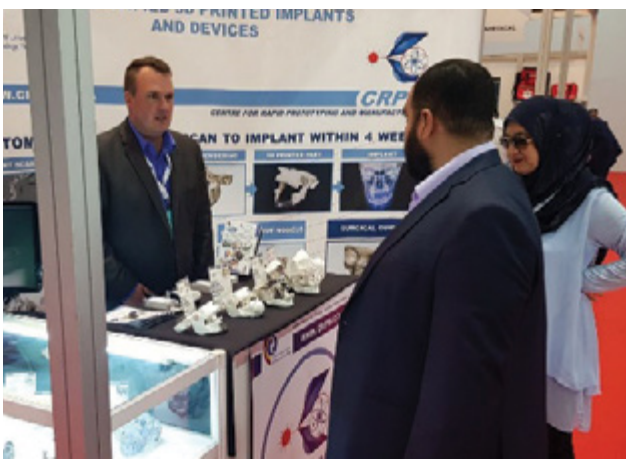
Over the past ten years, the primary focus has been on 3D printing of patient-specific implants and devices, which led to the first SA 3D-printed hemi-mandible implant in 2014. The CRPM has since received ISO 13485 certification in 2016 for design and manufacturing of patient-specific implants by means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

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

CRPM EXHIBITING AT ARAB HEALTH 2018 IN DUBAI

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

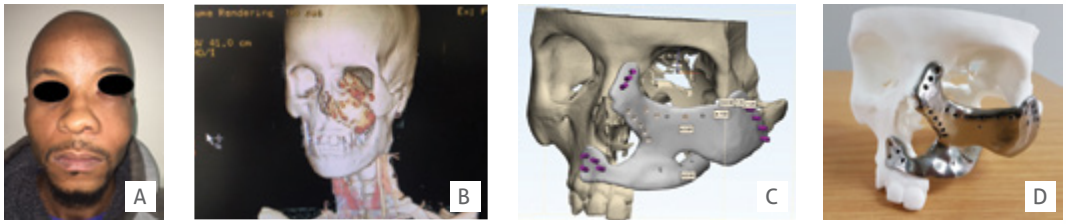
The CRPM was approached by the Medical Device Manufacturers Association of South Africa (MDMSA), which is an association that brings companies that produce medical devices together in South Africa to exhibit at the trade shows. The MDMSA is supported by the Department of Trade and Industry to promote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



This was the first time that the CRPM had the opportunity to exhibit their services in custom made medical device design and manufacturing internationally. Exhibiting at the show was considered very worthwhile with significant interest shown in the services of the CRPM by attendees and a good number of business opportunities were discussed. Around sixty leads were made during the 4-day event.

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

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



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

THE CARL AND EMILY FUCHS FOUNDATION

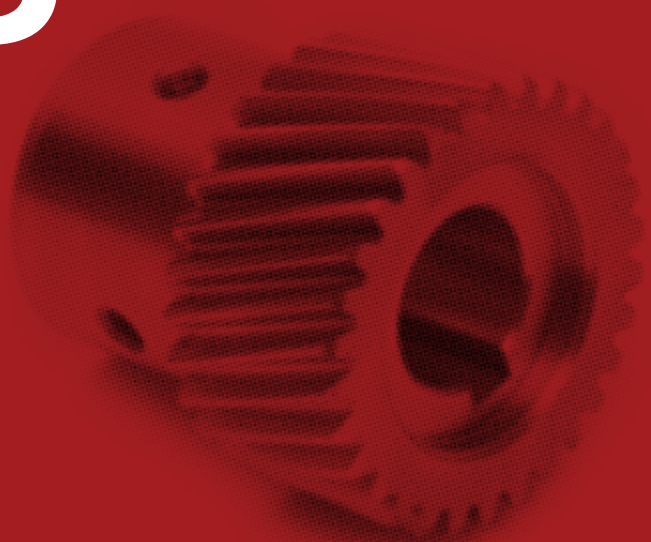
In an endeavour to continuously improve quality of life, the CRPM applied for funding from the foundation. The grant of R 2 250 000 was approved and will be rolled out over a period of 4 years starting in 2016. The foundation has fulfilled its obligation of releasing 2 tranches to the amount of R 600 000 for 2018 financial year.

The objectives of this project are to improve peoples' lives with cutting-edge technology. By making use of 3D printing technology, the CRPM can design and manufacture patient-specific implants, surgical guides and external prostheses. Some of the outcomes that the CRPM expects to see from this project is fully documented case studies showing patient and clinical advantages of making use of 3D printed pre-operative models to shorten operation time, which in turn will lead to faster recovery time for the patient. The CUT has been co-funded with R150000 and Wohlers Associates (USA) with R100 000 to assist patients in cases where tumours are removed and no reconstruction is done.

INDUS

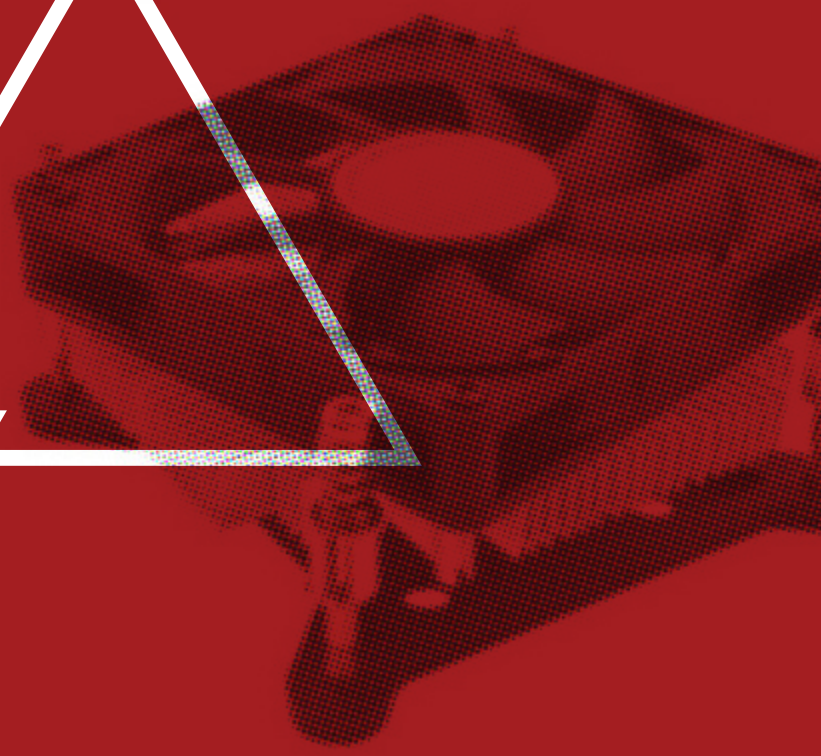
PART #5

BUILD



TRIAL

ENLIGHTENMENT



Faculty of Engineering and Information Technology (FEIT)

A MESSAGE FROM THE ACTING DEAN

In "What is Enlightenment", Immanuel Kant (1783) says:

"Enlightenment is man's leaving his self-caused immaturity. Immaturity is the incapacity to use one's intelligence without the guidance of another. Such immaturity is self-caused if it is not caused by lack of intelligence, but by lack of determination and courage to use one's intelligence without being guided by another. Sapere Aude! Have the courage to use your intelligence! Is, therefore, the motto of the enlightenment."

In 2018, the research, innovation and engagement activities of the Faculty of Engineering, Built Environment and Information Technology (FEBIT) mirrored the clarion call made by Kant in the Age of Enlightenment as quoted above. FEBIT evinced the courage to use individual and collective intelligence to tackle socio-technological problems beyond the borders of the central region of South Africa. The applied research efforts of the faculty led to the incubation of ideas and development of prototypes as solutions rooted in practical wisdom required by society.

Enlightened colleagues in the faculty created, advanced and disseminated knowledge that made a socio-economic impact at the various levels of society. The efficacy of the efforts of FEBIT was felt in the areas of 3D printing, additive manufacturing, farming, robotics, the supply of clean water, energy, shelter, infrastructure, urban development and drought mitigation. A notable achievement of FEBIT is the continued upward trajectory of research outputs from the faculty. The collegial and courageous strides of colleagues in the faculty engender a consistent quest for knowledge, which enables a frontal attack on industrial and societal problems of today and years to come.

Prof. F.A. Emuze
Acting Dean
Faculty of Engineering
and Tnformation
Technology (FEIT)

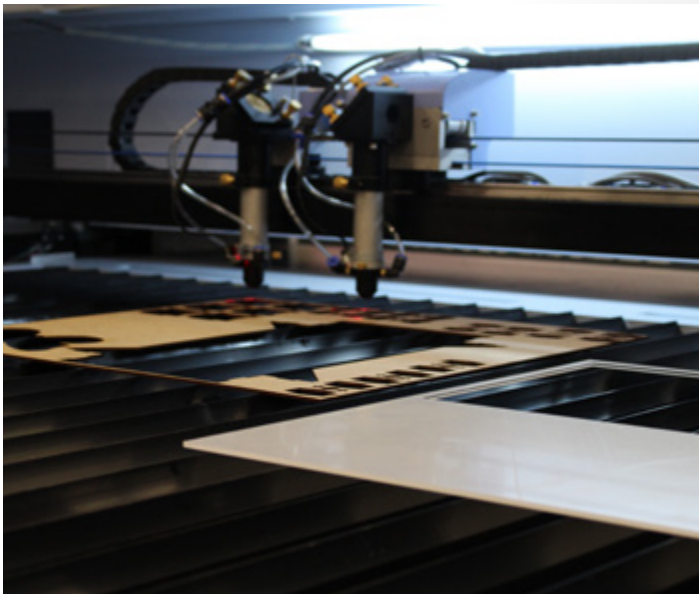
A MESSAGE FROM THE ASSISTANT DEAN

With continued hard work and commitment in 2018, the faculty was able to increase its research outputs as well as the percentage of overall CUT outputs. The quality of outputs, particularly in high impact publications, increased, although this is still a matter that can be improved upon over the coming years. FEBIT staff once again showed the quality of their research in national and international collaboration projects initiated and funding received. The postgraduate students also produced many more research outputs, showing that the research culture extends to the students in the faculty as well.

The CRPM once again shone brightly and a new Chair in Commercialisation and Innovation of Additive Manufacturing was established. The Centre for Sustainable SMART cities was initiated and the expectation is that this centre will expand and grow towards becoming a centre of excellence within the focus area of cities of the future.

The implementation of Industry 4.0 is progressing well in a large number of the faculty research projects, and national and international collaboration within this environment is growing. The challenge of study supervision and the enrolment of more full-time postgraduate students are still two major factors that, together with funding that always needs attention, will take research in the faculty to an even higher level. An excellent research culture is being fostered within the faculty and several inter-disciplinary and multi-skills projects were executed in 2018.

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



Dr Terry Wohlers, founder and President of Wohlers Associates, Inc., a CUT alumni and keynote speaker at the 21st annual research seminar. He is seen here sharing his knowledge, experience and views with his audience about the future of Additive Manufacturing (AM) and 3D printing.

ANNUAL RESEARCH SEMINAR

The CUT acclaimed alumni, Dr Terry Wohlers, took part in the 21st annual research seminar that took place on 18 October 2018 at the Bloemfontein campus of the CUT. The seminar, hosted by the Faculty of Engineering and Information Technology (FEIT), aimed to bring together researchers, postgraduate students, engineers from far and wide, and scientists from academia and industry to share views on the latest trends in engineering and information technology.

In delivering his keynote address, Dr Wohlers shared his knowledge, experience and views with his audience about the future of Additive Manufacturing (AM) and 3D printing. He said that AM and 3D printing are processes of taking a 3- dimensional object, making it digital, then slicing it up into thin cross-sections and printing it layer by layer. He also said that the AM industry is growing at a rapid pace and most companies are starting to invest in the technology. "Investment is propelling the AM industry, and we see many new approaches and applications of the technology. We have seen investment like never before in AM and 3D printing. We have system development, materials development, applications development and other software development that just cuts across so many areas and disciplines and it is exciting to see this happen."

He further mentioned that this technology is penetrating many areas such as those of sensors and electronics, and many companies have millions of dollars in inventory and spare parts and are working towards digitising them rather than having them in physical form. "This technology is also embraced in lighting design, standard and customised designed eyeware frames, footwear, fashion, food printing and printing of buildings and other structures," he added.

Dr Wohlers also said that a lot still needs to be learned from nature and that things are only just getting started. "We have only scratched the surface as to what we can do because we have built these very complex shapes and objects. I believe that we have a lot to learn from nature in biomimicry. In nature, we can learn from bone structures, from humming birds, and even shark skin. We can mimic it and build parts that were impossible to produce before."

He was also impressed by the achievements and good work that CRPM is doing in the area of AM and said "this centre is a crown jewel and is doing exceptionally well in AM. Last year alone about 580 projects were accomplished by this centre through AM and 3D printing. The centre has also managed to acquire an ISO certificate which allows them to do medical related products that could change and save lives of ordinary citizens. This is impressive," he concluded.

Apart from the seminar, Dr Wohlers' visit included a three-day course on Design for Additive Manufacturing (DfAM). The course presented best practices and included a DfAM guidelines document that had been created over the years. It also included design rules and guiding principles for most AM processes and materials, with an emphasis on building high-quality, functional parts. Topics covered were consolidating many parts into one, topology optimisation, and lattice or mesh structures, which covers considerations for metal, polymer, and composite materials, the creation of custom parts, and reducing expensive support material.

Delegates attending the workshop

Other presenters on the day were researchers from the faculty who presented on different engineering topics.

Dr Terry Wohlers is the President of Wohlers Associates, Inc., an independent consulting firm that has been in existence for 31 years. The company provides technical and strategic consulting on new developments and trends in rapid product development, additive manufacturing and 3D printing. Through this company, Wohlers has provided consulting assistance to more than 260 organisations in 26 countries. He has also provided advice to 180 companies in the investment community, most being institutional investors that represent mutual funds, hedge funds, and private equity valued at billions of dollars. An analyst, author, and public speaker, Dr Wohlers has authored more than 400 books, articles, and technical papers on product development and manufacturing and has given 150 keynote presentations on five continents. He was a featured speaker at manufacturing-related events at the White House in 2012 and 2014 and has also appeared on many television and radio news programmes, including Al Jazeera, CBS Radio News, Bloomberg TV, CNBC, CNN, Fox Business, MSNBC, NPR, and Australia's Sky News. He is a principal author of the Wohlers Report, the undisputed industry-leading report on additive manufacturing and 3D printing worldwide for 23 consecutive years. 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).

RESEARCH CULTURE WORKSHOP

The Faculty of Engineering, Built Environment and Information Technology hosted their 5th Annual Research Culture Workshop on 5 September 2018 with the theme "Research from the eye of the postgraduate students". Prof. Rossouw von Solms, Emeritus Professor from the Centre for Research in Information and Cyber Security at Nelson Mandela University, delivered the keynote address at the workshop. This was followed by student presentations from the Departments of Information Technology, Civil Engineering, Mechanical and Mechatronics Engineering and Electrical, Electronic and Computer Engineering. In their presentations, the students had the opportunity to highlight specific challenges and experiences in their postgraduate studies. Some of the issues discussed at the workshop were research supervision, funding for research, access to library resources, the need for a writing centre at CUT, accommodation of students and specific problems experienced by international students. Staff that attended the event took cognisance of challenges expressed by the students for further discussion in the faculty and with the University Research Office.

RESEARCH ENTITIES' ACTIVITIES

Research Centre for Rapid Prototyping and Manufacturing

The CRPM Research Centre is operating well. From September 2018, the DST Chair in Innovation and Commercialisation of Additive Manufacturing (Chair in I & C of AM) has been integrated into the CRPM structure.

The current main activities of the CRPM Research Centre are:

- the DST Collaborative Programme in Additive Manufacturing (CPAM): Cumulative income since February 2015: R 8 256 709 (excl VAT);
- the NRF SARChI research Chair in Medical Product Development through Additive Manufacturing (SARChI): Income per annum: R 1670000.
- the establishment of a Chair in Innovation and Commercialisation of Additive Manufacturing:
  - DST once-off contribution: R 2000000
  - merSETA contribution: R 6000000 over 3 years

Research in the centre is going from strength to strength with all outputs committed to for 2018 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 research of the CRPM aligns with the following focus areas:

- Additive Manufacturing of Medical Implants and Devices, using titanium alloy powders and polymers powders
- Additive Manufacturing of Aerospace Components
- Additive Manufacturing of Advanced Tooling
- Additive Manufacturing for Direct End-use by companies
- Design for Additive Manufacturing as cross-cutting enabling competence.

