



Central University of
Technology, Free State

2015

RESEARCH AND INNOVATION REPORT

SIGNIFICANT ACHIEVEMENTS OF 2015

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PART 1

Messages



Message from the Vice-Chancellor and Principal

Prof. Thandwa Mthembu

The year 2015 was a pivotal one for the university in staying true to the mandate and vision which positions it as an *engaged university that focuses on producing quality social and technological innovations in socio-economic developments, primarily in the central region of South Africa.*

The advances that the university has made in implementing research and innovation initiatives are guided by and aligned to our University's Vision 2020 Strategy, Research and Development and Innovation Plans. The university identified a need to support user-oriented research – this approach is imperative for this university in order to realise direct outcomes in the socio-economic development sphere.

This annual report reflects key milestones achieved by our researchers, our partners and collaborators, our communities and our support staff, through a range of activities within the research and innovation portfolio. I hasten to acknowledge and thank all of our quad-helix partners: government, business/industry and other organs of broader society without whom all our achievements would not have been possible.

In 2015, we 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 financial investment in research and innovation. The

investment has translated into a 27% growth in publication outputs from 2013-2014 compared to the previous year. Currently close to 32% of staff have doctorates, and during the year under review a total of 78 staff members were supported in improving their qualifications: 33 of these for master's degrees and 45 for doctoral studies – an opportunity to dramatically grow the research outputs with the increase of staff participating in research. The achievements in research also included the awarding of the SARCHI chair in Additive Manufacturing for Medical Devices over a five-year period. Besides advances in additive manufacturing, a number of other research units are doing sterling seminal work that is getting recognised nationally and internationally.

Our commitment as a University of Technology in ensuring undisturbed focus on research and innovation resulted in a strategic decision to establish a separate research and innovation portfolio which will commence at the beginning of the year 2016.

We live in extraordinary times, where the demands on higher education to make a positive socio-economic impact are forever accelerating. The communities that we serve and our quad-helix partners expect even more of us in times like these.

Our achievements in 2015 were the result of clear strategies and execution by our researchers, academic and support staff. And while we are proud of all that we accomplished during the year despite the challenges, what is more important is that we should not rest on our laurels. Rather, we should continue to prepare our university and encourage our staff and students to do much more to take make CUT a leading university of technology.

Prof. Thandwa Mthembu

Vice-Chancellor and Principal





Message from the Deputy Vice-Chancellor Academic and Research

Prof. Henk J. de Jager

The focus of all research and innovation activities at the Central University of Technology (CUT), Free State, is that they result in *outputs, outcomes* and *impact*. The importance of the above-mentioned approach is that whilst an enabling environment is created in support of research and innovation, the policy directives and management of research and innovation, are aimed at maximising these *outputs, outcomes* and *impact*. The year 2015 was no exception as can be witnessed in this Annual Research and Innovation Report.

We have continued on our exciting journey to align the academic project and our research and innovation programmes with Vision 2020, focusing strongly on *“producing quality social and technological innovations in socio-economic developments, primarily in the Central region of South Africa”*. CUT takes a highly entrepreneurial approach to university research and innovation and is focused on solving society's major challenges. The power of CUT's innovation ecosystem is driven by our applied research to produce solutions that benefit society as well as create a positive economic impact. We are also increasingly involved in partnerships with industry, science councils, and international partners. Focussed on our commitment to innovation and interdisciplinary applied research, we provided students with a rich educational experience that combines intellectual thoroughness and cross-disciplinary extensiveness in an intimate, student-centred environment. This commitment was illustrated in 2015 in which the university council, supported by the Department of Higher Education and Training (DHET) and the National Research Foundation (NRF), made more than R32 Million available for research support and development.

The process of implementing the CUT Research and Development Plan 2014 – 2020 was further enhanced with the establishment of two (2) Research Centres, twelve (12) Research Units and seven (7) Research Groups, all aligned with the research clusters

and programmes as is illustrated in Part 3 of this report, in order to grow our critical mass in focus areas which will ensure maximum impact in society and improve people's lives. Furthermore, our staff members made great strides in obtaining their doctorates, making CUT the leading university of technology with the highest percentage of academic staff holding doctorate degrees. We are progressing well towards reaching the 50% target by 2020.

The various exciting research projects conducted by our postgraduate students and researchers during 2015 are indicated in the faculties' and sections' reports, in Parts 4 -8. Our graduates and researchers are committed to make a positive societal change through their research and innovation contributions. I wish to express my sincere gratitude towards the Vice-Chancellor and Principal, CUT Council, members of Executive and Senior Management, the Section for Research and Innovation, students, staff and local and international partners who all worked tirelessly during 2015 to ensure outstanding research and innovation outputs and contributions. The support to CUT and the contributions from the Department of Science and Technology (DST), the National Research Foundation (NRF), the Technology Innovation Agency (TIA), Science Councils, the Department of Higher Education and Training (DHET) and several others during 2015 are acknowledged with profound sincerity.

In 2016 our contribution to society will be further underpinned by our entrepreneurial approach to research and innovation excellence, and we will continue to position CUT as the leading university of technology in South Africa and beyond.

Prof. Henk de Jager

Deputy Vice-Chancellor
Academic and Research

PART 2

INSTITUTIONAL PERFORMANCE HIGHLIGHTS AND ACHIEVEMENTS

INSTITUTIONAL PERFORMANCE HIGHLIGHTS

Prof. Laetus Lategan

Dean: Research and Innovation



This report reflects on the annual Research and Innovation activities of the units in Research and Innovation namely Research and Development, Technology and Innovation, the Regional Innovation Forum, the Library and Information Services and Community Engagement.

In the reporting period some remarkable achievements can be highlighted.

- A large number of staff and students are involved in and benefit from the academic support provided by these units.
- Existing and new initiatives attracted CUT staff and students and involve national and international partners.
- In all their activities the emphasis is placed on the curriculum (now known as the STEPS process) and on how staff and students can benefit from a connected curriculum (academic capitalism).
- In line with Vision 2020 the focus has shifted (but is not ignored), and the process should lead to outcomes and impact that should be measured. This will be a continuous process.

The following summative main-line activities and achievements in the different Units can be reported.

Significant Developments and Achievements in Research and Development

- The university has experienced a positive growth in its publication outputs since 2010. The university showed a 27% progress from 68.48 units in 2013 compared to 87.17 in 2014.
- 31 master's degrees and 13 doctorates awarded in 2015.
- Nine NRF-rated researchers in 2015.
- Collectively more than R 32 m available for research in 2015.
- SARCHi chair in Additive Manufacturing for Medical Devices. Period: 2015–2019(1st cycle) at grant value > R 8 million (over 5 years).
- Five postdoc scholarships awarded – one in the Faculty of Engineering and IT, one joint postdoc in the Faculty of Engineering and IT and Management Sciences and three in the Faculty of Health and Environmental Sciences.
- Collectively more than 380 attendees participated in internal workshops which also included external participants from NRF, DAAD, Stellenbosch University and International collaborators (Finland and Australia).

Significant Developments and Achievements in Technology and Innovation

- Recruitment of qualifying participants for the TIA Seed Fund programme and management of the execution of such.
- Expanding the Intellectual Property portfolio of CUT through the registration of additional products and maintenance of existing registrations.
- Securing CUT's participation in the SAB KickStart Ignite programme and local roll-out of this initiative.
- Securing a new management structure and process for CRPM.
- Preparing for an international ISO 13485 certification visit for CRPM during 2016.
- The value of the 499 projects completed at the CRPM during 2015 was R4 357 924, which was a decrease of 4.7% compared to 2014 (project value of R4 562 838). Approximately 4000 parts were manufactured for the 499 industrial and research projects. Furthermore, a total of R572 860 was spent on 52 research projects compared to R350 530 which was spent on research projects during 2014.
- CRPM was successful in three applications (with a total value of R1 215 000) for Technology Innovation Agency (TIA) seed funding.
- PDTS is currently running smoothly and most of the targets for the financial year have already been achieved. PDTS received feedback from the yearly Monitoring and Evaluation session by TIA. All is well and the PDTS is one of the outstanding technology stations.

Significant Developments and Achievements in Regional Innovation

The year started with the news that the DST will be putting the national Regional Innovation Forum initiative on hold pending investigations into the effectiveness of the project. This implied that the planned RIFFS activities following the 2014 financial term had to be revisited with the existing human and financial resources in mind. The Steering Committee was informed of this and a closing meeting was held. It was decided that RIFFS would manage the remaining funds toward the end of 2015 and that further existence of the entity would be accommodated under the new DVC: Research, Innovation and Engagement Portfolio.

Synopsis of activities and projects during 2015

A synopsis of the projects and events engaged in include:

- Launching, running and concluding the master caterers, assistive design and social innovation challenges in collaboration with ILO, FSSOCDEV and DESTEA
- Facilitating the aftercare programme for the master caterers via the CUT hotel school
- Conducted a catering feasibility study
- Facilitating the Design @ CUT project and an Inscape delegation to CUT

- Advancing the Science and Innovation Park concept at various regional forums and seeking avenues of funding
- Delivery of presentations at the FS trade bridge and SATN conferences on regional innovation
- Facilitation of the establishment of a Renewable Energy Task Team that investigates collaboration with Harmony Gold and other stakeholders in the green energy sector
- Participation in strategic discussions toward the establishment of a task team on city and regional development
- Participation in the roll-out of a CUT Entrepreneurial Education week, including the convening of an Art and Design Fair on CUT campus
- Preparation of the Solution Exchange platform for launching in the 2nd semester 2015
- Initiated a number of educational programmes with Quintiles, SATB and the ATNS
- Hosted a TIA visit to CUT with respect to the RIFFS project and way forward discussion
- Initiated collaboration with Dr Henriette van den Berg, Prof. Bennie Anderson and Dr Johan Bezuidenhout of UFS on an innovation chain of thought
- Participated in the FS Research Priority Project via the DRAC (Departmental Research Advisory Committee) project of government
- Advanced collaboration with FDC, IDC, MCCI, ILO, DESTEA, the Premier's Office and other role-players as part of the task team on regional collaboration
- Participated in the CUT's PBL and Entrepreneurial Education Project

Significant Developments and Achievements in Library and Information Services

- The LIS First-Year orientation was held on 21, 22 and 23 January 2015 at Bloemfontein campus.
- The Library and Information Association of South Africa (LIASA) declared 14 March to 21 March 2015 as the South African Library Week.
- At the CUT, the Library Week was celebrated from 16 March to 19 March 2015.
- The library embarked on the stocktaking of printed library resources in 2015, a major task.
- Another milestone was achieved at the beginning of the year when the CUT library effected subscription to LibGuides. LibGuides may be described as content management tools used by libraries to "curate knowledge and share information by creating topics, subjects, courses" relevant to a specific library client's needs. LibGuides can also be used by a library to market library resources and services (<http://cut-za.libguides.com/>).
- The Library also succeeded in effecting subscription to a new feature to enhance access to the increasing number of information sources uploaded on the CUT (IR). The IR's Handle was acquired, indexed and registered. This means that CUT's intellectual output uploaded on the IR would now be accessible to anyone using search engines such as Registry of Open Access, Directory of Open Access Repositories (OpenDoar), including the world renowned Google Scholar search engine. Meanwhile a CUT policy on IR was drafted and submitted for consideration by the relevant CUT management structures in November 2015.
- CUT Library and Information Services (LIS) elevated technology to another level when it launched e-Books (digital or electronic books).
- The World Book and Copyright Day is commemorated throughout the world on 23 April to remember and recognise creators of literary and scholarly works.
- The LIS took the lead in launching the International Open Access Week celebrations at CUT. The event was organised in the Art Gallery on 20 October 2015.

Significant Developments and Achievements in Community Development

In 2015, in support of the Community Engagement strategy the following progress was made:

- Engagement plan will be finalised in early 2016, and will be submitted to the UTLC in February 2016. Support for implementation has been assured from the ADS unit. During 2015, the following developments took place: the plan was approved by the CE Committee and the University Engagement Committee was established.
- No mainstreaming has taken place as yet. However, there is 'buy in' to integrate CE into the curriculum. Conscientising on CE is done continuously. A presentation on the Argentina visit was done for curriculum developers. Recommendations were well received. CE is part of the teaching and learning plan. Presently CE is integrated into the graduate attributes.
- Introduced Life Co to CUT. A social innovator has become a virtual incubatee, and receives training from the unit for Technology and Innovation. Life Co would like to partner with CUT in terms of entrepreneurship, innovation and incubation.
- Service Learning Workshop held. Curriculum. Developers attended a Service Learning workshop organised as part of SAHECEF Regional Chapter. Support and interest in mainstreaming CE into the curriculum has been gained.
- Marketing is done via newsletters and brochures. The Annual CE week was not held. Marketing of CE done at OECD. Incubatees are assisted in terms of resources wherever possible.
- Support gained in 1 project – Mahau Project. Funding received from Sweden.

There were 29 Community Engagement projects undertaken. The breakdown of projects according to faculties and SAA was as follows:

- Faculty of Engineering and Information Technology – 4 projects (Career Information, Computer Literacy, CISCO and Cloud SAMS)
- Faculty of Health and Environmental Sciences – 8 projects (Wheels of Hope, SL in Health Sciences,

Water Quality (2), Waste Management, Luckoff Farming Mentorship, Leratong Farm and LISSO)

- Faculty of Humanities – 2 projects (Mahau Nursery School and Bloemfontein Creche)
- Faculty of Management Sciences – 9 projects (Accounting Technicians, CENTLEC Project Management, ESKOM Project Management, Maccaulei Human Resource Management, ENACTUS Student Organisation, Executive Development Programme, Module in Restaurant Service, Thabiso Skills Development and FS TVET Colleges)
- Schools Advancement Academy – 4 projects (Saturday School, Winter School, Spring School, Educator Mentorship Project)

Research and Innovation Plan 2014-2020

The Central University of Technology, Free State's Research and Development Plan 2014-2020 was implemented during the first term of 2014.

During 2013, all role-players were engaged in Research and Innovation strategies towards the fulfilment of Vision 2020's committed research and innovation outputs. As a result of a two-day workshop, a Research and Development Plan 2014-2020 was drafted and approved by Senate in August 2013.

The University's Vision 2020 articulates the four leading principles as: *Sustainable development*, *Socio-economic development*, *Input leading to outcomes* and *Outcomes leading to impact*. Consequently, the CUT's Research and Development Plan aligned its strategies with the four key goals:

- The development of a sustained, relevant and responsive research culture
- The qualitative and quantitative improvement of research outputs
- Socio-economic development through transfer and innovation
- The development of strategic research and innovation partners and programmes

The four leading principles became the main performance indicators of Research and Innovation. This approach corresponds with international best practice in research management.

The focus of all research and development activities is that they result in *outputs*, *outcomes* and *impact*. The importance of the above-mentioned approach is that whilst an enabling environment is created in support of research, the policy directives and management of research are aimed at maximising the *outputs*, *outcomes* and *impact*.

The following plan was drafted:

THE PLAN

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

The following strategies will support this plan:

5 Key focus areas	18 Strategies aligned to the key focus areas		
Human skills and potential development strategies	Strategy 1: Ten integrated support programmes to grow research capacities.	<ul style="list-style-type: none">Undergraduate to Graduate Students Programme	<ul style="list-style-type: none">Mid-career Researcher Programme
		<ul style="list-style-type: none">Master’s Education Programme	<ul style="list-style-type: none">Established Researcher Programme
		<ul style="list-style-type: none">Doctoral Education Programme	<ul style="list-style-type: none">Black Female Researchers Career Programme
		<ul style="list-style-type: none">Next Generation Researcher Programme	<ul style="list-style-type: none">Rated Researchers Programme
		<ul style="list-style-type: none">Postdoc Fellowship Programme	
		<ul style="list-style-type: none">Emerging Researchers Programme	
	Strategy 2: Increasing the enrolment of postgraduate students		
	Strategy 3: Growing the seniority of the academic staff profile		
	Strategy 4: Introducing <i>research leave</i> to optimise opportunity for research participation		
Structural development strategies	Strategy 1: Reactivation of the Graduate School in support of Faculties.		
	Strategy 2: Implementing the approved constitution of the URIC.		
	Strategy 3: Training for Faculty Research Managers.		
	Strategy 4: Research and Technology and Innovation administrative support will be implemented at the Welkom campus.		
Intellectual skills development strategies	The University provides opportunities to travel to conferences and to develop scientific writing skills as <i>input</i> and <i>process</i> indicators in support of the <i>output</i> , <i>outcome</i> and <i>impact</i> indicators.		
	Strategy 1: Rolling-out of scientific writing skills programme		
	Strategy 2: Implementing revised <i>INTERIM</i> publication structure		
	Strategy 3: Increasing the research outputs of the postgraduate students		
	Strategy 4: Funding for conference attendance based on defined criteria		
	Strategy 5: Rolling-out of institutional training programmes		
	Strategy 6: Defining criteria for academic staff research outputs in a three-year cycle		
Resource strategies	Strategy 1: Allocation of Institutional Research Grant		
	Strategy 2: Allocation of DHET Research and Development Grant		
	Strategy 3: Revising the allocation of publication incentives		
	Strategy 4: Strategy to grow research equipment and facilities.		
	Strategy 5: Revise funding allocation to students.		
Policy strategies	Strategy 1: Revising institutional research policies to reflect the new institutional framework for Research and Development.		

THE STRATEGY

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

- Undergraduate to Graduate Programme
- Master's Programme
- Doctoral Programme
- Next Generation Researchers Programme
- Postdoctoral Fellowship Programme
- Early Career Researchers Programme
- Mid-Career Researchers Programme
- Established Researchers Programme
- Focused Researchers Programme
- Rated Researchers Programme

The following additional programmes and projects have 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 Project)
- Sabbatical Leave Programme
- SARChI (Nationally funded Research Chairs)

These programmes and projects are being funded through university funding (R&D Budget, 2015), DHET 2013-2014 and 2014 -2015 R&D Grant and External Funding Agencies (primarily NRF).

The next section of the report will provide feedback on the progress of implementation of the programmes and on the budget available in support of research.

RESEARCH AND DEVELOPMENT SUPPORT AND ACHIEVEMENTS

The following progress can be reported:

Research funding available for 2015

The following research funding was available during 2015:

- Mancom approved R4.8m in March 2015 to support the university's strategic research and development programmes, research and innovation operational budgets and the pay-out of 2013 research publication incentives.
- The Research and Development Plan, 2014-2020, was further supported by the DHET R&D Grants, 2013-2014, 2014-2015 and 2015-2016 respectively. R12 389 000 was available in support of the R&D Plan.
- The National Research Foundation remains the biggest funder of research activities. For the reporting year R14 765 205 was available for research.
- The CSIR awarded R351 000 through its Laser rental/access programme.
- The Research and Development Office also accessed R150 000 from the PA and A Malan Trust in support of the R&D Plan.

The table below outlines the amount of funding available for research during 2015:

In total, the R&D Unit had a budget of R32 455 205 available for research activities.

DHET research and development grants

Since 2013, the DHET has approved and provided an R&D Grant for the financial years 2013/2014, 2014/2015 and 2015/2016.

Comprehensive progress reports for the financial years 2013/2014 and 2014/2015 were submitted to DHET on the 30 April 2015.

For the 2015/16 financial year, the DHET released 30% of the 2015/16 RDG allocations to avoid delays experienced previously. However the Department has set a condition that the release of the remaining 70% will be determined by a satisfactory progress report on the utilisation of the 2014/15 RDG funds. Approval of the remaining 70% was granted by DHET on the 12 December 2015. The funding will be allocated in 2016.

Consultations were held in August 2015 with the Faculty Deans and Research Managers on the commitment and activities to utilise the allocations of the three year grant in line with the Grant approved by DHET.

The section below is a summative report of progress made for the DHET grant for the year under review:

Through the DHET R&D Grant the university was awarded R5.190m for 2014-2015. The Grant's major focus is on capacity development (especially) through growing the number of M & D qualified staff. This will support the university's own challenge in this regard and also contribute to the efforts of university to foster a research culture.

The university is mindful that the growth of a research culture is dependent upon a number of challenges. Some of these challenges are:

- uneven participation in research activities (internally – supervision, publications and externally grant applications);
- limited funding for staff and students (because of limited internal resources and low participation in external research grant applications);
- absence of well-equipped laboratories in some academic programmes, high volume of part-time postgraduate students and a small critical mass of staff contributing to limited participation in research activities.

SUPPORT TO POSTGRADUATE STUDENTS

For 2015 the following grants were awarded to M and D degree students and postdoctoral fellows. This can be compared to the period 2014:

Table: Postgraduate bursaries, 2014-2015

Year	Master's students	Doctoral students	Postdoc fellows
2014	R957 880	R628 494	R880 000
2015	R1 972 340	R1 147 030	R1 000 000
Total	R2 930 220	R1 775 524	R1 880 000

A total of R4 119 370 was available for postgraduate and postdoctoral fellow support.

Table: Research funding 2015

Agency	Funding objective	Amount
CUT	Operational Research Funds	R4 800 000
DHET R&D Grant	Support research capacity building	R12 389 000
NRF	Support research projects and student training	R14 765 205
CSIR	Laser rental/access programme	R351 000
PA & A Malan Trust	Studies in art and project on research education	R150 000
Total		R32 455 205

NRF Funding

For the period January 2015 – December 2015 the following funding was received from the NRF:

Table: NRF Funding, 2015

Programme	Amount
IFRR	R 320,000.00
International	R 99,876.25
KIC	R 370,241.00
National Equipment Award	R 3,100,000.00
S&F - Part-time doctoral studies	R 140,000.00
S&F - Extended support for scholarships and fellowships	R 35,000.00
S&F - Innovation Doctoral Scholarships	R 620,000.00
S&F - Scholarships & Fellowships Programme	R 7 240,000.00
SA Research Chairs – Open	R 1,670,000.00
Sabbatical Grants to Complete Doctoral Degrees	R 200,000.00
SANHARP	R 70,000.00
South African Square Kilometer Array Project	R 226,000.00
Thuthuka	R 674,088.00
Total	R14,765,205.25

Note : Although the National Equipment Award was awarded for the period December 2015 – December 2016, the funds will only be available in 2016.

RESEARCH OUTPUTS

DHET Publication submission 2014 (n-1) in 2015 (n)

In terms of the *Policy and Procedures for the Measurement of Research Output of Public Higher Education Institutions (2003)*, all public higher education institutions (HEIs) must submit annually their subsidy funding claims for research outputs, in the form of publications, to the Department of Higher Education and Training (DHET). The DHET allocates research subsidy based on unit calculations for approved publications. The following submissions were approved by DHET:

Table: Publication outputs 2004-2014

	Articles	Proceedings	Books
2004	26.99	2	0
2005	25.23	1.6	0
2007	28.3	0	0
2008	22.38	0.5	0
2009	33.04	1.67	0.55
2010	31.71	7.85	0
2011	40.11	6.75	0.45
2012	54.33	4.6	0
2013	55.02	13.02	0.44
2014	72.83	13.65	0.69

The 2014 outputs represent a positive growth and hence sustainability of the publication outputs. From the outputs illustrated in the graph below, the following observations can be made:

- There has been a continuous growth in research publication outputs. The university showed a 27% progress from 68.48 units in 2013 compared to 87.17 in 2014.
- Since 2010 the university has seen positive growth in its publication outputs.
- The number of accredited published conference proceedings has grown since 2012. Major challenges are still that i) too many researchers are not attending accredited conferences and/or do not participate in the publication opportunities of a conference; ii) researchers do not publish their conference proceedings; and iii) published conference proceedings do not comply with DHET requirements.

Postgraduate Studies

The Masters and Doctoral graduations are illustrated in Table and Graph contained in page 12. For the period 2001 (full year) – 2015 (full year) it is clear that the university has the ability to deliver on master's programmes and that more attention should be given to doctoral programmes.

Graph: CUT accredited publication outputs, 2004-2014

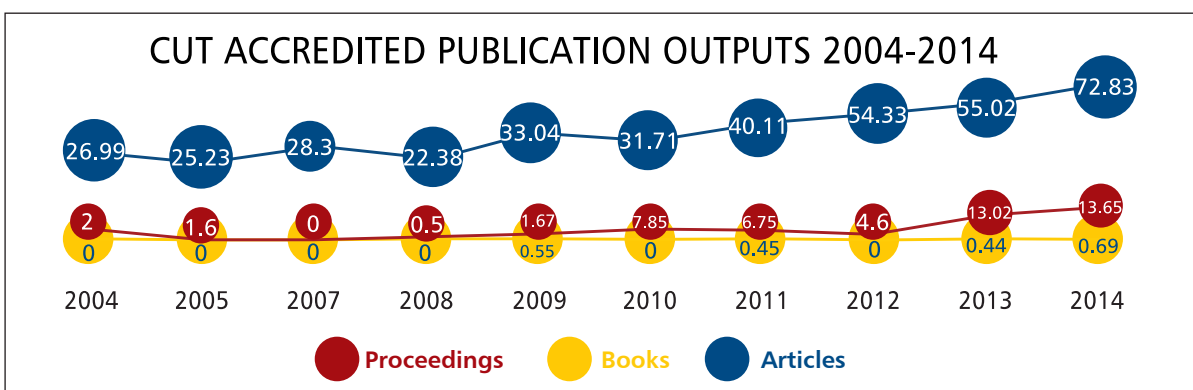


Table : Completed Postgraduate Studies

Year	M Degrees	D Degrees	M Course Work
2001	11	1	
2002	16	2	
2003	19	6	
2004	19	5	
2005	13	5	3
2006	17	8	2
2007	31	4	
2008	22	11	
2009	25	5	
2010	27	6	
2011	17	3	
2012	35	6	
2013	29	3	
2014	37	13	
2015	31	13	
TOTAL	349	91	5

Staff members' qualifications: The university currently has close to 32% of staff members with doctorates. During 2015, funding from DHET grant was used to support a total of 78 staff members (consisting of 33 master's and 45 doctoral studies) in improving their qualifications.

RESEARCH AND DEVELOPMENT WORKSHOPS

Research Process

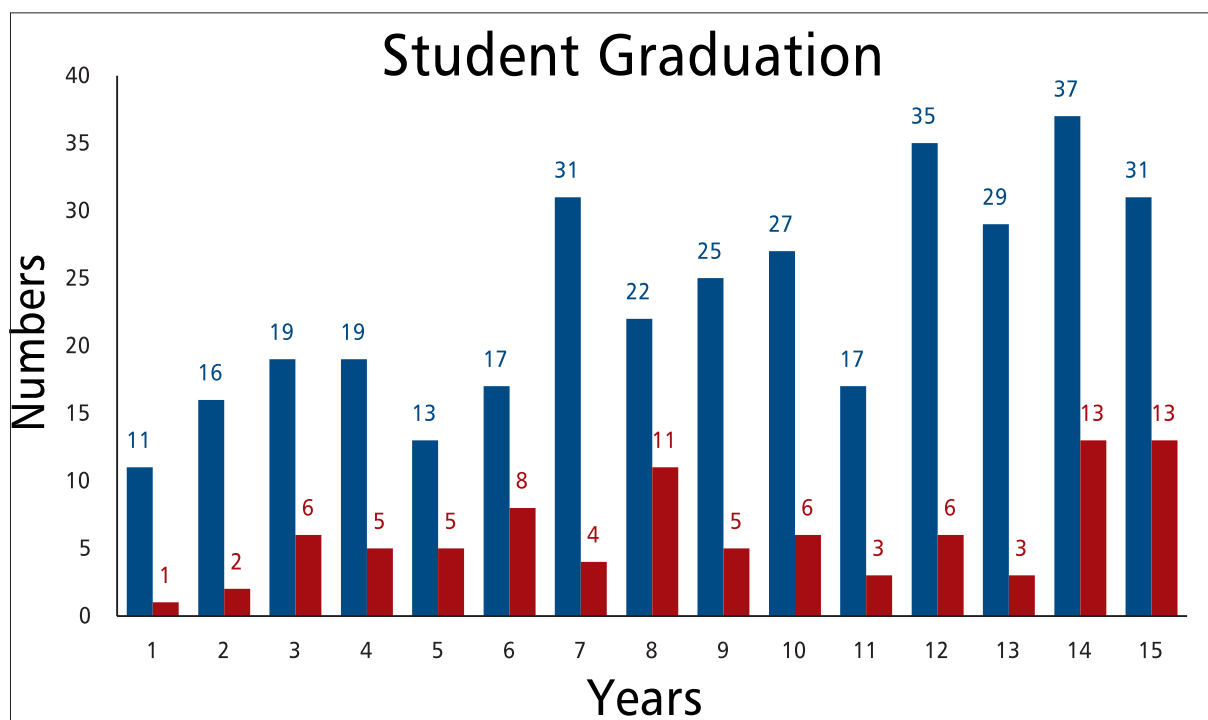
On 27 February 2015 the Unit for Research and Development launched its first annual Research and Development workshop for 2015. The focus of the workshop was on "The research process" and 90 staff

members and students registered for the workshop. The workshop reflected on a number of important milestones during the research process and focused on the following topics: Building blocks for the research process; Lessons learned from my journey: A female researcher's perspectives; An internal 'tool' to grow our 'own timber' in research publication; Persuasive writing in research; A step-by-step guide for external funding applications; Student support for postgraduate studies; Teamwork in research – together we are stronger; Digital support; and An ethical research culture. The presentations were collected and posted as a research workbook during the seminar. This workbook was also posted on the internet. This workshop was repeated at the Welkom campus on 21 April 2015. Approximately 40 staff members and students attended the workshop.