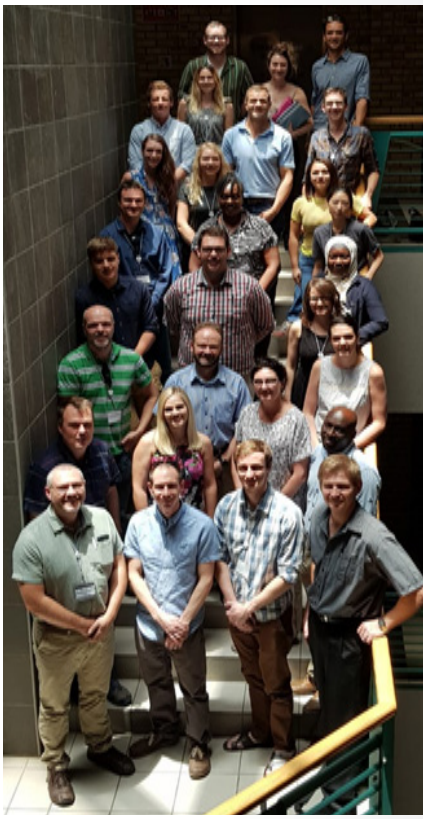
The research and development activities in these focus areas are supported by the DST-funded national *Collaborative Programme in Additive Manufacturing (CPAM)* and the NRF/DST SARChI research Chair in *Medical Product Development through Additive Manufacturing.*

Twenty-three master's and six doctoral students were registered in the research centre in 2018. Three staff members (Nsengimana, Kouprianoff and Moletsane) are presently reading towards their doctoral degrees. Four master's and two doctoral degrees were awarded to members of staff and students who completed their studies through the centre.

UK/SA workshop 2018

The Research Centre for Rapid Prototyping and Manufacturing hosted a workshop with PDR, a world-leading design consultancy and applied research centre at Cardiff Metropolitan University, UK from

4 – 7 December 2018. The title of the workshop was: *Enabling equitable access to health – Embracing new design technologies,* and it explored how 3D design and digital technologies can be used to improve access to state-of-the-art healthcare services in South Africa. Focus areas were patient specific devices such as surgical implants, rehabilitation devices, prosthetics and orthotics. Funding for the workshop was made available under the UK Newton Fund Researcher Links programme in collaboration with the SA National Research Foundation.



Attending the workshop from the UK were Dr Dominic Eggbeer as coordinator and Prof. Cathy Holt as mentor. Joining them were 13 early-career researches from different institutions across the UK. Prof. Igor Yadroitsev was the South African coordinator, with Prof. Anton du Plessis from Stellenbosch University and Mr Gerrie Booysen as mentors. Dr Kobus van der Walt and Ms Bronwen Harmse organised the workshop that was presented in the library on the main campus of the CUT. Attending the workshop from SA were nine early-career researchers and staff from CUT, two early-career researchers from Stellenbosch and North West Universities each and three industry partners of the CRPM working in the prosthetic design field.

Eight collaborative projects could be identified between UK and SA participants to help overcome some of the medical challenges faced by South Africa. All participants agreed that the workshop was well worth the effort and are looking forward to collaborating with new friends made during the week that the workshop was presented.

The Research Group in Evolvable and Manumation Systems

RGEMS – the Research Group in Evolvable and Manumation Systems at CUT – has three main focus areas. These are vision (machine vision and quality control systems), automation and robotics, and the important renewable energy and power management. The aim of the latter is to promote and undertake fundamental and applied research alongside pre-industrial development in the areas of energy technologies. We are engaged in cutting-edge fundamental and applied research underpinning sustainable energy technologies. Our activities are organised around a wide spectrum of mainstream and renewable energy technologies. Our mission is to address major scientific and technological challenges faced by the world in the 21st century and beyond in energy efficiency, emerging energy technologies and sustainability. We are also concerned with the social, economic and environmental impact of energy technologies.

RGEMS consists of 7 CUT members, 4 full time master's students, 2 part time master's students, 1 B.Tech student and 4 WIL practical interns. During 2018, members of RGEMS produced 21 journal papers, 42 peer reviewed proceedings and 3 books and chapters as outputs.

The main project of 2018 was the Sasol Solar Car Challenge 2018. From this there are publications ready for 2019. Large external sponsorships for this project included R750 000 from TIA and R450 000 from the Advanced Energy Foundation.

The Sasol Solar Car Challenge 2018 was a challenge that ran from 22 September to 30 September 2018. A 2000 km long route had to be completed over 8 days. The purpose of the Solar Challenge was to stimulate research into the development of sustainable road transport and energy management/ renewable energies utilisation. The Challenge is primarily a design competition. CUT's part in this is seen in its curriculum transformation. Their vision – vision 2020 – which is aimed at enhancing the academic project, was a Strategic Transformation and Educational Programmes (STEPS) process where the focus was the revision of the instructional programmes that were offered by CUT. During this programme, the CUT identified a global crisis, the energy and water crisis, and designed and introduced an instructional programme to be part of the solution. It was identified that there was a lack of availability of human resources with the required knowledge and skills that seemed to be the key reasons for poor dissemination of renewable energy technologies. In 2014 the Higher Certificate in Renewable Energy Technologies was implemented to address this.

As this was the CUT's first time participating in the solar challenge, a completely new car was designed and built from scratch. This opened the opportunity to really push the envelope in innovation. A different design approach from the normal "wing" car was considered, where solar tracking panels were incorporated. This novel car would give experimental data on the viability of solar tracking with still acceptable aero dynamics.

Unit for Lean Construction and Sustainability (ULCS)

The Unit for Lean Construction and Sustainability (ULCS) is a platform for a significant advance in lean construction and sustainability teaching, learning and research in South Africa. The unit conducted and shared research findings regarding performance improvement, lean construction, health, safety, and well-being, people in construction, and sustainability in 2018. Also, more than 100 general contractors and public sector workers in municipalities in the central region of South Africa were trained in 2018. Training offered included the CETA accredited Certificate in Construction Contracting modules, presented in Welkom. The unit also provided education and training to municipal government employees deployed in the Human Settlement space. Beyond the short courses, the unit hosted the 10th CIDB (Construction Industry Development Board) Postgraduate Conference, the 9th EPPM (Engineering, Production and Project Management) Conference, and the Joint CIB W099 (Safety and Health) and TG59 (People in Construction) Conference in 2018. The unit also hosted Professor Rodrigo Lozano of Gavle University, in September 2018. Prof. Lozano shared contemporary thinking on sustainability with colleagues at CUT, by means of interactive seminars and one-on-one meetings. Prof. Lozano also interacted with a doctoral student and the post-doctoral fellow in the unit (Dr M. Oladokun). Dr S.O. Eromobor graduated from the unit, obtaining a DEng in Civil Engineering and securing NRF funding support for an International Doctoral Candidate for three years. The candidate, Mr N. Geh, is from Ghana and he will commence his studies in CUT in April 2019. Through the Thuthuka NRF funding mechanism, the Unit was able to financially support the master's and doctoral studies of four colleagues in the Department of Built Environment. One of the colleagues, Mr R.B. Ramafalo, completed his MTech in Construction Management studies. The unit also collaborated with the NHBRC and UCT on research endeavours in 2018. The collaboration produced the Royal Society grant awarded to UCT, CUT and Napier University in 2019.

Unit for Research on Informatics for Droughts in Africa (URIDA)

The Unit for Research on Informatics for Droughts in Africa (URIDA) is dedicated to the advancement of scientific research and development of relevant and sustainable tools for predicting Africa's droughts. We adopt an inter-sectoral (meteorological, hydrological, computer science, engineering, health, agriculture and planning) approach to ensure people-centred solutions. In achieving our goals, we mainly make use of the following tools: indigenous knowledge, ICTs (informatics), mobile phones, wireless sensor networks (Internet of Things, Big Data) and artificial intelligence.

In 2018, the URIDA experienced growth and success in the following areas:

External funding: URIDA was successful in its application for Thuthuka funding, under the heading "*Integration of ICTs and Indigenous Knowledge in Realizing a Community-Based Drought Early Warning System for South Africa*". The funds will enable URIDA's project to expand to three provinces: KwaZulu Natal, Limpopo and the Free State. Besides this, more postgraduate students will be trained. Further, during 2018, our external USAID-funded project (to the tune of US$500,000) successfully graduated from Year 1 to Year 2 of the funding. This was after a rigorous audit of our achievement of milestones for the year.

Research outputs: Both the postgraduate students and staff members from URIDA contributed to our 2018 research outputs; these comprised 4 book chapters (recognised by DHET as articles), 1 journal article and 4 publications in conference proceedings.

Postgraduate students: Three (Ms Mpho Mbele, Mr Ahmed Showman and Ms Tanki Moloabi) postgraduates of URIDA completed their master's degrees and one completed her B.Tech (Ms Portia Thothela). Furthermore, four more students joined URIDA: Mr W. Wanjala was approved for PhD studies, while Ms P. Ntho, Mr V. Litabe and Ms V. Njokweni enrolled for and defended their master's research proposals. Through these new students, URIDA's application areas have now grown to include the application of artificial intelligence in climate change adaptation and disease surveillance.

Entrepreneurship and commercialisation: URIDA's flagship project (ITIK) has grown in leaps and bounds and is now a branded commercial product that is impacting on the lives of farmers in three countries. Further growth of ITIKI will continue through our start-up company, URIDA PTY LTD (registration number; *2017 /414568 / 07*) that was created in September 2017. The company has a dynamic website hosted at https://urida.co.za/

Unit for Sustainable Water and Environment (USWE)

During the year 2018, the Unit for Sustainable Water and Environment (USWE) was involved in various activities both nationally and internationally:

- USWE participated in a collaborative university internationalisation programme with the Namibian University of Science and Technology (NUST) and University of Namibia.
- The unit registered as a member of the international network for the UNESCO Chair on Sustainable Water Research for Climate Adaptation in Arid Environment.

- Members of the unit participated in peer review processes for articles in local and international journals.
- The unit participated and members of the unit (Prof. Woyessa and Dr Oke) made two presentations at the South African-Swedish University Forum (SASUF). Prof. Woyessa took part in the SASUF collaborative research project together with Lund University in Sweden – Water Resources Management for Small Catchments under Climate Change and Anthropogenic Pressures Delivering Hope to Disadvantaged Communities (HOPE). Dr Gericke took part in the National Flood Studies Programme: UKZN/SU/University of Bath, UK/Royal Academy of Engineering.
- The unit participated in the 2018 climate change day and two members of the unit (Prof. Woyessa and Dr Oke) gave presentations to climate change committees and workers of the Mangaung Municipality on climate resilience into city plans and budgets.
- In a collaboration between the USWE representing CUT, MerSETA and Department of Higher Education Free State, a member of the unit (Jaco Pietersen) facilitated an AutoCAD (essentials to 3D) training course to high school teachers.
- Members of the unit attended, facilitated or presented at the following: "How to Change the World (HTCTW) workshop" (Mr Ndhlovu and Prof. Woyessa); 2018 Flood Hydrology course in Stellenbosch (Mr Pietersen and Dr Gericke); BRICS-Network University (BRICS-NU) Workshop by the International Thematic Group (ITG) on Water Resources and Pollution Treatment at the Hohai University in Nanjing, China (Prof. Woyessa); signing of a Memorandum of Understanding between the South African Weather Service (SAWS) and the Central University of Technology (CUT) and an industrial visit held at SAWS offices, Pretoria (Mr Ndlovu); signing of an MoU with the Federal University of Rio De Janeiro (UFRJ) and the development of a joint research proposal with UFRJ which was submitted to the BRICS-NU International Governing Body for funding (Prof. Woyessa).
- The USWE through Dr Oke was awarded an amount of R 1.89 million in internship grants by Energy and Water SETA (EWSETA) for training of BSc. Hydrology and Water Management students. Likewise, the USWE secured the approval of a professional body (SACNASP), thereby meeting the full accreditation conditions for the BSHWRM programme.
- An amount of R 255,000 was granted to Dr Gericke by the NRF under the Thuthuka Grant.
- USWE participated and contributed during the ECSA visit for the accreditation of Civil Engineering programmes, April 2018.
- Prof. Woyessa completed a six-month Fulbright Visiting Scholar Programme at the University of Minnesota, USA. Dr Oke went on one-month research visit to the University of Silesia, Katowice Poland.
- Dr Gericke won the Vice-Chancellor's Excellence Award: Early Career Research for 2018. A member of the unit (Mr Ndhlovu) was awarded as the best presenter at the Research Development and Postgraduate Studies, Doctoral Education Summer School.

The following are international and local conferences in which the unit members participated:

- 4th National Conference on Global Change, Polokwane, 3-5 December, 2018.
- 1st Conference of the Arabian Journal of Geosciences (CAJG), Hammamet, Tunisia. Springer. 12-15 November 2018.

- International Conference on New Approaches to Groundwater Vulnerability, Ustron Poland. 4-8 June 2018.
- Water, Food and Health Nexus in BRICS-PLUS: Problems, Progress and Prospects, Bloemfontein, South Africa. 2-5 September 2018.
- 54th Annual International Conference of the Nigerian Mining and Geosciences Society (NMGS), Kano, Nigeria.
- WaterNet Symposium in Livingstone, Zambia

Research Group in Engineering Education (ARGEE)

The Research Group in Engineering Education (ARGEE) in the FEBIT currently has seven active members representing three of the six departments in the faculty. The members of ARGEE continue to seek new ways to improve their teaching practice and enhance student learning. Those who joined ARGEE in 2014 have also been able to increase their publication research outputs, as they continue to report on their teaching practice in the public domain. The overall success of the group is evident in the number of publications (87 to date) which they have produced over a five-year period (2014 – 2019). This encompasses 72 full conference papers and 15 accredited journal articles. This equates to around R5 million in total research output funding from DHET. The average return on investment exceeds 500%. Funding to attend conferences was primarily sourced from the Centre of Innovation in Teaching and Learning (CILT), for which ARGEE is deeply grateful. Research topics for 2018 focused on the use of educational technology (video reports, LMS, clickers, etc.) and reflective practice to improve student engagement and achievement, gamification, assessment of student learning, and the importance of linking learning outcomes to graduate attributes.

Soil Mechanics Research Group (SMRG)

The Soil Mechanics Research Group (SMRG) was started due to the high level of failure in light masonry structures, particularly in government subsidy housing. The overall purpose of the research group is to advance the understanding of expansive clays in all fields of soil mechanics. The aim of this research is to gain an in-depth understanding of the problems which lead to heave failures in large numbers of government subsidy housing developments so that these problems can be solved. The investigation to date has revealed aspects of this problem which have relevance to a wider field than just subsidy housing developments. Cooperation with national and international partners (the University of the Free State, the University of Pretoria, the University of East London, UK, Protsurv and Letaba Lab) has expanded the aim not only to solve expansive clay problems affecting housing developments, but also to solve problems affecting a broad range of other engineering projects as well.

The research conducted during the past 6 years has indicated that for the Free State soils:

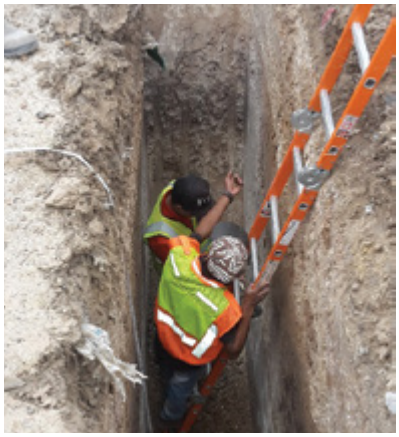
- currently used parameters may not be the best for solving the problem;

- current assessment of clay fraction is seriously flawed. Even if improvements to estimates of the percentage of clay can be found, an assessment (even if only qualitative and approximate), of the types of clay minerals present will be needed for a meaningful assessment of heave potential;
- heave predictions based on measured conditions under real foundations give a better basis for design than current assumptions; and
- variability of material, preparation and testing methods ought to be taken into account. Analysis based on a statistical "reliability analysis" approach, may give more dependable results for the design of foundations on heaving clay. This will most probably be applicable to all problematic/ expansive soil, not only in the Free State.