Postgraduate Supervision

On 12 June 2015 the Unit for Research and Development launched its third annual Research and Development workshop. The focus of the workshop was on "Postgraduate Supervision." According to the Research Office's records approximately 80 staff members and students registered for the workshop. External participants were from DAAD, SATN, Stellenbosch University and CUT. The workshop also focused on the following topics: A brief overview of postgraduate education, postgraduate supervision and research training; A discussion on postgraduate students' needs and expectations; A discussion on postgraduate studies beyond faculties, disciplines and institutions to secure regional responsiveness and international collaboration; Reflections on how to successfully complete postgraduate studies; Funding as enabler – for research, personal development, networks; and Pointers for internationalisation of postgraduate studies.

During the workshop the following important indicators for postgraduate supervision were identified: 1) Understanding the university, scientific and grants environment. 2) Understanding the triple helix relationship between supervisor (including



Graph : M and D Graduations, 2001-2015

mentors), students (including teams) and university (assessment, scholarships, partnerships, publication demand, etc.). 3) The role of research teams, support services and institutional promotion. 4) The important role of learning (academic experience, industry relevance, engagement, etc.)

How to be successful in your postgraduate studies

The Research and Development unit held a workshop on 21 August 2015, with the theme “How to be successful in your postgraduate studies.” This workshop was an extension of the discussions on postgraduate supervision and studies during the annual Research and Development breakaway which was held on 3 August 2015. About 60 staff members and students attended the workshop and there were constructive engagements on the various topics.

Following from the workshop, it was evident that there are certain common needs: What is research and how/when is new knowledge created?; Scientific writing skills; Literature review; Methodological training; Data analysis and interpretation; Supervisory skills; Funding application skills; Ethics, integrity, plagiarism, co-authorship; Presentation skills; Understanding a research topic in the broader context of the research discipline; How does one know that the research is relevant, may have impact and is in demand by business and industry?



Promoting a research culture through international partnerships

On 27 October 2015 thirteen staff members attended a workshop that was presented by Ms Asa Olsson, Director at the LH Martin Institute, University of Melbourne, on the promotion of a research culture through international partnerships. This workshop was a continuation of the Research Workshop that was arranged by SATN in order to promote a better understanding of the implications of current changes in research practices, which will provide new opportunities to promote better-informed decisions and discussions that expand the vision regarding the role of research in sustaining societies.

Research Strategic Breakaway

The Research and Development strategic breakaway – theme *Postgraduate Studies at CUT* was held on 3 August 2015 in order to allow engagement on the implementation of research and development strategies toward fulfilment of the Vision 2020's committed research outputs. The implementation is done based on strategies aimed at increasing

research outputs and in line with the framework of the Research Management Model – five focus areas with eighteen strategies. During the workshop the university research community engaged on 1) Overview and Performance of Research and Development, 2) Growing participation basis in research activities, 3) Postgraduate studies, 4) Strides for Research, and 5) Research and Development budget.

A total of 57 staff members and invited guests were in attendance. The aim of the breakaway was to engage on the following issues impacting on postgraduate studies CUT: 1) Postgraduate performance – finding the new perspective; 2) The relevance of the postgraduate research study. Roles and responsibilities and the postgraduate process; 3) Relevance of the postgraduate research in line with government, businesses, socio-economic and political imperatives; 4) Research culture and academic importance – relevance to real world challenges; 4) CUT inputs towards enabling research and challenges experienced by the research community.

Based on the discussions during the breakaway, actionable activities to enhance research were identified and implemented.



Research Entities: Centres, Units and Groups

The Senate approved a University Policy on Centres, Units and Groups on the 25 August 2014. Council approved the policy on 12 September 2014. The policy was informed by the University Research and Development Plan, 2014 – 2020, which was approved by Senate and Council in 2013. The objectives of this plan are directed at building a critical mass in research and optimising opportunities to grow research outputs. The Plan identified the approved Research Clusters and Programmes as a meaningful vehicle to meet the outputs of the Plan by 2020. Strategy 2 of the 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.

The university is conscious of the fact that this exercise is the most important process which has been undertaken by the institution in the grouping and identification of research niche areas. In order to ensure success of the process and sustainability of the approved entities, the process allows a progressive development of entities – from Group to Unit to Centre, the development will involve a peer review mechanism which will assist in achieving of outputs and also the refocusing of research within faculties.

A total of two Centres, twelve Units and seven Groups were approved.

During November 2015 the policy regulating the Research Centres, Units and Groups was reviewed and approved by Senate. In addition, a number of strategic matters raised by Senate pertaining to the establishment of Research Centres, Units and groups in an assessment of the sustainability of the newly formed research entities. Based on the assessment report, some of the recommendations were made to ensure more focused research and increased critical mass. The recommendation and repositioning process will be implemented during the 2016 academic year.

CUT/UFS Research Programme Joint Call

The university took on the initiative to promote active participation with Cluster A and B universities that will deliver on joint postgraduate supervision and joint publications. The Central University of Technology Free State (CUT) and the University of the Free State (UFS) undertook a joint research call with equal funding by both institutions. The collaboration was a first between the two universities and aimed at strengthening research within the institutions in the Free State Province. The research collaboration focused on the following objectives: 1) Building research critical mass, 2) Improvement of research outputs – publications and postgraduate supervision, and 3) Drafting of joint funding proposals.

On 18 February 2015, researchers at both institutions were invited to apply jointly, through a competitive process, for an Multi-, Inter- and Trans- (MIT) disciplinary collaborative research grant. The grant was provided as seed funding for research involving both institutions under the following research focus areas: 1) Sustainable Agriculture, 2) Health Sciences, 3) Education, 4) Enterprise Development, 4) Sustainability: Socio-Economic and Technological Development, and 5) Additive Manufacturing and Medical Devices.

A total of fifteen (15) joint research applications were received by 30 March 2015 across the research fields – natural sciences, engineering, urban developmental studies and humanities. The applications were assessed on 11 May 2015 by a panel made up of representatives from both CUT and UFS, and an independent external expert. Following the assessment by the panel, four research projects will be funded on a three year cycle depending on achievement of milestones. The following collaborative research applications were approved:

1. Bioprospecting for plant products for application in animal, human and plant health: Chemistry and Health Sciences
2. Detection and characterisation of emerging microbial pathogens and contaminants from drinking and recreational surface water in the Mangaung area: Environmental Microbiology / Water Quality within Natural Sciences
3. Re-engineering of civic infrastructure towards sustainable human settlements in the Free State, South Africa: A case study of Kopanong Municipal area: Civil Engineering / Urban Planning
4. Using soil maps to infer engineering properties for optimising urban planning: Civil Engineering / Urban Planning

The panel further made project specific recommendations to both successful and unsuccessful applicants on the following issues: 1) Reasons for the application not being successful, 2) Suggestions for improvements in order to strengthen the research project, including other possible collaborators, and 3) Recommendations for alternative funding sources.

In conclusion, both universities acknowledge the importance of the initiative for the region as well as high number of applications received. Concerns raised about, and contributory factors to, the low number of applications (four) being approved will be addressed in the next round of joint research grant call.

NRF/CUT Flagship Programme

The National Research Foundation (NRF) engaged the Central University of Technology (CUT) on 18 November 2014 on the establishment of the Flagship Initiative. The Flagship Initiative is a strategic intervention of the Department of Science and Technology (DST) and the NRF aimed at strengthening research and innovation capacity and the productivity of institutions in their areas of strength or comparative advantage. In addition to the existing competencies and established track records in research and innovation outputs and outcomes, a comparative advantage can be derived from a regional or geographic location and/or institutional positioning. Through the Flagship Initiative, the NRF intends to promote institutional identity; hence consideration must be given to ensuring that the NRF Flagship of an institution cannot easily be replicated elsewhere. The criteria of a flagship programme state clearly that the university must demonstrate availability and the development of critical mass, as well as capabilities and capacity to successfully train postgraduate students according to the postgraduate qualification mix.

Subsequent to the internal selection process and approval by all relevant institutional committees, a Concept Note on Leading Additive Manufacturing for Industrial Development in the Free State and across South Africa, was developed and submitted on 30 April 2015 as the university's Flagship Initiative for consideration by the NRF. A consultative meeting was further held with the NRF on 17 June regarding the above Concept Note for the Flagship programme and a detailed proposal was submitted to the NRF in October 2015. The detailed proposal is the last stage of the process and the document will be subjected to peer-review before the final outcome.

Research Ethics and Integrity Committee

As part of the Senate approved University Research and Innovation Committee (URIC), a working group to activate a Research Ethics and Integrity Committee (REIC) convened for the first time in 2014. This committee will address ethical matters related to research. The following themes will form part of the scope of this committee's activities: a) Clinical Research; b) Animal Research; c) Sustainable Development; d) Safety and Security; e) Research with people and vulnerability; f) Postgraduate Studies; g) Publications; h) Stewardship; i) Law; and j) Corporate Responsibility.

In an effort to implement an REI system and to ensure responsible conduct of research as part of the university's research culture, a number of activities were identified and the following progress was made:

- A draft Research Ethics and Integrity Policy Framework for the Central University of Technology, Free State and a Draft REIC Constitution were approved by URIC as part of the basis for the implementation plan/activities.
- A gap analysis was conducted on the current research ethics system within CUT and gaps were identified in terms of personnel, processes, policy, roles and responsibilities. It was found that some faculties have implemented standard forms that are used to assess research ethical considerations.
- Benchmarking with other HEIs – a detailed benchmark exercise was undertaken with North West University, and an additional document/form was received from Rhodes University. Appointments with the other universities could not materialise due to the unfavourable prevailing climate which took place within the HEIs.

Despite the benchmark not being completed as planned, the information received seemed sufficient to enable completion of the project during the 2016 academic year.

Journals: INTERIM and Journal for New Generation Sciences

The university has two Journals namely:

- *INTERIM* in-house journal to build capacity in science writing and publication; this journal was established in 2002 and is in its 14th year of existence.
- *Journal for New Generation Sciences (JNGS)*: this is a DHET accredited journal established in 2003.

The following progress on the journals is reported:

The Faculty of Health and Environmental Sciences committed to dedicated faculty editions. The Faculty of Engineering and Information Technology completed a two-volume dedicated edition of 24 papers.

Three editions published in 2015:

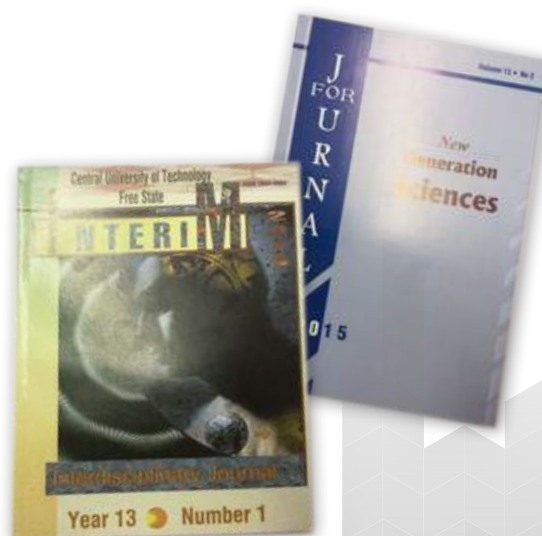
- JNGS 13 (1) – 7 papers
- JNGS 13 (2) – dedicated edition on teaching and learning programmes – 11 papers
- JNGS 13 (3) – 14 papers

According to SABINET the JNGS had 17 106 views and 19 431 downloads during 2015.

These numbers represent a total of 36 000 views and downloads. On request of ASSAF (delegated by DHET) the JNGS submitted its application for evaluation for the next cycle of evaluation. The outcome is expected towards the end of 2016.

For the period 2015 the *Interim* collectively had 35 794 views and downloads and the JNGS 36 537. The latest discussions in scientometrics suggest that over two downloads represent one citation. Should this argument become a reality, this will contribute towards the impact factor of the journals. A random selection of authors in 2014 suggests an H-index of 4.

The high visibility of the journals is due to its online status (open access journals). With the application for the JNGS to be accommodated on Scopus the visibility will increase even more, and based on the institutional "Scopus strategy", the international footprint will increase substantially.



SUMMATIVE PROGRESS

The following summative progress on record and development activities can be reorted

Table: Progress on CUT R&D Programmes and Projects

Programme / Project	Target	R&D Support	Output
1. Undergraduate to graduate Programme	Grow total postgraduate student enrolment by 5% of overall student enrolment (5% x 16 000 = 800)	NRF block grants = R 3,450 m available to B Tech students.	Current postgraduate below master's enrolment = 3.4% of total enrolment compared to 4.8% of target.
2. Master's Programme	1.8% of total student enrolment	CUT Funding of R1 972 234 and NRF block grants of R160 000 available. 4 x R&D workshops (Research Process, Postgraduate Supervision and Postgraduate Studies).	
3. Doctoral Programme	0.7% of total student enrolment	CUT funding of R1 147 030 available. 4 x R&D workshops (Research Process and Postgraduate Supervision)	13 Doctorates graduated (on target). 0.8% of total student enrolment target – compared to target of 0.7%.
4. Next Generation Researchers Programme	80 staff members studying for M or D degrees	DHET R&D grant of R 2.4m allocated. 2 x R&D workshops (Research Process and Postgraduate Supervision) Publication writing	The following awards were made: Humanities = 20 (6 master's and 14 doctorates) FEIT = 23 (13 master's 10 doctorates) FHES = 18 (9 master's and 9 doctorates) FMS = 20 (9 master's and 11 doctorates) 99 staff with doctorates and 123 staff with master's degrees. 100 staff members active in postgraduate supervision.
5. Postdoctoral Fellowship Programme	5	Living stipends awarded = R1m and project expenses of R370 000.	Career development programme in draft format for postdoc fellows.
6. Focused Researchers Programme	Grow number of black female researchers.	Operational funds of faculties to support development of black female researchers.	1 x application to NRF sabbatical programme for 2016. 1 x award from NRF for sabbatical programme for 2015. 1 x career development award for 2015.
7. Rated Researchers Programme	10	9 rated researchers	R340 000 allocated to sustainability of rated researchers. 2 x renewal applications submitted. One approved for rating. 1 x new application submitted. Approved for rating from 2016. Five research professors' positions re-advertised to attract rated researchers.
8. CUT and UFS Joint Research Programme	5	Fifteen (15) applications received.	4 applications funded. Two applications funded at R100 000 each and two applications funded at R500 00 each.
9. Centres, Units and Groups Project	2 Centres 7 Units	2 Centres 12 Units 7 Groups	R530 000 allocated for research entity development. Revision of policy to align research entities to regional, African, continental and global needs. Evaluation of current entities to assess performance was completed end of 2015.

10. Sabbatical Programme	Grow annual staff qualifications by 10%	Two NRF calls for research sabbaticals	Call 1: Three applicants – two successful Call 2: Five applicants committed for application, one submitted application.
11. SARCHI Chair	2 SARCHI Chair	Application in female programme only – application in sustainable development pending	NRF approved SARCHI chair in medical product development.
12. NRF Funding	R 6 m	Increase applications for external funding from both staff and students	R14 765 205 in 13 categories.
13. INTERIM	2 Editions	Continuous support on how to write for publication	Faculty of EIT and Faculty of Health and Environmental Sciences committed to dedicated faculty editions. Faculty of EIT completed a two-volume dedicated edition of 24 papers. Note: Interim in 14 th year of existence.
14. JNGS	2 Editions	Limited support available to run journal on a professional basis	Three editions published in 2015: JNGS 13 (1) – 7 papers JNGS 13 (2) – dedicated edition on teaching and learning programmes – 11 papers JNGS 13 (3) – 14 papers According to SABINET the JNGS had the following views and downloads during 2015: <ul style="list-style-type: none">Views: 17 106Download: 19 431 These numbers represent a total of 36 000 views and downloads. On request of ASSAF (delegated by DHET) the JNGS submitted its application for evaluation for the next cycle of evaluation. Outcome expected end 2016.



PART 3

BUILDING THE RESEARCH STRUCTURE AND CAPACITY



RESEARCH ENTITIES: CENTRES, UNITS AND GROUPS

Research within the university is organised based on the Policy on Centres, Units and Groups approved by Senate and Council in 2013 and reviewed in 2015. The policy is informed by the University Research and Development Plan, 2014 – 2020. During the year under review two (2) Research Centres, twelve (12) Research Units and seven (7) Research Groups were approved.

The following Research Centres and their key performance areas are highlighted:

Centre for Rapid Prototyping and Manufacturing (CRPM) has, since its inception in 1997, been offering services to the Free State and national industry and has a client base of around 750. Annually, the centre

completes on average 540 short term projects for industry, manufactures approximately 4000 parts and undertakes about 22 research projects. Since 2011 the CUT researchers and students have produced 29 peer reviewed journal articles and 51 peer reviewed conference papers. To further enhance the CRPM operations, the centre has established an international ISO 13485 quality management system and underwent an audit for certification by the international organisation TÜV in February 2016. The scope and focus of the CRPM Research Centre is positioned in the field of Additive Manufacturing (AM), more popularly known as 3D Printing. The Director: CRPM Research is Professor Willie du Preez, who is also the CUT coordinator of the national Collaborative Programme in Additive Manufacturing, funded by the DST since 2015.



Figure: Focus areas recommended in the SA Additive Manufacturing Strategy

The centre is supported by key researchers:

- Prof. Ihar Yadroitsau, Research Professor, C1 rated researcher, Principal Investigator: NRF Research Chair in Medical Product Development through Additive Manufacturing
- Prof. Michele Truscott, Associate Professor: Mathematical and Physical Sciences
- Dr Kobus van der Walt, Senior Researcher: Mechanical and Mechatronics Engineering
- Mr Gerrie Booysen, Director: CRPM Services
- Dr Ina Yadroitsava, post-doctoral fellow
- Mr Jacques Combrink, Lecturer: Mechanical and Mechatronics Engineering
- Dr Maina Maringa, Senior Lecturer: Mechanical and Mechatronics Engineering

This team is further strengthened by external extraordinary professors.

Centre capabilities, qualification mix and capacity: On a strategic level the CRPM research focus areas are aligned with the recommendations of the SA AM Strategy as reflected in Figure on the previous page.

The CRPM postgraduate qualification mix includes the following:

- Materials science and metallurgical engineering
- Mechanical engineering
- Design, simulation and modelling, including industrial and graphic design
- Laser physics
- Product development
- Medical expertise in reconstructive surgery
- Prosthetics

The combined expertise of the CRPM, the Product Development Technology Station (PDTs), Mechanical and Mechatronics Engineering and the Department of Design and Studio Art (DDSA) provides the opportunity

to establish a research and development programme focused on niche areas that build on the strengths of CUT and result in offerings that contribute strongly towards improving the competitiveness of the Free State and South African industry.

Given these strengths of CUT, the following focus areas in the research and development (R&D) strategy of the CRPM have been defined:

- Development of qualified AM titanium alloy and polymer parts for medical implants and devices, as well as aerospace parts
- Impact in traditional manufacturing sectors, particularly through advanced AM tooling
- SMME development through AM for direct end-use in industry

In support of the above, various projects on design for additive manufacturing are on-going and additive manufacturing machine/process development is also being pursued.

Based on the above, the research strategy of the CRPM Research Centre can be presented by the diagram in Figure below.

The research outputs cover a wide range of applications of AM based on metal, polymer and sand powders and illustrates the impact the CUT R&D has had in the manufacturing industry and the medical field. The work by Prof. Ihar Yadroitsau and colleagues deals with physical aspects of laser-matter interaction; factors influencing selective laser sintering/melting processes; formation of inter-particle contacts and the rearrangement of particles during laser sintering of powder mixtures; balling processes; and the thermal properties of powders.

The research is supported by the following infrastructure:

- Substantial additive manufacturing infrastructure (estimated value: R35 million) is available in the CRPM. This includes 3 EOS metal AM machines, 6 polymer AM machines and 1 sand AM machine.

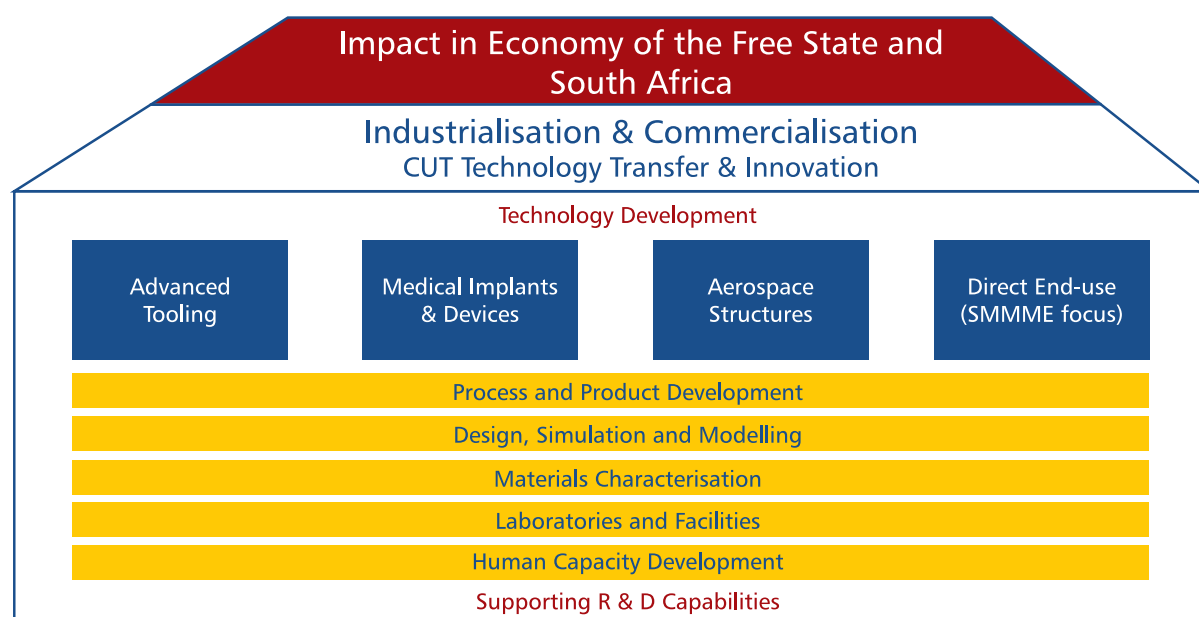


Figure: R&D Strategy of the CRPM Research Centre

- The PDTS has a well-equipped mechanical workshop, as well as 3 scanners for reverse engineering. This technology station has a current capacity of 30 staff members and students.
- In addition to the above, a wide range of computer software packages (MIMICS™, MAGICS™, GeoMAGIC™, 3-MATIC™) for the conversion of CT and MR scan files into formats suitable for direct implementation into AM machines, is available. Design software (SolidWorks, SolidEdge) and finite element analysis packages (NASTRAN and PATRAN) are also available.
- In support of the required materials research, a materials laboratory with the basic equipment has been established.
- A teacher education laboratory with CRPM equipment on loan (Stratasys Dimension machine and handheld Z-Corp reverse engineering scanner) is operating for the exposure of future teachers to additive manufacturing/3D printing. This project was started in 2014 and now has five 3DSYSTEMS CUBE (desktop) machines. Around 90 future teachers have been exposed (over the last 3 years) to CAD and 3D printing, with each of them completing a design and 3D printed part.
- Equipment in the DDSA laboratory includes four ABS 3D printers, an Envision Tech Wax printer and a laser cutter.

Staff members of CRPM are part of the Rapid Product Development Association of South Africa (RAPDASA) which was founded in 2000. RAPDASA has played a national leading role in introducing Rapid Prototyping, currently known as Additive Manufacturing or 3D Printing, to the South African R&D community and industry. RAPDASA presents an annual international conference in which CUT staff and students have been, and are still, active participants with a number of papers presented each year.

The Centre for Applied Food Safety and Biotechnology operates under the School of Agriculture and Environmental Sciences within the Faculty of Health and Environmental Sciences at the CUT, and has existed since 1995 as part of the then Activity Programme of the National Research Foundation. The main aim of the unit is to perform cutting-edge food safety and microbiology research and the group is currently one of the most comprehensive in South Africa focusing exclusively on aspects of food safety and hygiene.



The centre has over 100 publications and carries the status of Developed Niche Area at the NRF. It currently boasts a critical mass of about 32 members, including 11 master's and 8 doctorates, 1 post-doc, 3 full-time researchers; 3 external grant holders and 1 administrative assistant. The Centre Director is Prof. JFR Lues, an NRF rated researcher and in 2013 elected vice-president of the SA Association of Food Science and Technology.

The work of the centre falls mainly in the field of sciences – natural and science engineering technology.

- Level 1: Science, Engineering and Technology
- Level 2: Food Science
- Level 3: Food Safety

Postgraduate programme mix:

- Product shelf-life and packaging
- Spoilage and preservation
- Novel antimicrobials
- Pathogen/hazard ecology in high-risk food environments
- Industrial effluent characterisation
- Novel/safe/green food processing technologies
- Food safety management systems and behaviours

For its exclusive use the UAFSB boasts fully equipped laboratories with contemporary analytical equipment such as HPLCs, capillary electrophoresis systems, GCs and a GC-MS, an electron microscope and state of the art molecular apparatus. Generous funding from both internal and external sources is available to conduct projects and support current and prospective postgraduate students.

The research done in the UAFSB is categorised under the following sub-groups:

Bioactive oils: Dr Ntsoaki Malebo's sub-group specialises in the search for bioactive oils against foodborne spoilage and pathogenic microorganisms. Currently this group is using various techniques such as electron microscopy and mass spectrometry based proteomics to elucidate the mode of action of bioactive oils against these microbes. The main aim is to find alternative antimicrobials that will serve as natural bio-preservatives and disinfectants to replace currently used synthetic antimicrobials. The research links with work done by another member of the faculty, Dr Moosa Sedibe, into aromatic oils found in *Rose geranium* and other plant species. Apart from its internal linkages, the projects are conducted in collaboration with the Institute for Tropical and Sub-tropical crops at the Agricultural Research Council and the University of Johannesburg. Dr Malebo is currently an NRF-CUT Research Fellow who supervises three master's and one doctoral student. She has successfully supervised two master's students who have since graduated. Dr Malebo is jointly responsible for setting up a microscopy unit that will boast a scanning, AZ100 zoom electron-microscope and a fluorescence microscope. Dr Malebo, together with her group, has published papers in international peer-reviewed journals, and presented papers at national and international conferences such as the HOPE Meeting attended by a number of Nobel Laureates.