The highlights for 2018 were:

- one doctoral student graduated in 2018;
- three master's students graduated, all Cum Laude;
- students attended the UNSAT2018 conference in Hong Kong, where three papers and three posters were presented;
- students attended the Out-of-the-Box Conference in Pretoria, presented by the Department of Science and Technology and the Council for Scientific and Industrial Research. The doctoral student was part of the academic panel of above conference;
- The JE Jennings Award was won for the second year in a row. A paper was published in the Geotechnical Engineering Journal (SEAGS and AGSSEA) with the title: *Estimation of the shrink / swell potential and variability of clays by small-scale suction tests*; and
- Prof. E Theron presented a workshop based on shear strength of soil at Humboldt, in Elgin, Illinois, Chicago, USA.

Dr Stott busy with soil suction tests



Students in test pit busy with observations

Community outreach by group to inform learners about ground hazards

Completed master's degrees

Badenhorst, W.S. (2018). *An investigation into current procedures for estimating heave potential of clay.* Central University of Technology, Free State.

Bester, D.M. (2018). *The determination of moisture variation patterns in clay soils under a light structure house.* Cum laude. Central University of Technology, Free State.

Gagblezu, M. (2018). *Sustainable maintenance guidelines of non-toll roads in South Africa.* Cum laude. Central University of Technology, Free State.

Hohne, P.A. (2018). *Optimal energy management of a hybrid solar water heating system with grid connection under time-based pricing.* Cum laude. Central University of Technology, Free State.

Kouprianoff, D. (2018). *Direct Metal Laser Sintering of Titanium Alloys for Biomedical Applications.* Cum laude. Central University of Technology, Free State.

Kukuni, T.G. (2018). *Evaluation of the efficiency of a linear based alternator in a free piston engine configuration.* Central University of Technology, Free State.

Makoana, N.K. (2018). *Investigation on upscaling selective laser melting process parameters using 17-4PH stainless steel powder.* Cum laude. Central University of Technology, Free State.

Masheane, L. (2018). *Polymer heart valve manufacture through dip moulding.* Central University of Technology, Free State.

Moloja, M.D. (2018*). A cloud based intrusion detection and prevention system for mobile voting in South Africa.* Central University of Technology, Free State.

Siecker, J. (2018). *Optimal switching control of flow in PV/T systems with forced circulation.* Cum laude. Central University of Technology, Free State.

Thejane, K.T. (2018). *Characterisation and Monitoring of Ti6Al4V (ELI) powder used for the Qualification of Medical Implants produced through Additive Manufacturing.* Cum laude. Central University of Technology, Free State.

Yaka, A. (2018). *Investigation of recycling perspectives of grey water for resource recovery in Witbank, South Africa.* Cum laude. Central University of Technology, Free State.

Completed doctoral degrees

Combrinck, J. (2018). *Alumide® tooling for limited production plastic injection moulding.* Central University of Technology, Free State.

Dzogbewu, T. (2018). *Direct Metal Laser Sintering of Titanium Alloys for Biomedical Applications.* Central University of Technology, Free State.

Eromobor, S.O. (2018). *Sustainable design of built infrastructure and engineering services for South African Universities.* Central University of Technology, Free State.

Stott, P.R. (2018). *Identification and assessment of problematic expansive soils.* Central University of Technology, Free State.

List of national conference papers

Abejide, O., Adedeji, J. and Hassan, M.M. (2018). *Intelligent Transportation System as an Effective Remedy to Improve the Public Transportation in South Africa.* In Proceedings: 37th Annual Southern African Transport Conference (SATC 2018); pp. 728-741. ISBN: 978-1-920017-89-7.

Adam, I., Du Preez, W.B., Combrinck, J. and Zwemstra, M. (2018). *Conformal cooling channel design for direct metal laser sintering of maraging steel injection mould inserts.* In Proceedings: 19th RAPDASA Annual International Conference, Parktonian Hotel, Johannesburg, 7-9 November 2018, RAPDASA 2018 Conference Proceedings. ISBN: 978-0-620-80987-0.

Akanbi, A.K. and Masinde, M. (2018). *Towards the Development of a Rule-based Drought Early Warning Expert Systems using Indigenous Knowledge.* In Proceedings: 2018 International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD) (pp. 1-8). IEEE. Durban, South Africa. 6-7 August 2018. ISBN: 978-1-5386-9236-3.

Allu, E.L.A. and Emuze, F.A. (2018). *Perceptions of Lean Implementation: A Case Study of a South African Construction Client.* In: Smallwood, J.J. and Emuze, F.A. (eds). In Proceedings: The Construction Industry Development Board (CIDB) 10th Postgraduate Conference, Port Elizabeth, 26-28 February 2018. pp. 315-323. ISBN: 978-1-920508-83-8.

Bambiso, S. and Kusakana, K. (2018). *Life Cycle Cost Comparison between Motors Equipped with Variable Speed Drives and Dampers for Pumps and Fans.* In Proceedings: Power Africa 2018.

Bashingi, N., Hassan, M.M. and Das, D.K. (2018). *Public Transportation and Land Use Impacts on Accessibility for Sustainable Public Transportation System in Bloemfontein.* In Proceedings: 37th Annual Southern African Transport Conference (SATC 2018), pp. 769-780. ISBN Number: 978-1-920017-89-7.

Cogho, M.E., Jacobs, G.G. and Du Preez, J.J. (2018). *Design lessons for additive manufactured small radial flow Ti-6Al-4V turbines for application in organic rankine cycles.* In Proceedings: 19th RAPDASA Annual International Conference, Parktonian Hotel, 7-9 November 2018. ISBN: 978-0-620-80987-0.

Das, D. and Emuze, F. (2018). *A conceptual System Dynamics modelling approach for tackling delays in Indian construction projects.* In Proceedings: 10th CIDB Postgraduate Conference, Port Elizabeth, South Africa, pp. 503-512, ISBN: 978-1-920508-83-8.

Diba, N.M.J, Awuzie, B.O and Aigbavboa, C.O. (2018). *An Assessment of Social Sustainability Considerations during Public Sector Infrastructure Procurement in Free State.* In: Smallwood, J.J. and Emuze, F.A. (eds). In Proceedings: Construction Industry Development Board (CIDB) 10th Postgraduate Conference, Port Elizabeth, 26-28th February 2018. ISBN: 978-1-920508-83-8.

Emuze, F.A., and Mollo, L.G. (2018). *Technical Enablers of Human Errors and Violations in Construction.* In Proceedings: 9th International Conference on Engineering Project and Production Management (EPPM) 24-26 September 2018, Cape Town, South Africa. ISBN: 978-1-9205508-84-5.

Hohne, P.A., Kusakana, K. and Numbi, B.P. (2018). *Operation cost and energy usage minimization of a hybrid solar/electrical water heating system.* In Proceedings: 2018 International Conference on the Domestic Use of Energy (DUE). ISBN: 978-1-5386-6732-3.

Hohne, P.A., Kusakana, K. and Numbi, B.P. (2018) *Optimal Energy Management and Economic analysis of a grid-connected Hybrid Solar Water Heating System in Bloemfontein.* In Proceedings: Power Africa 2018.

Kinnear, W.A., Van der Walt, J.G., Kleinhans, F.A. and Buchanan, T. (2018*). Patient specific dynamic hand splints produced through Selective Laser Sintering.* In Proceedings: 19th RAPDASA Annual International Conference, Parktonian Hotel, Johannesburg, 7-9 November 2018. ISBN: 978-0-620-80987-0.

Kouprianoff, D., Luwes, N, Yadroitsava, I. and Yadroitsev, I. (2018). *Validation of microphone placement for acoustic emission for online detection of porosity forming phenomena during metal laser powder bed fusion.* In Proceedings: 19th RAPDASA Annual International Conference, Parktonian Hotel, Johannesburg, 7-9 November 2018, RAPDASA 2018 Conference Proceedings. ISBN: 978-0-620-80987-0.

Kukuni, T.G. and Kotze, B. (2018) *Evaluation of a linear motor for utilization in a free piston generator*. In Proceedings: SAUPEC 2018.

Kulor, F., Markus, E.D. and Apprey, M.W. (2018). *A Heuristic Approach to Effective Grounding in Africa*. In Proceedings: Domestic Use of Energy (DUE)-International Conference towards Sustainable Energy Solutions for the Developing World, Cape Town, April 2018.

Kusakana, K. (2018). *Prospective energy cost savings in CUT facilities equipped with wall mounted instant water boilers*. In Proceedings: 2018 International Conference on the Domestic Use of Energy (DUE).

Luwes, N. and Van Heerden. (2018). *Student perceptions of a proposed generic e-learning template aligned with the Engineering Council of South Africa accreditations template*. In Proceedings: 4th International Conference on Higher Education Advances 2018.

Mabanza, N. (2018). *Evaluating the Usability of Flat Panel Displays: A Case Study of the Faculty of Engineering and Information Technology*. In Proceedings: International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD 2018), Durban, South Africa, 6-7 August 2018.

Mabanza, N. and De Wet, L. (2018*). Influence of Previous Computer Experience on Adult Learners' Satisfaction Levels with Pedagogical Interface Agents*. In Proceedings: International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD 2018), Durban, South Africa, 6-7 August 2018.

Madikane, W., Emuze, F. and Oladokun, M. (2018). *Barriers to Attaining Quality in Construction: A South African Perspective*. In: Smallwood, J.J. and Emuze, F.A. (eds). In Proceedings: The Construction Industry Development Board (CIDB) 10th Postgraduate Conference, Port Elizabeth, 26-28th February 2018, pp. 111-122. ISBN: 978-1-920508-83-8.

Mafongosi, K.N, Awuzie, B.O and Talukhaba, A. (2018). *Exploring stakeholders' perceptions on the green campus initiative in South African higher education institutions*. In: Smallwood, J.J. and Emuze, F.A. (eds). In Proceedings: The Construction Industry Development Board (CIDB) 10th Postgraduate Conference, Port Elizabeth, 26-28th February 2018. ISBN: 978-1-920508-83-8.

Manditereza, P.T. and Manditereza, B. (2018) *Increased student intake, reduced funding, how should engineering departments react? A case study on the implementation of a remote lab platform*. In Proceedings: 4th South Africa International Conference on Educational Technologies (SAICET), Pretoria, South Africa, 23-25 April 2018.

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Visiting professors

Professor Lukas W. Snyman – Director of the School of Engineering from the College of Science, Engineering and Technology, UNISA

Professor Ashley Ross – Deputy Dean in the Faculty of Health Sciences, DUT

Professor Richard Ray – Department of Structural and Geotechnical Engineering, Széchenyi István University

Professor Dr Ulrich Klauck – Aalen University, Germany

Professor Chris Gorse – Director of Leeds Sustainability Institute, Leeds Beckett University, United Kingdom

Professor Cules van den Heever – Advisor to the SARChI Chair in Medical Product Development through Additive Manufacturing

DISCOVERY

PART #6

Faculty of Health and Environmental Sciences

ETHICS

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 we must do so in a sustainable, ethical, and humane way.

One of the noteworthy achievements of the year under review was the significant increase in postgraduate students and publications in high-impact journals. In fact, the Faculty of Health and Environmental Sciences has the highest number of full-time postgraduate students. We will continue to expand our research enterprise to address our nation's most difficult and pressing technological problems. The goal for all of our research activities is to improve the lives of ordinary people. The challenge is to continue creating an enabling environment that inspires researchers to achieve their ambitions and attracts the most talented academics and scholars. I am certainly proud of our achievements in 2018 and wish to thank all researchers, Assistant Dean (RIE) and staff for their support, dedication and hard work.

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

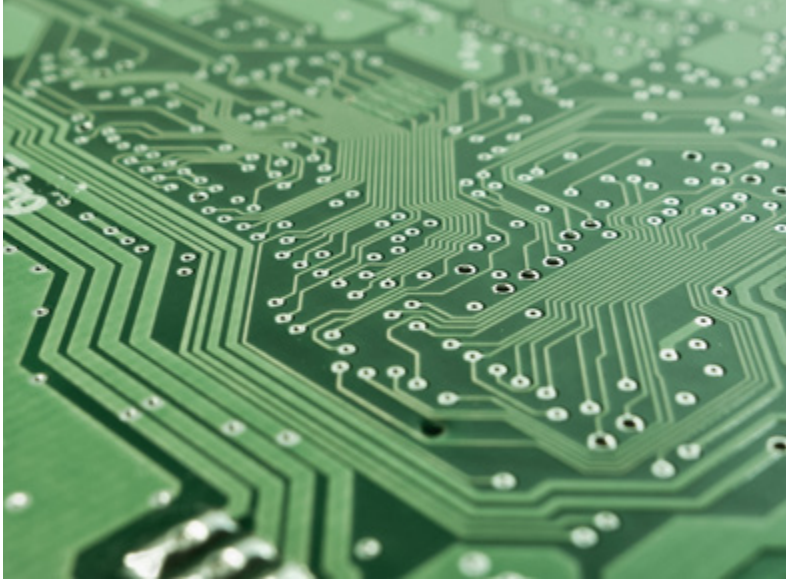
A MESSAGE FROM THE ASSISTANT DEAN

Since the objective of universities of technology is to conduct applied research, it is pleasing to witness that most of the key focus areas of research in the faculty seek to address issues and challenges that affect our communities both directly and indirectly. It is also important to note that some of the research outputs, as contributed by both postgraduate students, academic staff and full-time researchers, were published in high-impact journals. These achievements were made possible mainly by the Unit for Drug Discovery Research led by Prof. S.S. Mashele and the Centre for Applied Food Safety and Biotechnology (CAFSaB) led by Prof. Ryk Lues, and supported by our three postdoc fellows.

The large number of articles published in popular magazines also brings valuable information to the community and industry. It is encouraging to see a growing number of our academics obtaining master's and doctoral degrees, thus enlarging our pool of staff that, potentially, can effectively supervise postgraduate students. We are also elated by the ever-increasing external financial support, mostly from the NRF and DHET, but also a significant contribution by third stream income obtained from industry.

The faculty remains committed to recruiting good quality, innovative students and providing them the best possible learning experience. We ensure quality through vigorous quality control measures within the faculty, warranting that the research produced is not only of good quality but also adheres to high ethical standards and is endorsed by good research conduct. Various staff members and postgraduate students attended local and international conferences where they shared their research findings with peers and created new partnerships with other institutions in line with the university's internationalisation strategy. A renewed effort was also made to promote and stimulate innovation by staff and students and to assist these individuals in registering patents and developing the new products.

Prof. Carlu van der Westhuizen
Assistant Dean: Faculty Health
and Enviromental Sciences



HIGHLIGHTS REGARDING RESEARCH AND INNOVATION IN THE FHES DURING 2018 WERE THE FOLLOWING:

There were 185 registered postgraduate students in the FHES in 2018, consisting of 53 doctorate students and 132 master's students. Most of these students received financial support from the CUT and other sources, mainly the NRF. An overview of funding received by staff and students is the following:

Other 3rd stream income to the value of R2 677 521,66 was generated by the faculty. This brings the total amount of funding generated by the Faculty of Health and Environmental Sciences to R18,7m.

There was a vast increase in graduate numbers during the March and September ceremonies, where 8 doctorates and 11 master's degrees were awarded.

Papers and posters were presented by 18 staff members at local and international conferences and workshops.

A total of 22 articles were published in accredited scientific journals, while another 5 were accepted but not yet published, totalling 27 – a marked improvement on the past.

The faculty has 3 post-doctoral fellows who are actively involved in research.

Staff continue to improve their formal qualifications and skills in that 21 staff members are currently enrolled for a master's degree, 11 for doctoral degrees and 2 for postgraduate diplomas. Dr Jane Nkhebenyane graduated with a PhD in Environmental Health during the spring graduations in 2018, while Ms C Viljoen received a master's degree in Law at the UFS. Dr Malebo obtained a postgraduate diploma in Higher Education for Academic Developers in April 2018.

Several innovation activities were initiated and attended by staff and students. Prof. JFR Lues, our Faculty's NRF-rated researcher, also leads the CUT's Task Team on Innovation and Engagement.