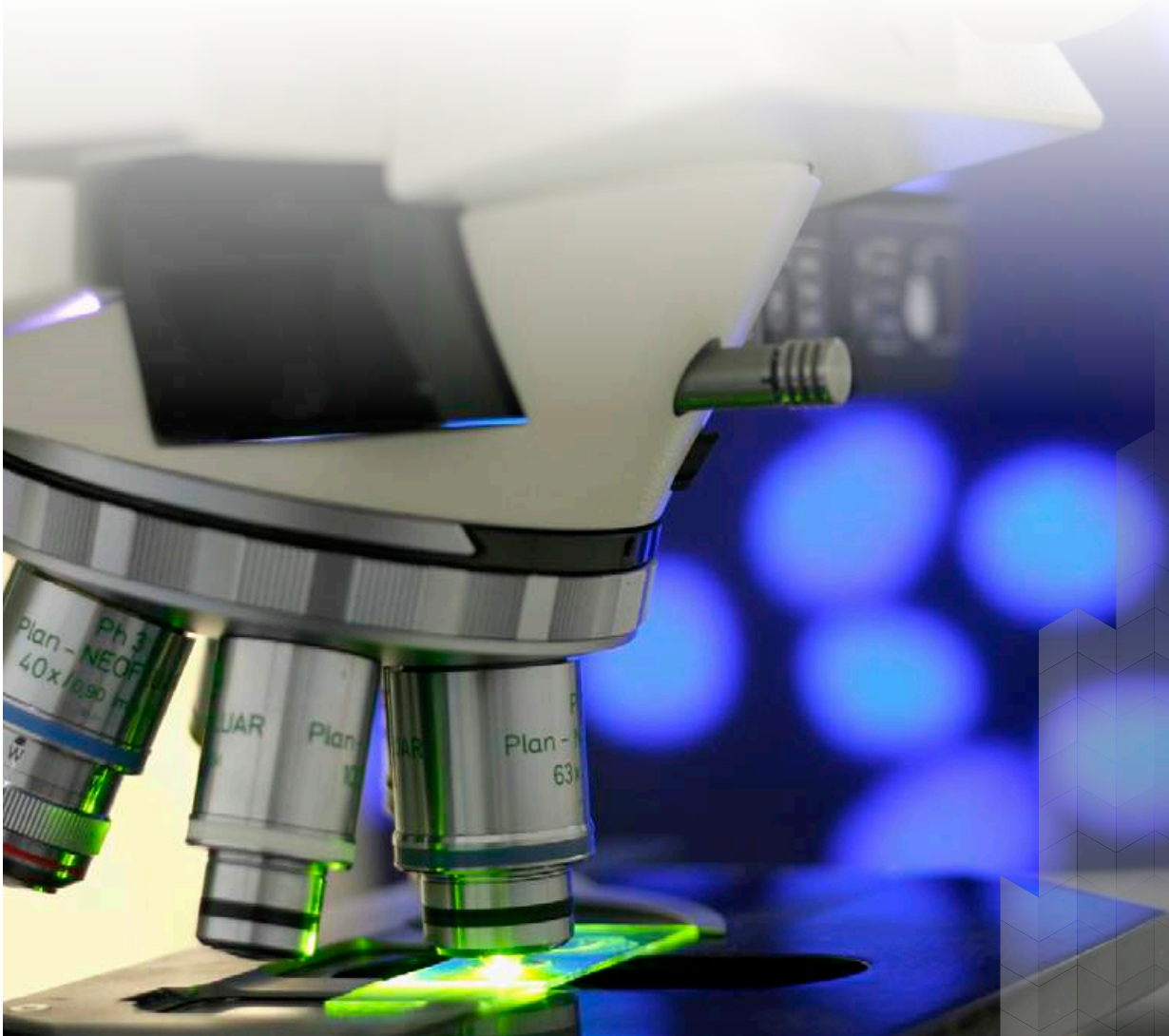
Food effluent characterisation: The effluent research team, headed by Dr Olga de Smidt, focuses on applying micro- and molecular diversity analyses as a tool to establish multifaceted fingerprints for food industry wastewater contributors as an instrument for microbial source tracking. Current projects aim to assess the current status of wastewater monitoring and treatment in the towns/cities in the Free State with food production, processing or packaging factories. This is achieved by constructing, analysing and assembling microbial fingerprints for abattoirs, fruit juice bottling factories and dairies, amongst others. In cases where optimal methodologies do not yet exist, various projects in the group focus on finding methodologies to assemble microbial diversity profiles for food industry effluents. Ultimately the activities endeavour to introduce bio-treatment options in attempts to remediate effluents and contribute to general environmental sustainability of the food industry. The team collaborates with the University of the Free State in terms of Sanger Sequencing, Stellenbosch University for Next Generation Sequencing and the University of Ljubljana for skills development and student exchange. The sub-group boasts six master's students, three doctoral students and five graduate student assistants. The group was initiated in 2012 and is currently funded by the National Research Foundation (NRF) under the Thuthuka programme. The team regularly publishes in foremost journals, while members regularly attend conferences locally and abroad – usually the group sends notable delegations abroad to the International Committee of Food Microbiology and Hygiene.

Food safety assessment in health care and traditional environments: Ms Jane Nkhebenyane is the group

leader and the main research focus is the assessment of food handling behaviours, including the evaluation of food safety interventions, hygiene promotion and food safety training in compromised environments. Antimicrobial profiling and molecular characterisation of foodborne pathogens in vulnerable health care settings are also part of the group's activities. The work of the group contributes to the development of health interventions and their evaluation, and situational analyses in social and economic contexts through the use of qualitative empirical research. The group currently has 1 doctoral, 1 master's and 2 fourth-year students, with Prof. Oriel Thekisoe (University of the Free State) as a participating member. The group also collaborates with the London School of Hygiene and Tropical Medicine in the UK. Research articles that have emanated from the research work of the group are regularly published in reputable journals and members presents papers at international and national conferences; these include recent visits to the US, Canada and Switzerland. Application for funding has been submitted to the NRF and the group enjoys financial support from MRC and SANPAD.

Other research foci in the UAFSB include:

- Biofilms (Dr Willem Groenwald),
- Maize biotechnology and fermentation (Dr Hanita Swanepoel),
- Entrepreneurial education (Miss Elvina Smith) and
- Antimicrobial adaptation (Mr Ruan Slabbert).



The following research units and their objectives are highlighted below:

UNITS	
Unit for Foundations of Education	
OBJECTIVE	To build capacity of prospective and well established academics and researchers in the area of research in the different sub-disciplines of education including curriculum studies, psychology of education, educational management and education law, philosophy of education, sociology of education.
LEADER	Prof. Schlebusch: HOD for Postgraduate Studies: Faculty of Humanities
Unit of Research in Scholarship of Teaching and Learning (RSoTL)	
OBJECTIVE	The purpose of the proposed unit is to become a home for all research activities on teaching and learning at CUT in general, and for the DHET teaching and learning development grant at the Central University of Technology (CUT). The project aims to build capacity of staff and students to carry out research in teaching and learning and thus improve their teaching and student success. It aims to build capacity of staff to develop abstracts and papers for conferences and journals on RSoTL, develop capacity in the development of a common philosophy and approach to teaching and learning of different professional and sectoral fields of practices of higher education in general, and universities of technology (UoTs) and technical vocational education and training (TVET) institutions in particular, as well as research academic development and support practices and programmes. Thus, this mentorship project is to create RSoTL as a scholarly niche, and the development of a critical mass in this area.
LEADER	Prof. IM Ntshoe: C Rated NRF Researcher
Unit for Scholarship in Research Education	
OBJECTIVE	The objective of the research entity is to identify and develop a research culture through two core themes: The type of research training that is required for researchers (staff and postgraduate students) to participate in the research and innovation value chain (basic research focus). Identify on the basis of these results appropriate research education strategies to train researchers (at various levels of experience) with regard to the on-going demands of a research culture and the requirements of the research and innovation value chain. These strategies include knowing and understanding the research environment, personal and career advancement, to be ethical and trustworthy, acquiring adequate planning skills, communication skills and science writing skills and to engage actively in knowledge transfer and innovation.
LEADER	Prof. Laetus O.K. Lategan: NRF rated researcher
Research Unit for Evolvable and Manumation Systems (RGEMS)	
OBJECTIVE	The unit will do applied research in renewable energy technologies and optimisation as well research on Vision systems and applications within the Manufacturing/Assembly/Quality fields. The projects are done with industry, government and the current projects have the aim to engage with the community and especially the rural community as well as SMME's in South Africa and in particular our region.
LEADER	Prof. HJ Vermaak: Professor: Electrical Engineering
Unit for Lean Construction and Sustainability	
OBJECTIVE	The primary vision of this Unit is: to develop further understanding of 'lean' and 'sustainability' in relation to 'theory and practice' as it impacts on the built environment in developing economies; and to critically appraise lean construction as an efficiency driven strategy with key aspects tied to management sciences, social sciences, and engineering in order to lead the development of novel strategies for the proliferation of sustainability in the built environment.
LEADER	Prof. FA Emuze: Associate Professor and HoD: Built Environment
Unit for Drug and Discovery Research	
OBJECTIVE	The increased incidence of multiple drug resistance, hypersensitivity, immune-suppression and allergic reactions encountered with the use of conventional medicines, necessitates the bioprospecting for drugs from new and natural sources such as plants. These issues will be addressed in the research unit through the systematic recording of medicinal plant resources used by traditional medical practitioners, their evaluation for medicinal potential and by the creation of medicinal plant gardens which contribute to their conservation. Furthermore, the use of bioinformatics in the identification of new drug targets and development of inhibitors puts us in line with recent developments in drug development and design. This multidisciplinary Unit for Drug Discovery Research has identified 4 themes. 1) 1. Medical Biochemistry and Ethno-pharmacology, 2) Genomics, Proteomics and Bioinformatics, 3) Agriculture, Essential Oils and Aromatic plants, and 4) Clinical Research.
LEADER	Prof. Samson Sitheni Mashele: Acting Dean of the Faculty of Health and Environmental Sciences (Medical Biochemistry, Ethnopharmacology)
Unit for Public Management and Administration	
OBJECTIVE	The main objectives of research conducted within the Research Unit in Public Management and Administration include the following: to align the research strategy of the Department of Government Management Research Unit with CUT's Vision 2020. The CUT's Vision 2020 aims to ensure that CUT becomes an engaged university that focuses on producing quality social and technological innovations in socio-economic developments, primarily in the central region of South Africa; to strengthen the research capacity of our students and staff through mentoring, workshops, conferences and seminars; and to focus our research around the focus areas with the aim to increase our research outputs. The major focus areas of research in the Department of Government Management.
LEADER	Prof. T van Niekerk (Edwards): HOD, Department of Government Management.
Unit for Mathematics, Science and Technology Education Research	

OBJECTIVE	The objectives of the project are: to identify the needs of the practising Mathematics, Science and Technology teachers in the high schools around Bloemfontein; to develop a teacher support programme that will pedagogically capacitate these teachers to meet the needs of their learners; to improve learner performance in Mathematics, Science and Technology education in the schools that are going to take part in the project; and to recruit Mathematics, Science and Technology teachers into our postgraduate programmes.
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LEADER	Prof. M. K. Mhlolo: Mathematics Education
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Unit for Tourism Destination and Management

OBJECTIVE	The research unit on Tourism Destination Management aligns with the Leisure Management cluster which is a strategic research focus for CUT. The objectives of the research unit are as follow: to align the research strategy of the unit to CUT's Vision 2020 which aims to ensure that CUT becomes an engaged university that focuses on producing quality social and technological innovations in socio-economic developments, primarily in the central region of South Africa; to build the research capacity of our students and staff through mentoring, workshops and seminars; to focus our research around the areas where we have the capacity to generate research outputs; and to optimise our research outputs through the completion of postgraduate qualifications, publications in accredited journals, presentations at national and international conferences and applications for external research funding.
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LEADER	Dr. R Haarhoff; HOD: Tourism and Event Management
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Unit for Research on Informatics for Droughts in Africa (URIDA)

OBJECTIVE	The unit is dedicated to the advancement of scientific research and development of relevant and sustainable information technology and communication (ICTs) tools for predicting Africa's persistent climatic variability, especially in relation to droughts. The unit adopts an inter-sectoral (meteorological, hydrological, computer science, engineering, health, agriculture and planning) approach to ensure people-centred early warning systems that are both accessible and perceived as relevant to at-risk communities in Africa. Africa consistently contributes over 50% of people affected by droughts. By providing solutions to this calamity, the unit will make a positive contribution to the Agenda 2063: The Africa We Want.
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LEADER	Dr EM Masinde
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Unit for Sustainable Water and Environment

OBJECTIVE	The research on sustainable water resources and environment is aimed at addressing problems related to water scarcity and environmental issues. Impacts of the major drivers of water scarcity and environmental issues, such as population growth, economic growth, improved living standard, climate change, etc. are investigated with the final goal of contributing to the three pillars of sustainability (social, environmental and economic). To this effect, the research is organised under two major thematic areas, namely extreme hydrologic events and hydrological and water resources modeling. The extreme hydrologic event theme focuses primarily on the analysis, forecasting and management of droughts and floods in the central regions of South Africa whereas the hydrological and water resources modeling theme focuses on the assessment of impacts of land use and climate change in the region.
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LEADER	Prof. Yali Woyessa: Associate Professor and Head: Department of Civil Engineering
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Unit for Enterprise Studies (UES)

OBJECTIVE	Activities under this unit will cover broad areas of public, private and social enterprises and will dovetail with the socio economic development. The specific objectives of the unit are to: 1. conduct blue sky research on topical/contemporary issues in business with entrepreneurship bias; 2. disseminate research findings through journal articles and conference papers; 3. publish books on public, private and/or social enterprise; 4. provide business consultancy services to SMMEs in the FS; 5. offer contract research services based on demand; and 6. conduct research seminars and host conferences on enterprise issues.
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The research thematic areas are:

New venture creation	• Entrepreneurial marketing	Emerging technologies in entrepreneurship
• Ethical entrepreneurship	• Leadership	• Higher education in entrepreneurship
• Responsible/sustainable entrepreneurship	• Strategic management	• Small business development
• Social entrepreneurship	• management	• Corporate entrepreneurship
• Organisational behaviour	• Public Private Partnership	• Human capital development
• HRM	• Retail studies	• Sustainable HRM in SMMEs

LEADER	Prof. Dennis Yao Dzansi: HoD: Business Support Studies - Entrepreneurship; Business Ethics; Business Social Responsibility
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The following Research Groups and their objectives are highlighted below:

GROUPS	
Sustainable Urban, Roads and Transportation (SURT)	
OBJECTIVE	The general aim of the research group is to study towards sustainable engineering solutions to have an impact on the lives of the people through research in transportation related topics.
LEADER	Dr. M Mostafa: Senior Lecturer Civil Engineering
Advanced Database and Software Engineering	
OBJECTIVE	Provide innovative and affordable solutions to day to day problems faced by a previously and currently disadvantaged population with regard to areas of society, education, and businesses,
LEADER	Mr. N Mabanza: Lecturer Information Technology
Distributes Systems and Networks	
OBJECTIVE	Investigate appropriate and innovative IT technologies of local relevance touching on the following areas – education, health, local government, SMEs, among others.
LEADER	Mr G M Muriithi: Lecturer Information Technology
Mobile Technologies for Education	
OBJECTIVE	To provide innovative mobile technologies for education that can be used to improve the skills level of the community.
LEADER	Mrs MI Venter: Lecturer Information Technology
Research Group in Engineering Education (ARGEE)	
OBJECTIVE	ARGEE aligns itself with the Teaching and Learning Plan 2014-2020 of CUT and undertakes to promote the scholarship of teaching and learning. It forms part of the Research Programme of Education. Two of its main aims are to create awareness of research possibilities in engineering education and promote innovative pedagogies within the FEIT.
LEADER	Prof. James Swart: Associate Professor Electrical, Electronic and Computer Engineering
Sustainable Bio-Environment	
OBJECTIVE	This group focuses on water quality research aimed at the development of new tools (ways) to describe water quality data. Included is the development of new technologies for safe waste disposal of health care risk waste, development of a waste water guide at abattoirs, improvement of health care waste services.
LEADER	Prof. A Fossey: Department of Life Sciences
Soil Mechanics	
OBJECTIVE	The focus of the group is to assess or investigate foundation problems due to heaving clays in the Free State. The research will be based on: the development of reliable and readily applicable methods for assessing the heave potential of the active clays commonly found in the Free State; and the development of reliable methods for designing foundations using the new developed methods.
LEADER	Dr Elizabeth Theron

RESEARCH CHAIR IN MEDICAL PRODUCT DEVELOPMENT THROUGH ADDITIVE MANUFACTURING



Professor Ihar Yadroitsau (Igor Yadroitsev)

has more than 30 years of academic experience in applied optics and laser technologies. In July 2015 he was appointed Research Chair in Medical Product Development through Additive Manufacturing at the Faculty of Engineering and Information Technology, Central University of Technology (CUT), Free State, Republic of South Africa.

He has a strong interdisciplinary background and broad experience in the field of physics, material science and engineering, which allows him to comprehend scientific and technical problems with the purpose of finding original solutions in different fields of laser applications. His activity in additive manufacturing began in the middle of 90s in the Institute of Technical Acoustics of the Belarusian Academy of Science. From 2005 to 2013 he worked as Senior Researcher in France, at the National Engineering School of Saint-Etienne, which is a member of the Research and Higher Education Centre of the University of Lyon. In January 2014 he was appointed as Research Professor at the Faculty of Engineering and Information Technology, Central University of Technology, Free State. Since his appointment, he has gone through SA NRF rating process and has been placed in the C category (level C1). Professor Yadroitsau has published more than 120 papers and 1 book; he is the holder of nine patents.

Current research interests include biomedical applications of additive manufacturing (AM); advanced implants by AM; programming and optimising of selective laser melting (SLM) processes; investigation of microstructure samples manufactured by SLM and post-processing of as-built parts; influence of manufacturing process-parameters on mechanical characteristics of AM samples; synthesis of functionally graded and multi materials by AM; optical monitoring systems as applied to the SLM process; physical aspects of laser-matter interaction.

Since 2015 Prof. Yadroitsau has been the supervisor of four (4) master's students and one (1) doctoral student in Engineering. Their studies are devoted to selective laser melting, residual stresses, heat treatment and mechanical properties of additive manufacturing objects. To involve the students in Material Science studies, to expand their horizons and to be at the forefront of the world's research in the field of additive manufacturing, the new metallographic laboratory at the Department of Mechanical and Mechatronic Engineering was organised.

Prof. Yadroitsau has fruitful cooperation links with other researchers from RSA, Brazil, Sweden, France, Singapore, USA, China, Russia and Belarus. He participated in the Collaborative Programme in Additive Manufacturing, which was granted by the DST. Professor Yadroitsau has been recognised for his research achievements with awards: trophies AFPR 2005, rewarded for developing a process for direct manufacturing of multi-materials parts by SLM

technology (France); the laureate of the CLP's (Club Laser et Procédés) prize, Laser Innovation, Academic Prize 2009 (France); CUT VC Excellence Research Awards 2015 in the category: Innovation.

In August 2015, the CUT was awarded a Research Chair under the Department of Science and Technology's South African Research Chairs Initiative (SARChI), the goal of which is to increase the research output and innovation in areas that are considered essential to the country's strategic growth and development. Prof. Yadroitsau is the grant holder of the Research Chair in Medical Product Development through Additive Manufacturing.

RATED RESEARCHERS

Professor Laetus O.K. Lategan

is currently the Dean: Research and Innovation. 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 currently acts as founding editor of the Journal for New Generation Sciences, a Department of Higher Education and Training accredited research journal.



As 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 current research interests centre around three themes:

- **Medical humanities:** This project focuses on the many ethical challenges faced today by health care practitioners. These challenges are not limited to the conventional bioethical challenges of life and death, informed consent, palliative care or research on human subjects only. The literature review suggests that complex matters such as a weakening health care system, health care research supported by the medical industry, socio-economic and socio-political circumstances, communication, and the globalisation of bioethics contribute towards the ethical challenges health care practitioners are experiencing. These challenges contribute towards the ethical vulnerability of health care practitioners. The project intends to address ethical vulnerability of the health care practitioners.
- **Research ethics and integrity:** The research questions that emerge are a) What kind of ethical code is required to address i) the complexity of research ethics and integrity, ii) the dynamics of the situation and iii) how research workers can

be sensitised and educated to progress in their comprehension of research ethics and integrity? and b) How best can researchers be made aware of the meaning and value of these research codes?

- *How to educate a new generation of researchers:* This project defines research education as *the process of developing future researchers to participate in the research and innovation value chain*. The process of researchers' development is studied on the basis of two core themes namely (i) what kind of research training is required for a next generation of researchers to participate in the research and innovation value chain (basic research focus) and (ii) appropriate research education strategies to train researchers (at various levels of experience) with regard to the ongoing demands of a research culture.

His current research interest is framed around applied ethics, especially in research ethics and integrity, healthcare ethics and ethical challenges in doctoral education. In 2015 his focus was on:

What research ethics and integrity guidelines are needed to deal with the training of researchers (research education) and students (doctoral education)?

What ethical challenges should be addressed in doctoral education? The focus was on the supervisor/student relationship and the university's responsibility towards the supervisor and the student. His research pointed towards the challenges associated with supervisor as research manager and advisor, the supervisor as mentor and the supervisor as custodian of academic quality, integrity and relevance. With regard to the student, the focus was on the responsibilities of the student towards the research for the study and the student as researcher.

The basis of healthcare ethics for healthcare practitioners. His research pointed towards ethical training for healthcare practitioners, patients, managers and administrators and habitats. The research pointed out that it is a limitation to focus only on the healthcare practitioner's responsibilities (for cure and care) and not to also deal with their ethical challenges and vulnerability.

The following achievements can be reported:

- Four categories for research ethics and integrity on the training of researchers and students were identified. The categories are:
 - **academic:** academic citizenship, research as a common good, relevance, markets and social impact, role models, partnership, the next generation of researchers;
 - **science:** new knowledge, scholarship, quality and standards, funding;
 - **values:** do no harm, protect vulnerability, add value and meaning, public accountability; and
 - **application:** authorship, postgraduate supervision, data and IP protection, training, education, role profiles, mentorship, engagement.
- Ethical challenges in doctoral education. The following challenges were identified:

Roles and responsibilities

- Modes of knowledge production and presentation
- Safety and security
- Data integrity
- Personal and professional relationships
- Role of public trust and integrity
- Ethical training

Basis of healthcare ethics for healthcare practitioners:

- Ethical vulnerability necessitates a new understanding of *healthcare ethics*; its meaning(s) and application(s). In addition, a post-religious and post-structural world together with a technology-driven society, require a new understanding of the healthcare environment.

During the year of report the following publications were published and the following presentations were made:

Accredited journal publications

The contribution of a doable hospitality and engagement ethics in the ethical care of healthcare workers. (translated title). (Co-authors - Roger Burggraeve & Linus Vanlaere). Stellenbosch Theological Journal 1 (1): 217-233.

"Managing the household of God": The contribution from management sciences to the sustainability of the church as an organization (Co-author as first author – with Andre Oosthuizen – first author). Stellenbosch Theological Journal 1 (2): 551-568.

Medical ethics as the science of normative perspective in healthcare and its role to address ethical vulnerability. Journal for Christian Scholarship. (3 & 4). 23-41.

Book chapter

Software for research integrity. The role of research codes, statements and declarations in research ethics and integrity. 2015. Steneck, N., Anderson, M., Kleinert, S. and Mayer, T. Integrity in the global research arena. Singapore: World Scientific Publishing. 165-176.

Public intellectualism

Doctoral diet: an appetite for instruction. Getting ahead. Supplement to the Mail and Guardian. 6-12 February. 7.

Papers read at conferences

Engaged scholarship? Lessons for the research agenda. Paper read at the Community Engagement Learning Symposium, Rhodes University. 4-6 May 2015.

A South African framework for research ethics and integrity for researchers, postgraduate students, research managers and administrators. Paper read at the Fourth World Conference on Research Integrity. Rio de Janeiro, Brazil. 31 May – 3 June 2015.

Get set. Get ready. Go! Planning and activating your research career. Workshop during the 4th DAAD NRF in Country Scholarship Holders Meeting. Stellenbosch. 21-23 June.

Presentation on Institutional Engagement Strategies to the NRF's Research Administrators Workshop. 30 September – 2 October. Port Elizabeth.

Research, innovation and entrepreneurship. An intersecting perspective. Eighth annual SATN international conference. Entrepreneurship education for economic renewal. Vaal University of Technology. 19-21 October. (presentation by LOK Lategan and abstract submission jointly by SATN RI Committee members).

Posters presented at conferences

Ethical challenges in post-graduate supervision. Poster read at the Fourth World Conference on Research Integrity. Rio de Janeiro, Brazil. 31 May – 3 June 2015.

More than truth telling: Academic ethics as accountability. Poster read at the 28th Consortium for Higher Education Researchers Conference, Lisbon, Portugal, 7-9 September 2014.



Professor Ryk Lues 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 Safety 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 has held the positions of Programme Head of Environmental Health, Director of the School for Agriculture and Environmental Sciences, Faculty Research Manager and rotating Acting Dean of the Faculty of Health and Environmental Sciences at CUT, and has served on CUT council in the portfolio of senate representative.

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. He is an NRF-rated scientist and has to date authored 67 articles in ISI accredited journals, 3 book chapters and 1 book on topics related to research methodology, food preservation, food safety culture and food hygiene systems management. He has supervised several master's, doctoral and post-doctoral candidates and often acts as independent examiner, referee, auditor and guest speaker, both locally and abroad. He has served on national committees, professional working groups and referee panels of a number of journals, scientific boards and associations including the International Association of Food Protection, the Global Food Safety Initiative, the International Committee of Food Microbiology and Hygiene, the National Research Foundation, the Technology and Innovation Agency and the Food Safety Inspection Service. He serves on a number of teams tasked with, amongst other things, the revision

of the national food-related standards (R619) as well as the ministerial task team on the roll out of the South African e-waste initiative. He held the office of Vice-President of the South African Association of Food Science and Technology (SAAFoST) during the 2013/14 term.

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).

During 2015, he achieved the following: 1) a paper that was presented at an International Conference on Sociology, Psychology and Education (ICSPE) in Singapore from 19 to 21 January 2015 was published in the peer-reviewed conference proceedings in 2015; 2) a paper that was presented at the 8th International Conference of Education, Research and Innovation (ICERI) held in Seville, Spain, from 16 to 18 October 2015, was published in the peer-reviewed conference proceedings in 2015; and 3) another paper was presented at the Southern African Society for Education Conference from 7 to 9 October 2015. An article from this paper was submitted to the special issue of Africa Education Review Journal for publication in September 2016.

Achievements related to research work include:

- SAAAD sponsorship for participating in research training programme on qualitative research – African perspective (1997-1998).
- DSE sponsorship for attending a workshop and presenting a paper in Berlin, Germany (9-21 August 1998).



- NORAD sponsorship for visiting some schools and the University of Oslo in Norway (21-25 August 1998).
- NUFFIC sponsorship for visiting Wageningen University in the Netherlands (23-30 September 2006).
- UNIZUL Research Committee funding to present a paper at an international conference in Honolulu, Hawaii, USA (2006)
- UNIZUL Research Roll of Honour for being a Senate representative in the Research Committee (21 November 2007).
- UNIZUL Certificate of Recognition for research service (21 November 2007).
- Finland and HEQC funding for a research project, as part of South Africa-Finland Cooperative programme (April 2008).
- UNIZUL Research Committee funding to present a paper at an international conference in Prato, Tuscany, Italy (July 2008).
- UNIZUL Research Committee funding to present a paper at an international conference in Greece (July 2009).
- UNIZUL Research Committee funding to present a paper at an international conference in Canada (May 2010).
- UNIZUL Research Committee funding to present a paper at an international conference in UK (August 2010).
- CUT Central Research Office funding to present a paper at SASE annual national conference in Zimbabwe (October 2012).
- NRF Research rating (Category C) (1 January 2014 – 31 December 2019).
- NRF incentive funding for rated researchers: R40 000.00 (grant award per year) = R240 000.00) (01 January 2014-31 December 2019).

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.

During 2015 his research work was carried out in close collaboration with the recently established research unit on Lean and Sustainable Construction in the Department of the Built Environment at CUT. A post-doc fellow was recruited and the focus of the work was identification of critical success factors that would create an environment of sustainability such that construction firms that develop in this environment will embrace sustainability as part of their organisational culture.

During this period, he delivered a keynote address at Construction Industry Development Board (CIDB) Conference, and two conference papers were delivered in South Africa and the United Kingdom. Further engagements involved participation at the 6th Regional Conference of Vice Chancellors, Provosts and Deans of Science, Engineering and Technology (COVIDSET 2015) where he urged universities to pursue sustainability practices by ensuring that the planning, procurement and construction of their facilities incorporate sustainability attributes.



Professor Alfred Beati Ngowi

is a C2 NRF rated researcher currently occupying the position of Dean of the Faculty of Engineering and Information Technology at the Central University of Technology, Free State. He is a registered professional construction project manager (Pr.CPM), member of the Botswana Institute of Engineers

(BIE); Member of the Institution of Engineers, Tanzania (MIET); 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

Professor Isaac Ntshoe is a

C-rated researcher currently occupying a position of Research Professor in the 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 technical and vocational education and training (TVET) institutions.

These foci followed his recruitment by the Central University of Technology (CUT) to develop vocational pedagogy as a scholarly niche area for the institution.



The intention was that this area of research would be shared with other universities of technology in South Africa. The need for these foci was evident, particularly because of the dearth of research in this field, including research on the differentiation between curricula and pedagogy of different fields of practices in universities of technology. This focus has been extended to cover technical and vocational education and training (TVET) colleges, previously known as further education and training colleges. The reason for including the TVET sector was because of overlaps between the types of knowledge offered by universities of technology and TVET colleges.

The framework used to embed research into the curricula design of professional and sectoral fields of practice has been drawn from Basil Bernstein's work on knowledge differentiation, the nature of knowledge of disciplines and knowledge boundaries.

Furthermore, his research in 2015 included research into the scholarship of teaching and learning (SoTL), which was assisted by a Department of Higher Education and Training (DHET) grant, introduced to encourage universities to promote the scholarship of teaching and learning. Twenty (20) of the papers prepared by SoTL mentees were reviewed.

His position regarding the DHET project on the scholarship of teaching and learning extends over the next three years, with the plan being to link this project with continuing discussions on the curricula design and pedagogy of professional and sectoral fields of practices. Accordingly, the current theoretical framework used to understand research in curricula design and the pedagogy of professional and sectoral fields of practice will be used. Professor Michael Young will be coming to conduct a day seminar on research into the scholarship of teaching and learning in terms of the Bernsteinian framework. This framework takes as its premise, the nature of knowledge of disciplines and how it shapes their pedagogy.

Professor Ntshoe's key performance areas include the following:

- Advancing curriculum and pedagogy of universities of technology
- Furthering scholarship of teaching and learning (SoTL) in higher education
 - Organising workshops and colloquia on SoTL – 2 workshops and 2 colloquia
 - Conducting workshop on SoTL – 3 workshops conducted
 - Organising an international conference on SoTL
- Presentation of conference papers and developing articles from the conference proceedings
- Mentoring staff to write Journal articles: Twenty-five (25) papers have been presented at the various SoTL national and international conferences, which have been published in peer reviewed conference proceedings.
- Supervising master's and doctoral students: four (4) seminars were organised and conducted for 5 master's and 5 doctoral students working in curricula and pedagogy of UoTs and TVET colleges.

Seminars and workshops exposed students to the various components of their M and D research including Research designs, Literature Review, Findings and Reporting of Results, and Discussion chapters. Five (5) doctoral students are researching areas of curriculum and pedagogy of UoTs and TVET Colleges. Four (4) master's students are researching areas of curriculum and pedagogy of UoTs and TVET colleges and eight (8) drafts of articles prepared by SoTL mentees have been reviewed and will be submitted for editorial consideration.

In addition Prof. Ntshoe has established collaborations with a number of researchers in the field of sustainable construction. These include: 1) Prof. Rwelamila of the University of South Africa on incorporation of project management skills for contractor development; 2) Prof. Smallwood of the Nelson Mandela Metropolitan University on the incorporation of Health, Safety and Environment in contractor development; 3) University of Botswana for which a comparative study on the development of contractors in Botswana and South Africa. These collaborations have proved invaluable in sharing knowledge and experiences in dealing with contractors of different knowledge levels.

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 Electronic Communication and research into engineering education. His research focus area on metrology is one of his fields of specialisation where he measures different photovoltaic module parameters in order to verify the application of the module within specific environments.



These parameters include tilt and orientation angles, photovoltaic module voltages, currents and temperatures. The objective of this research is to try and optimise the output power of a given photovoltaic module for different electrical and environmental conditions. Most of his recent research in this field has been done with Dr Pierre Hertzog, a colleague in the department.

Engineering education is his other field of specialisation, where he focuses mainly on the use of educational technology to help fuse theory and practice for engineering students in higher education. Throughput rates remain low in higher education, which mandates academics to search for innovative methods to help students demonstrate the right graduate attributes that are required by industry today. He considers himself privileged to be part of a research group in Engineering Education (ARGEE) within the faculty; this group has published 5 accredited journal articles and presented 15 international conference papers over the past two years.

Additional responsibilities include current service as a board member of the South African Society for Engineering Education. He also serves on a number

of technical committees for various IEEE based conferences. Achievements related to his research work include a KIC grant to present a number of papers at international conferences on engineering education. Dr Pierre Hertzog and Prof. Swart were shortlisted by the Wharton-QS Stars: Reimagine Education Awards for their innovative educational jig which they presented in December in Philadelphia, USA.

Makgothi, O.G., Kanengoni, A.T. and Umesiobi, D.O. 2015. The influence of energy level on nutrient digestibility in pigs raised either indoors or outdoors on the South African Highveld. *Trop. Anim. Health Prod.* (in press).

Published abstracts and conference proceedings

Netshirovha, T.R., Umesiobi, D.O., Masenya, M.B., Mphaphathi, M.L., Sebothoma, P.M., Kanengoni, A.T. and Nedambale, T.L. 2015. The role of feeding different levels of protein inclusion in pig diets on nitrogen balance and nutritional digestibility of Kolbroek boars. Published Proceedings of the 48th Annual Congress of the South African Society for Animal Science (SASAS), held at the Umfolozi Hotel, Casino and Conference Resort Empangeni, KwaZulu-Natal, 21-23 September 2015. p. 103.

Nwafor, I.C., Radebe, N.E., Umesiobi, D.O. and Achilonu, M.C. 2015. Haematological and nutritional health expressions of broilers fed admixture of whole hatchery waste meal. Published Proceedings of the 48th Annual Congress of the South African Society for Animal Science (SASAS), held at the Umfolozi Hotel, Casino and Conference Resort Empangeni, KwaZulu-Natal, 21-23 September 2015. p. 106.

Prof. Umesiobi supervised a post-doctoral fellow Dr Matthew Achilonu in research focusing on bioactive phytochemicals: Modulatory effects of pumpkin (*Cucurbita moschata*) seeds on general performance and carcass quality of indigenous chickens.

He also participated in the following professional development activities:

2015 Presented papers at the 48th Annual Congress of the South African Society for Animal Science (SASAS), held at the Umfolozi Hotel, Casino and Conference Resort Empangeni, KwaZulu-Natal, 21-23 September 2015.

2015 Participated at a training session on Celebrating Diversity facilitated by Marc Hemmens of the Pacific Institute South Africa, held at the Japie van Lill Auditorium, Central University of Technology, Free State, 3-4 September 2015.

2015 Presented a paper titled: The status of Agriculture in Free State: opportunities for ICT applications, at a Workshop on applications of wireless sensor networks for weather and water quality monitoring in Southern Africa held at the Prosperitas Auditorium, Central University of Technology, Free State, 21 May 2015 - 22 May 2015.

2015 Participated in the CUT Quality Enhancement Project (QEP Committee and Task Teams) Second institutional workshop: Responsive quality enhancement culture leads to students' success, held at the Bloem Spa Lodge and Conference Centre, Lilyvale-Bloemfontein, 14 May 2015.

2015 Participated in the Workshop on exploring design thinking, problem-based learning

Professor Dennis O. Umesiobi

currently occupies the position of Professor: Agriculture, in the Department of Agriculture at the Central University of Technology, Free State. His specialisation is in Animal Reproductive Physiology and in his research career, Prof. Umesiobi has produced over 20 publications, supervised over 26 master's and doctoral postgraduate students, four (4)

post-doctoral fellows and presented more than 40 papers at national and international conferences and seminars.

During the year under review Professor Umesiobi achieved the following:

Published book chapters: An exciting study resulted in the publishing of two book chapters by a reputable German publisher as follows:

Umesiobi, D.O. 2015. Enzootic Geophagia: Adaptive and Allelomimetic Responses in Farm Animals. In *Human and Enzootic Geophagia: Ingested Soils and Practices*, Saarbrücken, Germany: LAP Lambert Academic Publishing. pp. 281-302. Published on: 2015-04-24.

Umesiobi, D.O., Masia, L.P. and Fourie, P.J. 2015. Enzootic Geophagia of Livestock in the Central Free State of South Africa: Farmers' Observations. In *Human and Enzootic Geophagia: Ingested Soils and Practices*, Saarbrücken, Germany: LAP Lambert Academic Publishing. pp. 336-367. Published on: 2015-04-24.

Published journal articles

Achilonu, M.C. and Umesiobi, D.O. 2015. Bioactive phytochemicals: Bioactivity, sources, preparations, and/or modifications via silver tetrafluoroborate mediation. *J. Chemistry*, 15: 1-22.

Achilonu, M.C. and Umesiobi, D.O. 2015. The formation of carbon-carbon and carbon-heteroatom bonds using silver tetrafluoroborate as a promoter. *Arabian Journal of Chemistry*, 1712: 1-32.

Netshirovha, T.R., Umesiobi, D.O., Masenya, M.B., Mphaphathi, M.L. and Nedambale, T.L. 2015. Effects of dietary protein levels on growth performance and back fatness in Kolbroek boars. *South African Journal of Animal Science* (in press).

and entrepreneurial education, held at the Japie van Lill Auditorium, Central University of Technology, Free State, 13 April 2015.



Professor Elmiën van den Heever-Kriek is a C-rated professor of Clinical Technology and an NRF rated researcher since 2012. Her primary research fields include medical science and systems, disease control and health sciences. Clinical technology is divided in seven specialisation fields namely: Cardiology, Pulmonology,

Perfusion, Nephrology, Reproductive, Neurophysiology and Critical care. Due to the nature of the programme her research involvement is extremely diverse, covering all seven specialisation fields as displayed in her publication list. However, her core research areas and interests are HIV and cancer (especially throat and breast cancer).

Prof. Van den Heever-Kriek has published over 35 scientific papers in peer-reviewed journals, presented over 50 papers at international and national conferences and continues to review manuscripts for accredited scientific journals. She has successfully supervised over 25 master's and 7 doctoral students and has also mentored two post-doctoral research fellows.

During her academic career she has received various academic awards. In 1998, she received the Junior Ernst Oppenheimer Memorial Trust medal for her PhD project proposal and in 2000 the Struwig Germeshuysen Trust award for cancer research. In 2001, the South African Association for Woman Graduates awarded her for her contribution towards cancer research. In 2001 she was nominated by the Japanese Government to attend a 4 month course in advanced microbial enzyme technology, in Japan. The Central University of Technology, Free State also awarded her with the vice-chancellor's medal for best researcher in 2005 and 2010.

POST-DOCTORAL FELLOWS



Dr Matthew C. Achilonu is a postdoctoral research fellow at the Department of Agriculture, Faculty of Health and Environmental Sciences, Central University of Technology, Free State. He received his doctoral degree in Chemistry from the University of the Free State in 2009. His other degrees are: M.Sc. in Polymer Science and

Technology (with distinction/cum laude), and B.Sc. Tech. in Industrial Chemistry were both obtained from the Federal University of Technology, Owerri, Nigeria in 1989 and 1994 respectively. Dr Achilonu's bachelor's degree research was on extraction and purification of Furfural from agricultural wastes (rice husks). His master's degree research focused on grafting

of acrylamide onto gum Arabic macromolecules to produce modified biopolymer.

Dr Achilonu's focus areas of current research are:

- Utilising biologically active phytochemicals in animal diets: investigating their modulatory effects and possible use as a replacement for the synthetic antibiotics, hormones and growth promoters in poultry species.
- Chemical modification of renewable agricultural wastes to a biodegradable biopolymer for wastewater remediation. About eight postgraduate students are working on these ideas under his supervision/co-supervision.

Specialisation

Bioactive phytochemicals in animal diets: In this field of study, Dr Achilonu focuses on pumpkins (*cucurbitaceae*), which are known to display a wide range of biological activities. Hence, the growing interests by farmers in using them as feed additives to fortify animal feeds.

The worldwide growing need to increase animal productivity has necessitated the massive use of harmful synthetic hormones and antibiotics in livestock production. Discovery of the synthetic drugs in animal products is a concern to consumers and hence, the urgent need for their replacement with beneficial bioactive phytochemicals. The bioactive phytochemicals exhibit antimicrobial, antioxidant, antiparasitic, antiprotozoal, antifungal, and anti-inflammatory properties, and consequently have beneficial effects on appetite, growth and the immune status of the animal. Pumpkin species, favoured by nutritionists and researchers for their high nutrient contents, are major crops produced in South Africa. The flesh serves as a traditional food, while the seeds and peels are thrown out as wastes. Pumpkin seed extract is useful for immunomodulation, reproductive health, therapeutics over a wide range of disease conditions and also stimulates metabolism of accumulated fats. Studies have also shown that the pumpkin seeds are a valuable source of protein and fat. Their complexity and extent of bioactivity offer enormous prospects for natural control of pathogenic/ parasitic organisms, stimulation of nutrition, or enhanced resistance to disease infections; they reduce abdominal fat and serum levels of harmful lipids, while the serum levels of beneficial lipids are increased. This study on the effect of pumpkin meals on the general performance of poultry will reveal the pumpkins' phytochemicals, the dosage at which effects are seen, and a possible alternative to synthetic growth hormones and antibiotics used in poultry industry. The present study is therefore expected to show that pumpkin meals have a positive impact on the general performance of all poultry species, via increased feed conversion ratio (FCR), growth rate and egg production traits, as well as its role in the health of poultry by maintaining a balanced microflora in the digestive system.

Agricultural wastes modification and use in wastewater remediation: Studies have shown that organic micro-pollutants such as pesticides, pharmaceutical compounds, personal care products and industrial chemicals are found in surface waters, ground waters, sewage effluents and even in drinking water. When the organic micro-pollutants and their metabolites are dissolved or attached to colloids they are marginally

eliminated by conventional coagulation, flocculation, or biological wastewater treatment processes. Though synthetic polymers are very efficient flocculants, they are limited by not being shear resistant and the residual monomers being detected in treated water are undesirable because of their neurotoxicity and strong carcinogenic properties. Natural biopolymers (polysaccharides) function as bridging flocculants, though they are associated with the following disadvantages: (i) effective at large dosages; (ii) the chitosan is soluble in acidic media and therefore cannot be used as an insoluble sorbent; and (iii) chitosan is used in acidic media only after physical and chemical modifications. Environmental concerns and ecological issues favour the use of the chemically modified biodegradable polysaccharide flocculants because of their improved flocculation efficacy. This study thus aims at modifying natural biopolymers by preparing different ionic polysaccharides; preparation of chitosan blends and crosslinks of the chitosan derivatives to produce modified polysaccharides that are nontoxic, biodegradable, shear stable and efficient adsorptive flocculants that would remove extraneous materials, such as heavy metal ions, persistent organic micro-pollutants and pathogens from abattoir wastewater and industrial effluents within the Mangaung Metropolitan Municipality. Chitosan flakes have a high antibacterial activity and are therefore a promising antimicrobial agent, which could be helpful in the water treatment and in wastewater reuse. The flakes do not lose their antibacterial activity and could directly be reused.

Additional responsibilities

- i) NRF Reviewer: NRF-CPRR Assessment of research proposal: Prof P.A. Ajibade (2015).
- ii) Prestige Research Day Committee Member 2015: Interim abstracts reviewer.

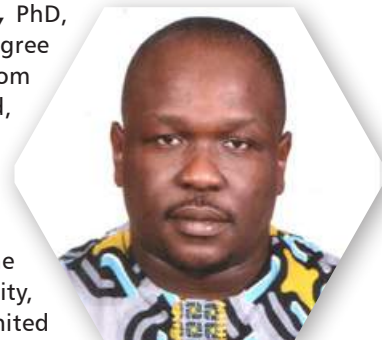
Achievements related to research work:

- iii) Matthew C. Achilonu and Dennis O. Umesiobi. 2015. The formation of carbon-carbon and carbon-heteroatom bonds using silver tetrafluoroborate as a promoter. *Arabian Journal of Chemistry*, <http://dx.doi.org/10.1016/j.arabjc.2015.06>.
- iv) Matthew C. Achilonu and Dennis O. Umesiobi. 2015. Bioactive phytochemicals: Bioactivity, sources, preparations and/or modifications via silver tetrafluoroborate mediation. *Journal of Chemistry*. Vol. 2015, ID 629085, 22 pages, <http://dx.doi.org/10.1155/2015/629085>.
- v) Matthew C. Achilonu, Ifeoma C. Nwafor and Dennis O. Umesiobi. 2016. Biochemical proximates of pumpkin (*Cucurbitaceae* spp.) and their beneficial effects on the general wellbeing of poultry species. *Journal of Animal Physiology and Animal Nutrition*. (under review).
- vi) Matthew C. Achilonu, Susan L. Bonnet, Jan H. van der Westhuizen and Dennis O. Umesiobi. 2015. First quantitative oxidative synthesis of free phenolic 3,4-cis procyanidin B3 oligomer – an active anti-oxidant. Poster presentation at the UNESCO/IUPAC Workshop & Conference on Macromolecules & Materials,

7-10 September 2015, Port Elizabeth, South Africa.

- vii) Department of Education Free State Province full time bursary awards to four M. Agri students.

Dr Bankole Osita Awuzie, PhD, received his doctoral degree in Built Environment from the University of Salford, UK in 2014. Prior to this, he had obtained an MSc degree in Construction Project Management from the Robert Gordon University, Aberdeen, Scotland, United Kingdom and a BSc (Honours) degree from the Imo State University, Owerri, Nigeria in Real Estate Management. He also has experience working in the construction and the facilities management sectors, both in Nigeria and the United Kingdom. Currently, he is a post-doctoral scholar at the Central University of Technology, Free State, South Africa. His research interests consist of the following: strategic procurement; socio-economic sustainability; infrastructure asset delivery and management; and sustainable development in higher education, especially as it pertains to infrastructure assets delivery and management within the campuses of higher education institutions. His research is a joint or MIT project on sustainability between the faculties of Management and Engineering, Information Technology. His post-doctoral activities have presented the following results thus far:



- Awuzie, B.O., Emuze, F.A. and Ngowi, A.B. 2015. Towards sustainable procurement of infrastructure in a South Africa university of technology. In: CIB Joint International Symposium: Going North for Sustainability, 23-25 November, 2015, London, United Kingdom, pp. 13-22.
- Awuzie, B.O. and Emuze, F.A. 2015. Assessment of organizational factors affecting sustainable development in a South African university. In: Proceedings of the 4th Construction Management Conference, 29 November to 1 December 2015, Port Elizabeth, South Africa, 73-82.
- Awuzie, B.O. and Emuze, F.A. 2015. Managing knowledge flows within temporary multi-organisations - the case of an infrastructure delivery system cementing the future. In: Proceedings of the 8th South Africa Council for the Quantity Surveying Profession International Conference, 15-16 October, Bloemfontein, South Africa, pp. 184-200.
- Awuzie, B.O., Emuze, F.A. and Ngowi, A.B. 2015. Critical success factors for smart and sustainable facilities management in a South African university of technology. In: 5th CIB International Conference on Smart and Sustainable Built Environment, 9-11 December, 2015, Pretoria, South Africa, pp. 377-384.



Dr Hanita Swanepoel (née Theron) is the current post-doctoral research fellow at the Centre of Applied Food Security and Biotechnology (CAFSaB) at the Department of Health Sciences, Faculty of Health and Environmental Sciences, Central University of Technology. She aims to assist the maize milling industry

with solutions towards the utilisation and value addition of some of their by-products, such as the fines. Through her research, she wants to provide strategies and solutions to the milling industry to compete by increasing the demand for maize and thereby contribute to the sustainability of the milling industry. Dr Swanepoel worked full-time at Continental Beverages in Bloemfontein, initially as Product Development Manager and after a promotion as Technical Manager (responsible for Product Development and Quality Control Assurance). Her research experience was vital and she managed to solve numerous problems, either in production or in the final product ensuring safe, stable and high quality products. She did the development for new innovations on the flagship brand, namely Wild Island and other variants such as Super Fruit and the other concentrated beverages.

Specialisation: Research and Development (R&D) in Food Science with the focus on food safety (including food safety systems and product shelf life) and food security (reduction of waste during product development and the use of waste or by-products).

Key performance areas:

R&D using the by-products from the milling industry. Recipe development for products such as cookies and beverages and different experiments has been done to find a solution to utilise the fines as carbon source for fermented beverages.

The establishment of a fermentation laboratory which involves the management, planning and approvals for this laboratory with the various role players such as the architect, quantity surveyor etc. It also includes the budgeting, control of expenses and procurement of the equipment, raw materials, etc.

The development of relationships with internal partners (e.g. PDTS and REGMS) and external industry and government partners such as DESTEA, Pioneer Foods, OVK, SAB, Entecom and the International Labour Organisation (ILO) amongst others.

Dr Swanepoel currently supervises 3 x master's students and co-supervises 1x master's and 1x doctoral student.

Reviews articles from peer-reviewed journals and theses from other institutions on an ad hoc basis.

Lectures Aroma Chemistry to the 3rd year Somatology students and annually organises an industry visit for the B.Tech Food Hygiene students.

Achievements and Research outputs for 2015:

Dr Swanepoel secured a R466 000 TIA grant and R100 000 in the form of raw materials from OVK for her post-doctoral research focus to utilise fines.

Dr Swanepoel was nominated by her Food Science peers to represent the South African Association for Food Science and Technology (SAAFoST) at the Institute for Food Technologists (IFT) as the South African 360 LEAD candidate in Chicago, USA during July 2015. She used the opportunity to visit the University of Purdue while in USA.

She formed part of the prestige research day organising committee and she reviewed the abstracts for this. She also reviewed abstracts for the SAAFoST International Conference for 2015, where she presented:

- Swanepoel, H., Lues, J.F.R. and Venter, P. 2015. Mathematical predictions of cold chain integrity and microbial influence on selected fatty acids in South African Cape Hake.

In addition, she managed to secure contract work from the ILO - Mangaung Restaurant feasibility report – the formal report was presented to the winners of the DESTEA/ILO Master Caterer's Challenge.

Due to her partnership with the OVK, the Hotel School was sponsored with all cake flour used during the last term in 2015.

The following article was published during 2015 in a peer-reviewed journal:

Venter, P., Swanepoel, H., Lues J.F.R. and Luwes, N. 2015. Contamination predictions of Cape Hake Fillets during display and storage by artificial neural network modelling of hexadecanoic acid. *Journal of Food Process Engineering*.

- Dr Swanepoel published an article in the FST Magazine (Food Science and Technology Magazine) about her LEAD 360 experience in the November 2015 issue.

Additional responsibilities:

Dr Swanepoel is currently registered as a Professional Natural Scientist with the South African Council of Natural Scientific Professions (SACNASP). Dr Swanepoel is a council member of the SAAFoST. She was invited by the late president of SAAFoST, Prof. Amanda Minnaar, and the immediate past president (2013-2015) Mr Ryan Ponquett, to host a session for the young food science professionals during the SAAFoST International Conference for 2015 namely: My SAAFoST.

She was invited to become part of the Provincial Research Advisory Committee (PRAC) and is now involved with DESTEA in a process to develop a Provincial Economic Development Strategy for the Free State. Dr Swanepoel is involved with the Regional Innovation Forum of the Free State (RIFFS) and is busy with entrepreneurial activities of her own. She completed her tasks as LEAD 360 candidate from IFT during 2015/2016. She serves as committee member for TIA at CUT and has been invited to judge at the Bloem show since 2010. She also assists the Hotel school in judging competitions when needed.

Dr Khajamohiddin Syed is a postdoctoral fellow at the Department of Health Sciences, Faculty of Health and



Environmental Sciences, Central University of Technology, Bloemfontein, Free State. Dr Syed completed his M.Sc. in Biochemistry, receiving a gold medal, and a Ph.D. at Sri Krishnadevaraya University, Andhra Pradesh, India. During his doctoral studies he published three articles in high impact-factor journals and made presentations at

various conferences, including the Society of Biological Chemists, India. After his doctoral studies he worked as postdoctoral research associate at the University of the Free State, Bloemfontein, South Africa (2006-2009) and then moved to the University of Cincinnati, Ohio, USA as a visiting faculty member (2009-2013).

Dr Syed as academician enjoys lecturing and supervising students. At present he is teaching Biochemistry IV for B Tech students. Currently, he supervises quite a number of doctoral (6), and master's (17) students.

Dr Syed's research is focused on Cytochrome P450 monooxygenases (P450s), heme-thiolate proteins present in all living organisms. Research specifics include (i) genome wide data mining and their annotation; (ii) structure-function analysis; (iii) evolution; and (iv) applications. Dr Syed's research work has been published in highly ranked peer-reviewed scientific journals, including Science and PNAS, USA. For more information on his research articles, please visit Google scholar webpage: <http://scholar.google.com/citations?user=9SX649AAAAAJ&hl=en>.

Dr Syed's research achievements were highlighted in the University of Cincinnati Newsletter, Cincinnati, Ohio, USA and also in Research and News Letter, Central University of Technology (CUT), Bloemfontein, South Africa. He has been an invited speaker at both national (South African) and international conferences. Dr Syed carries international recognition in P450 research as it evident from national and international invited talks and his research index as shown as of 01 April 2016: Google scholar – total citations: 899; h-index: 13; i10-index: 15 (<https://scholar.google.com/citations?user=9SX649AAAAAJ&hl=en>) and Researchgate score: 27.00; Impact points: 116.52 (https://www.researchgate.net/profile/Khajamohiddin_Syed).

Recently, Dr Syed's group identified a novel drug target against Oomycete pathogens. The discovery of novel P450 fusion protein as drug target was aired on South African news channels and in newspapers (<https://www.youtube.com/watch?v=VbOdUMTsEyc&feature=youtu.be>).

Dr Syed serves as editorial board member and reviewer for reputed international scientific journals. He is an active member in microbial genome sequencing projects carried out by the Joint Genome Institute (JGI) of the Department of Energy, USA. Dr Syed is involved in research collaboration with high-profile researchers from various countries, including the USA, UK, Canada, Europe, Japan, India and South Korea.

Since he joined the CUT (July 2013), Dr Syed has successfully established a molecular biology laboratory and a bioinformatics laboratory with Prof. Samson

Sitheni Mashele. Currently, Dr Syed holds a major research grant from the Technology Innovation Agency (TIA), South Africa. Dr Syed has been a key member in establishing the Unit for Drug Discovery Research at CUT (<http://centerfordrugdiscoveryresearch.weebly.com/>) and he is also the creator of South African Cytochrome P450 Researchers (SACPR) community website. For more information on this society please follow the link: <http://sacpr.weebly.com/>.

Dr Ina Yadroitsava has been a postdoctoral fellow in the Department of Mechanical and Mechatronic Engineering in the Faculty of Engineering and Information Technology at the Central University of Technology, Free State since 2014. She is furthermore an established researcher with over 20 years of academic experience in physics, mathematics, statistics and life sciences. Her research interests include physical aspects of laser-matter interaction, numerical simulation, investigation of microstructure and stresses in the samples manufactured by additive manufacturing, design of experiments, quality and process-control. Dr Yadroitsava, holds one (1) registered patent, has also contributed over eighty (80) publications in various academic journals and has participated in numerous conference proceedings. Dr Yadroitsava is a co-supervisor of one (1) doctoral and four (4) master's postgraduate students.



Since 2015, her research has received support from the South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation of South Africa, and Collaborative Programme in Additive Manufacturing.

Her main research interests and fields of expertise include:

- Physical aspects of laser-matter interaction, numerical simulation
- Investigation of microstructure samples manufactured by selective laser melting, laser cladding and cold-spray coating, analysis of the quality of samples
- Statistics, design of experiments, quality and process-control
- Analysis of physical properties of powders.