The FHES successfully presented a Public Lecture on 29 October 2018, during which Dr Adriana Marais, a theoretical physicist and aspiring extra-terrestrial, made a presentation entitled "*Africa Defining its Own Path Amidst the 4th Industrial Revolution*".

The annual Prestige Research Day was hosted on 30 October 2018, and 30 students and staff members made public presentations. The keynote speech was presented by Prof. S. Nemutandani on the topic "*National Health Insurance: Implications on medical aids and healthcare in South Africa*".

The faculty is in the process of restructuring its current research centres and units. URIC has approved the following 2 centres where most staff could be involved:

- The Centre for Applied Food Security and Biotechnology (CAFSaB), which is headed by Prof. J.F.R. Lues, with its main objective:
  - To ensure sustainable, safe and nutritious food sources.
- The Centre on Quality of Health and Living (instituted as from 2018 and incorporating the current Unit for Drug Discovery) headed by Prof. S.S. Mashele with the following main objectives:
  - The development of biological substitute tissue for cardiovascular use that has the potential to recellularise *in vivo*.
  - To understand the causal mechanisms of diseases, prevention and promotion of health and wellness at population, community and individual levels.
  - To perform epidemiological studies to determine the burden of disease of various cardiovascular diseases in Central South Africa (e.g. heart failure, cardiomyopathy, infective endocarditis, rheumatic heart disease, coronary artery disease).
  - To develop partnerships with government, communities and with other research institutions, both nationally and internationally, in Drug Discovery Research.
  - To shape government policies on research and training in drug development, through research.

The performance of the faculty with respect to research and innovation has been remarkable, given the heavy workload of staff and the limited available resources. Appreciation is due to all staff members for their major inputs, as well as congratulations on the numerous outputs generated. A special word of thanks must also go to the members of FRIC for the major role that they play in enhancing and managing research in the faculty. It is an honour to be part of this team!

This report represents the culmination of many hours of hard work by staff and we would like to acknowledge everyone in the Faculty of Health and Environmental Sciences who has contributed to the faculty achievements and to encourage others to learn from these achievements.

CENTRE FOR APPLIED FOOD SECURITY AND BIOTECHNOLOGY

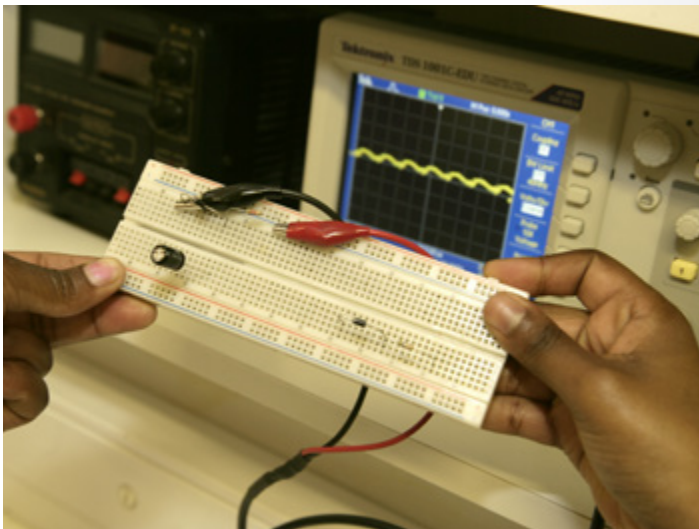
The centre has made significant progress and has, amongst other things, participated in the repositioning process of research entities at the CUT. This process is nearing completion and has seen the addition of certain aspects of waste and agricultural sciences. Also, the centre has seen significant progress in concluding master's and doctoral projects for submission in 2018. In terms of infrastructure, the product development laboratory negotiated the start of construction in 2018, while the repurposing of facilities in the dungeon (cellar) were ongoing. The centre initiated the beer and food pairing event in collaboration with the CUT hotel school, RIFFS and FEIT. The postgraduate student cohort of the centre expanded considerably, with 14 students joining the centre in 2018. Various members of the group (staff and students) were successful in securing external grants from Thuthuka, KIC, DHET, Erasmus Mundus, MSU, Marler-Clark, SETAS and FoodFocus, amongst others. The subjects Research Methodology and Food Hygiene 4 were coordinated in full by the centre, and the additional group in EH from KZN was accommodated. An AA and HPLC were allocated to the centre under the CUT capital grant budget.

During the 3rd quarter, the centre saw significant progress in concluding master's and doctoral projects, with a number of graduates completing in time for the fall graduation ceremony. The beer and food pairing affair in collaboration with the CUT hotel school and FEIT event was completed successfully with very positive feedback received from guests and stakeholders. Ms Manneheng Raphuthing was recruited to join the centre as technical assistant while various members of the group conducted local and international travel visits and attended conferences.

Strategic initiatives, awards, achievements, collaborations and commercialisation activities of CAFSaB during 2018 were the following:

- The centre held a number of strategic events for 2018 in addition to the beer and food affair held toward the end of semester 1. These included participating in a publication writing retreat, participating in the 11th Intervarsity craft beer competition and participating actively in Free State Regional Research collegium.
- The centre, with guidance and support from Drs Lewtak and Swanepoel, and the student team received the award for the best people's choice product from SAB-InBev.
- Prof. Lues presented an online course in GMOs at the University of Michigan, USA.
- Ms Precious Tsolo was awarded a R20000.00 travel grant from SAAFoST to present a paper at the IUFoST conference in India during October 2018.
- Dr Manduna was awarded an NRF Knowledge Interchange and Collaboration travel grant to attend a conference.
- Prof. Lues attended a training course on food handler behaviours and corporate governance at Michigan State University.
- The Centre presented, in collaboration with the CUT hotel school, a very successful beer and food affair event.

- Ms Nkhebenyane received her PhD qualification and conducted a US study visit while attending the IAFP conference in Washington, USA.
- Dr Nkhebenyane received student bursaries to the amount of R600k from the EWSeta.
- Dr Conradie conducted a study visit to China.
- Ms Lerato Mogotsi secured a Thuthuka grant as well as an Erasmus Mundus scholarship to Montpelier in France.
- Ms Elvina Smith conducted a visit and empirical study at the University of Mauritius and has submitted about 50% of her narratives.
- Dr Lewtak was selected as one of 35 applicants from 750 submissions and 94 countries to participate in the Global Entrepreneurship Summer School at the University of Monterrey, Mexico City. The selection is accompanied by a R10000.00 sponsorship.
- Dr Swanepoel acted as external examiner for a PhD at Wits University, Serena Moodley.
- Dr De Smidt was appointed as external examiner for an MSc. thesis (UFS).
- Dr De Smidt reviewed manuscripts for the Journal of Food Science.
- Dr De Smidt was appointed as external examiner for a BSc. Honours course in Biotechnology at the Rhodes University Biotechnology and Innovation Centre (RUBIC)
- Dr Manduna attended a workshop to Review the NRF KIC and Conference Fund Call documents.
- Dr Lewtak served as member of the NRF Advisory Panel on Thuthuka grant evaluations.
- Various members participated in expert panels for the NRF and other funding agency award assessments.
- Dr Manduna attended a Writing for Publication Workshop and Retreat hosted by the Department of Clinical Sciences, FHES, Central University of Technology (26-28 March 2018) and thereafter submitted a manuscript to Economic Botany.
- Dr Manduna examined an MSc. dissertation for the Plant Sciences Department, University of the Free State.
- Dr Malebo graduated with distinction from Rhodes University in the Advanced Diploma Higher Education Management.



- Prof. Lues was appointed by the US Legal Firm Marler-Clark as coordinator of the SA Advisory Team to the victims' class action in the SA Listeria Outbreak.
- Prof. Lues and Dr De Smidt visited the Saldanha Mussel Farming Association toward initiating a THRIP project in collaboration with CPUT, DAFF and industry.
- Prof. Lues was approached by the firm Holanathi to assist with product development and product endorsement, amongst other things.

EXPERIMENTAL AGRICULTURAL FARM

The Department of Agriculture within the Faculty of Health and Environmental Sciences was assisted to purchase a small farm nearby Bloemfontein. This production unit is used for training of students and also for research purposes. The available infrastructure and resources allow staff and postgraduate students to run long-term research projects. A multi-disciplinary approach is being followed, according to which other departments will also be involved on the farm, e.g. engineering students are assisting in developing monitoring equipment for water levels in boreholes, reservoirs and in the soil profile in different fields. Many innovative projects have also been lined up, one example of which is the processing of prickly pears.

Staff of the Department of Agriculture attending to the prickly pear plantation on the CUT experimental farm.

The Advisory Committee of the Department of Agriculture observing some of the animals on the CUT experimental farm. Several research projects will be implemented on this farm.

The CUT farm provided excellent opportunities for the presenting of practicals during 2018. The following activities took place during the year:

- Several students are completing their WIL (Work Integrated Learning) on the farm. WIL student Mr Bezewel Mbengwani (student number 217009946) did his WIL on the farm from February 2018.

- Pecan nuts, prickly pears, spinach, red onions, pumpkins, maize and teff were planted.
- The farmhouse has been fully renovated and houses WIL students.
- Several tractors, farming implements and other equipment were purchased and used for farming activities and student training.
- Several pumps, a water pipe network and water troughs were installed. Electrical upgrades were also done to the water pumping facility.
- A sheep shearing day was held on 2 August 2018 for Agriculture students, where the students had the opportunity to shear sheep themselves. Wool classing was also part of the programme. In addition, several other livestock practicals were also conducted on the farm.
- Sheep and cattle were raised on the farm and marketed for 3rd stream income.
- Students calculated the financial feasibility of each activity.

INDIGENOUS KNOWLEDGE SYSTEMS RESEARCH: APPLICATION OF AN ECO-STORE MODEL BASED ON BASOTHO INDIGENOUS PLANT KNOWLEDGE

The research team consist of Dr I.T. Manduna (principal investigator), Ntate T. Ntjane (traditional healer and co-investigator), Ms Mofammere (traditional healer and co-investigator) and Mr L.J. Kobo (farmer and co-investigator).Through a multilateral and multidisciplinary partnership between academics and various indigenous knowledge practitioners, this project aims to establish a replicable biocultural eco-store model based on indigenous plant knowledge of the Basotho people of the Free State, South Africa. Rather than merely integrating knowledge systems, the eco-store model builds a synergy and complementary relationship between indigenous knowledge (IK) and modern science. The pilot products of this eco-store model are mainly traditional healing plants. Indigenous vegetables, because of their multifunctional characteristics, are also kept.

Several activities have been carried out towards the establishment of the eco-store. Ethnobotanical surveys done in the study area have allowed the documentation of several plants that are used routinely by traditional healers in their practice. This information is being compiled in a catalogue that will be published in Sesotho to ensure accessibility to the people who use these plant resources.

Workshops were held with students and staff of the CUT and traditional healers of the Kopanang Dingaka Association of Thaba 'Nchu, to give examples of beneficiation through the production of tinctures and bath salts from medicinal plants. This is important as beneficiation helps to keep

Ntate Kobo presenting on the economic benefits of indigenous plant knowledge to students and staff at the Product Development Workshop Part 1.

medicinal plants relevant for contemporary life and can promote income generation from traditional medical practice. The workshop also emphasised important issues such as the maintenance of good hygiene, use of consistent measurements, and also good plant collection practices. The eco-store will source some products from the traditional healers.

A number of postgraduate students are involved in the study. Students have projects that evaluate the bioactivity of the plants and their potential in:

- drug development as antimicrobials etc. for human and veterinary applications,
- development of biopesticides, and
- development of new phyto-preservatives for food (e.g. fruit juices).

Other student projects investigate preservation methods for indigenous vegetables and their safety. The students were also involved in tincture and bath salts making.

Picture of a tincture made from a medicinal plant named khoara (Pelargonium sp.)

Pictures of bath salts made from Eucalyptus oil and Maringa (tropical plant used to enhance the colour and antioxidant properties of the salt)

Left: Pictures of bath salts made from Eucalyptus oil and Maringa (tropical plant used to enhance the colour and antioxidant properties of the salt)

Right: Picture of a tincture made from a medicinal plant named khoara (Pelagonium sp.)

RESEARCH REPORT: DR O. DE SMIDT - FOOD INDUSTRY EFFLUENT CHARACTERISATION

Dr De Smidt has been active in the Centre for Applied Food Security and Biotechnology (CAFSaB) as a contract researcher since 2011. She conceptualised and spearheads the "Food industry effluent characterisation" research initiative. This focus area has three core interests: effluent traceability (or source tracking), exploring bioremediation opportunities and indigenous microbial consortia application for treatment of food industry effluents and establishing a microbial culture collection from different effluents. The research team consists of postgraduate students and academic collaborators, as well as partners from local industries.

Projects require extensive research operations both in the field and in the laboratory. To date, Dr De Smidt and her team have demonstrated the usefulness of microbial diversity as fingerprints for poultry abattoir effluent and traceability of effluents to the recipient wastewater treatment works when using denaturing gradient gel electrophoresis (DGGE) as fingerprinting tool. Successful lowering of contaminant levels in red meat abattoir effluent has been demonstrated when treated in sequencing batch reactors (SBRs) custom designed for the project. Furthermore, the microbial culture collection is expanding rapidly and contains over 1 000 bacterial and yeast isolates from the effluents of various food industries including beverage manufacturers and abattoirs.

Other projects that Dr De Smidt is actively involved in include bioaerosols in the food industry environment, yeast diversity and associated antimicrobial resistance in beverage production facilities and antimicrobial properties of metal alloys used for printing medical implants.

Dr De Smidt received funding for 2017 from the NRF under the Thuthuka instrument. Two postgraduate students received research travel grants from Whitehead Scientific and TestIt LAB to attend an international conference.

OPTIMAX SUMMER SCHOOL

From 23 July to 17 August 2018, two of the final year radiography students, Mr MacDonald Molehe and Ms Jana Kotze, attended the Optimax Summer School in Dublin, Ireland, where they collaborated on research activities with students from a variety of other universities. Mr Molehe presented the research he engaged in at the Summer School this year at the European Society of Radiology conference in Vienna, Austria.

In the picture from left are Ms Martina Moss (international office), Mrs Ida-K Sebelego, Mr McDonald Molehe and Prof. Hesta Friedrich-Nel

HUMAN CAPACITY DEVELOPMENT

Dr De Smidt hosted four NRF final year student assistants from the Environmental Health programme who were involved in the food industry effluent characterisation focus area. Three postgraduate students were given the opportunity to present their research at the 4th International Conference on Microbial Diversity held in Bari, Italy during October.

Ms KM Corbett completed her research on yeast diversity and rapid detection of spoiler yeasts in a beverage production facility and was awarded a master's degree in Health Sciences in Environmental Health (*cum laude*).

Dr De Smidt collaborated with researchers from the University of the Free State, Stellenbosch University, Cape Peninsula University of Technology and the University of Ljubljana. Several partners from local food industries also participated in food industry effluent characterisation research projects. Dr De Smidt has a shared equipment agreement with Van Rensburg-Lancet Pathologists. They are currently the only private sector laboratory in the Free State that owns and operates a matrix-assisted laser desorption/ionization-time of flight mass spectrometer (MALDI-TOF MS) with both a clinically relevant (IVD) and environmental isolate database (SARAMIS RUO) exclusively used for rapid microbial identification.

Inter-institutional collaboration included partnerships with Dr L. Esterhuizen (Life Sciences), Dr N. Luwes (Electrical Engineering) and Prof. I. Yadroitsau (SARChi research chair – CRPM).

4th International Conference on Microbial Diversity held in Bari, Italy. Attended by Francois le Roux, Olga de Smidt, Morakane Keswa, Leana Esterhuizen and Edrick van der Merwe. Edrick and Morakane participated in the student research poster competition.

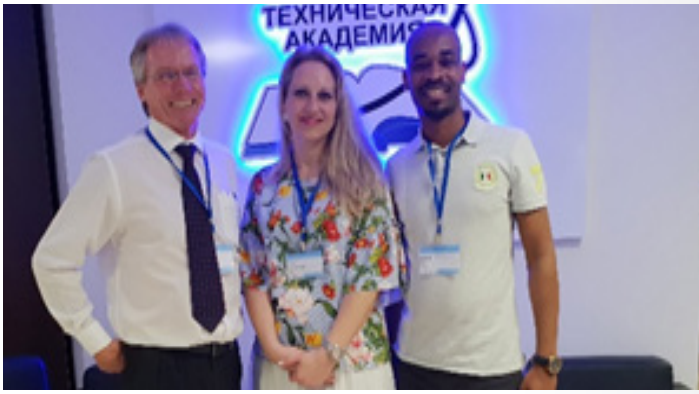
In the picture are the staff members from the DoCS with Dr Andersson sitting on the right.

APPOINTMENT OF A VISITING SCIENTIST

The appointment of Dr Bodil Andersson as a visiting scientist in the FHES was approved at the senate meeting in November 2018. Dr Bodil visited the Department of Clinical Science in January 2019 to present a workshop on peer-assisted learning and to discuss the way forward regarding research collaboration between the department and the faculty for future.

INTERNATIONAL SUMMER SCHOOL ON RADIOCHEMISTRY

Dr Je'nine Horn-Lodewyk and Mr Nape Phahlamohlaka received a ROSATOM grant and attended the International Summer School on Radiochemistry in Moscow, Russia from 23 July to 03 August 2018, where they engaged with participants from many countries about capacity building and international collaboration in research activities.



NRF FAMELAB COMPETITION

As a FameLab finalist in 2018, Ms Sylvia Mokuoane was invited to spend a day at the NRF's Research and Innovation Support and Advancement (RISA) offices on 7 August 2018, where she had the opportunity to interact with staff and give a 3-minute presentation on a science communication topic of her choice.

Ms Sylvia Mokuoane is third from the left in the picture.

SASUF COLLABORATION

From 15 to 17 May, Prof. Hesta Friedrich-Nel, Dr Jeanette du Plessis and Dr Malebo Ntsoaki participated in the Swedish Research Collaboration on the CUT campus and at the University of Pretoria.

PROPOSAL AND ARTICLE WRITING WORKSHOPS

Staff from the FHES were invited to attend two sessions of a proposal and article writing initiative organised by the Department of Clinical Science. The two sessions took place in May and September respectively. Flowing from this initiative, staff members in the Department of Clinical Science published six articles, and four master's students who worked on their proposals at the sessions, will register in 2019.

ACTION RESEARCH PROJECT APPROVED FOR DEPARTMENT OF CLINICAL SCIENCE

A proposal for an action research project in the Department of Clinical Science on peer-assisted learning was approved institutionally and at the Health Science Research Ethics Committee of the UFS. The implementation of the project is focused on enhancing student success in the radiography programme.

PRESIDENTIAL HEALTH SUMMIT

On 18 and 19 October 2018 Prof. Hesta Friedrich-Nel attended the Presidential Health Summit in Johannesburg. Among the VIP guests was the Honourable Minister of Higher Education, Dr Naledi Pandor.

Hounarable Minister of Higher Education, Dr Naledi Pandor and Prof. Hesta Friedrich-Nel.

Completed doctoral degrees

Bamal, H. (2018). *Phylogenetic, structural and functional analysis of cytochrome P450 monooxygenase CYP5619A1 from Saprolegnia declina*. Central University of Technology, Free State.

Fadeyi, O. (2018). *Sectoral impacts of global financial crisis and high food prices. A Computable General Equilibrium (CGE) analysis for South African agriculture*. Central University of Technology, Free State.

Igene L. (2018). *Innovative methods for identifying training needs of Shea butter processors in North Central Agro-ecological zone of Nigeria*. Central University of Technology, Free State.

Nkhebenyane, S.J. (2018). *Food hygiene risks and related practices in central South Africa HIV/AIDS hospices: A qualitative assessment*. Central University of Technology, Free State.

Nwafor, I.C. (2018). *Development of an effective feeding regimen using dry chicory (Cichorium intybus) roots to eradicate zoonotic helminths in pigs*. Central University of Technology, Free State.

Nwigwe, C.S. (2018). *Root-enhancing properties of rhizopheric bacteria on Eucalyptys hybrid cuttings*. Central University of Technology, Free State.

Parvez, M. (2018). *Cytochrome P450 monooxygenase analysis in the genus Mycobacterium: Special focus on CYP123*. Central University of Technology, Free State.

Completed master's degrees:

Adukpo, D.L. (2018). *Designing a strategy for construction of human P450 expression library in Escherichia coli*. Central University of Technology, Free State.

Katikati, A. (2018). *Assessment of production practices of emerging cattle farmers in selected districts of the Eastern Cape Province, South Africa*. Central University of Technology, Free State.

Makhanya, L.G. (2018). *Phenotypic and reproductive characterisation of Kolbroek pig*. Central University of Technology, Free State.

Matowane, R.G. (2018). *P450s of skin infectious fungus Sporothrix schenckii: In silico characterisation of azole drug target P450 CYP51*. Central University of Technology, Free State.

Perkins, J.J. (2018). *Evaluation of accurate tidal volume as displayed on the Avea ventilator using predetermined neonatal ventilator settings*. Central University of Technology, Free State.

Pretorius, F.J. (2018). *Impact of peak intraoperative lactate levels on post-operative outcomes in congenital cardiac surgery*. Central University of Technology, Free State.

Richards, M.T. (2018). *Analysis of cytochrome P450 monooxygenases and their redox partner ratios in the genus Mycobacterium*. Central University of Technology, Free State.

Senyatsi, K.L. (2018). *A descriptive analysis of smallholder pig production in KwaZulu-Natal Province, Republic of South Africa*. Central University of Technology, Free State.

Thompson-Jooste, L. (2018). *Comparison of heart valve flow dynamic assessment between echocardiography and pulse duplication*. Central University of Technology, Free State.

Van Wyk, R. (2018). *In silico analysis of cholesterol catabolic genes/proteins in the genus Mycobacterium*. Central University of Technology, Free State.

List of conference posters

Nthabiseng[a], C., Seopa[a], M., Mashele[a], S.S., Salunke[b], D., Kulkarni[c], C., Taylor[d] , G. and Kendrekar, P.S. (2018). *Pharmacokinetic Evaluation of a Novel Synthetic Anti-malarial Compound.* Poster presentation at 6th Asian Network for Natural & Unnatural Materials 27-28 July 2018, Gifu, Japan.

Tonyane, A.A., Van der Westhuizen, R. and Van der Westhuizen, C. (2018). *Small holder climate-smart Agriculture in the Northern Cape Province of South Africa.* Poster presented at the SASAE Conference, East London, 5-7 June 2018.

Khetsha, Z.P. (2018). *Effects of abscisic acid and methyl jasmonate on the recovery of hail damaged rose geranium (Pelargonium graveolens L.) plant.* Poster presented at 30th International Horticultural Congress, 12-16 August 2018, Istanbul, Turkey.

List of conference papers

Friedrich-Nel, H. and Dhunpath, R. (2018). *Towards a radiography curriculum framework: Deconstructing and reconstructing knowledge, competencies and attributes.* In Proceedings: SAAHE, 28-30 June 2018. Gateway Hotel, Durban.

Friedrich-Nel, H. and Munro, L. (2018). *Ethics presentations at CPD events: do we care about the patient?* In Proceedings: 19th ISRRT Conference, 12-15 April 2018. Hyatt Regency hotel, Trinidad and Tobago.

Kujane, K., Mofokeng, A. and Sedibe, M.M. (2018). *Diversity analysis of soybean (Glycine max) genotypes using simple sequence repeat markers.* In Proceedings: All African Combined Congress, 18-19 January 2018, Cape Town, RSA.

Magunga, B.T. and Malebo, N.J. (2018). *Thyme oil and Thyme oil hydrosol coating as alternative to synthetic fungicides against Phyllosticta citricarpa post-harvest.* In Proceedings: The International Food Association for Food Protection Conference in Salt Lake, Utah, 8-11 July 2018.

Muller, H. (2018). *Sink or Swim? A novice lecturer's experience.* In Proceedings: SAAHE, 28-30 June 2018. Gateway Hotel, Durban.

Nhabe, B. and Malebo, N.J. 2018. *Antimicrobial properties of Artemisia afra against bacteria isolated from bulk tank milk.* In Proceedings: International Food Association for Food Protection Conference in Salt Lake, Utah, 8-11 July 2018.

Nkhebenyane, S.J. (2018). *The composition of an intervention programme based on the World Health Organization's five keys to safer foods and the assessment of hospice food preparation surface cleanliness.* In Proceedings: International Food Association for Food Protection Conference in Salt Lake, Utah, 8-11 July 2018.

Nthabisenga, P.K.C., Seopaa, M., Mashele, S.S. and Kendrekar, P.S. (2018). *A Pharmacokinetic Evaluation of a Novel Synthetic Anti-malarial Compound.* In Proceedings: 18th World Congress of Basic and Clinical Pharmacology (WCP2018) held at Kyoto, Japan.

Phahlamohlaka, M. (2018). *Simulated Based Education in Radiation Therapy.* In Proceedings: SORSA, 19 May 2018.

Sebelego, I-K. (2018). *Clinical role-play videos as a supporting tool for conventional teaching and learning strategies in the Radiography programme.* In Proceedings: SAAHE, 28-30 June 2018. Gateway Hotel, Durban.

Setlhare, G.G., Nkhebenyane, S.J. and Malebo, N.J. (2018). *Effect of Thymus vulgaris essential oil on the fatty acid profile of the antibiotic resistant Bacillus cereus cell membrane.* In Proceedings: International Food Association for Food Protection Conference in Salt Lake Utah 8-11 July 2018.

Slabbert, R. and Du Plessis, J. (2018). *An introduction to peer-assisted learning to enhance student performance in Health Professions education.* In Proceedings: 5th Innovation in Learning and Teaching conference. 14 to 15 June 2018. Central University of Technology, Free State.

Slabbert, R. (2018). *Peer-assisted learning as an academic advising tool for ECP Health students.* In Proceedings: SAAHE, 28-30 June 2018. Gateway Hotel, Durban.

Van Der Merwe, B. (2018). *Social learning with a mobile phone.* In Proceedings: 5th Innovation in Learning and Teaching conference. 14 to 15 June 2018. Central university of Technology, Free State.

List of journals/articles (DHET subsidised)

Bamal, H.D., Chen, W., Mashele, S.S., Nelson, D.R., Kappo, A.P., Mosa, R.A., Yu, J., Tuszynski, J.A. and Syed, K. (2018). Comparative analyses and structural insights of the novel cytochrome P450 fusion protein family CYP5619 in Oomycetes. *Scientific Reports,* 8:6597, pp. 1-11 | DOI:10.1038/s41598-018-25044-0.

Belle, G., Fossey, A. and Esterhuizen, L. (2018). Use of multiple indicators to assess the pollution condition of urban streams: A case study of Bloemspruit, Free State Province, South Africa. *Water and Environment Journal*, 2018: 1-13 CIWEM, doi:10.1111/wej.12444.

Bester, D., Botes, L., Van den Heever, J.J., Kotze, H., Dohmen, P., Pomar, J.L. and Smit, F.E. (2018). Cadaver donation: structural integrity of pulmonary homografts harvested 48 h post mortem in the juvenile ovine model. *Cell Tissue Bank*, 2018 Dec; 19(4): 743-754 (Online). https://doi.org/10.1007/s10561-018-9729-7(0123456789().,-volV()0123456789().,-volV).

Du Plessis, J. (2018). Stakeholders' viewpoints on work-integrated learning practices in radiography training in South Africa: towards improvement of practice. *Radiography, 25 (2019) 16-23.* DOI:10.1016/j.radi.2018.06.011. (Available online since 21 July 2018).

Foster, L.A., Fourie, P.J. and Neser, F.W.C. (2018). Production parameters of a beef herd on transitional *Cymbopogon-Themeda* veld, receiving three different levels of lick supplementation. *SA J. Anim. Sci.,* Vol 48 (no2), P213-221, ISSN 0375-1589. http://dx.doi.org/10.4314/sajas.v48i2.2.

Fourie, P.J., Mahlako, S.R. and Van der Westhuizen, C. (2018). Assessment of the management practices of emerging sheep production systems in the Eastern Free State: can the extensionist make a difference? *S. Afr. J. Agric. Ext.,* Vol. 46, No. 2, 57-68. DOI: http://dx.doi.org/10.17159/2413-3221/2018/v46n2a463 (License: CC BY 4.0).

Friedrich-Nel, H., Van der Merwe, B. and Kotzé, B. (2018). Neonatal chest image quality addressed through training to enhance radiographer awareness. *Health SA Gesondheid*, 23(0), a1067. http://doi.org/10.4102/hsag.v23i0.10. ISSN: (Online) 2071-9736, (Print) 1025-9848.

Fuku S. and Mashele, S. (2018). The antibacterial and antioxidative stress activities and characterisation of *Asparagus laricinus* aqueous extract. *Medical Technology SA*, Vol. 32, No. 2, December 2018, pp. 44-48.

Hooper, R.W., Zhanga, J.A., Koszelewski, D., Lewtak, J.P., Koszarna, B., Levy, C.J., Gryko, J.T. and Stillman, M.J. (2018). Differential quenching of the angular momentum of the B and Q bands of a porphyrin as a result of extended ring π-conjugation. *Journal of Porphyrins and Phthalocyanines*, 22: 1111-1128. DOI: 10.1142/S1088424618501110.

Igene, L., Sedibe, M.M., Solomon O. and Van der Westhuizen, C. (2018). Processors preference and effectiveness of extension teaching methods used by raw material research development council for dissemination of shea butter processing technologies in Moro local government area of Kwara State Nigeria. *South African Journal of Agricultural Extension*, Vol. 46, No. 2, 2018: 36-44. http://dx.doi.org/10.17159/2413-3221/2018/v46n2a461.

Igene, L., Sedibe, M.M., Solomon O. and Van der Westhuizen, C. (2018). Constraints hindering processors' effective access to training programmes on modern shea butter processing in Niger State Nigeria. *South African Journal of Agricultural Extension*, Vol. 46, No. 1, 2018: 26-33. http://dx.doi.org/10.17159/2413-3221/2018/v46n1a420.

Jansen, K.E., Kocks, D.J. and Roberts, H. (2018). Hazardous waste management solutions in South Africa – still a challenge. *Occupational Health Southern Africa,* Vol. 24 (4). pp. 105-106.

Kotzé, B., Friedrich-Nel, H. and Van der Merwe, B. (2018). An instrument to access neonatal chest image quality. *Journal for New Generation Sciences*. Vol. 16 (2) pp. 47-58.

Matowane, R.G., Wieteska, L., Bamal, H.D., Kgosiemang, I.K.R., Van Wyk, R., Manume, N.A., Abdalla, S.M.H., Mashele, S.S., Gront, D. and Syed, K. (2018). In silico analysis of cytochrome P450 monooxygenases in chronic granulomatous infectious fungus *Sporothrix schenckii*: Special focus on CYP51. *BBA - Proteins and Proteomics,* 1866 pp. 166-77. https://doi.org/10.1016/j.bbapap.2017.10.003.

Mokhena, T.C., Sefadi, J.S., Sadiku, E.R., John, M.J., Mochane, M.J. and Mtibe, A. (2018). Thermoplastic Processing of PLA/Cellulose Nanomaterials Composites. *Polymers (MDPI)*, 10 (12). https://doi.org/10.3390/polym10121363.

Mugomeri, E., Olivier, D. and Van den Heever, W.M.J. (2018). Health system challenges affecting the implementation of isoniazid preventive therapy in people living with HIV in Lesotho. *HIV & AIDS Review*, Vol. 17, No. 4, pp. 65-73. https://doi.org/10.5114/hivar.2018.80263.

Mugomeri, E., Olivier, D. and Van den Heever, W.M.J. (2018). The Effect of Isoniazid Preventive Therapy on the Occurrence of Tuberculosis in Lesotho, Southern Africa. *Medical Technology SA*, Vol. 32, No. 2, December 2018, pp. 34-45.

Ogundeji, O.A., Porotloane, B.F., Pohl, C.L., Kendrekar, P.S. and Sebolai, O.M. (2018). Copper Acyl Salicylate has Potential as an Anticryptococcus Anti-Fungal Agent. *Antimicrobial agents and chemotherapy*, Vol 62(8) pp. 1-11. https://doi.org/10 .1128/AAC.02345-17.