H-INDEX: 5 by Scopus (<http://www.scopus.com/authid/detail.url?authorid=36906324000>) and Google Scholar (<http://scholar.google.co.za>)

List of publications in 2015:

Yadroitsev, I., Yadroitsava, I., Bertrand, Ph. and Smurov, I. 2015. Factor analysis of selective laser melting process parameters and geometrical characteristics of synthesized single tracks. In: A Focus on SLM and SLS Methods in 3D Printing. Emerald Group Publishing Limited. pp. 121-134.

Yadroitsava I., Els J., Booysen G. and Yadroitsev I. 2015. Peculiarities of single track formation from Ti6Al4V alloy at different laser power densities by SLM. The

South African Journal of Industrial Engineering, 26 (3): 86-95.

Krakhmalev P., Yadroitsava I., Fredriksson G. and Yadroitsev I. 2015. In situ heat treatment in selective laser melted martensitic AISI 420 stainless steels. *Materials & Design*, 87: 380-385.

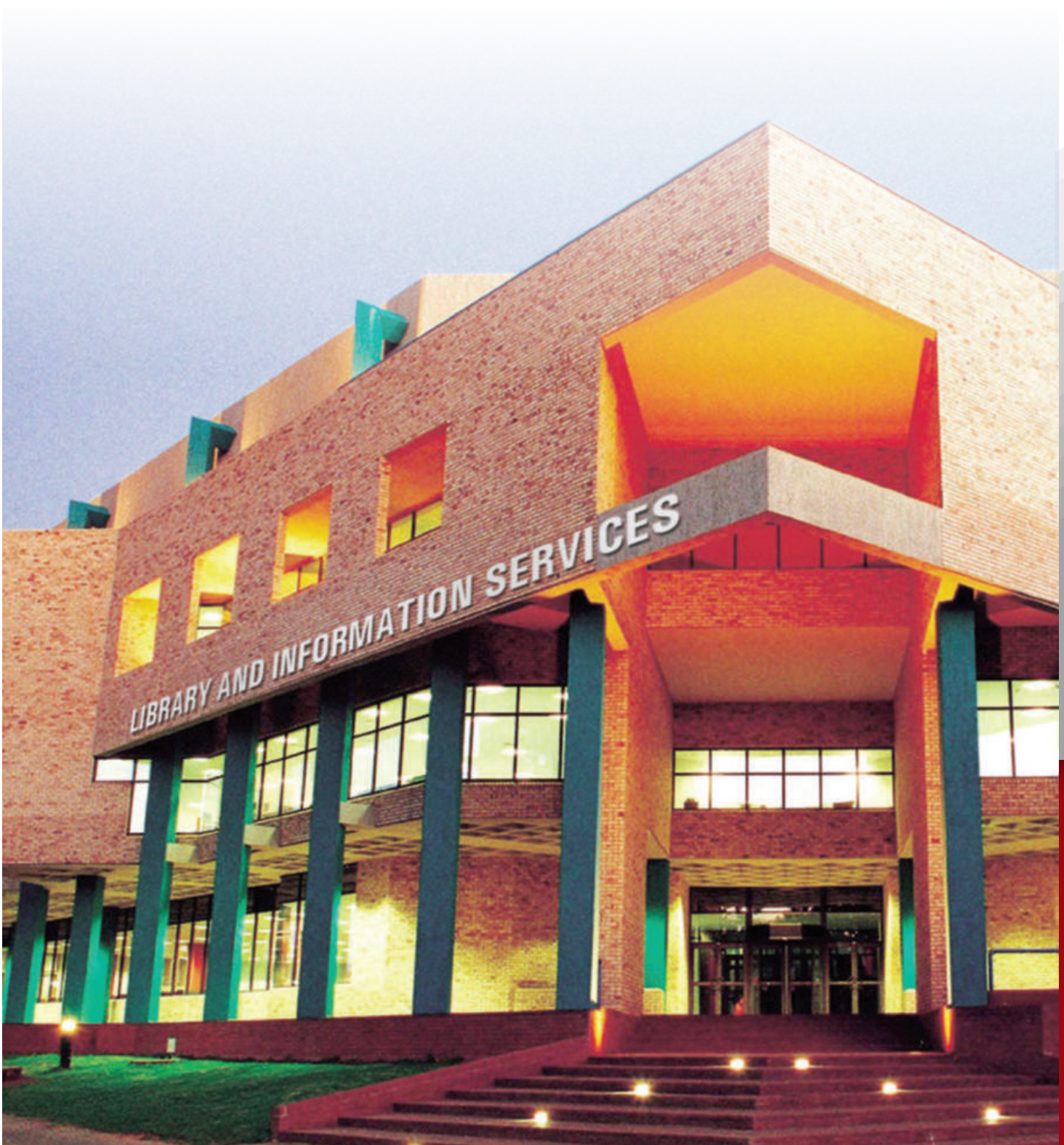
Yadroitsava I., Grewar S., Hattingh D. and Yadroitsev I. 2015. Residual stress in SLM Ti6Al4V alloy specimens, *Materials Science Forum*, 828-829: 305-310.

Zhirnov I., Yadroitsava I. and Yadroitsev I. 2015. Optical monitoring and numerical simulation of

temperature distribution at selective laser melting of Ti6Al4V alloy. *Materials Science Forum*, 828-829: 474-484.

Yadroitsev I. and Yadroitsava I. 2015. Evaluation of residual stress in stainless steel 316L and Ti6Al4V samples produced by selective laser melting. *Virtual and Physical Prototyping*, 10 (2): 67-76.

Yadroitsev, I., Krakhmalev, P. and Yadroitsava, I. 2015. Hierarchical design principles of selective laser melting for high quality metallic objects. *Additive Manufacturing J.* 7, 45–56.



PART 4

FACULTY
ENGINEERING
AND
INFORMATION
TECHNOLOGY

FACULTY ENGINEERING AND INFORMATION TECHNOLOGY

A message from the Dean



Prof. A. Ngowi

One of the core values of Central University of Technology (CUT) is excellence. Excellence, particularly in research at a university of technology, is important because the purpose of such research goes beyond generating new knowledge to generating knowledge that can improve development outcomes. One could argue that excellence in research is desirable in any type of research, but the stakes are higher when the findings are meant to influence decisions that affect people's lives, the environment, or other areas of development involving technology. Research findings gain credibility and are more likely to be used if they derive from excellent research. But if excellence in research is important, how do we know the good from the bad? Which criteria do we use to evaluate excellence in research?

While there might not be consensus on appropriate criteria for research excellence, the Faculty of Engineering and Information Technology will strive to measure the impact of its research on two levels: scientific contribution, particularly publication in high impact journals; and the degree to which our research solves identified challenges (problems) in the industry and also in the wider community.

We recognise that people's ability to meet these expectations depends upon their having proper support from the faculty in particular and the institution in general, both directly in terms of resources, and less directly in term of sustaining a thriving community of scholarship. The faculty will strive to identify and make use of resources such as NRF schemes, other national research support schemes; and international schemes such as the Erasmus Mundus programme. Furthermore, the faculty will strive to create a vibrant community of scholarship through student research colloquia, and staff research seminars and workshops.

activities running by and in the faculty. This is a new challenge which needs effort to ensure success.

FEIT shone in 2015 research in different areas, as witnessed by its domination in the VC excellence in research awards. Moreover, the CRPM research chair was launched officially by the minister of science and technology. This was awarded by the National Research Foundation (NRF) under the Department of Science and Technology (DST) through the South African Research Chairs Initiative (SARChI). The CRPM research chair, under the leadership of Prof. Ihar Yadroitsau, SARChI research chair at CUT, is awarded in recognition of the phenomenal work that the CUT is doing in this dynamic and exciting field.

Furthermore, CUT won the 2015 NRF "Excelleration" Award, which acknowledges South African research institutions for achieving the most improved research performance over recent years and the contribution of FEIT is noteworthy in this achievement.

It is evident that the growth rate of FEIT research (in all aspects) is accelerating; however, we cannot yet be satisfied with our research activities as FEIT still needs to show evidence of research different levels. The new research centres, units and groups are facing a number of challenges to achieve the set targets. Therefore, we need to work hard to progress further.

NARRATIVES ON RESEARCH PROJECTS IN THE FACULTY

FEIT Annual Research Seminar: A new step forward

The Faculty of Engineering and Information Technology hosted its 18th annual research seminar on 28 October in the Japie van Lill auditorium with over 150 delegates from CUT, industry, consultants, and academia in attendance. This annual event has been in existence for the last sixteen years and has proven to be very valuable as a means to showcase industry-related research that is being done in the faculty by staff members and postgraduate students.

This year there were two additions to the seminar, in that there were two keynote speakers and also the accepted full papers were published in a special



A message from the Research Manager

Dr M. Mostafa

During 2015, FEIT changed the name and focus of FRC to FRIC to include innovation



edition of the CUT journal, *Interim*. Twenty papers were received, reviewed and presented on the seminar day.

The keynote speakers came from two different backgrounds: one is a professor in electrical engineering and the other is Elsevier regional manager in South Africa who attended the seminar together with the Africa main branch manager. Prof. H Motoun's presentation covered the enabling technologies for future energy systems with an emphasis on renewable energy. This presentation was followed by Mr Blanche's presentation which showed the progress of CUT in general and FEIT in particular in research; this was in addition to Mr Blanche's presentation on recent developments in research management tools.

At the end of the seminar, presentations were adjudicated by a panel of judges, and prizes were handed out. The prize recipients were CJ van der Mescht, A Kinnear and J Honiball. The SAIEE also donated a prize which was won by PE Hertzog.

FEIT Annual Research Culture Workshop

The Faculty of Engineering and Information Technology hosted a research workshop entitled "Journey to Doctoral Degrees" on 7 Sep 2015. The workshop was honoured by the presence of a high profile keynote speaker, Prof. T Marwala, the Deputy Vice-Chancellor: Research, Innovation, Postgraduate Studies and the Library at the University of Johannesburg. Prof. Marwala is a recent recipient of an NRF award for research development.

Prof. Marwala delivered a very descriptive presentation on some key issues in research and innovation. He deliberated on the aims and drivers of research before discussing the performance of staff and postgraduate students. This was followed by his touching on the importance of visiting professors and internationalisation in research. The key points he raised included the importance of the postgraduate students' environment, strong linkages with industry, sourcing funds of from municipalities, the joint appointments of researchers, and the importance of recruiting post doctoral fellows.



His presentation was preceded by a presentation from Prof. A Ngowi, the faculty dean, on how to link research to teaching and learning and engagement. There was a strong emphasis on research centres, units and group. Thereafter, Dr M Mostafa, the faculty research manager, talked about the recent achievements of CUT in research and discussed the current challenges to improve CUT research output.

Other presentations were delivered by Dr M Masinde from the IT department, Dr K van der Walt from mechanical engineering and Dr D Das from civil engineering. The presenters took the audience through their PhD journeys and showed different experiences. For example, Dr Masinde is a foreign national who studied in Kenya and Belgium before obtaining her PhD in South Africa. She emphasised the role of the family in supporting female progress. Dr Van der Walt showed, by means of a model, how involvement in local problems can lead to international recognition. He stressed that the student should take the ownership of the study. Finally, Dr Das gave a very dramatic presentation on the importance of choosing the right supervisor.

The event was concluded by Dr M Mostafa, the faculty research manager, who thanked Prof. Marwala for sharing his experience with CUT and the other presenters for inspiring our postgraduate students. He expressed the need for speeding up the research culture improvement at CUT.

FEIT launches a research chair in medical product development

The Centre for Rapid Prototyping and Manufacturing (CRPM) at CUT is at the cutting edge of 3D printing or additive-manufacturing (AM) technology for medical purposes. The Centre does ground-breaking work in the design, development and manufacturing of medical devices using 3D printing, and has assisted 12 patients to date. Two of them had titanium implants installed in their jaws by doctors at Kimberley Hospital last year. These implants were printed layer by layer using the AM process to ensure they fitted perfectly into the individual jaws of each patient.

The CRPM has been awarded a Research Chair in Medical Product Development under the Department of Science and Technology's South African Research Chairs Initiative (SARChI), the goal of which is to increase the research output and innovation in areas that are considered essential to the country's strategic growth and development. This Research Chair, under the leadership of Prof. Igor Yadroitsau, was awarded in recognition of the excellent work that CUT is doing in this dynamic and exciting field.



Speaking at the launch of the chair, the Minister of Science and Technology, the Honourable Naledi Pandor, said it was important for the country to continue to build a public environment supportive of higher education institutions: "As with many developing countries, South Africa faces the challenge of competing for leading scientists." The Minister added that South Africa's funding of public basic research had, however, risen sharply over the past 21

years, as university research was now closely linked to national priorities and global knowledge networks.

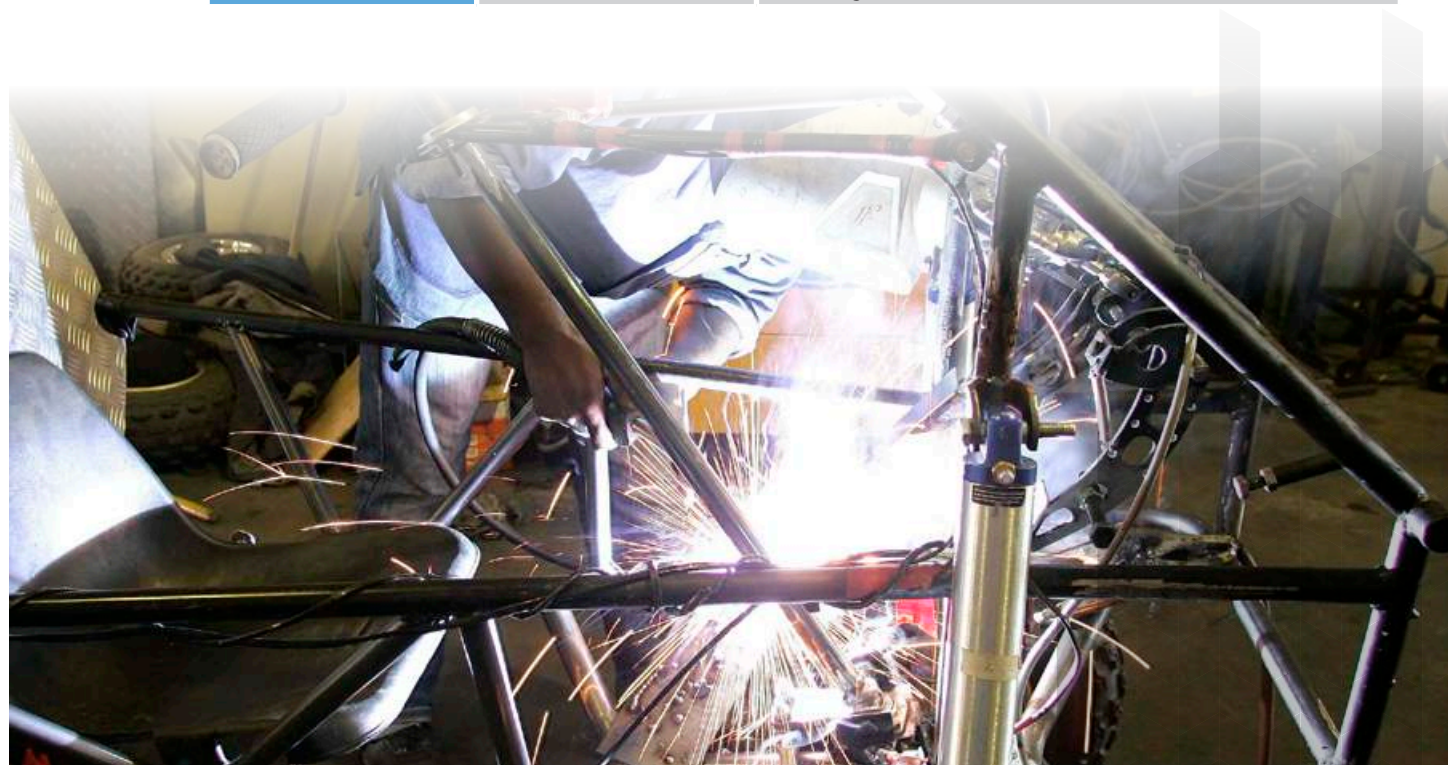
Most of the DST's funding – well over R4 billion this year – was invested in people, said the Minister. SARCHI alone had made R470 million available this year as part of increasing research capacity at the country's

universities. The Minister said the CUT Research Chair in Medical Product Development would have a positive impact on research as a whole, and that more research projects would run concurrently to help strengthen knowledge and technological know-how in complementary research infrastructure.

Fostering Partnerships

The following partnerships and collaborations were fostered:

Institution	Nature of partnership	Activities in 2015
Department of Electrical, Electronic and Computer Engineering		
Stellenbosch University	Research partnership: Reconfigurable Manufacturing Systems assembly project funded by DST	The Mechatronics, Design and Automation Research Group of Prof. Anton Basson at Stellenbosch University (SU), and the Research Group in Evolvable and Manumation Systems of Prof. Herman Vermaak at Central University of Technology (CUT) developed technologies aimed at Reconfigurable Manufacturing Systems (RMSs) with funding from the Advanced Manufacturing Strategy (AMTS) and the DST. Phase 1 of the AMTS project, which started in 2008, was aimed at the conceptual design of an RMS, while Phase 2 (completed in 2013) further developed the selected concept to laboratory scale demonstration of the technical feasibility of applying RMS technology to the target application. Phase 3 was aiming at developing the technology to the level of testing prototypes in a representative environment and prototype implementations on full-scale realistic problems, but in a laboratory environment to demonstrate engineering feasibility. This phase will be completed in 2016.
Cape Peninsula University of Technology (CPUT), Cape Town, Western Cape Province	Academic: Collaborative academic writing.	Strategically involved with a community engagement and research project in the Elgin region of the Western Cape Province.
ULM Applied Science University in Germany	Academic and research partnership	The activities include: student exchange, staff visits, research collaboration, and external examiners. Projects within the following fields are done and new projects developed: 1) Energy projects (renewable/management), 2) Automation – reconfigurable systems, 3) PV panel cleaning, and 4) Solar conditions – data logging We also do a Laboratory Interaction between our Control Systems students and the Control Systems students of Prof. Commerill. A Skype feedback session between the two groups of students takes place annually.
Informatics Development for Health in Africa (INDEHELA)	Academically: Collaborative research and academic writing.	Strategically: Member and collaborative community engagement and project planning, development and deployment in South Africa, Botswana, Kenya, Nigeria and Mozambique.
University of Illinois	Research Collaboration: project of pavement modelling	Dr Mostafa initiated contacts with the Illinois Centre for Transport (ICT) in 2014. He visited the ICT in January 2015 and agreed on activities for 2015. Dr Mostafa collaborates with the University of Illinois in terms of a running project of pavement modelling.



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Das, D.K. and Keetse, M.S.M. Assessment of traffic congestion in the central areas of Kimberley city, INTERIM 2015 Year 14. No.1, 70-82.

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Ellis, M.H. An algorithm for calculating the evolutionary stable strategy for an age-structured population model with a shepherd recruitment function, INTERIM 2015 Year 14. No.2, 251-285.

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Heyns, M.W. and Hassan, M.M. Environmental effects of road pavements stabilized with class f fly ash. INTERIM 2015 Year 14. No.2, 197-206.0

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Mckenzie, E. and Mostafa Hassan, M. Sustainable approach to upgrade low volume roads in Petrusville. INTERIM 2015 Year 14. No.1, 83-99.00

Pretorius, J. and Gaunt, C.T. Cost-benefit analysis of recloser placement for reliability. INTERIM 2015 Year 14. No.2, 153-163.

Swart, A.J. Validating the acceptance zone for PV modules using a simplified measuring approach. INTERIM 2015 Year 14. No.1, 24-37.

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Report from Research Professors: Additive Manufacturing

Prof. Yadroitsau was appointed Research Professor at the Central University of Technology, Free State (CUT) on 1 January 2014. His background includes PhD and MSc degrees in laser physics and optics along with 30 years of academic experience in applied optics and laser technologies (selective laser melting/sintering, laser cladding, interferometry and optical monitoring system, material science). Prof. Yadroitsau has a strong interdisciplinary background and broad experience in the fields of Physics and Engineering which allows him to comprehend thoroughly scientific and technical problems with the purpose of finding original solutions in different fields of laser applications. It should be specially mentioned that Prof. Yadroitsau has more than 120 scientific publications.

Prof. Yadroitsau has supervised four (4) master's and one (1) doctoral student in Engineering. Their studies were devoted to selective laser melting, residual stresses, heat treatment and mechanical properties of additive manufacturing objects. To involve the students in Material Science studies, to expand their horizons and to be at the forefront of the world's research in the field of additive manufacturing, the new metallographic laboratory at the Department of Mechanical and Mechatronic Engineering was organised.

In 2015 the patent "Additive manufacturing system and method" was approved. The invention relates to an innovative method and device for in-process monitoring, measurement and control of the geometric characteristics of 3D objects produced by selective laser melting (SLM). The proposed system will create real-time reports and a "certificate of quality" of SLM manufactured objects with estimated porosity and location of probable defects. It also makes provision for a feedback controller to optimise the quality of grown products. Furthermore, by using software for analysing the behaviour of the part at different loads, a determination can be made as to the loads that can be used, and the life expectancy of the part can be predicted. Thus, the present invention will not only allow a certificate of part quality after manufacture (pointing to potential problem areas within a manufactured product) to be obtained, but it will also allow potential weak spots to be corrected dynamically during SLM manufacturing. Reliability and high quality of SLM parts is a vital task for this innovative technology.

Currently a new patent, "Multi-material delivering system for selective laser melting" is in the process of application. This patent describes the multi-material layered device for manufacturing objects consisting of more than one material in a one-step SLM process. Multi-material objects have great potential in the fast-growing AM market, which requires complex objects with prescribed properties. For medical usage, special advanced implants combining different

material properties allow the implants to be more bio-compatible and their lifespan to be increased. The rising costs of healthcare may be attributed to an increasing number of medical procedures with great complexity and costly instrumentation. Advanced innovative materials and devices must be developed to reduce the time, economic cost, and physical pain associated with implants, hence the urgent need for this life-saving research work.

In 2015 Prof. Yadroitsau, in cooperation with other researchers from RSA, Brazil, Sweden, France and Russia, published seven (7) articles and seven (7) conference proceedings. Prof. Yadroitsau participated in a number of scientific seminars at the CSIR, Stellenbosch University, University of Cape Town, Vaal University of Technology, and Nelson Mandela Metropolitan University. These seminars were devoted to closer cooperation, the scientific challenges and the establishment of a national consortium for producing parts from titanium alloys by additive manufacturing (AM). He participated in the elaboration of the three-year programme “Qualification of Additive Manufacturing of Ti6Al4V for Medical Implants and Aerospace Components” which has been granted by the DST.

Report from Post-Doctoral Fellows

Centre for Rapid Prototyping and Manufacturing:
Mechanical Engineering – Dr Ina Yadroitsava

Title of research project: “Mechanical properties and microstructure of selective laser melted samples”

Dr Yadroitsava’s research includes physical aspects of laser-matter interaction, numerical simulation, investigation of microstructure and stresses in the samples manufactured by additive manufacturing, design of experiments, quality and process-control. New metallographic equipment was installed to the laboratory, and all microstructures and micro-hardness measurements were made by new equipment. Since 2015, she has co-supervised one (1) doctoral and three (3) master’s students. Two (2) theses (I van Zyl and WA Kinnear) are currently in the finalisation stage. See article and conference proceeding outputs below.

She was involvement in the following projects:

South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation of South Africa (Grant 97994)

Collaborative Programme in Additive Manufacturing (Contract CSIR-NLC-CPAM-15-MOA-CUT-01)

The following articles were published:

Krakhmalev, P., Yadroitsava, I., Fredriksson, G. and Yadroitsev, I. 2015. In situ heat treatment in selective laser melted martensitic AISI 420 stainless steels. *Materials & Design*, 87, 380-385.

Yadroitsava, I., Els, J., Booysen, G. and Yadroitsev, I. 2015. Peculiarities of single track formation from Ti6Al4V alloy at different laser power densities by SLM. *The South African Journal of Industrial Engineering*, 26 (3): 86-95.

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of synthesized single tracks. In: *A Focus on SLM and SLS Methods in 3D Printing*. Emerald Group Publishing Limited. ISBN 9781785608650, pp. 121-134.

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Zhirnov, I., Yadroitsava, I. and Yadroitsev, I. 2015. Optical monitoring and numerical simulation of temperature distribution at selective laser melting of Ti6Al4V alloy. *Materials Science Forum*, 828-829: 474-484.

Yadroitsev, I. and Yadroitsava, I. 2015. Evaluation of residual stress in stainless steel 316L and Ti6Al4V samples produced by selective laser melting. *Virtual and Physical Prototyping*, 1-10, <http://dx.doi.org/10.1080/17452759.2015.1026045>.

Yadroitsev, I., Krakhmalev, P. and Yadroitsava, I. 2015. Hierarchical design principles of selective laser melting for high quality metallic objects. *Additive Manufacturing J.* 7, 45–56.

The following papers were submitted:

Krakhmalev, P., Yadroitsava, I., Fredriksson, G. and Yadroitsev I. Microstructural and thermal stability of selective laser melted 316L stainless steel single tracks. *The South African Journal of Industrial Engineering*.

Van Zyl, I., Yadroitsava, I. and Yadroitsev, I. Residual stress in Ti6Al4V objects produced by direct metal laser sintering. *The South African Journal of Industrial Engineering*.

The following conference proceedings were submitted:

Kinnear, A., Dzogbewu, T.C., Yadroitsava, I. and Yadroitsev I. 2015. Multi material powder delivering system for direct metal laser sintering. In: *Proceedings of the 16th International conference RAPDASA*, 4-6 November 2015, Pretoria, South Africa.

Yadroitsev, I., Krakhmalev, P. and Yadroitsava, I. 2015. A systematic approach to manufacturing parts with desired properties by Selective Laser Melting. In: *Proceedings of the Materials Science & Technology Conference (MS&T15)*, 4-8 October 2015, Columbus, OH.

Yadroitsava, I. and Yadroitsev, I. 2015. Residual stress in metal specimens produced by Direct Metal Laser Sintering. In: *Proceedings of the International Solid Freeform Fabrication Symposium*, August 10-12, 2015, University of Texas at Austin, USA.

Krakhmalev, P., Yadroitsava, I., Fredriksson, G. and Yadroitsev, I. 2015. Microstructure development and in-situ heat treatment of SLM manufactured stainless steel. In: *Proceedings of the International Conference on Powder Metallurgy & Particulate Materials*, May 17–20, 2015, San Diego, California.

Unit for Lean Construction and Sustainability (ULCS): Dr B.O. Awuzie, Post-Doctoral Fellow

Project Information: Towards a Viable Implementation of the Sustainability Agenda: A Systems Approach to (Re) Designing the Infrastructure Client (CUT's) Business Model

Research Aims and Objectives: Research Aim: This study seeks to propose a mechanism to drive the successful implementation of the sustainability agenda during delivery of infrastructure within CUT.

Research objectives:

- To develop a systemic understanding of the sustainability agenda's implementation within the context of infrastructure delivery within the CUT.
- To develop an understanding of the extant inter-organisational relationships and processes involved in the delivery of infrastructure and services within the CUT.
- To apply the VIDM in evaluating the CUT's business model from an activity-based systems perspective.
- To (re)design the CUT's business model towards ensuring viable implementation of sustainable projects.

The significance of the study is premised on the need to develop a robust mechanism which would enable infrastructure client organisations (ICO), particularly higher education institutions (HEIs), to contribute to the implementation of the sustainability agenda across various facets of their campus infrastructural development endeavours. It is expected that such moves will engender a high degree of sustainability awareness amongst various stakeholders present within the microcosm that an HEI has become.

Milestones and achievements: The study concluded an initial comprehensive review of state-of-the-art literature pertaining to the implementation of the sustainability agenda in the various HEIs across the globe. This review of the literature led to the identification of critical success factors (CSF) as well as other factors which constitute barriers and potential drivers. Furthermore, literature pertaining to the applicability of the viable systems model (VSM) methodology to serve as a mechanism for enhancing the implementation of the sustainability agenda at the CUT was also explored.