Phahlamohlaka, M.N., Mdletshe, S. and Lawrence, H. (2018). Psychosexual experiences of men following radiotherapy for prostate cancer in Johannesburg, South Africa, *Health SA Gesondheid* 23(0), A1057 pp. 1-6. https://doi.org/10.4102/hsag.v23i0.1057.

Polori, K.L., Mashele, S.S., Madamombe-Manduna, I. and Semenya, S.S. (2018). Ethno-medical Botany and Some Biological Activities of *Ipomoea oblongata* collected in the Free State Province, South Africa. *J. Biol. Sci.*, 18 (8): 441-449. DOI: 10.3923/jbs.2018.441.449.

Pretorius, R.J., Hein, G.L., Blankenship, E.E., Purington, F.F., Wilson, R.G. and Bradshaw, J.D. (2018). Comparing the effects of two tillage operations on beneficial epigeal arthropod communities and their associated ecosystem services in sugar beets. *Journal of Economic Entomology,* 111(6): 2617-2631. https://doi.org/10.1093/jee/toy285.

Rathebe, P.C., Weyers, C. and Raphela, S.F. (2018). Exposure levels of ELF magnetic fields in the residential areas of Mangaung Metropolitan Municipality. *Environmental Monitoring and Assessment*, 190: 544. https://doi.org/10.1007/s1066-018-6916-8.

List of journals/articles (not DHET subsidised)

Bhosale, H.D., Shisodia, S.U., Ingle, R.D., Kendrekar, P.S., Shisodia, A.U. and Kótai, L. (2018). An Expeditious and Green Approach for the Synthesis of 2-Amino-4h-Chromenes using a Catalyst of Natural Origin. *European Chemical Bulletin*, 7 (3), 120-122.

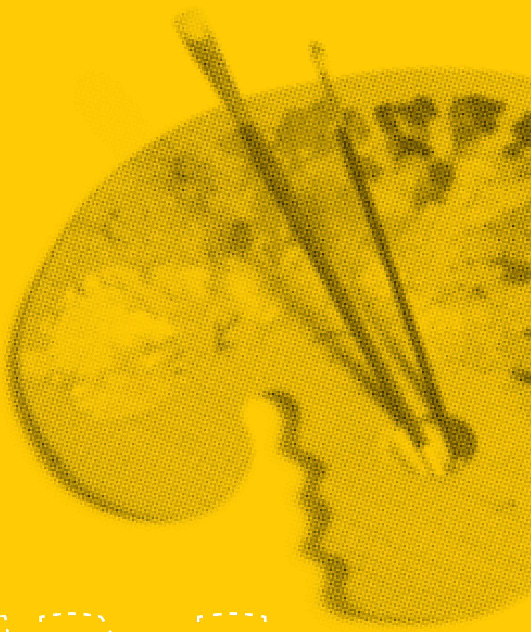
Khandare, K.P.S., Ingle, R.D., Tekale, S.U., Jadhav, A.S., Mashele, S.S. and Kendrekar, P.S. (2018). Green Synthesis of Pyran Derivatives Using Lemon Peel Powder as a Natural Catalyst and their Antimicrobial Activity. *SF Journal of Pharmaceutical and Analytical Chemistry,* 1 (1), 1-3.

Nwafor, I.C., Roberts, H. and Fourie, P.J. (2018). Porcine helminthiasis and the prevalent farm management operations among smallholder pig farmers in the Free State Province of South Africa. Paper accepted for the 32nd Conference of the Australian Society of Animal Production. Abstract published in *Animal Production Science*, Volume 58, Issue 8.

Roberts, H., Watanabe, K. and Struck, M., Hfebicek, J., Horsak, Z. (ED. JIAWEI ZENG). (2018). A glance at the world. *Waste Management,* 75(2018)1-VI. www.elsevier.com/locate/wasman. Not peer-reviewed.

Tekale, S.U., Thore, S.N., Dodkey, A.M., Kendrekar, P.S. and Pawar, R.P. (2018). Yb(OTf)3 Catalyzed Synthesis, Antimicrobial and Insecticidal activity of some Biscoumarins. *Chemistry and Biology Interface,* 8 (1).

Yogesh, W., More, Y.W., Tekale, S.U., Kaminwar, N.S., Kótai, L., Pasinszki, T., Kendrekar, P.S. and Pawar, R.P. (2018). Synthesis of 3,4-dihydropyrano[c]chromenes using carbon microsphere supported copper nanoparticles (Cu-NP/C) prepared from loaded cation exchange resin as a catalyst. *Current Organic Synthesis,* 15,8,22.



PART #7

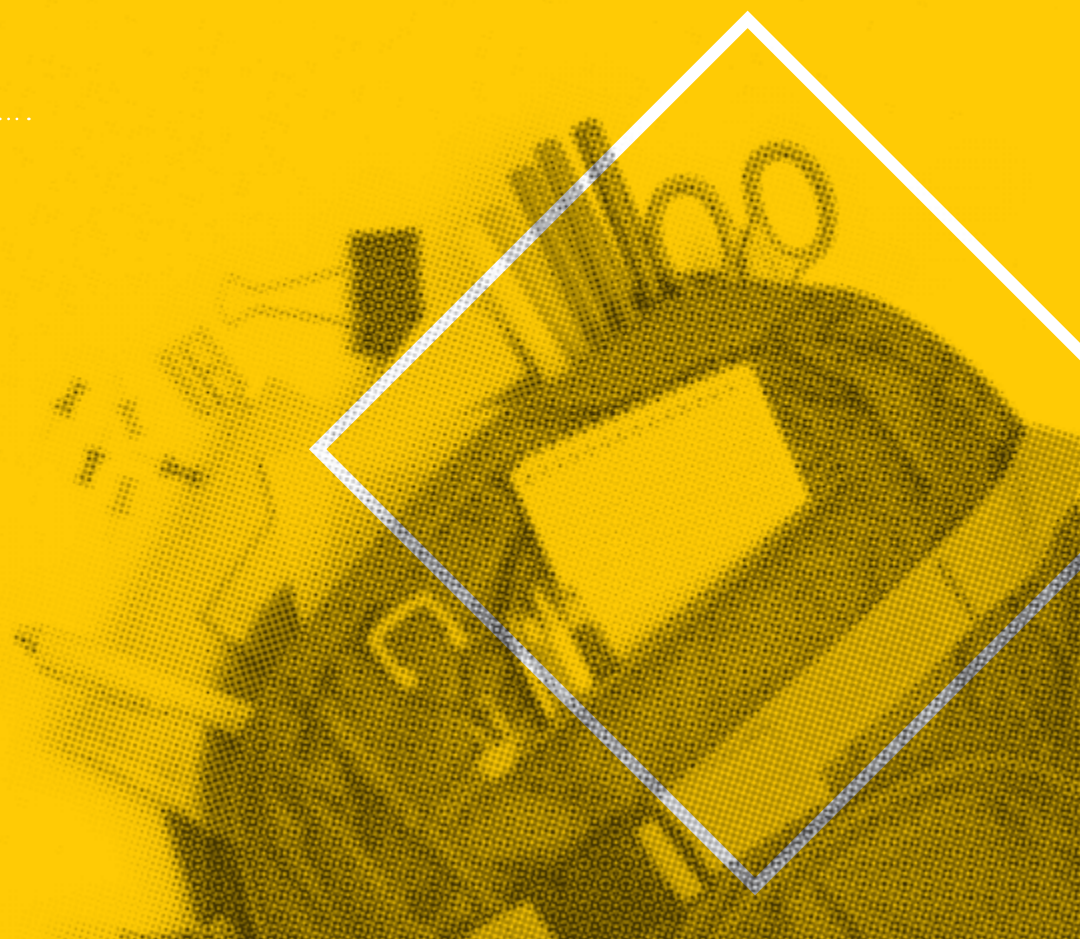
SEVEN

EDUCATE

ART

Faculty of Humanities

CREATIVITY



A MESSAGE FROM THE DEAN

The Faculty of Humanities graduates the majority of master's and doctoral candidates at the University. This is as a direct result of the support we give our students in the form of writing workshops and research seminars. This indicates that there is a potential for research outputs that should be aligned to the graduation rate. While the faculty reflects on its low performance in journal publications, it must also acknowledge the need to implement interventions to increase of research productivity. The faculty commits to using all relevant motivation strategies that will improve the quality of outputs. Conference attendance has to reflect in journal publications. Therefore, as we move forward, conference attendance may not in future exceed quality output.

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

A MESSAGE FROM THE ASSISTANT DEAN

It is my singular honour and privilege once again to present the Faculty of Humanities Annual research report. This 2018 report is special to me in that it is likely to be my last one as an Assistant Dean Research, Innovation & Engagement. This is because research reports at CUT, like many other universities, are written in year n for year n-1. In this regard the 2018 report is being written in 2019, the year in which my term of office as an Assistant Dean comes to an end. As part of its restructuring programme, the CUT introduced the post of Research Manager and I was first appointed as the Faculty of Humanities First Research Manager on 1 October 2013 and that contract ended on the 30 September 2016. This post was later changed to Assistant Dean and I was again appointed as the Faculty's first Assistant Dean Research Innovation and Engagement on 1 October 2016, with an end date of 30 September 2019. During the 6 years that I have been in this leadership position I must admit that 'industry' is a difficult place to be in. It is not at all rosy. There are judgements being made, but that is part and parcel of it. However, I am grateful for whatever I have got from the 'industry' because I learned a lot about what it means to lead people. If you want everyone else to be passionate, committed, dedicated, and motivated, you must go first! You don't lead people by what you say to them; you lead them by what they see you do and that meant I had to lead by example in conference attendance, journal publications, grant proposal writing, supervision of students etc. Although I cannot toot my own hornin terms of the achievements I made, suffice it say that leading by example made me grow professionally. This is evidenced by the fact that I leave the 'industry' as an NRF-rated researcher: something I might not have achieved had I not been tasked to lead. So, I would like to thank the university for having confidence in me and giving me the opportunity to lead the faculty in terms of research and its related activities. I hope by doing it first I motivated some of those whom I led, and I wish the next Assistant Dean success.

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

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

Prof. Bongani Bantwini, Professor at North-West University, Potchefstroom Campus, presenting on diversity in research at the research seminar hosted by the Faculty of Humanities.

FACULTY OF HUMANITIES RESEARCH SEMINARS

On 22 October 2018, the Faculty of Humanities held the prestigious research seminar themed: "Towards Diversity in Research". The purpose of the event was to harness and encourage research activities in the faculty by giving both academic staff and students from different programmes the expertise, experience, and opportunities to present their research projects and actively engage in research-related discussions.

Prof. Bongani Bantwini, Professor at North-West University, Potchefstroom Campus, and guest speaker, believes in research and innovation as the hope and driver to the future. He also said that the CUT's vision is aligned with the idea that research, innovation and development are key to unlocking the innumerable challenges faced by society. "As a higher education institution, it is imperative that you always remember that the higher education sector is the biggest contributor to the increase of research and development of any country. Research and innovation have become our hope and drive for our better tomorrow. When we talk about research, we also look at the growth of the country, technology advances and changes. Our democracy is still young and needs research to grow it beyond. We believe that solutions to our shared challenges will only come from ground-breaking research and innovation."

He mentioned diversity in research as a better way to solve complex problems. He also encouraged upcoming researchers to continue digging deeper, to get more involved and to come up with great topics. He also advised the faculty to look into having a research identity and philosophy, and to promote multidisciplinary and interdisciplinary research.

The Faculty's Research Prestige Seminar is an annual capacity-building event, the purpose of which is to harness and encourage research activities in the faculty by giving both academic staff members and students an opportunity to present their research projects and engage with colleagues in research-related discussions. As mentioned, this year our prestige seminar was held on 22 October 2018, and the theme was: "Towards Diversity in Research". Consistent with tradition, each year we invite a guest speaker and this year our guest speaker was Prof. Bongani Bantwini who is a Research Professor at North West University, Potchefstroom, in the School of Natural Sciences and Technology Education. Prof. Bantwini is a Fulbright Fellow who received both his master's and PhD degrees in Science Education from the University of Illinois at Urbana-Champaign in the USA. The Deputy Vice Chancellor (DVC) Research Innovation and Engagement, Prof. A. Ngowi, graced our seminar by giving an opening talk on the Fourth Industrial Revolution,a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, which describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives. People have no control over either technology or the disruption that comes with the 4th Industrial Revolution, hence the concept of digitising everything is becoming a reality that no one can choose to ignore. Although

the industrial revolutions have often been considered as separate events, together the 1st, 2nd, 3rd and 4th Industrial Revolutions can be understood better as a series of events building upon innovations of the previous revolution and leading to more advanced forms of production. With specific reference to education, the 4th Industrial Revolution is more than just a technology-driven change. Rather, it is powered by disruptive innovation which redefines the conventional ways educational institutions deliver their content to students. New modes of curriculum and teaching arise, and the focus changes from modes of teaching to modes of learning. Alternative curriculums are constantly being developed. During the seminar a total of 18 papers were presented covering a wide range of topics in education including success rates, the roles played by teachers and school principals in the improvement of learning, code switching, inclusion of pregnant learners, female instructional leadership, single mother parenting and gifted education.

Here we see the Dean, Prof. Feza and the guest speaker, Prof. Bantwini (in front row), together with some of the participants listening attentively to the DVC's talk.

INTERNATIONALISATION RESEARCH ACTIVITIES

During 2017, the Faculty of Humanities spearheaded the signing of a number of MoUs between the CUT and some of the universities in Thailand. The International Conference on Educational Reform (ICER) 2018 was jointly organised by Khon Kaen University of Thailand, the Education University of Hong Kong (EdUHK) of China, the State University of Surabaya (UNESA) of Indonesia, Mindanao State University-Iligan Institute of Technology (MSU-IIT) of the Philippines, the Central University of Technology (CUT), Free State, South Africa, Thailand Education Deans Council, and the Consortium of Sixteen Education Deans of Thailand (Group 16). In accordance with those MOUs, in 2018 a number of visits were undertaken by our researchers.

Prof. Alexander participated in a writing for publication seminar organised by the Global Social Sciences Forum, in Thailand (5 – 6 April, 2018).

Engagement with the Faculty of Humanities, Rajabhat University, Thailand (10 April 2018 – morning session).

Engagement with the Centre for Multicultural Education, Faculty of Education, Chiang Mai University, Thailand (7-8 April 2018).

Mrs Pornmanee Harnhak, Director of the Autistic Research Centre at Khon Kaen University, and teaching staff of the Autistic Research and Development Centre, welcomed Prof. Alexander to their boardroom (11 September 2018).

RESEARCH PROJECTS IN THE FACULTY

Improving the education of gifted students in mathematical sciences – NRF-funded project

Our research project on the education of gifted students in mathematical sciences is one of the flagships in the faculty in which we aim to monopolise children's academic talent. Although education has many objectives which vary from one country to another, there is a global convergence into two commonly accepted objectives: that of expanding access (social equity) and that of developing skills needed by society in a modernising economy (human capital development).

Within the debates on human capital development in a modernising economy, today education finds itself at the dawn of a revolution considered to be the Fourth Industrial Revolution (4IR). The 4IR, a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives (Miller 2015). Considering the evident

challenges and opportunities inherent in 4IR, Schwab (2016) subsequently calls for the mobilisation of the collective wisdom of people's minds, and our project is premised on the view that students gifted in mathematical sciences will provide the much-needed wisdom in the 4IR and beyond.

This view is further supported by Xu, David and Kim (2018), who argue that the scarcest and most valuable resource in an era driven by digital technologies will be neither ordinary labour nor ordinary capital; rather it will be those people who can create new ideas and innovations. In this regard Renzulli (2005) argues that the field of gifted education has been a true laboratory for the many innovations that have subsequently become mainstays of many educational systems. Hence it can be argued that in the 4IR and beyond, talent, more than capital, will represent the critical factor of production. People with ideas, not workers or investors, will be the scarcest resource (Brynjolfsson, McAfee and Spence, 2014). In 2017, in the Bloomberg Global Business Forum, Apple CEO Tim Cook commented: "If I were a country leader, my goal would be to monopolize the world's talent" (Leswing, 2017). We see our project responding to these calls in many ways.

Teaching and learning in integrated educational settings – NRF-funded project

Prof. Gregg Alexander was awarded an NRF Thuthuka Rating Track Project. The project deals with teaching and learning in integrated educational settings (schools, universities and TVET colleges). The overarching aim of this research project is to explore teaching and learning practices in integrated educational settings of the Northern Cape and Free State provinces and its underlying implications for multicultural education. Attached to the project are four students (two at PhD level and two at master's level), investigating various issues and challenges related to multicultural education.

Through the project, Prof. Alexander managed study visits to two MoU universities in Thailand in 2018. He visited the Centre for Multicultural Education, Chiang Mai University, where he was involved in a workshop session on Civic Education and Multicultural Education. He also made two presentations on *Critical Multiculturalism in Multicultural Contexts* at the Faculties of Education at Mahasarakham University and Rajabhat University, respectively. At a national level, colleagues from the School for Education, Sol Plaatje University, and Faculty of Education, University of the Free State, also collaborated with Prof. Alexander. A total of 11 research outputs were produced through this project (1 research article, 1 book chapter, 3 papers presented at international conferences, 2 papers presented at national conferences and 4 papers published as conference proceedings papers).

Completed master's degrees

Hlatshwayo, P.M. (2018). *The nature and prevalence of gang related violence in Secondary Schools in Lejweleputswa District*. Central University of Technology, Free State.

Lemeko, P.A. (2018). *Diachronic investigation into current issues in language variation. A case of Sesotho language*. Central University of Technology, Free State.

Mapuya, M. (2018*). First year student teachers' perceptions of their constructivist classroom learning environments in Accounting 1 and implications for teacher educators*. Central University of Technology, Free State.

Mokhomo, M.I. (2018). *Promoting of life-long learning through early childhood development.* Central University of Technology, Free State.

Mokhuwa, G.A. (2018*). The formalist approach in selected Sesotho novels*. Central University of Technology, Free State.

Mokuoane, M.C.N. (2018). *The reflection of language in culture and identity: A case of Basotho in the Free State Province and Lesotho*. Central University of Technology, Free State.

Moliko, R.Z. (2018). *Towards strengthening pedagogical knowledge in a Teacher Education Programme: a case of Postgraduate Certificate in Education*. Central University of Technology, Free State. [posthumously]

Mothibeli, T.R. (2018). *The effect of uncontrolled teacher absenteeism on the leadership and management of selected Public Primary Schools in Mangaung Municipality*. Central University of Technology, Free State.

Motsoane, S.G. (2018). *Learners' attitude towards Mathematics in Grade 9 and its effect on learners' choice of subjects in Grade 10: A case study conducted in Lejweleputswa District*. Central University of Technology, Free State.

Peens, S. (2018). *Enhancing further education and training accounting teacher training capacity at a University of Technology: Educational implications for theory and practice*. Central University of Technology, Free State.

Setenane, R.V. (2018). *Multimedia Sotho-English e-dictionary for undergraduate students in Design and Studio Art*. Central University of Technology, Free State.

Singo, N.E. (2018). *Teacher perceptions on alternatives to corporal punishment in Vhembe District*. Central University of Technology, Free State.

Wheeler, W. (2018). *Exploring job satisfaction of teachers at Special Schools in the Lejweleputswa District in the Free State Province*. Central University of Technology, Free State.

Completed doctorate degrees

Amaechi, C.E. (2018). *Language and power relations in the Further Education and Training band in South Africa.* Central University of Technology, Free State.

Hlohlolo, S.D. (2018). *The use of translators at local municipalities: A case study of Moqhaka Local Municipality, South Africa.* Central University of Technology, Free State.

Khauoe, K.F. (2018). *Management of organisational systems at township Secondary Schools in the Free State Province.* Central University of Technology, Free State.

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Ndlovu, O. (2018). *The role of critical reflective teaching in teaching practice for the 21st century: A case study.* Central University of Technology, Free State.

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List of conference proceedings

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Alexander, G. and Mpisi, A. (2018). *Perceived reluctance of parental involvement: a perspective of black learners attending South African historically white multicultural schools.* In Sures, P. (ed.), Proceedings: International Conference on Psychology, Language and Teaching (ICPLT), Yangon, Myanmar, 29-30 June 2018, pp.6-11. ISBN 978-93-87405-18-9.

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Kimanzi, M.K. and Gamede, V. (2018). Sustainability reporting practices for small and medium enterprises in Pietermaritzburg: *Journal of Economics and Business Law*, (7): 279-308. ISSN 2047-8747.

Makola, S., Garthe, R.C., Griffin, B.J., Worthington, E.L, Goncy, E.A., Sullivan,T.N., Coleman, J.A., Davis, D.E., Kwakye-Nuako, C.O., Mokushane, T. and Anakwah, N. (2018). Negative Interpersonal Interactions and Dating Abuse Perpetration: The mediating role of dispositional forgivingness. *Journal of Interpersonal Violence,* 33 (15): 2311-2333. ISSN 0886-2605.

Markus, E.D. and Mhlolo, M.K. (2018). Improving Performance in Mathematics and Science: A Case Study of High Schools in Local Municipalities of South Africa. *Advanced Science Letters,* Volume 24,Number 11, 8540-8544(5).

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Venter L. (2018). 'n Beskouende ondersoek van humorontwikkeling, humorsin en enkele meganismes onderliggend aan humor. *LitNet Akademies, 807-841.*

List of books and book chapters

Alexander G. (2018). *Integrating Multicultural Education into the Curriculum for Decolonisation – Benefits and Challenges*. New York, Nova Science. ISBN 978-1-53613-584-8

PART #8

BUSINESS


GROWTH
Faculty of Management Sciences
MARKETING

A MESSAGE FROM THE DEAN

The Faculty of Management Sciences is fully committed to reach the targets set out in CUT's Research and Development Plan 2014 to 2020. The year 2018 was a stable one in terms of research performance. Although we could not manage to reach the set targets in terms of publications in accredited journals, we still recorded a growth of 17% in outputs compared to 2017. We managed to exceed the target in terms of the production of master's and doctoral graduates.

Despite this, the faculty is still facing challenges in terms of broadening its research participation base, increasing the number of full-time postgraduate students, internationalisation in research, improvement in staff qualifications and filling of vacant professorial positions. A major step in the right direction was the implementation of two Memoranda of Understanding with the following counterparts in Africa:

- HO Technical University in Ghana, and
- Great Zimbabwe University

A direct result of these MoUs is the fact that more than 30 staff members of those universities enrolled as postgraduate students at CUT!

We will continue to address all challenges in an attempt to position the faculty as a role-player to be reckoned with in the international arena.

My sincere appreciation goes to the Assistant Dean: Research, Innovation and Engagement and all contributors to a successful 2018!

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

A MESSAGE FROM THE ASSISTANT DEAN

Research and development in the faculty was on a steady growth path, with staff participation showing signs of increase, as exemplified by staff with master's degrees involved in supervision of postgraduate students, the number of staff registered for higher qualifications, as well as those who graduated (5 doctorates and 2 master's). There was also a general increase in the number of staff interested in applying for external funding (37 out of 85, compared to 11 in 2017), who registered for NRF Online. For both staff and students, a total of R 613 700 was generated through external applications.

There were 101 postgraduate students registered in the faculty (59 master's and 51 doctoral students), and the faculty continued to be inundated with prospective postgraduate students throughout the year. The number of international postgraduate students continued to grow in 2018, with the addition of Ho Technical University staff, mostly registered for doctoral studies.

In terms of internationalisation, the faculty hosted a number of international visitors and continued the implementation of the MoU signed between Great Zimbabwe University and the Ho Technical University, Ghana, with a public lecture on entrepreneurship presented by Professor D.Y. Dzansi at Ho Technical University, and Professor C. Chipunza visiting Great Zimbabwe University for on-site supervision of doctoral students and also for exploring possible research areas. In terms of publicity, a faculty research and postgraduate webpage was designed and is live.

Despite the above, the faculty still faces some research and development related challenges, with research publications contributed by the same few staff members annually, with few new additions, being one of them. There is still lack of staff cooperation in research publications across departments, and issues of academic writing continue to be a challenge for both staff and students. Recruitment of a professor in entrepreneurship has continued to be a challenge in 2018, in addition to lack of statistical knowledge for analysing postgraduate and staff research work. Lastly, the number of rated researchers did not grow in 2018.

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

Prof. C. Chipunza (Assistant Dean, RIE); Prof. D.R. Thakhathi (guest speaker) and Prof. A.J. Strydom (Dean: Faculty of Management Sciences)

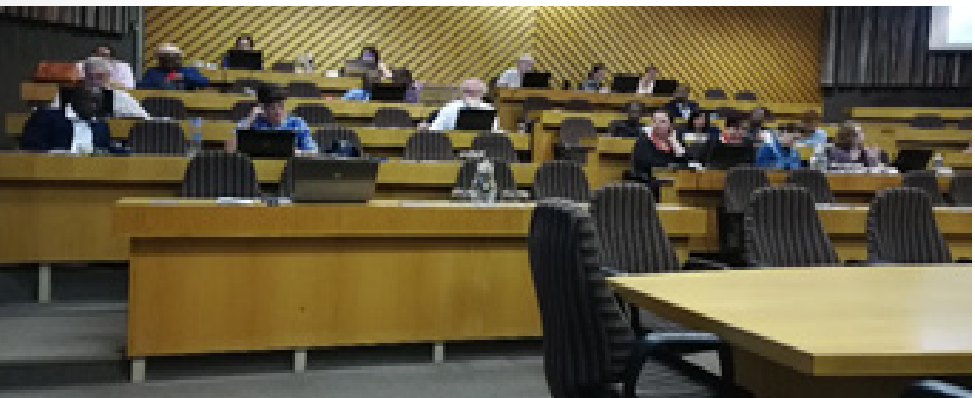
RESEARCH SEMINARS

The faculty held several workshops, although three major ones stood out. The first to be held was on language and academic writing, held in March 2018 by Dr P. Kaburise from the University of Venda. The workshop focused on parts of speech and academic/scientific writing tips for both staff and postgraduate students. Academic writing is an integral part of higher education and the faculty places emphasis on this in the first quarter of every year.

The second major seminar to take place was the one between industry partners and researchers in the faculty on 18 May 2018, in collaboration with the Black Management Forum (BMF). The seminar's objectives were (a) to give an opportunity to small businesses, government, and the corporate world to highlight their critical business challenges, and (b) to provide an academic platform for faculty researchers and students to focus their research on the highlighted critical business challenges.

The third Seminar was the Research Prestige Seminar, held on 26 September 2018, under the theme *"Contemporary entrepreneurship research for regional socio-economic development"*. The theme was chosen to align with the focus of the strategic direction of the faculty in terms of entrepreneurship development, and to resonate with the institutional focus on regional socio-economic development.

The guest speaker was Professor D.R. Thakhathi, a full professor of Public Administration from the University of Fort Hare, with extensive experience in teaching, research and community engagement. His speech focused on the entrepreneurial role that academics can play in transforming the public sector environment in South Africa through a number of strategies such as, among others, creating social cohesion with public sector departments, developing academics' emotional intelligence, and serving as critical information players for the public sector through engaging in commissioned research.



Some of the delegates at the prestige research seminar.

There was a variety of presenters at the seminar from all six departments of the faculty in terms of academic seniority, gender, race and papers presented. The papers presented ranged from marketing, entrepreneurship in agri-business, work place spirituality and tourism, to financial management. For the first time in the history of the faculty, a delegate from the Welkom campus attended through video/Skype conferencing, an imperative which speaks to living the notion of 4th Industrial Revolution by the faculty.

Some of the presenters, from left: Mr Anele Nkoyi, Dr D. Crowther and Dr E. Palmer

SUMMER SCHOOL: DEPARTMENT OF BUSINESS MANAGEMENT, THE FACULTY OF MANAGEMENT SCIENCES

The Department of Business Management in the Faculty of Management Sciences hosted a week long 2nd Summer School for a group of Aalen students from Germany. Prof. D. Kokt was the facilitator for the module on Advanced Human Resource Management (see picture).

Furthermore, a total of 51 officials from the Free State Department of Education, Human Resources Division, registered for our much sought after B.Tech-HRM degree. This flexible, blended mode programme runs for a full year on a block release system, where students come to the campus for one intensive face-to-face contact session for each of the six modules offered in the programme, and the rest of the tuition, tests, projects, communication, etc., are conducted and supported online, through our Blackboard E-Learning platform. One module takes approximately 8 weeks to complete. All of these delegates had to go through a tedious and exhaustive RPL process to obtain admission into the programme, all from an HR background and across various districts of the Free State Department

A group of Aalen University of Applied Sciences students from Germany attends summer school at CUT.

Free State Department of Education officials admitted into B.Tech: HRM for Capacity Development Training Union officials (SAMWU) admitted into the B.Tech: HRM for capacity development training.

of Education's Human Resource Division. This group of matured working students is the third intake of our TVET/FSDoE 3rd Stream Project. A well-established relationship between the Department of Business Management in the Faculty of Management Sciences and the Free State Department of Education together with the TVET Sector has developed over the years as a direct response to the local, regional and national outcry for capacity development across various economic sectors of our country, especially for matured, working persons who cannot afford to leave their work stations for a protracted period of time (see picture below).

The Department of Business Management, through its HRM programme, also admitted 63 Maccauvlei delegates for the 2019 academic year. This is to be the 12th intake since the inception of this most popular B.Tech: HRM programme among matured and working people. Furthermore, the ongoing SAMWU group registered in 2018 for the very same programme. Offered in a flexible, blended and block-released mode, the primary intention is to upskill and capacitate the Human Resources practitioners (see picture above).

Completed master's degrees

Dreyer, T.F. (2018). *An expatriate mentoring plan for Abu Dhabi Oil and Gas Industries (GASCO)*. Central University of Technology, Free State.

Jafeta, R.J. (2018). *The influence of social media advertising on consumer brand preferences and consumption: A case of advertisers and students' perspectives on energy drinks.* Central University of Technology, Free State.

Masupa, M.E. (2018). *Internet banking adoption decisions and e-service quality of rural customers.* Central University of Technology, Free State.

Mathe, L.S. (2018). *Perceptions and attitudes of CENTLEC maintenance employees towards theft of copper cables.* Central University of Technology, Free State.

Matsepe, M.R. (2018). *The nature and utilisation of marketing practices among bed and breakfast (B&B) establishments in Mangaung, Metropolitan Area, Free Stat*e. Central University of Technology, Free State.

Mkhize, D. (2018). *Evaluating budget preparation, implementation and control process in secondary schools in the Lejweleputswa District, Free State.* Central University of Technology, Free State.

Mofokeng, K.F. (2018). *The influence of learning orientation and creative broadcasting techniques on small business sustainability: A case study of selected community radio stations in Bloemfontein.* Central University of Technology, Free State.

Mokgosi, B.K. (2018). *Influence of demographic and social variables on the creation of technology-oriented ventures in the Free State Province.* Central University of Technology, Free State.

Phalatsi, B.M.C. (2018). *A comparative study of marketing communications between local and foreign national small grocery tuck-shop owners in selected municipalities in the Free State Province*. Central University of Technology, Free State.

Completed doctoral degrees

Bothloko, T.S. (2018). *Promoting effective financial accountability in local government in the North West Province: Developing operational guidelines for Municipality Public Accounts Committees*. Central University of Technology, Free State.

Crowther, D. (2018). *Formulation of a sustainable financial management strategy for South African universities' hotel schools*. Central University of Technology, Free State.

Gumbochuma, J. (2018). *The status and impact of technology transfer and innovation on the productivity and competitiveness of small-scale agro processing businesses in Mashonaland Central (Zimbabwe) and Free State (South Africa)*. Central University of Technology, Free State.

Makoni, J. (2018). *Corporate community engagement framework for stakeholder relations in the extractive sector in the Western Cape, South Africa*. Central University of Technology, Free State

Palmer, E.P. (2018). *The impact of workplace spirituality on organisational commitment: The case of the Central University of Technology*. Central University of Technology, Free State

List of conference papers

Coetzee, A. (2018). *Private retirement facilities in the Mangaung area: A corporate governance perspective.* In Proceedings: Southern African Accounting Association – Central Regional Conference, Brandfort, 27-28 September 2018.