Upon the identification of the factors, various stakeholders involved in the delivery of infrastructure projects as well as the sustainability agenda at the CUT were identified with the aid of the viable infrastructure delivery systems model (VIDSM) – an offshoot of the VSM. A generous sample of stakeholders were interviewed to validate the CSFs identified and also to establish the potential drivers and barriers to the smooth implementation of the sustainability agenda at the CUT. These interviews were premised on a qualitative interview protocol which was developed between May and June, 2015. To date, a total of 18 semi-structured, face to face interviews were conducted by the researcher. Whereas this sample may appear small, it proved to be very apt at this stage of the research process as it concerned the identification of CSFs, barriers and drivers. It is expected that the

responses obtained during this phase will be applied towards gaining statistical generalisation from a wider sample of the population through questionnaires. The interviews have been transcribed and subsequently analysed thematically. Thus far, the findings from these interviews have been presented and published in various conference proceedings in South Africa and the United Kingdom respectively, whilst three journal articles have been submitted to the Journal of Sustainability in Higher Education, and the Built Environment Project and Asset Management Journal. They are presently at various stages of the review process.

Research highlights: A review of extant literature reveals that the implementation of the sustainability agenda in South African HEIs has been largely underreported. Arguably, this is as a result of the poor understanding of what the agenda entails and lack of effective communication between the stakeholders in the HEIs such as the CUT. Further investigation into the implementation of the sustainability agenda in various HEIs across the globe indicates varying degrees of implementation performance. The quest to understand the reasons behind these varying degrees of performance underpinned the need to determine the CSFs for improved performance and to apply them to the scenario at the CUT. It is expected that the mechanism to be developed for the smooth implementation of the sustainability agenda at the CUT would be premised on the lessons learned from the experiences of other HEIs as well as the perspectives of the various stakeholders within the CUT infrastructure delivery system. As such, the overall objective of this study was to develop a mechanism for the robust implementation of the CUT's sustainability agenda through the delivery of infrastructure on its campuses at Bloemfontein and Welkom.

Synthesis of research findings: Besides establishing the applicability of the VSM methodology as enshrined in the VIDSM as a suitable mechanism for carrying out an evaluation of the infrastructure delivery system's sustainability implementation framework at the CUT, the study proceeded through the review of extant literature to identify a list of potential barriers to effective implementation of the sustainability agenda in HEIs across the globe. The drivers necessary for the successful implementation and CSFs were also identified from the literature.

Relying on a juxtaposition of the VIDSM and the factors so identified, a cross-section of the stakeholders within the CUT infrastructure delivery system were identified and interviewed. The interviews were intent on a validation of these CSFs, barriers and drivers from a CUT infrastructure delivery perspective.

Thus far, emergent findings indicate that the CSF for the successful implementation of the CUT sustainability agenda, particularly within the infrastructure delivery system present within the campus consists of: effective communication between stakeholders, optimal information/ knowledge management, less emphasis on construction costs rather than whole lifecycle cost savings, proper collaboration amongst stakeholders, and the development of a sustainability-based social ontology in the various stakeholders. Barriers identified include the presence of silos as a result of compartmentalisation. Compartmentalisation is often referred to as an attribute of HEIs as they arise from the prevalence of individual specialisms

within the HEI. These specialisms make information/knowledge sharing between them very difficult, if not impossible. The various perspectives of different stakeholders on the sustainability agenda were also discovered as inhibiting successful implementation. The absence of the requisite skill sets for ensuring successful implementation and cohesive policy for the implementation of the sustainability agenda within the CUT were also identified as significant barriers.

Research impacts: It is expected that the proposed mechanism would provide the CUT with the opportunity to successfully implement its sustainability agenda through its infrastructure delivery programme and as such, assume the enviable position of a sustainable university by the turn of this decade. Furthermore, it would encourage a paradigmatic shift in the social ontology present within the campus from one that is seemingly indifferent to the sustainability agenda towards one that is pro-sustainability.

Benefits of collaboration: This research endeavour provides a platform for the development of interest in sustainability based research amongst present day researchers and built environment practitioners in South Africa and beyond. It is expected that the research would also boost the level of awareness and the development of a common understanding of what

the sustainability agenda entails for the university community and its environs.

Impact of funding on the project: the funding received has assisted in: 1) the attendance of conferences; 2) the collection of required data for the research; 3) supervision/mentoring of sustainability related studies at CUT, and 4) provision of living allowances to enable dedicated research.

Student supervision: One B. Tech student with a topic that was centred upon the identification of the drivers for sustainability on a university campus. CUT was used as a case study. We held several supervision meetings, most of which were focused on the development of a qualitative interview protocol, development of aim and objectives, literature review, data collection and analysis of the collected data. The student successfully defended her research in October 2015. I also assisted in providing mentorship to doctoral students at the Unit for Lean Construction and Sustainability (ULCS), particularly those working on sustainability-themed research. I was also involved in occasional lecture delivery to B. Tech students registered for Research Methodology and Construction Management at the CUT.

Publications: Six (6) articles under review in Journals, and five (5) articles in Conference Proceedings.



PART 5

FACULTY
HEALTH AND
ENVIRONMENTAL
SCIENCES

FACULTY OF HEALTH AND ENVIRONMENTAL SCIENCES

A message from the Dean



Prof. S. Mashele

The nature of research in the Faculty of Health and Environmental Sciences defines the intellectual climate of the faculty. I am truly passionate about the intellectual energy and scholarly productivity generated by our staff and students. We must address the most pressing problems facing society – problems with water, food, health and the environment – and do it in a sustainable, ethical and humane way. The CUT Faculty of Health and Environmental Sciences is well known as home to international breakthroughs in research. One of the major achievements of the faculty includes among others the discovery of a new drug target that has huge potential to help fight aquatic animal infections caused by aquatic parasites. The results of this study attracted media attention and were published in the Nature Publication Group journal, “Scientific Reports”. One of the significant events to occur in the year under review was the significant increase of high impact publications in accredited journals. We will expand our research enterprise to address our nation’s most difficult and pressing technological problems. The challenge is to continue creating an enabling environment that inspires researchers to achieve their ambitions and attracts the most talented academics and scholars. I am certainly proud of our achievements in 2015 and wish to thank all researchers, managers, and staff, for their support, dedication and hard work.

academics obtaining master’s and doctoral degrees. We are also elated by the ever increasing external financial support, mostly from the NRF and the DHET. The faculty remains committed to recruiting good quality students who are innovative, and giving them the best learning experience. We ensure quality through vigorous quality control measures within the faculty, ensuring that the research we produce is not only of good quality but that it also adheres to ethics and endorses good research conduct. To illustrate the high level of research we produce, a team of researchers from our faculty, in the Unit for Drug Discovery, discovered a new drug that has the potential to fight aquatic animal infections caused by aquatic parasites. Their findings were published in the Nature Publication Group journal, “Scientific Reports”, a prestigious multidisciplinary scientific international journal with an impact factor of 5.6. Furthermore, researchers from the same unit attended an international symposium on Methods for Studying Drug Metabolism and Transportation on African Traditional Medicines (METHODS-2015) (23-25 November 2015) at the St George’s Hotel and Conference Centre, Pretoria, South Africa. Dr Syed delivered an invited talk on “The role of CYP450s in drug targeting/development against tuberculosis and fungal pathogens” during the symposium.

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

A message from the Research Manager



Dr M. Sedibe

It is exciting to see that most of the key focus areas of research in the faculty seek to address issues and challenges that affect our communities directly and indirectly. It is also important to note from the report that most of the research outputs achieved were from our postgraduate students and some of these outputs were published in high impact journals. These achievements were made possible mainly by the newly formed Unit for Drug Discovery Research led by Prof. SS Mashele and Dr K Syed and also by the Centre for Applied Food Safety and Biotechnology (CAFSaB) led by Prof. Lues. It is encouraging to see a growing number of our



NARRATIVES ON RESEARCH PROJECTS IN THE FACULTY

The Faculty of Health and Environmental has two flagship projects Unit for Drug Discovery Research, UDDR and Centre for Applied Food Safety and Biotechnology, CAFSaB.

Unit for Drug Discovery Research

The Unit for Drug Discovery Research (UDDR) is a newly established unit in the Faculty of Health and Environmental Sciences. The unit is led by Prof. Samson Sitheni Mashele and Dr Khajamohiddin Syed. The UDDR is focused on the development of novel drugs to combat human (cancer, diabetes, HIV, TB and other microbial infections) animal and plant diseases. The unit consists of two research groups with different approaches to drug discovery. The Natural Products and Phytomedicine Research Group specialises in ethnopharmacology with special emphasis on medicinal plants. The Bioinformatics and Drug Designing group focuses on genome-data mining and comparative genomics to identify novel enzymes that can be used as drug targets against bacterial and fungal pathogens.

The UDDR has experienced great success during the year 2015. Researchers from the UDDR discovered a novel P450 fusion protein as a drug target against aquatic pathogens. The discovery has been reported in major news channels including SABC, eNEWS and

eNCA and all major South African newspapers. The results of this finding were published in the Nature Publication Group journal, "Scientific Reports", a prestigious multidisciplinary scientific international journal with an impact factor of 5.6.

Furthermore, UDDR member Dr Moosa Sedibe was elected as Chairperson of the Taung College Advisory Council, inaugurated by the Hon. M Tlhape, MEC for Rural, Environment and Agricultural Development, NW province.



From left to right: Sitting: Dr Khajamohiddin Syed, Prof. Samson Sitheni Mashele, Dr Malebo Ntsoaki and Mr Mokoena Jack. Standing: Mr Mohammad Parvez, Mr Ntsane Trevor Mthakathi, Mr Richie Monyaki, Ms Ipeleng Kopano Rosinah Kgosiemang, Ms Norventia Jafta, Mr Mopeli Marshal Sello, Mr Lehlohonolo Benedict Qhanya and Mr Seiso Caiphus Raselemane



Front row from left: Dr P Mokaila, HoD NW READ; Dr M Sedibe; Hon. M Tlhape, MEC, NW READ; Prof.. PJ Fourie; Ms P Matlhoko, College Vice-Principal

The UDDR has 7 staff members as researchers, 1 postdoctoral fellow, 22 master's and 4 doctoral students. Five master's students graduated from the unit. Master's student Ms Mhaladi was selected for the Vice-Chancellor's award for best postgraduate student for 2015. UDDR researchers published five research articles in international accredited high impact factor journals. In addition to this, UDDR researchers presented conference papers and posters at national and international conferences. UDDR members had great success in sourcing funding from different agencies. More than R1.5 million in funding was received by UDDR researchers.

Centre for Applied Food Safety and Biotechnology, CAFSaB.

In 2015 the Unit for Applied Food Safety and Biotechnology was awarded centre status by the

university – one of two research entities to be evaluated at this level at the time. The centre was consequently rebranded as the Centre for Applied Food Security and Biotechnology (CAFSaB) from its previous nomenclature as a Developed Research Niche Area at the NRF. Benchmarked nationally, the centre plays a leading role in the field of food safety and security, in terms of both specialisation and output. In recent years the centre has secured several million Rand in external funding which includes a recent R6m grant from DHET to expand infrastructure and facilities. CAFSaB currently boasts a critical mass of 16 master's and 5 doctoral students, 4 full-time researchers; 5 NRF grant holders, 1 NRF-rated researcher and 2 full-time technical/administrative staff. Through its ca. 20 years' existence the centre has seen a number of noteworthy milestones including delivery of the first black doctorate graduate (male), the first black doctorate graduate (female), the first Indian doctorate graduate (female) and the first black

NRF grant holder. To date the centre has hosted 8 post-doctoral fellows of whom 5 advanced to fixed-term positions. Achievements include three VC's medallion awardees, numerous cum laude graduates including best institutional postgraduate student, holders of Erasmus Mundus fellowships, S2A3 medals, Lead 360 awards and others. Internationally, members have received awards for best publications in high impact journals, best conference contributions and most promising young researcher. Former staff and alumni have advanced to leadership positions institutionally and nationally including two (2) Deans, three (3) HODs and three (3) professorships. Members and students regularly travel abroad and occupy leading roles on councils, advisory boards, and ministerial task teams, national and international scientific associations.

Research activities also took place in the following departments:



Agriculture

Animal production and optimisation

The research group into animal production and optimisation focuses on animal production, primarily in the Free State and Northern Cape areas. The head of the group is Prof. Pieter Fourie of the Department of Agricultural Management at CUT. This group is currently one of the leading units in SA, specialising in the Dorper breed since 1999, and has published various publications in recent years, delivered presentations at local and international conferences as well as having registered a patent. This patent (pelvic meter for sheep) is currently being duplicated and will soon be available for purchase by the small stock industry. Research collaboration exists with institutions such as UFS, ARC, NMMU, SA Studbook, Grootfontein Agricultural Development Institute and the SA Dorper Breeder's Association. Collaboration exists with authoritative academics in the field including Profs Nesar (UFS) and Greyling (UFS). Formal collaboration will soon be established between the CUT and Dr Gordon Refshauge from the Centre for Red Meat and Sheep Development in Australia, who is also interested in purchasing a pelvic meter. Close cooperation has also been forged with various livestock industries that generously provide animals for research studies. Outputs include publications by members of the group in popular and semi-scientific journals, accredited scientific journals and accredited conference contributions. Currently the group comprises 3 doctoral and 5 master's students; these include one student working on security measures pertaining to rhinoceros on game ranches and nature reserves in the Free State Province against the backdrop of the increasing illegal trade in rhino

horn. Other projects in the group include profitability during the back-grounding of beef calves, the viability of Dorper sheep farming systems, optimising muscle-massage techniques for performance horses, sheep and cattle production in emerging farming systems and parasite control in broilers and sheep.



Bioactive phytochemicals in animal diets

Prof. Umesiobi and Dr Achilonu are doing research on *bioactive phytochemicals in animal diets*. In the current field of study, focus is on pumpkins (*cucurbitaceae*), which are known to display a wide range of biological activities. Hence, there is a growing interest by farmers in using them as feed additives to fortify animal feeds.

The worldwide growing need to increase animal productivity necessitated the massive use of harmful synthetic hormones and antibiotics in livestock production. Discovery of synthetic drugs in animal products is a concern to consumers and hence, the urgent need for their replacement with beneficial bioactive phytochemicals. The bioactive phytochemicals exhibit antimicrobial, antioxidant, antiparasitic, antiprotozoal, antifungal, and anti-inflammatory properties, and consequently have beneficial effects on appetite, growth and the immune status of the animal. Pumpkin species, favoured by nutritionists and researchers for their high nutrient contents, are major crops produced in South Africa. The flesh serves as a traditional food, while the seeds and peels are thrown out as wastes. Pumpkin seed extract is useful for immunomodulation, reproductive health, therapeutics over a wide range of disease conditions and it also stimulates metabolism of accumulated fats. Studies have also shown that the pumpkin seeds are a valuable source of protein and fat. The complexity and extent of bioactivity of pumpkin seeds offers enormous prospects for natural control of pathogenic/parasitic organisms, stimulation of nutrition, enhanced resistance to disease infections, reduction of abdominal fat and serum levels of harmful lipids, while the serum levels of beneficial lipids are increased. The study on the effect of pumpkin meals on the general performance of poultry will reveal the pumpkins' phytochemicals, the dosage at which effects are seen, and a possible alternative to synthetic growth hormones and antibiotics used in the poultry industry. The present study is therefore expected to show that pumpkin meals have a positive impact on the general performance of all poultry species, via increased feed conversion ratio (FCR), growth rate and egg production traits, and that they play an important role in the health of poultry by maintaining a balanced microflora in the digestive system.

Agricultural wastes modification and use in wastewater remediation: Studies have shown that organic micro-pollutants such as pesticides, pharmaceutical compounds, personal care products and industrial chemicals are found in surface waters, ground waters, sewage effluents and even in drinking water. When the organic micro-pollutants and their metabolites are dissolved or attached to colloids, they are marginally eliminated by conventional coagulation, flocculation, or biological wastewater treatment processes. Though synthetic polymers are very efficient flocculants, they are limited by not being shear resistant and the residual monomers being detected in treated water is undesirable because of their neurotoxicity and strong carcinogenic properties. Natural biopolymers (polysaccharides) function as bridging flocculants, however, and are associated with the following disadvantages: (i) effective at large dosages; (ii) the chitosan is soluble in acidic media and therefore cannot be used as an insoluble sorbent; and (iii) chitosan are used in acidic media only after physical and chemical modifications. Environmental concerns and ecological issues favour the use of the chemically modified biodegradable polysaccharide flocculants because of their improved flocculation efficacy. This study therefore aims at modifying natural biopolymers by preparing different ionic polysaccharides, and preparing of chitosan blends and cross links of the chitosan derivatives to produce modified polysaccharides that are nontoxic, biodegradable, shear stable and efficient adsorptive flocculants that would remove extraneous materials, such as heavy metal ions, persistent organic micro-pollutants and pathogens from abattoir wastewater and industrial effluents within the Mangaung Metropolitan Municipality. Chitosan flakes have a high antibacterial activity and are therefore, a promising antimicrobial agent, which could be helpful in water treatment and in wastewater reuse. The flakes do not lose their antibacterial activity and could directly be reused.

Assisted animal reproduction technologies research group

The leader of the group is Professor Dennis O. Umesiobi, who is a professor in animal reproductive physiology. The research projects run in the group include innovative animal reproduction technologies, genetic characterisation and enhanced reproduction in swine, sheep and chicken; sustainable animal production systems, mammalian multiple ovulation and embryo transfer technology, enzootic geophagia and zoological ecosystems and habituation. The group boasts 6 doctoral and 10 master's students. Members of the group generate research outputs by means of peer-reviewed accredited journal contributions as well as presentations to international and local conferences. Collaborations exist with the majority of South African higher education institutions and colleges as well as the Agricultural Research Council Irene; Glen Agricultural College and SADC institutions including the University of Botswana (Gaborone, Botswana), and the University of Swaziland (Luyengo, Swaziland). Prof. Umesiobi also has ongoing international links with universities in Nigeria, the US, Canada; Netherlands, Australia and Japan.

DEPARTMENT OF CLINICAL SCIENCES

Research group into Health Science Education

This group is headed by Prof. Hesta Friedrich-Nel and focuses on the educational constructs of health sciences, including primarily Radiography, Somatology, Biomedical Technology and Clinical Technology, amongst others. Although the research and disciplines investigated encompass the social and educational sciences, a number of members of the faculty have found a home under this group toward furthering their postgraduate careers. The group has strong ties with the Health Science Education division and the Faculty of Education at UFS, and have a number of times hosted Prof. Joyce MacKinnon from IUPUI as Fulbright Scholar to CUT. Other collaborations exist with Prof. Deborah Murdock-Eaton (Leeds, UK), and various members of the SA Association of Health Educationalists. The research focuses on the contemporary modes of delivery and assessment required to ensure optimal skills development in the health field, and the group boasts 3 doctorates and 2 master's students. Group members often publish in the SA Journal of Higher Education and the African Journal of Health Professions Education.



Depicted at the centre of the picture is Prof. Joyce MacKinnon, who is conducting a mind stimulating discussion with CUT's staff members.



Back row Second from the left is Prof. Hesta Friedrich-Nel with a group of Hanze University (Radiography) students participating in the CUT and Hanze University Internship Mentorship programme

DEPARTMENT OF LIFE SCIENCE

Sustainable Bio-Environments research group

The research group comprises 3 sub-groups which consist of *water, forestry and waste management*. The *Water Quality Research Group* operates under the leadership of Professor Annabel Fossey and focuses on assessing the quality of water in greater Mangaung, Free State province. Projects include researching the quality of water in rural towns, groundwater and water used in African funeral rituals. The research focus was broadened to also include studying the ecological quality of streams. The sub-group boasts one doctoral student and six master's students, of which three master's students graduated in 2013 – one of them cum laude. This research is funded by the NRF and Mutual and Federal. *Forestry Research Group*: This sub-group, also led by Prof. Fossey, specialises in rooting enhancement strategies tested for commercially important *Eucalyptus* hybrids and species. Collaborators in this research are the Institute for Commercial Forestry Research and a commercial forestry nursery, Sunshine Seedling Services. This research is funded by the NRF. One student completed her master's studies in 2013 and the remainder of the group comprises 3 doctoral and 8 master's students. A third sub-group focuses on waste management and is headed by Dr Hester Roberts, boasting 3 doctoral and 7 master's students. This group focuses primarily on optimisation strategies for landfill sites as well and novel solid, liquid and hazardous waste technologies and includes municipal solid waste, abattoirs, e-waste and projects taking climate change into account.

The Centre for Applied Food Safety and Biotechnology

The Centre for Applied Food Safety and Biotechnology has existed since 1995 as part of the then Activity Programme of the National Research Foundation. The main aim of the unit is to perform cutting-edge food safety and microbiology research and the group is currently one of the most comprehensive in South Africa focusing exclusively on aspects of food safety and hygiene. The unit carries the status of Developed Niche Area at the NRF and currently boasts a critical mass of about 32 members, including 11 master's and 8 doctoral students, 1 post-doc, 3 full-time researchers, 3 external grant holders and 1 administrative assistant.

The leader of the group, Prof. JFR Lues is an NRF-rated researcher. Prof. Lues was elected vice-president of the SA Association of Food Science and Technology in 2013. Successes of the unit include producing the first black doctoral graduates (male and female) at CUT, the first Indian doctoral graduate (female) and the first black male and female NRF grant-holders at CUT. To date the unit has accommodated 7 post-doctoral fellows of whom 4 advanced to fixed-term positions. Members of the unit continuously review and assess external contributions to scientific journals, master's and doctoral theses, and funding and rating applications, while members serve on the editorial panels of authoritative journals such as the *Journal of Food Protection* and *British Food Journal*. Since 2005, a number of visiting professors have visited the centre, and the group regularly sends members and students on local and overseas conferences and study visits (delegates have in recent years attended conferences and conducted study visits across the US, Greece, Italy, Hungary, NZ, Brazil, Canada, France, Slovenia, Turkey, China and the UK). Local conferences where papers are read on an annual and bi-annual basis include amongst others SASM (SA Society for Microbiology), SAAFoST (SA Association for Food Science and Technology), Bio2Biz (SA Biotechnology Conference), SASDT (SA Society of Dairy Technology), SAIEH (SA Association of Environmental Health), WasteCon (hosted by the Institute of Waste Management of Southern Africa) and FIDSSA (Federation of Infectious Diseases of South Africa). The majority of members of the centre are either student or professional members of these associations. International associations where members are affiliated and that are visited during annual events include the ICFMH (International Committee on Food Microbiology and Hygiene) and IAFP (International Association of Food Protection). Selected individuals also hold membership with the IAFP, ICFMH and SFAM (Society for Applied Microbiology) and serve on various working groups. To date, 5 members of the unit have received VC's medallions for best researchers as well as best postgraduate student at the institution and various other in-house accolades.

The research done in the Centre is categorised under the following sub-groups: 1) Bioactive oils; 2) Antimicrobial tolerance and adaptation; 3) Food effluent characterisation; 4) Food related biofilms; 5) Food safety assessment in health care and traditional environments; 6) Food-related bioaerosols; 7) Maize biotechnology and safety; and 8) Food handler and consumer behaviour in formal and informal settings.

For its exclusive use the Centre boasts fully equipped laboratories with contemporary analytical equipment such as HPLCs, capillary electrophoresis systems, GCs and a GC-MSs, an electron microscope and state-of-the-art molecular apparatus. Generous funding from both internal and external sources is available to conduct projects and support current and prospective postgraduate students.

Sub-group food safety assessment and infection control: Jane Nkhebenyane is the group leader and the main research focus is the assessment of food handling behaviours including the evaluation of food safety interventions, hygiene promotion and food safety training in compromised environments. Antimicrobial profiling and molecular characterisation of food-borne pathogens in vulnerable healthcare settings are also part of the group's activities. The work of the group contributes to the development of health interventions and their evaluation, and situational analyses in social and economic contexts through the use of qualitative empirical research. The group currently has 1 doctoral, 2 master's and 2 fourth-year students with Prof. Oriel Thekiso (North West University) as a participating member. One master's student has been successfully supervised and has since graduated. The group also collaborates with the London School of Hygiene and Tropical Medicine in the UK and also with Ghent University in Belgium. Research articles that have emanated from the research work of the group are regularly published in reputable journals and members present papers at international and national conferences; international collaborations include recent visits to the US, Hungary, Switzerland and Ghent, Belgium. Jane Nkhebenyane is currently an NRF Thuthuka grant holder and the group also enjoys financial support from MRC and SANPAD.

Dr Ntsoaki Malebo's sub-group specialises in the search for bioactive oils against food-borne spoilage and pathogenic microorganisms. Currently this group is using various techniques such as electron microscopy and mass spectrometry based proteomics to elucidate the mode of action of bioactive oils against these microbes. The main aim is to find alternative antimicrobials that will serve as natural bio-preservatives and disinfectants to replace currently used synthetic antimicrobials. The research links with work done by a community farmer who produces various essential oils; other collaborators include Dr Manduna of the Department of Health Science. Apart from its internal linkages the projects are conducted in collaboration with the Institute for Tropical and Sub-tropical Crops at the Agricultural Research Council and the University of South Africa. Dr Malebo is currently an NRF-CUT research fellow who supervises five master's and one doctoral student. She has successfully supervised three master's students who have since graduated. Dr Malebo is jointly responsible for setting up a microscopy unit that will boast a scanning, AZ100 zoom electron-microscope and a fluorescence microscope. Together, the group has published papers in international peer-reviewed journals, presented papers at national and international conferences such as the HOPE Meeting attended by a number of Nobel Laureates.

Food industry related effluent characterisation sub group: The effluent research team, headed by Dr Olga de Smidt, focuses on applying micro- and molecular diversity analyses as a tool to establish multifaceted fingerprints for food industry wastewater contributors

as an instrument for microbial source tracking. Current projects aim to assess the current status of wastewater monitoring and treatment in the towns/cities in the Free State with food production, processing or packaging factories. This is achieved by constructing, analysing and assembling microbial fingerprints for amongst others abattoirs, fruit juice bottling factories and dairies. In cases where optimal methodologies do not yet exist, various projects in the group focus on developing methodologies to assemble microbial diversity profiles for food industry effluents. Ultimately the activities endeavour to introduce bio-treatment options in attempts to remediate food industry effluents using indigenous microbes. The team collaborates with numerous food industries in and around Bloemfontein, the University of the Free State in terms of Sanger Sequencing, Stellenbosch University for Next Generation Sequencing and the University of Ljubljana for skills development and student exchange. The sub-group boasts seven master's students, three doctoral students and two graduate student assistants. The group was initiated in 2012 and is currently funded by the National Research Foundation (NRF) under the Thuthuka programme. The team regularly publishes in foremost journals, and members regularly attend conferences locally and abroad – usually the group sends notable delegations abroad to the International Committee of Food Microbiology and Hygiene.

Other research foci in the Centre include maize biotechnology and fermentation, product development (Dr Hanita Swanepoel), entrepreneurial education (Miss Elvina Smith) and Mr Roan Slabbert (antimicrobial adaptation).

DEPARTMENT OF HEALTH SCIENCE

The research group is headed jointly by Dr Lizelle Botes and Prof. Elmien van den Heever, and focuses on heart valve development and assessment as well as aspects of cardio-thoracic surgery. The impact of HIV-Aids, either separately or on cardiomyopathy and associated surgical outcomes, is also investigated. The group has intact collaborative agreements with the Department of Cardiothoracic Surgery at the UFS, led by Professor Francis Smit. Currently the group boasts 6 master's and 2 doctoral students and receives external funding and support from the Free State Government, the Red Cross and the MRC. Research outputs are regularly produced by means of conference contributions locally and abroad, as well as publications in journals such as the Journal of Heart Valve Development and the African Cardiovascular Journal.

The phytochemistry research group is led by Prof. S Mashele and managed by Dr IT Manduna. The group specialises in ethno-pharmacology with special emphasis on medicinal plants. Current projects involve the scientific validation of the use of plant medicines by traditional healers through a number of screening tests for antimicrobial, anti-diabetic, anticancer, anti-inflammatory and antioxidant activity. The chemical profiling of medicinal plants is also carried out. These projects are aimed at contributing to the development of novel drugs or drug leads as well as the documentation of indigenous knowledge in partnership with the Kopano Dingaka Association (Traditional Healers of Thaba Nchu). The group has established national collaboration with scientists from the CSIR, MRC, Stellenbosch University and

the University of the Free State. International collaborations include the NRF-funded bilateral project with Universidade Eduardo Mondlane of Mozambique. The phytomedicine research group has had one doctoral student (who graduated in 2014) and 6 master's students who will graduate in 2015. Numerous journal articles were published in 2015 and research results have been presented at various national and international conferences.