Crowther, D. and Strydom, A.J. (2018). *Towards a sustainable financial management strategy for Hotel Schools at South African universities*. In Proceedings: International Academy of Business and Economics Conference in Munich, Germany, 14-16 June 2018.

De Freitas, E. (2018). *Trust Asset Disposals a Potential Value Shifting Arrangement*. In Proceedings: Southern African Accounting Association – Central Regional Conference, Brandfort, 27-28 September 2018.

Eben, P. and De Klerk, B. (2018). *Collaborative marketing: increasing weekday visits to Clarens towards a domestic tourist destination*. In Proceedings: 30th Southern African Institute of Management Sciences (SAIMS) Conference Proceedings 2018, Stellenbosch, South Africa, pp. 1035-1046.

Haarhoff, R. (2018). *Destination Choice: Consumer price considerations – a South African case study.* In Proceedings: International Conference on Environmental, Cultural, Economic & Social Sustainability, Cairns, Australia, January 2018.

Haarhoff, R. (2018). *Linking environmental responsibility in tourism to education: do the future generations really care?* In Proceedings: 6th International OFEL Conference on Governance, Management and Entrepreneurship. Dubrovnik, Croatia. *[External Funding NRF].*

Hurter, C. 2018. *Software to assist a clinical trial site with financial and administrative management*. In Proceedings: Southern African Clinical Research Association, Conference, Midrand, 26-28 September 2018:

Kokt, D. (2018). *Is it possible for universities to create a spiritual workplace for academic staff?* In Proceedings: International Institute of Social and Economic Sciences (IIESS), 24-28 September 2018, Lisbon, Portugal.

Koma, V. (2018). *The accounting profession and the training of accounting teachers.* In Proceedings: Teacher Education and Interdisciplinary Research Conference (TEIR), Cape Town, 9-12 October 2018.

Lezar, L. and Van der Walt, F. (2018). *The relationship between cultural intelligence and thriving at work: Preliminary empirical results.* In Proceedings: 1st African Positive Psychology Conference, North-West University, Potchefstroom, 4-7 April 2018.

Lubbe, N. (2018). *Moving client trust funds away from lawyers to a third party.* In Proceedings: International Conference of Legal Regulators (ICLR) 2018, The Hague, 4-6 October 2018.

Lubbe, N. (2018). *Transferring attorneys' fiduciary duties concerning client trust funds to third parties: a feasibility evaluation.* In Proceedings: Southern African Accounting Association – Central Regional Conference, Brandfort, 27-28 September 2018.

Mabope, N.C. (2018). *The practice of talent management within Mangaung Metropolitan Municipality.* In Proceedings: Association of Southern African Schools and Departments of Public Administration and Management (ASSADPAM) Conference, Tuscan Rose, Bloemfontein, 26-27 September 2018.

Magagula, B.S. (2018). *Monitoring and evaluation practices in the Office of the Premier, Free State Provincial Government.* In Proceedings: Association of Southern African Schools and Departments of Public Administration and Management (ASSADPAM) Conference, Tuscan Rose, Bloemfontein, 26-27 September 2018.

Magubane, T. (2018). *Self-reflection and academic performance of the Economic Management Science (EMS) students in South Africa.* In Proceedings: Teacher Education and Interdisciplinary Research Conference (TEIR), Cape Town, 9-12 October 2018:

Mkhize, D. (2018). *Understanding the roles of the Governing Bodies in the Finance of the Schools in South Africa.* In Proceedings: 45th International Conference of the Southern African Society for Educators (SASE), 3-5 October 2018.

Molomo, P. (2018). *Knowledge to reason: Using Conceptual Knowledge to Stimulate Inquiry in Assessment: A Case in Higher Education, South* Africa. In Proceedings: 1st International Conference on Religion, Social Sciences and Technological Education, Malaysia, 25-26 September 2018.

Mpholo, T.S. and Van der Walt, F. (2018). *The relationship between perceived religious discrimination and job satisfaction, with specific reference to the Rastafari religion.* In Proceedings: Academy of World Business Marketing and Management Development (AWBMAMD) Conference Proceedings, 17-20 July 2018, Athens, Greece.

Naidoo, A. (2018). *Xenophobia and the treatment of international students at higher education institution in South Africa.* In Proceedings: Scholarship of Teaching and Learning (SoTL) in Higher Education: Transforming Teaching and Learning through a culture of research in higher education, Central University of Technology, Bloemfontein, 24-25 October 2018.

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Van Niekerk, T. (2018). The rationale, value, benefits and challenges of Work Integrated Learning towards employability of graduates. pp. 55-87. Title of book: *Critical Perspectives on Work Integrated Learning in higher education institutions*. Cambridge Scholars Publishing. ISBN (10) 1-5275-0677-0 ISBN (13) 978-1-5275-0677-0.

Visiting professors

The faculty officially appointed two visiting professors, namely:

- Prof. E.K. Sakyi (Ho Technical University in Ghana)
- Prof. D. Lubbe (retired Professor from University of the Free State in Bloemfontein)

The faculty has one officially appointed extraordinary professor, namely:

- Prof. U. Holzbaur (Aalen University of Applied Sciences in Germany)

FOSTERING STRATEGIC PARTNERSHIPS (A SUMMARY OF FACULTIES' STRATEGIC PARTNERSHIPS)

Project title	Pavement modelling for sustainability
Project leader	
Collaborative parties	University of Illinois, (USA) Brunel University, London, UK Central University of Technology (SURT research group)
Description	Prof. Mostafa initiated contacts with the Illinois Centre for Transport (ICT) in 2014 and Brunel University in 2016. He visited the ICT in January 2015 and agreed on activities for 2015 and beyond. Brunel University joined the project in 2016. The project is looking at modelling of pavement for sustainability with a focus on modelling of pavement incorporating non-conventional materials. In a time of decreasing highway funds and increasing expectations for performance and quality, it has become more important to understand the effect of environmental conditions on hot-mix asphalt (HMA) pavement performance. Considering the significant role of roadways in the economy and communication activities of the modern societies, researchers have been searching for ways to attain the most suitable road pavement behaviour and subsequently to design and construct safe, stable, cost-effective and environmentally friendly roads. Structural collapse in a flexible pavement structure is caused by the evolution of different types of damage mechanisms: fatigue cracking, advanced crushing, temperature variation and increased moisture content resulting in delamination. The design standard adopted for this research will focus on South African and American codes for flexible road pavement design. The use of the finite element method to determine the stress-strain non-linear response behaviour of the pavement model structure considering mechanistic-empirical design guide will be developed. The analysis of pavement structures, using the finite element method which allows for the implementation of constitutive models that can properly capture the non-linear behaviour of unbound aggregate layers will be considered. The general purpose finite element programme ABAQUS, which has been used to study pavement conditions such as multiple wheel loads, unbound aggregate behaviour, non-linear behaviour, and anisotropy will be implemented to determine the stress intensity of the road pavement. Necessary data required for the analysis will be acquired within situated study locations; since this forms the basis of the design for a reliable sustainable design. By the end of this research, data generated will be used in the design of hybrid flexible road pavement to enhance a national sustainable development and enhance growth and development of the South African economic sector in the transportation of goods and agricultural products from state to state within the country.

Project title	Sustainable transportation framework
Project leader	
Collaborative parties	Central University of Technology (SURT research group) University of the Free State
Description	Mountains and highlands have always played an important role in the history of humankind and have been sources of valuable assets – fresh water, refuges, natural barriers, and spiritual sanctuaries, to mention a few. Yet, for the most part, they have been viewed as peripheral to the rest of the global ecosystem, with an associated lack of attention to their sustainable development. Mountainous regions face important developmental questions concerning ecosystem services, as well as climate change. Although there is growing international interest in montane environments and livelihoods, the "montane" element of South Africa/Lesotho has not been adequately recognised in research or planning terms. The Drakensberg Montane Grassland, Woodland and Forest ecoregion is the centre of southern Africa's Afromontane region. It is the southernmost point of the Afromontane regional centre of endemism, and supports endemic plants, amphibians, birds and reptiles. The highest parts of this ecoregion have been equated to Alpine tundra vegetation by some researchers. Unlike mountains further north, where Afromontane communities are found only above 2000 metres, here latitude compensates for altitude, allowing Afromontane communities to occur down to sea level. These mountains supply the industrial heart of South Africa with water, and give rise to southern Africa's longest river, the Orange River. The QwaQwa Campus of the UFS is ideally suited to be the home of a research unit that harnesses interdisciplinary expertise to focus on addressing the sustainable development of this important montane area. Sustainable development promotes the idea that social, environmental and economic progress are all attainable within the limits of earth's natural resources. While development is needed to overcome issues of poverty and unequal distribution of wealth and resources, this development must be sustainable so as not to cause the same problems of environmental degradation that were caused in the past. It is also necessary to understand and appreciate the unique histories and cultures of these regions. The area which will form the primary focus of the activities stretches across two countries: South Africa (Free State, KwaZulu-Natal and the Eastern Cape) and Lesotho, incorporating more than 600km of mountain range. The area is prone to a number of environmental stresses, including land degradation and loss of biodiversity – with associated effects on the communities that live there. Under predicted climate change conditions, these stresses will become more pronounced and hence undermine sustainable development efforts.
Project title	**Research collaboration with Prof. Claudia Polese under the CPAM**
Project leader	
Collaborative parties	University of the Witwatersrand
Description	Collaboration in the fields of research of materials science, advanced materials and laser shock peening (LSP) technology, joint master's student supervision.

Project title	Research collaboration under SARChI and CPAM projects
Project leader	
Collaborative parties	École nationale d'ingénieurs de Saint-Etienne, France
Description	Collaboration in the fields of Selective Laser Melting with Prof. I Smurov, carrying out of joint experiments, discussion of results and writing of joint articles.
Project title	**Research collaboration under the SARChI project**
Project leader	
Collaborative parties	Vitebsk State Medical University
Description	Collaboration in the fields of medical product development through Additive Manufacturing with Prof. A. Kabanova and Prof. I. Generalov, joint investigations and papers.
Project title	**Research collaboration with Prof. Peter Mendonides, Mr Heinrich van der Merwe, Mr S Havenga under the CPAM**
Project leader	
Collaborative parties	Vaal University of Technology
Description	Collaboration on AM of Ti6Al4V, surface finishing of Polymer AM and Design for AM. Joint master's and doctoral supervision.
Project title	**Research collaboration with Prof. Deon de Beer under the CPAM and PlatForum**
Project leader	
Collaborative parties	North-West University
Description	Collaboration on Polymer AM, Design for AM and AM of platinum.
Project title	**Collaboration with Dr Kevin Slattery on support for a master's study**
Project leader	
Collaborative parties	Boeing Research and Technology
Description	Collaboration on AM of Ti6Al4V from blended powder.
Project title	**Research collaboration with Dr Lethu Chikosha, Mr Pierre Rossouw and Mr Chris McDuling under the CPAM**
Project leader	
Collaborative parties	CSIR Materials Science and Manufacturing
Description	Collaboration on characterisation of Ti6Al4V powder for AM, AM patterns for investment casting and mechanical testing of AM parts. Joint master's supervision.
Project title	**Research collaboration with Prof. Francis Smit and the Robert WM Frater Centre for Cardio-vascular Surgery**
Project leader	
Collaborative parties	University of the Free State
Description	Collaboration on the development and testing of mechanical and polyurethane heart valves.

Project title	Collaboration with Dr Ettienne Snyders and Dr Jaco van der Walt under CPAM
Project leader	
Collaborative parties	Nuclear Energy Corporation of South Africa (Necsa)
Description	Collaboration on characterisation of Ti6Al4V powder, spheroidisation of powder and AM of plasma system components.
Project title	**Collaboration with Mr Frazer under CPAM**
Project leader	
Collaborative parties	Altech UEC South Africa
Description	Collaboration on design rules for AM tooling inserts.
Project title	**Collaboration on design for AM under CPAM**
Project leader	
Collaborative parties	Technimark
Description	Collaboration on design of AM tooling inserts in maraging steel for high volume plastic injection moulding.
Project title	**Collaboration with Prof. Rob Knutsen of the Materials Engineering Centre under CPAM**
Project leader	
Collaborative parties	University of Cape Town
Description	Collaboration on the physical metallurgy of titanium alloys produced through AM.
Project title	**Research collaboration with Mr D. Louw and Mr T. du Plooy, National Rental Pool Programme**
Project leader	
Collaborative parties	CSIR, National Laser Centre
Description	Collaboration in the fields of research of optical diagnostics of selective laser melting. Carrying out of joint experiments, discussion of results, writing joint articles and joint master's student supervision.
Project title	**Research collaboration with Dr A. Donmez and Dr S. Mekhontsev under SARChI and CPAM programmes**
Project leader	
Collaborative parties	National Institute of Standards and Technology, USA
Description	Collaboration in the fields of optical monitoring of selective laser melting process (SLM), discussion of results and writing of joint articles.
Project title	**Research collaboration with Prof. DG Hatting in Materials Science under SARChI and CPAM programmes.**
Project leader	
Collaborative parties	Nelson Mandela Metropolitan University
Description	Collaboration in the field of residual stress of SLM objects, discussion of results and writing of joint articles.

Project title	Research collaboration with Dr Ernst Langer in Polymer research under CPAM programme
Project leader	
Collaborative parties	University of the Free State
Description	Collaboration in the field of polymer research and joint master's student supervision.
Project title	**Research and development of a quasi-isothermal compressor**
Project leader	
Collaborative parties	Nanyang Technological University(NTU), Singapore
Description	Collaboration between Prof. A. Romagnioli (NTU), Dr G.G. Jacobs (CUT) and Mr C. Plekker (CUT master's student) on the research and development of a quasi-isothermal compressor for application in compressed air and liquid air energy storage systems.
Project title	**Summer School**
Project leader	
Collaborative parties	Aalen University, Germany
Description	This is a one-week summer school on Digital Product Development that is staged here at CUT under the auspices of the Department of Mechanical and Mechatronics Engineering. The course is staged for 13 students each from Aalen University and the Central University of Technology. The course is offered together by 5 members of staff from CUT and 2 from Aalen University. The course culminates in the design, development and eventual manufacture of selected products for each student on the DMLS EOS additive manufacturing equipment at CRPM.
Project title	**Research collaboration under SARChI and CPAM projects**
Project leader	
Collaborative parties	Karlstad University, Sweden
Description	Collaboration in the fields of selective laser melting and material science with Prof. P Krakhmalev, carrying out of joint experiments, discussion of results and writing of joint articles. Joint DEng supervision.
Project title	**Research collaboration under SARChI and CPAM projects**
Project leader	
Collaborative parties	Stellenbosch University
Description	Collaboration on non-destructive testing and material science with Dr A. du Plessis and Prof. D. Blaine, carrying out of joint experiments, discussion of results and writing of joint articles. Joint master's supervision.
Project title	**Research collaboration on Construction Health and Safety in Developing Countries**
Project leader	
Collaborative parties	The University of Manchester (Dr Patrick Manu), Asia Institute of Technology (Prof. Bonaventura Hadikusumo), the Federal University of Port Alegre (Prof. Tarcisio Saurin)
Description	Collaboration on an edited book on Construction Health and Safety in Developing Countries to be published by Routledge.

Project title	
Project leader	
Collaborative parties	Great Zimbabwe University (GZU)
Description	Staff development programme where four staff members from GZU are enrolled for doctorate degrees in the faculty.
Project title	
Project leader	
Collaborative parties	Ho Technical University
Description	30 staff members from Ho technical university are enrolled for doctoral degrees in the faculty.
Project title	
Project leader	
Collaborative parties	Aalen Hochshule, Germany
Description	Research project on digitization of the travel industry.
Project title	
Project leader	Dr L. Steenkamp
Collaborative parties	CUT, TUT Universiti Utara Malaysia University of Bournemouth
Description	Several research projects on Big Data, Data Analytics and Generalised Audit Software. The projects runs with the support of the Institute of Internal Auditors Global.

RESEARCH

INFLUENCE

INNOVATION

Tel: +27 51 507 3336 | Fax: +27 51 507 3275
E-mail: llategan@cut.ac.za
Central University of Technology, Free State (CUT)
Private Bag X20539, Bloemfontein, 9300, South Africa

Design and production by SUN MeDIA Bloemfontein | sunmedia@sunbloem.co.za