Bioinformatics Cytochrome P450 monooxygenases: from basics to evolution and novel drug targets to biotechnological tools

Recent advances in genome sequencing of organisms have changed the way in which research is carried out. Nowadays, before researchers proceed with laboratory experiments, a great amount of information can be obtained by bioinformatics analysis of organisms' genomic data. Dr Syed's group at the Central University of Technology (CUT) uses such tools to understand cytochrome P450 monooxygenase (P450s) heme-thiolate proteins that are ubiquitously distributed in organisms across the biological kingdoms. The group's research is focused on P450-based drug-designing against human pathogens, development of P450 enzyme-based novel tools for bio-remediation of cancer-causing and endocrine-disrupting chemicals and evolutionary analysis of P450s through genome data mining. Research specifics include (i) unravelling the role of orphan P450 enzymes in microbial physiology; (ii) structure-activity relationship of P450 enzymes; (iii) P450 enzyme-based rational drug-designing; (iv) protein engineering; and (v) genome-wide P450 annotation and phylogenetic analysis.

Completed Master's Degrees

Filmlalter, C. 2015. Bio-impedence monitoring in patience with intradialytic hypertension. Central University of Technology, Free State.

Jawallapersand, P. 2015. *Cytochrome P450 Monooxygenase CYP53A family in fungi: Structural analysis of CYP53 and its redox partner from the Thermophilic terrestris*. Central University of Technology, Free State.

Mhaladi, R. 2015. The therapeutic value of *Aloe ferox* mill. Central University of Technology, Free State.

Modise, K.D.T. 2015. The influence of extrinsic and intrinsic parameters on the quality of cottage cheese. Central University of Technology, Free State.- M Tech Life Science

Motlatla, M.F. 2015. Assessment of health care waste management compliance in the Northern Cape Department of Health. Central University of Technology, Free State.

Muller, H. 2015. Patient radiation dose for procedure in Universitas hospital vascular laboratories. Central University of Technology, Free State.

Netshirovha, T.R. 2015. Protein accretion and its effect on growth rate and testicular traits of Kolbroek boars. Central University of Technology, Free State.

Ntsoelinyane, P.H. 2015. Investigating of anticancer properties of *Philenoptera violacea* (Klotzsch) Schrire

and *Xanthocercis zambesiaca* (Bake) Dumaz-le-Grand. Central University of Technology, Free State.

Nwafor, C.U. 2015. Prospects of commercialization among small scale potato farmers in Bizana. Central University of Technology, Free State.

Okolie, O.D. 2015. Evaluation of *Asperagus africanus* L. root extracts for anti diabetic properties. Central University of Technology, Free State.

Polori, K.L. 2015. The medical properties of *Ipomoea ablongata* E.Mey.ex Coisy. Central University of Technology, Free State.

Completed Doctoral Degrees

Esterhuizen, L. 2015. Drinking water quality and farming practices on dairy farms in the greater Mangaung Metro, South Africa. Central University of Technology, Free State.

Oosthuysen, J. 2015. Infection prevention and control audit-feedback instrumental for oral health care in South Africa. Central University of Technology, Free State.

List of Conference Posters

Bamal, H.D., Mashele, S.S., Chen, W. and Syed, K. 2015 *Understanding the P450 subfamily evolution in biotechnologically valuable and catalytically versatile P450 families CYP63 and CYP5136*. Poster presentation at the Annual International Association for Food Protection Conference.

Booi, W.I., Nkolanyane, P., Wieteska, L., Parvez, M., Van Wyk, M., Mashele, S.S., Grontand, D. and Syed, K. 2015. *In silico approach to understand the molecular basis of ketoconazole-resistance in chronic granulomatous infectious fungus Sporothrix schenckii*.

Foster, L.A., Fourie, P.J. and Naser, F.W.C. 2015. *Effect of different levels of supplementation on the reproduction and profitability of a cow-calf*. Poster presented at the 48th Congress of the South African Society of Animal Sciences. Empangeni, 21-23 September, 2015.

Foster, L.A., Fourie, P.J. and Naser, F.W.C. 2015. *Effect of different levels of supplementation on beef heifer development in the south-eastern Free State*. Poster presented at the 48th Congress of the South African Society of aAimal Sciences. Empangeni, 21-23 September, 2015.

Kgosiemang, I.K.R., Mashele, S.S. and Syed, K. 2015. *Restriction enzyme profiling of Mycobacterium tuberculosis cytochrome P450 monooxygenases and its redox partners*. Poster presentation at the Annual International Association for Food Protection Conference.

Mongale, B.L., Monyaki, R., Mashele, S.S. and Syed, K. 2015. *Comparative modelling of twenty-one cytochrome P450 monooxygenases of novel common alternative anti-fungal drug target CYP53 family*. Poster presentation at the Annual International Association for Food Protection Conference.

- Monyaki, R., Mashele, S.S. and Syed, K. 2015. *Structural analysis of essential P450 CYP125 in ecologically diverse mycobacteria species*.
- Motolwana, A.S., Fourie, P.J., De Witt, F.H. and Fair, M.D. 2015. *Effect of dietary inclusion levels of diatomaceous earth on production and carcass characteristics of broilers*. Poster presented at the 48th Congress of the South African Society of Animal Sciences. Empangeni, 21-23 September, 2015.
- Mthakathi, N.T., Matowane, G.R., Kgosiemang, I.K.R., Chen, W., Mohlatsaneme, Mojahi, T.J., Yu, J.H., Mashele, S.S. and Syed, K. 2015. *Cytochrome P450 monooxygenase analysis in biotechnologically valuable microalgae Coccomyxa sp. C-169 and Chlorella sp. NC64A*. Poster presentation at the Annual International Association for Food Protection Conference.
- Parvez, M., Mashele, S.S., Syed, K. 2015. *Genome-wide identification and annotation of cytochrome P450 monooxygenase CYP123A1 in sixty mycobacterial species*. Poster presentation at the Annual International Association for Food Protection Conference.
- Qhanya, L.B., Matowane, G., Chen, W., Sun, Y., Letsimo, E.M., Parvez, M., Yu, J.H., Mashele, S.S. and Syed, K. 2015. *Genome-wide annotation and comparative analysis of cytochrome P450 monooxygenases in basidiomycete biotrophic plant pathogens*. Poster presentation at the Annual International Association for Food Protection Conference.
- Raseleman, S.C., Mashele, S.S. and Syed, K. 2015. *Comparative genomics of cytochrome P450 monooxygenase redox proteins in mycobacteria*. Poster presentation at the Annual International Association for Food Protection Conference.
- Sello, M.M., Jafta, N., Nelson, D.R., Chen, W., Yu, J.H., Parvez, M., Kgosiemang, I.K.R., Monyaki, R., Raseleman, S.C., Qhanya, L.B., Mthakathi, N.T., Mashele, S.S. and Syed, K. 2015. *Genome-wide annotation and phylogenetic analysis of cytochrome P450 monooxygenases in pathogenic oomycetes*. Poster presentation at the Annual International Association for Food Protection Conference.
- Van Wyk, M., Letsimo, E.M., Qhanya, L.B., Mashele, S.S. and Syed, K. 2015. *Analysis of cytochrome P450 monooxygenases in skin infectious yeasts Malasseziaglobosa and M. sympodialis*. Poster presentation at the Annual International Association for Food Protection Conference.
- Friedrich-Nel, H. 2015. Soaring or sinking? Workshop 12 June 2015 with the topic: Doctoral Education at CUT.
- Friedrich-Nel, H. and Mackinnon, J. 2015. Expectations in postgraduate supervision. 5th Postgraduate Supervision Conference, Spier, Stellenbosch, 25-27 March 2015.
- Khetsha, Z.P. and Sedibe, M.M. 2015. The effect of NaCl and rooting media on the yield and mineral composition of rose geranium (Pelargonium graveolens). Combined congress, George, 19-22 January 2015.
- Malebo, N.J., Sedibe, M., Khetsha, Z.P. and Kativu, E. 2015. The influence of essential oils on developmental structures and morphology of the yeast pathogen Eremothecium ashbyii. Edulearn Conference 2015 in Princesca Sophia Barcelona, Spain from 4-7 July 2015.
- Mogongoa, L.F. 2015. A reflection on pedagogical approach and innovative methods used to deliver health related content to different communities that the programme Biomedical Technology at the Central University of Technology (CUT), Free State, engages with during service learning. 6th International Symposium on Service Learning, 28-30 May 2015, University of Indianapolis, Indiana, USA.
- Mogongoa, L.F. 2015. The in vitro effect of different alcohol beverages on coagulation screening tests, factor VII and VIII activity. Medical Laboratory Professionals Congress, 15-17 May 2015, Port Elizabeth.
- Mokgawa, S.D. 2015. The toxicology of Asparagus laricus in rats. Medical Laboratory Professionals Congress, 15-17 May 2015, Port Elizabeth.
- Sedibe, M.M. 2015. Yield and quality of hydroponically grown rose geranium (Pelargonium graveolens) to shading. Combined Congress, George, 19-22 January 2015.
- Smit, F.E., Bester, D., Van den Heever, J.J., Botes, L., Rossouw, S., Goedhals, J. and Dohmen, P.A. 2015. A subcutaneous rat model to study the efficacy of decellularization to determine calcification of bovine pericardium. Annual Conference of the Heart Valve Society, 6-9 May 2015, Grimaldi, Monaco.
- Smit, F.E., Bester, D., Van den Heever, J.J., Schlegel, F., Botes, L. and Dohmen, P.A. 2015. Impact of prolonged post-mortem cold ischemic harvesting time on leaflet calcification in the juvenile sheep model. Annual Conference of the Heart Valve Society, 6-9 May 2015, Grimaldi, Monaco.
- Swanepoel, H. 2015. Production system in the south-eastern Free State. IFT Conference in the USA during July 2015 as LEAD Fellow.
- Van der Merwe, B. 2015. Best practice for standardised training and assessment for diagnostic radiography. Edulearn Conference 2015 in Princesca Sophia Barcelona, Spain from 4-7 July 2015.

List of Conference Papers

- Botha, R. 2015. A framework for service-learning in the undergraduate radiography programme in the Mangaung area. International Symposium on Service Learning in Indianapolis USA, 28-30 May 2015 presented by the University of Indianapolis & University of Stellenbosch.
- Du Plessis, J. and Bezuidenhout, J. 2015. The use of new teaching technologies in the delivery of work-integrated learning in radiography training. Edulearn Conference 2015 in Princesca Sophia Barcelona, Spain from 4-7 July 2015.

List of Conference Proceedings

Khetsha, Z.P. and Sedibe, M.M. 2015. Effect of NaCl and root-media selection on yield attributes, oil composition and mineral composition of rose geranium. In: Proceedings of the 2nd International Conference on Agriculture and Forestry (Virtual Presentation), 10-12 June, Colombo, Sri-Lanka.

Motho, L., Tsotetsi, A.M., Nkhebenyane, J.S., Mokoatsi, T.E. and Thekiso, M.M.O. 2015. Assessment of water quality and documentation of macro- and micro-invertebrates on dams and river of Qwaqwa, South Africa. In: Proceedings of the 7th International Symposium in Africa.

List of Publications/Articles in Journals (DHET subsidised)

Achilonu, M. and Umesiobi, D.O. 2015. Bioactive phytochemicals: Bioactivity, sources, preparations and/or modifications via silver tetrafluoroborate mediation. *Journal of Chemistry*, 62: 90-85.

Achilonu, M.C. and Umesiobi, D.O. 2015. The formation of carbon-carbon and carbon-heteroatom bonds using silver tetrafluoroborate as a promoter. *Arabian Journal of Chemistry*, <http://dx.doi.org/10.1016/j.arabjc.2015.06.038>.

Botha, R. and Kotze, K. 2014. The preparedness of Bloemfontein radiographers for common medical emergencies. *Journal for New Generation Sciences*, 12, 18-23.

Botha, R.W., Friedrich-Nel, H. and Africa, M. 2015. Demonstrating the cervico thoracic junction: a comparison of two radiographic x-ray techniques. *JNGS*, 13:19 – 35.

De Smidt, O. 2015. The use of PCR-DGGE to determine bacterial fingerprints for poultry and red meat abattoir effluent. *Letters in Applied Microbiology*, 62:1-8 (DOI: 10.1111/lam.12505).

Esterhuizen, A., Fossey, A. and Potgieter, E. 2015. Groundwater quality on dairy farms in central South Africa. *Water SA*, 41(2), 194-198.

Fourie, P.J. and Matli, K.P. 2014. Promoting profitability and sustainability in the background of beef calves: the role of agricultural extension. *South African Journal of Agriculture*, 2: 115-126.

Fourie, P.J. 2015. Promoting the purchasing of performance tested Dorper rams: the role of Agricultural extension. *S. African J. Agricultural Extension*, 43: 32-40.

Friedrich-Nel, H.S. and MacKinnon, J.L. 2015. Formative assessment in doctoral education. *JNGS*, 13, 1-14.

Hadebe, G.P. and Van der Westhuizen, C. 2015. Assessment of vegetable production practices in Qwaqwa within Thabo Mofutsanyana District. *South African Journal of Agricultural Extension*, 43:1-9.

Hadebe, G.P. 2015. Assessment of poultry developments in the Lejweleputswa District within the Free State province. *South African Journal of Agricultural Extension*, 43: 10-16.

Khetsha, Z.P. and Sedibe, M.M. 2015. Effect of potassium and potting-bag size on foliar biomass

and related attributes and oil composition of rose geranium (*Pelagonium graveolens*). *S. Afric J Plant Soil*, 1-8.

Mthakathi, N.T., Kgosiemang, I.K.R., Chen, W., Mohlatsane, M.E., Mojahi, T.J., Yu, J.-H., Mashele, S.S. and Syed, K. 2015. Cytochrome P450 monooxygenase analysis in free-living and symbiotic microalgae *Coccomyxa* sp. C-169 and *Chlorella* sp. NC64A. *Algae*, 30, 233-239.

Oosthuysen, J. and Fossey, A. 2015. Assessment of the audit-feedback instrument for oral health care facilities in South Africa. *South African Dental Journal*, 70:282-290.

Oosthuysen, J., Potgieter, E. and Fossey, A. 2014. Compliance with infection prevention and control in oral health-care facilities: a global perspective. *International Dental Journal*, 297-311.

Qhanya, L.B., Matowane G., Chen, W., Sun, Y., Parvez, M., Yu, J.H., Mashele, S.S. and Syed, K. 2015. Deciphering distinct Cytochrome P450 Monooxygenase profiles in the Basidiomycete biotrophic plant pathogens *Armillaria mellea*, *Melampsora laricis-populina*, *Puccinia graminis* and *Ustilago maydis*. *PLoS ONE*.

Raphela, S.F. 2014. Treatment and disposal of medical waste in rural and urban clinics within Polokwane Municipality of South Africa. *Journal for New Generation Sciences*, 12: 97-109.

Raphela, S.F. 2015. Occupational injuries among workers in a welding company within Mangaung Metropolitan Municipality. *Journal of Occupational Health Southern Africa*, 21: 8-11.

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Khetsha, Z.P. and Sedibe, M.M. 2015. Effect of NaCl and Root-Media Selection on Yield Attributes, Oil Composition and Mineral Composition of Rose Geranium. In: Proceedings of the 2nd International Conference on Agriculture and Forestry1: 10-12.

- Pretorius, R.J. 2015. Grondkewers. *S.A. Vegetables & Fruit*. Jul/Aug issue, no. 166.
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- Pretorius, R.J. 2015. Liewenheersbesies. *S.A. Vegetables & Fruit*. Nov/Dec issue, no. 168.
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Fostering Strategic Partnerships

Institution	Nature of partnership	Activities in 2015
Central University of Technology, Angola, Mozambique and external stakeholders	African partnership	A joint workshop on science and technology between CUT, Angola, Mozambique and external stakeholders was held early in 2015.
University of New England, Australia; University of Manitoba, Canada; Cornell University, USA	International collaborations	On-going collaborations
South Africa's Department of Science and Technology (DST) and the Ministry of Science, Research and Technology of the Islamic Republic of Iran	International collaborations	On-going collaborations joint project
United States of America, RSA, Canada, Europe (Slovenia, Poland and Germany), Japan, India, South Korea and China.	International collaborations	Joint genome sequencing projects carried out by the Joint Genome Institute (JGI) of the Department of Energy, USA.
University of Eduardo Mondlane in Mozambique.	International collaborations	On-going collaborations
Hanze university		Co-coordinator of the internship programmes Mentorship of Radiography students from Hanze.

REPORT FROM POST-DOCTORAL FELLOWS

Dr Khajamohiddin Syed is a postdoctoral fellow at the Department of Health Sciences, Faculty of Health and Environmental Sciences, Central University of Technology, Bloemfontein, Free State. Dr Syed completed his M.Sc. in Biochemistry, receiving a gold medal, and a Ph.D. at Sri Krishnadevaraya University, Andhra Pradesh, India. During his doctoral studies he published three articles in high impact-factor journals and made presentations at various conferences, including the Society of Biological Chemists, India. After his doctoral studies he worked as postdoctoral research associate at the University of the Free State, Bloemfontein, South Africa (2006-2009) and then moved to the University of Cincinnati, Ohio, USA as a visiting faculty member (2009-2013). Dr Syed as academician enjoys lecturing and supervising students. At present he is teaching Biochemistry IV to B Tech students. Currently, he supervises quite a number of D Tech (6), and M Tech (17) students. Dr Syed's research is focused on Cytochrome P450 monooxygenases (P450s), heme-thiolate proteins present in all living organisms. Research specifics include (i) genome-wide data mining and their annotation; (ii) structure-function analysis; (iii) evolution; and (iv) applications. Dr Syed's research work has been published in highly ranked peer-reviewed scientific journals, including Science and PNAS, USA. For more information on his research articles, please visit his Google scholar webpage: <http://scholar.google.com/citations?user=9SX649AAAAAJ&hl=en>. Dr Syed's research achievements were highlighted in the University of Cincinnati Newsletter, Cincinnati, Ohio, USA and also in Research and News Letter, Central University of Technology (CUT), Bloemfontein, South Africa. He has been an invited speaker at both national (South African) and international conferences. Dr Syed carries international recognition in P450 research as is evident by national and international invited talks and his research index as shown as of 01 April 2016: Google scholar - total citations: 899; h- index:

13; i10- index: 15 (<https://scholar.google.com/citations?user=9SX649AAAAAJ&hl=en>) and Research gate -Score: 27.00; Impact points: 116.52 (https://www.researchgate.net/profile/Khajamohiddin_Syed). Recently, Dr Syed's group identified a novel drug target against Oomycete pathogens. The discovery of novel P450 fusion protein as drug target is aired in South African News Channels and Newspapers (<https://www.youtube.com/watch?v=VbOdUMTsEyc&feature=youtu.be>). Dr Syed serves as editorial board member and reviewer for reputed international scientific journals. He is an active member in microbial genome sequencing projects carried out by the Joint Genome Institute (JGI) of the Department of Energy, USA. Dr Syed is involved in research collaboration with high-profile researchers from various countries, including the USA, UK, Canada, Europe, Japan, India and South Korea. Since he joined CUT (July 2013), Dr Syed has successfully established a molecular biology laboratory and a bioinformatics laboratory with Prof. Samson Sitheni Mashele. Currently, Dr Syed holds a major research grant from Technology and Innovation Research (TIA), South Africa. Dr Syed is a key member in establishing the Unit for Drug Discovery Research at CUT (<http://centerfordrugdiscovery.research.weebly.com/>) and he is also the creator of South African Cytochrome P450 Researchers (SACPR) community website. For more information on this society please follow the link:<http://sacpr.weebly.com/>.

Dr Hanita Swanepoel is the current postdoctoral research fellow at the Centre of Applied Food Security and Biotechnology (CAFSaB) at the Department of Health Sciences, Faculty of Health and Environmental Sciences, Central University of Technology. She aims to assist the maize milling industry with solutions towards the utilisation and value addition of some of their by-products, such as the fines. Through her research, she wants to provide strategies and solutions to the milling industry, giving the industry a means to compete by increasing the demand for maize and thereby contributing to the sustainability

of the milling industry. Dr Swanepoel worked full-time at Continental Beverages in Bloemfontein, initially as Product Development manager and after a promotion as Technical Manager (responsible for Product Development and Quality Control Assurance). During this period her research experience assisted her to solve numerous problems that occurred in the industry, either in production or in the final product ensuring safe, stable and high quality products. She did the development for new innovations on the flagship brand, namely *Wild Island*, and other variants such as the *Super Fruit* and other concentrated beverages. Specialisation: Research and Development (R&D) in Food Science with the focus on food safety (including food safety systems and product shelf life) and food security (reduction of waste during product development and the use of waste or by-products). Key performance areas: R&D using the by-products from the milling industry; recipe development for products such as cookies and beverages: different experiments have been done to find a way to utilise the fines as carbon source for fermented beverages; the establishment of a fermentation laboratory which involves the management, planning and approvals for this laboratory with the various role players such as the architect, quantity surveyor etc. It also includes the budgeting, control of expenses and procurement of the equipment, raw materials, etc.; the development of relationships with internal partners (e.g. PDTS and REGMS) and external industry and government partners such as DESTEA, Pioneer Foods, OVK, SAB, Entecom and the International Labour Organisation (ILO) amongst others. Dr Swanepoel currently supervises postgraduate students and reviews articles from peer-reviewed journals and theses from other institutions on an ad hoc basis. She lectures Aroma Chemistry to the 3rd year Somatology students and annually organises an industry visit for the B.Tech Food Hygiene students. Dr Swanepoel secured a R466 000 TIA grant and R100 000 in the form of raw materials from the OVK for her postdoctoral research focus to utilise fines. Dr Swanepoel was nominated by her Food Science peers to represent the South African Association for Food Science and Technology (SAAFoST) at the Institute for Food Technologists (IFT) as the South African 360 LEAD candidate in Chicago, USA during July 2015. As part of the prestige research day organising committee, she reviewed the abstracts. She also reviewed abstracts for the SAAFoST International Conference for 2015, where she also presented a paper. In addition, she managed to secure contract work from ILO-Mangaung Restaurant feasibility report – the formal report was presented to the winners of the DESTEA/ILO Master Caterers challenge. Due to her partnership with the OVK, the Hotel School was sponsored with all cake flour used during the last term in 2015. Dr Swanepoel published an article in the November 2015 FST Magazine (Food Science and Technology Magazine) about her LEAD 360 experience. She was invited to publish in the FST magazine again and her article *Food shedding* featured in the February issue. This article focused on food wastage and security issues with which the industry is struggling, looking specifically at the effects of load shedding. She compiled a workshop for *Entecom*, an accredited food safety training provider, on the South African food regulations and the labelling thereof. Additional responsibilities: Dr Swanepoel is currently registered as a Professional Natural Scientist with the South African Council of Natural Scientific Professions (SACNASP). Dr Swanepoel is a council member of the SAAFoST. She was invited by the late president of

SAAFoST, Prof. Amanda Minnaar, and the immediate past president (2013-2015) Mr Ryan Ponquetto, host a session for the young food science professionals during the SAAFoST International Conference for 2015 namely: My SAAFoST. She was invited to become part of the Provincial Research Advisory Committee (PRAC) and is now involved with DESTEA in a process to develop a Provincial Economic Development Strategy for the Free State. Dr Swanepoel is involved with the Regional Innovation Forum of the Free State (RIFFS) and she is busy with entrepreneurial activities of her own. Dr Swanepoel completed her tasks as LEAD 360 candidate from IFT during 2015/2016. She serves as committee member for TIA at CUT. She has been invited to judge at the Bloem Show since 2010. She also assists the Hotel School in judging competitions when needed.

Dr Matthew C. Achilonu is a postdoctoral research fellow at the Department of Agriculture, Faculty of Health and Environmental Sciences, Central University of Technology, Free State. He received his doctorate degree in Chemistry from the University of the Free State in 2009. His other degrees are: M.Sc. in Polymer Science and Technology (*cum laude*), and B.Sc.Tech. in Industrial Chemistry, both obtained from the Federal University of Technology, Owerri, Nigeria in 1989 and 1994 respectively. Dr Achilonu's bachelor's degree research was on extraction and purification of *Furfural* from agricultural wastes (rice husks). His master's degree research focused on grafting of acrylamide onto *gum Arabic* macromolecules to produce modified biopolymer. Key performance areas: 1) Utilising biologically active phytochemicals in animal diets: investigating their modulatory effects and possible use as a replacement for the synthetic antibiotics, hormones and growth promoters in poultry species; and 2) chemical modification of renewable agricultural wastes to a biodegradable biopolymer for wastewater remediation. About eight postgraduate students are working on these ideas under his supervision/co-supervision. Specialisation: *Bioactive phytochemicals in animal diets*: In this field of study, Dr Achilonu focuses on pumpkins (*cucurbitaceae*), which are known to display a wide range of biological activities, hence the growing interest by farmers in using them as feed additives to fortify animals' feeds. The worldwide growing need to increase animal productivity necessitated the massive use of harmful synthetic hormones and antibiotics in livestock production. Discovery of the synthetic drugs in animal products is a concern to consumers and hence, the urgent need for their replacement with beneficial bioactive phytochemicals. The bioactive phytochemicals exhibit antimicrobial, antioxidant, anti-parasitic, antiprotozoal, antifungal, and anti-inflammatory properties, and consequently have beneficial effects on appetite, growth and the immune status of the animal. Pumpkin species, favoured by nutritionists and researchers for their high nutrient content, is a major crop produced in South Africa. The flesh serves as a traditional food, while the seeds and peels are thrown out as wastes. Pumpkin seed extract is useful for immunomodulation, reproductive health, therapeutics over a wide range of disease conditions and also stimulates metabolism of accumulated fats. Studies have also shown that the pumpkin seeds are a valuable source of protein and fat. Their complexity and extent of bioactivity offer enormous prospects for natural control of pathogenic/parasitic organisms, stimulation of nutrition, or enhanced resistance to disease infections, reduce

abdominal fat and serum levels of harmful lipids, while the serum levels of beneficial lipids are increased. This study on the effect of pumpkin meals on the general performance of poultry will reveal the pumpkins' phytochemicals, the dosage at which effects are seen, and a possible alternative to synthetic growth hormones and antibiotics used in the poultry industry. The present study is therefore expected to show that pumpkin meals have a positive impact on the general performance of all poultry species, via an increased feed conversion ratio (FCR), growth rate and egg production traits, as well as its role in the health of poultry by maintaining a balanced microflora in the digestive system.

Agricultural wastes modification and use in wastewater remediation: Studies have shown that organic micro-pollutants such as pesticides, pharmaceutical compounds, personal care products and industrial chemicals are found in surface waters, ground waters, sewage effluents and even in drinking water. When the organic micro-pollutants and their metabolites are dissolved or attached to colloids, they are marginally eliminated by conventional coagulation, flocculation, or biological wastewater treatment processes. Though synthetic polymers are very efficient flocculants, they are limited by not being shear resistant and the residual monomers being detected in treated water are undesirable because of their neurotoxicity and strong carcinogenic properties. Natural biopolymers (polysaccharides) function as bridging flocculants; however they are associated with the following disadvantages: (i) effective at large dosages; (ii) the chitosan is soluble in acidic media and

therefore cannot be used as an insoluble sorbent; and (iii) chitosan is used in acidic media only after physical and chemical modifications. Environmental concerns and ecological issues favour the use of the chemically modified biodegradable polysaccharide flocculants because of their improved flocculation efficacy. This study thus, aims at modifying natural biopolymers by preparing different ionic polysaccharides; preparation of chitosan blends and cross-links of the chitosan derivatives to produce modified polysaccharides that are nontoxic, biodegradable, shear stable and are efficient adsorptive flocculants that would remove extraneous materials, such as heavy metal ions, persistent organic micro-pollutants and pathogens from abattoir wastewater and industrial effluents within the Mangaung Metropolitan Municipality. Chitosan flakes have a high antibacterial activity and are therefore a promising antimicrobial agent, which could be helpful in the water treatment and in wastewater reuse. The flakes do not lose their antibacterial activity and could directly be reused.

Additional responsibilities and achievements: 1) NRF Reviewer: NRF-CPRR Assessment of research proposal: Prof. P.A. Ajibade (2015); 2) Prestige Research Day Committee Member 2015: Interim abstracts reviewer; 3) Achievements related to research work; 4) UNESCO/IUPAC Workshop & Conference on Macromolecules & Materials, 7-10 September 2015, Port Elizabeth, South Africa; and Department of Education Free State Province Full Time bursary awards to four of my M. Agri students.



PART 6

FACULTY OF
HUMANITIES

FACULTY OF HUMANITIES

A message from the Dean

Prof. D.P. Ngidi



It is my singular honour and privilege as Dean of the Faculty of Humanities, to present an overview of the faculty's 2015 research-related activities. I want to start by thanking all members of staff who contributed towards the research achievements in 2015. The faculty produced 18 articles in accredited journals generating a total of

15.5 DHET credits. The faculty staff attended and presented papers at 13 national/regional conferences and 26 international conferences. Much of the financial support to attend these conferences came from the Scholarship of Teaching & Learning (SoTL) grant as well researchers' own external funding. On behalf of the faculty I would like to express my sincerest gratitude for such support. The faculty further produced 7 master's graduates and 3 doctoral graduates against the targeted 10 completed M degrees and 2 D degrees. A key highlight for my faculty is that in the 2015 academic year I travelled to Thailand with the Director of International Affairs and one other member from my faculty and we signed three MOU's with some Thailand universities, details of which are provided in this report. This is consistent with the institution's Vision 2020 and the Strategic Research Goals.

A message from the Research Manager

Prof. M.K. Mhlolo



It is that time of the year again when I have to present the Faculty of Humanities' Research and Innovation Report. A number of milestones were reached in the faculty during the year under review. Our committee changed its name from the Faculty Research Committee

(FRC) to the Faculty Research and Innovation Committee (FRIC) in line with the university's vision to incorporate innovation in all our research-related activities. This change in name also meant that we had to change our constitution and composition of the committee members to accommodate this innovation element. In this regard I would like to thank

Prof. Makura for drafting our amended constitution and Mr O. Ojo for accepting our invitation to join the FRIC committee as the member specifically charged with the responsibility of guiding the committee on innovation-related activities. We were privileged as a faculty in that at the time of incorporating Mr O. Ojo into our FRIC, he was already a committee member of the university's Innovation Committee. This put us in a better position to tap on his experiences on such matters.



In the 2014 Annual Report, I gave a very brief summary on the developments leading to an international collaboration between the University of Free State, Mahasarakham University, Chiang Mai University, Rajabhat Mahasarakham University and the Central University of Technology. In 2015 our collaborative efforts bore fruit and three MOUs were signed. Plans are at an advanced stage to roll out some collaborative research projects with these universities. Having provided this brief overview the report now goes into more detail on the following activities:

NARRATIVES ON RESEARCH PROJECTS IN THE FACULTY

National and International Collaboration

Research activities under this project are in line with the university's vision towards partnerships with public and private funding agencies and regional, national and international universities.

The first project under this collaboration was the partnership in organising the Multi-Cultural Education and Special Education (MESPED) International Conference which was hosted by Chiang Mai University, Thailand from the 17-19 December, 2014. A special invitation was extended to four delegates from CUT to represent this university at the MESPED International Conference as part of that partnership. At the opening of this conference, Chiang Mai University awarded each of the collaborating universities with a symbol in silver of this collaboration (see photo below).



Here we see the four-member delegation handing over the symbol to the Dean of the Faculty of Humanities (From left: Prof. Mhlolo, Dr Setlaltoea, Prof. Ngidi, Prof. Makura and Prof. Alexander)

As a follow-up to the December 2014 collaboration initiatives, Prof. Mike Mhlolo, Dr Wendy Setlaltoea and Prof. Gregg Alexander undertook a short, intensive study visit to Thailand for the period 06-10 April 2015 to engage in discussions regarding the exploration of research collaboration, networking, staff and student exchange and teacher professional development. This engagement then laid the platform for the signing of Memoranda of Understanding (MOUs) with 3 Thai universities (Khon Kaen University, Mahasarakham University and Rajabhat University).



Here we see the CUT delegates and their Thai counterparts engaged in discussions



Here we see from left to right Dr W. Setlaltoea (CUT), Dr Kanokporn Rattanasuteerakul (the Dean of the Faculty of Humanities & Social, Mahasarakham University), Prof. G. Alexander (CUT), Dr Apiradee Jansaeng (Associate Dean for Research, Academic Service and International Relations – Mahasarakham University) and Prof. M.K. Mhlolo (Research Manager, Faculty of Humanities, CUT) after finalising the discussions on possible areas of collaboration.

As a result of these discussions, Prof. Ngidi (Dean of Faculty of Humanities) then undertook a visit with Mr Johnson (Director International Affairs) and Prof. Alexander (Department of Postgraduate Studies in Education) for the official signing of the MOUs with the three Thai universities. The DVC Research &

Innovation, Prof. Henk De Jager, also provided financial support for the signing of MOU visits to Thailand. This part of the report gives a brief description of each visit and its related activities.

Visit to Chiang Mai University (CMU)

Although an MOU has not yet been finalised with Chiang Mai University, the CUT delegation visited the Faculty of Education, Chiang Mai University (CMU) on 20 October 2015, where they were welcomed by the Dean of Education, Prof. Pondsak Pankaew, Prof. Ratchaneekorn Tongsookdee (Associate Dean for Research, Academic Service and International Relations), Ms Ajaan Patajan, Director of the Demonstration School and a few staff members. The idea behind this meeting was to discuss and establish the frame of reference for the drafting of a future MOU between CMU and CUT. It needs to be noted that CUT was partner to the first MESPED (Multicultural and Special Education International Conference) in Chiang Mai, in December 2014. Chiang Mai University has a Faculty of Fine and Applied Arts and a Faculty of Mass Communication which could be to the benefit of other Departments in the Faculty of Humanities, CUT.



On the left hand side of the board we see Mr Arthur Johnson (Director of International Affairs) and Prof. Alexander (Postgraduate Studies – CUT). On the right hand side of the board we see Prof. Ngidi (Dean of Faculty of Humanities – CUT) sharing some happy moments with their hosts at Chiang Mai University.

Visit to Khon Kaen University (KKU)

On 21 October 2015, the CUT delegation visited the Faculty of Education, Khon Kaen University (KKU), where they were welcomed by the Dean of Education, Prof. Maitree Inprasitha, International Relations Officer, Mr Jakkrapong Thongpai, and some representatives of the faculty management team.



Here we see Prof. Ngidi (left of the board) and his counterpart Prof. Inprasitha (right of the board) after the signing ceremony.

The faculty MOU was signed with the following activities in mind:

- CUT becoming involved in the Lesson Study and Open Learning approaches in Mathematics teaching and learning

- Ventures for joint research initiatives in Mathematics Education and other forms of teacher professional development
- Staff exchange programmes with a special focus on developing English academic writing skills (KKU)

Khon Kaen University is one of the few universities in Thailand which offers a PhD in Mathematics, Science Education and Educational Technology. The globally-used and well known 'Lesson Study' and 'Open Approach' and Math Innovations approach have been introduced in 22 schools in Thailand over the past 10 years and are overseen by the Centre for Research in Mathematics Education, Centre for Research on International Cooperation in Educational Development (University of Tsukuba, Japan) and the APEC Human Resources Development Working Group. Besides its special position regarding Mathematics, Science and Technology Education, Khon Kaen University also has a vibrant Faculty of Fine and Applied Arts.

Visit to Mahasarakham University

On 22 October the CUT delegation visited Faculty of Humanities, Mahasarakham University (MSU), where we were welcomed by the Dean of Humanities (Dr Kanokporn Rattanasuteerakul), Dr Apiradee Jansaeng (Associate Dean, for Research, Academic Service and International Relations) and various Heads of Departments.



Here we see Prof. Ngidi and Dr Kanokporn Rattanasuteerakul signing the MOU.



Here we see Prof. Ngidi with his counterpart on his left, Prof. Kanokporn Rattanasuteerakul (Dean of Faculty - Mahasarakham University) with other staff members from both partners CUT and MSU

A faculty MOU was signed with the following activities in mind:

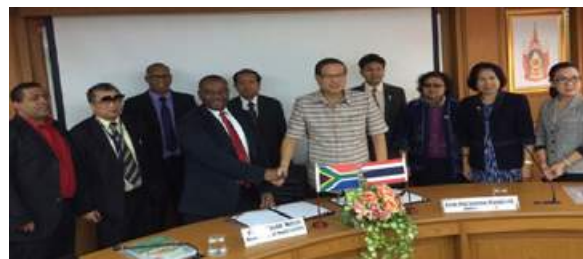
- Joint academic and research activities with a view to enhancing joint publication in SCOPUS, ISI indexes and DHET accredited journals

- Academic writing and opportunities to sharpen MSU staff in English publication development initiatives. In this regard, CUT shared some initiatives such as the annual writing and publication workshop with Prof. Elias Mpofu, editor of the Journal of Psychology in Africa.
- Sharing knowledge and exchanging ideas for the enhancement of sustainable community development and service learning engagement initiatives.
- Initiating opportunities for staff and student exchange via identified scholarship and leadership programmes.

The MOU also makes provision for the inclusion of activities with the Faculty of Education. MSU has a Faculty of Fine and Applied Arts. The Programme for English for International Communication is also offered in the Faculty of Humanities. These faculties at MSU are critical to the further engagement of the other departments in the Faculty of Humanities, CUT.

Visit to Rajabhat Mahasarakham University

On 22 October 2015, the CUT delegation also visited the Faculty of Education, Rajabhat Mahasarakham University (RMU), where we were welcomed by the University President (Prof. Somchai Wongkasem), the Dean of Education (Prof. Surawat Thongbu), the Dean of Humanities (Prof. Prontip Worakul), Dr Nitaya Klangchanee (Vice President for International Relations), Prof. Toansakul Santiboon (Head of STEM Postgraduate Education) and other university representatives.



Here we see Prof. Ngidi shaking hands with his counterpart at Rajabhat Mahasarakham University after the signing ceremony.

The faculty MOU was signed with the following activities in mind:

- Joint research collaboration with a view of enhancing joint publication in SCOPUS and ISI indexes. The understanding is that a CUT colleague in a designated field of study will pair with an RMU colleague to language and technically edit a paper and submit it for publication to an accredited ISI and/or SCOPUS indexed journal. The Thai counterpart will attempt the first draft in English.
- Academic writing and opportunities to sharpen RMU staff in English publication. In this regard CUT shared some thoughts with RMU on such initiatives as the annual writing and publication workshop with Prof. Elias Mpofu, editor of the Journal of Psychology in Africa.
- Staff and student exchange with a special focus on academic collaboration and leadership development initiatives for students.

The MOU was signed at institutional level. The initial implementation steps of this MOU will focus on postgraduate students and staff exchange with a STEM focus, and in particular, Science Education. The Dean of Education, RMU, who is also the Chair of the Rajabhat Universities' Forum in Thailand has been tasked by the Thai government to spearhead a strategy aimed at developing and implementing a National Teacher Development initiative for Instructional Leadership in STEM for Thailand. In rolling out this initiative, RMU has prioritised the establishment of a Centre for Teacher Education Development. A request was made via the Dean of Education, RMU for the involvement of CUT's Faculty of Humanities (Teacher Education Section) in this process. RMU offers a PhD in Mathematics Education. The Faculty of Humanities offers Fine and Applied Arts and Business English and Communication.

Chiang Mai University, Visit to Central University of Technology for the Period, 25-27 November 2015

On 26 November 2015, a Chiang Mai University (CMU) delegation met with Ms Refilwe Molelane (Academic Exchange and Study Abroad Coordinator, International Affairs) and representatives from the faculty's Internationalisation Committee (Profs Alexander, Matoti, Mhlolo and Dr Kalobo) at the International Affairs Office. This visit by Chiang Mai University to CUT followed the visit by the Faculty of Humanities (Profs Ngidi and Alexander) and the International Affairs Office (Mr Arthur Johnson) to Chiang Mai University on 20 October 2015. The CMU delegation to CUT was led by Prof. Ratchaneekorn Tongsookdee (Associate Dean for Research, Academic Service and International Relations). The rest of the team comprised of: Assistant Professor Dr Ruetinan Samuttai (Associate Dean for Policy and Planning Affairs); Assistant Professor Dr Rajchukarn Tongthaworn (Associate Dean for Academic and Student Development Affairs) and Lecturer Pathumwadi Sirisawat (Director, Chiang Mai University Demonstration School).



Here we see Prof. Ratchaneekorn Tongsookdee highlighting some issues for CUT's consideration with regard to the draft MOU.

CMU referred to two critical points that need to be taken forward with Mr Arthur Johnson and CUT's legal department. In essence, CMU is in accord with the rest of the MOU contents and expressed its sincere wish to collaborate with CUT on research projects, joint hosting of conferences, teaching, staff and student exchange. The faculty hosted the CMU delegation to a lunch.



The CMU delegates with the CUT hosts

Engagement with CUT Welkom Campus

On 27 November 2015, Dr Luzaan Schlebusch arranged and coordinated a visit for the CMU delegation to Welkom Gymnasium high school, which is the best performing school in the Lejweleputswa region of the Free State province. The CMU delegation was exposed to this school's facilities, infrastructure, learners and classrooms; they also received a hearty welcome from the principal, Mr J. Slabbert.



Here we see the CUT (Welkom and Bloemfontein) staff together with their CMU partners.

During the CMU delegation's second activity, our guests met with representatives of the faculty (Dr Luzaan Schlebusch, Dr Awelani Rambuda and Mr Alfred Modise), a member of the Faculty Internationalisation Committee (Dr Jo Badenhorst), the Head of Department Postgraduate Studies in Education (Prof. Gawie Schlebusch) and the Campus Manager (Dr Solomon Makola). A close and interactive session between CMU and CUT staff brought forth an array of issues, such as staff exchange, guest lecturing and joint project collaboration, especially activities in the field of Computer Applications Technology, Multicultural Educational Studies, Inclusive Education, Community Service Learning and Mathematics Education. Prof. Ratchaneekorn Tongsookdee proposed staff exchange and the consideration of a cultural student exchange programme as an initial activity within the frame of reference of the inter-institutional MOU, once it has been endorsed by CMU and CUT. The CMU delegation, especially Ms Pathumwadi Sirisawat (Director, Chiang Mai University Demonstration School) was especially grateful for being afforded the opportunity to observe activities and facilities at Welkom Gymnasium. The afternoon was concluded with a lunch at a restaurant on the outskirts of Welkom.

Writing for Publication Workshop

There is a well-known adage in higher institutions of education that says “publish or perish”. This is because writing for publication plays a critical role in the professional life of any academic. Given this critical role that writing for publication plays, we as a faculty will continue to support our staff members in this regard. In my previous annual report, I did indicate the relationship we had established with Prof. Elias Mpofu, who is the editor of the Journal of Psychology

in Africa (JPA) which is accredited by DHET. This year once again, Prof. Mpofu ran a workshop on writing for publication from the 23 – 25 November 2015.

The following members took part in Prof. Mpofu’s writing workshop.

The titles of their draft articles are shown in the table below and I am looking forward to getting some papers published out of these drafts.



From left to right: Mr M.A. Modise, Prof. A. Makura, Mr W. Manduna, Ms Taoana, Prof. M. Mhlolo, Ms J. Bihi, Prof. E. Mpofu (facilitator), Dr M. Lekhu, Prof. G. Schlebusch, Prof. S.N. Matoti, Dr L. Schlebusch, Dr Kayi Ntinda (facilitator) Dr R. Sebolai, and Dr W. Setlalentoa

Lekhu and Matoti	Using secondary school science experience as prior knowledge to improve and enhance pre-service science teachers’ teaching efficacy beliefs
Modise	Reflection and understanding of HIV & AIDS by the student teachers at Higher Education in South Africa
Bihi and Matoti	Pre-service teachers’ reflections on mentor support during teaching practice and lessons for teacher educators
Taoana and Matoti	The preparedness of student-teachers in tackling problematic Chemistry topics: preferences and perceptions (work-in-progress)
Meda and Rambe	Barriers and constraints to educators’ use of educational technology in the curriculum: A case of a university of technology in South Africa
Alexander G	Perceptions regarding white teachers’ staff development needs in integrated school settings of South Africa: An exploratory study
Schlebusch L	Computer Applications Technology as a vehicle to teach computational thinking – a conceptual paper
Schlebusch G	Collaborative Leadership
Mogashoa L.G.	The effectiveness of Student Teams Academic Division as a teaching and learning strategy to enhance university students’ understanding of the double entry principle.
Ndamani L	Leadership efficacy of school principals in Instructional Leadership in Secondary Schools in the Five Districts of the Free State Province
Matoti S. N.	Pre-service teachers’ anxiety during teaching practice
Segalo L	The proliferation of the teachers’ right to discipline in South African Public Schools
Makura, H	Reliability and equity of teacher performance appraisal
Maimane, J.R.	An evaluation of ICT usage in the Southern African higher education institutions through the HEQC’S institutional audit reports
Setlalentoa, W.	Cultural diverse Grade 12 learners’ perceptions of the efficacy of Science tutors during winter school sessions
Manduna, W.	The use of social network sites (SNS) to enhance preservice and in-service training programmes: An Information Communications Technology Perspective
Sebolao, R.	The academics’ exposure to industry and alternative pedagogical practices in higher education: A pragmatic perspective
Komati & Setlalentoa	Perceptions of culturally diverse grade 12 learners regarding problem-solving in Physical Science during winter school sessions

FACULTY'S ANNUAL PRESTIGE RESEARCH SEMINAR

The Annual Prestige Research Seminar aims at encouraging academic staff and postgraduate students to showcase their research work.



Here we see some of the academic staff members and students who presented their papers at the Prestige Seminar.

Completed Master's Degrees

- Koai, M.I. 2015. The use of Sesotho as an official medium of communication in selected departments within the Free State Provincial Government as proposed in the draft Free State Provincial Government Language Policy. Central University of Technology, Free State.
- Beukes, J.A.G. 2015. A study of the emotional intelligence levels of first-year student teachers at the Central University of Technology, Free State. Central University of Technology, Free State.
- Jurrius, J.G. 2015. The implementation of mobile learning in a developing community. Central University of Technology, Free State.
- Letompa, T.P. 2015. Performance of learners in English in primary schools in Leribe District, Lesotho. Central University of Technology, Free State.
- Mafojane, M.A.J. 2015. The relationship between researchers' pedagogical content knowledge and learners' performance in physical sciences from selected schools of Lejweleputswa District. Central University of Technology, Free State.
- Mokgobo, M.S. 2015. Educational leadership and sustainable learner academic performance at schools in the Lejweleputswa Education District. Central University of Technology, Free State.
- Segola, K.B. 2015. Teachers' perceptions of factors influencing learners' choice of Physical Sciences in Grade 10. Central University of Technology, Free State.

Completed Doctoral Degrees

- Leepo, S.R. 2015. Strategies to deal with academic underperformance in Grade 12 in the Free State. Central University of Technology, Free State.
- Padayachi, R.A. 2015. The effect of internal quality assurance reviews on departmental academic programmes at the University of KwaZulu Natal. Central University of Technology, Free State.

- Radile, R.S. 2015. Leadership and management strategies to improve performance of national certificate (vocational) students at Technical and Vocational Education and Training Colleges in the Free State Province. Central University of Technology, Free State.

List of Conference Papers

- Alexander, G. 2015. Multicultural development initiatives for supporting teachers in an integrated school context. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Beukes, J.A G. 2015. A study of the emotional intelligence levels of teacher training students at the central university of technology – Free State. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Bihi, J.K. and Matoti, S.N. 2015. Pre-service teachers' reflections on mentor support during teaching practice lessons for teacher educators. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Kalobo, L. and Du Toit, G.F. 2015. Teaching Statistics in the Further Education and Training Curriculum. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Lekhu, M.A. and Matoti, S.N. 2015. Using secondary school science experience as prior knowledge to improve and enhance pre-service teachers teaching efficacy beliefs. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Maimane, J.R. 2015. Student Teachers' Perceptions of Using E-Learning in Teaching and Learning: A Case Study. Proceedings of EDULEARN15 Conference Barcelona, Spain. 6-8 July 2015.
- Makura, H. 2015. Coping with large classes in democratic South Africa: Are female teachers crying foul? Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Matoti, S.N. and Lekhu, M.A. 2015. Measuring academic self-efficacy of first year university students. Proceedings of EDULEARN15 Conference Barcelona, Spain. 6-8 July 2015.

- Matoti, S.N. and Lekhu, M.A. 2015. Potential barriers to learning of first year university students. Proceedings of EDULEARN15 Conference Barcelona, Spain. 6 -8 July 2015.
- Matoti, S.N. and Lekhu, M.A. 2015. Large classes and micro-teaching experiences of student-teachers and teacher-educators (work in progress). Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius, 20-24 July 2015.
- Matoti, S.N. and Lekhu, M.A. 2015. Perceived barriers to learning and academic self-efficacy of pre-service students and their effect on academic performance. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20 -24 July 2015.
- Matselane, N. 2015. Learner gender roles and stereotyping notions and the educator mindset regarding equity and equality in schools and academic institutions. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Mhlolo, M.K. 2015. To what extent is the regular classroom conducive for the talent development of the mathematically gifted learners in South Africa? A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Mhlolo, M.K. 2015. Examining covert impediments to inclusive education for the mathematically gifted learners in South Africa. A paper presented at The 9th Mathematical Creativity and Giftedness International Conference, Sinaia, Romania 25-28 June, 2015.
- Mhlolo, M.K. 2015. The learning paradox: an analysis of high school learners' experiences of the informal and formal worlds of reflective symmetry. A paper presented at the 21st Annual National Congress of the Association for Mathematics education of South Africa, Polokwane, South Africa; 29 June – 3 July, 2015.
- Mhlolo, M.K. 2015. To what extent are teacher training programmes meeting the needs of the 21st century? The case for mathematically gifted children. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Modise, M.A. and Mogashoa, L.G. 2015. Teaching Accounting in multilingual classrooms in South Africa. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Modise, M.A. 2015. Learners' mistakes and misconceptions on the subject General Ledger and proposed strategies. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Modise, A.M. 2015. Student teachers experience during practice teaching In South Africa. Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Moeketsi, V. 2015. Moral degeneration emanating from a disjuncture between cultural values and nature of education. A case of township schools in South Africa. A Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Mogashoa, L. and Matoti, S.N. 2015. The effectiveness of student teams academic division as a teaching learning strategy to enhance university students' understanding of double entry principle in accounting. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Mokhombo, M.I. and Moliko, R.Z. 2015. The disjuncture between Pedagogy and Practice of mother tongue teaching in early childhood development. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Ngidi, D. and Ngidi, S. 2015. Job satisfaction, organisational commitment and self-esteem of university lecturers: A case study of the faculty of humanities at a university of technology in South Africa. Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain. 18-20 November, 2015.
- Ngidi, D.P. 2015. Adoption of pedagogical content knowledge in preparation of teacher education students: Practices in South African universities. A Paper presented at the International Conference on Society, Psychology and Education (ICSPE 2015), Hotel Fort Canning, Singapore. 19-21 January, 2015.
- Phindane, P.A. 2015. Perceptions of primary school learners on use of riddles in teaching and learning. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Phindane, P.A. 2015. Educators' perceptions on the use of folklore in primary school. A paper presented at the International Conference on Education and new Developments Porto, Portugal. 26-30 June, 2015
- Phindane, P.A. 2015. Issues of ambiguity in Sesotho: Meaning Retrieval. A paper presented at the international conference on multi-disciplinary academic research and global Innovation.
- Phindane, P.A. 2015. Issues of ambiguity in Sesotho. A paper presented at the African Language Association of Southern Africa (ALASA) Conference Cape Peninsula University, Cape Town, 24-26 June, 2015.
- Rankhumise, M.P. 2015. Effective teaching of electric circuits in Grade 12 Physical Science learners around Motheo District in Free State. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius 20-24 July 2015.
- Rankhumise M. and Sepeng, P. 2015. Alleviating alternative conceptions and conceptual difficulties of electric circuits among first year university

- students using contextual-conceptual-formal understanding and a model. Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Rankhumise M. and Setlhako, M. 2015. Challenges faced by students in an online teaching and learning module in a South African university: A case study. a paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Rankhumise, M. 2015. Effective teaching of electric circuits in grade 12 physical science learners around Motheo District in Free State. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius 20-24 July 2015.
- Schlebusch, C.L. 2015. Assessing computer phobia of 1st Year students at a university of technology. A paper presented at the International Education Conference Puerto Rico, 23 -26 March 2015.
- Segalo, L.J. 2015. Perceptions of secondary school teachers regarding Human Rights Education Pedagogy in the Free State Province. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Segalo, L. 2015. Democratic pedagogy literacy among fourth year and PGCE student teachers at one university of technology in South Africa. Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Segalo, L. 2015. Joint postgraduate students' supervision at one university of technology: a case study of masters' and PhDs. A Paper presented at the 8th International Conference of Education, Research & Innovation. Seville, Spain, 18-20 November, 2015.
- Setlalentoa, W.N. and Manduna, W. 2015. Applied use of Whatsapp in addressing teaching and learning challenges encountered by university students: An ICT4D Approach. Proceedings of EDULEARN15 Conference Barcelona, Spain. 6-8 July 2015.
- Setlalentoa, W.N. 2015. Reflections on inquiry based learning strategies with Biology teacher education students at a university of technology. A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- Setlalentoa, W. and Alexander, G. 2015. Improving service to students through enhancement of academics as teachers at a university of technology. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Setlalentoa, W., Alexander, G. and Komati, F. 2015. Perceptions of culturally diverse Grade 12 learners regarding problem-solving in Physical Science during winter school sessions. Paper presented at the Distance Education and Teachers' Training in Africa (DETA) Conference, Mauritius Institute of Education, Mauritius. 20-24 July 2015.
- Taoana, T.N. and Matoti, S.N. 2015. The preparedness of student teachers in tackling problematic chemistry topics: Preferences and perceptions (work-in progress). A paper presented at the Annual Conference on Social Studies, Communication and Education (ACSSC), Tokyo, Japan, 2-4 December, 2015.
- List of Publications/Articles in Journals (DHET subsidised)**
- Badenhorst, J.W. and Van der Merwe, M.M. 2015. How do we do it? The use of Mathematics taxonomy in developing statistical learning outcomes for Grade 12 Learners. *International Journal of Educational Sciences*, 9(3): 351-360.
- Kalobo, L. and Du Toit, F.G. 2015. The use of Mathematics taxonomy in developing statistical learning outcomes for Grade 12 learners. *International Journal of Educational Sciences*, 9(3): 351-360.
- Maimane, J.R. and Ndlela, B.P. 2015. The role of school governance in the democratisation of public schools: A reference to KwaCeza Circuit in KwaZulu Natal Province. *International Journal of Educational Sciences*, 10(2): 241-247.
- Makola, S. 2015. Using a meaning-centred leadership model to ignite a field of inspired connections in youth leaders. *Commonwealth Youth & Development*, 13 (2), 20-35.
- Makola, S. 2015. The effect of sense of meaning in the first-year of study on throughput at an institution of higher learning in South Africa. *International journal of Educational Sciences*, 9(3): 361-374.
- Mhlolo, M. 2015. Investigating learners' meta-representational competencies when constructing bar graphs. *Pythagoras*, 36(1), 21 – 30.
- Modise, A.M. 2014. School and community participation of in-school teenagers affected by orphanhood in a rural South Africa setting. *Journal of Psychology in Africa*, 24(5), 453-456.
- Modise, A.M. 2015. Resourcing single parents in a South African community rural setting: An exploratory study. *Journal of Psychology in Africa*, 25(2), 110-113.
- Mokhothu, K., Maimane, J.R. and Rankhumise, M.P. 2015. The integration of technical subjects in Civil Technology curriculum with special reference to further education and training

(FET) technical schools. *International Journal of Educational Sciences*, 9(1): 11-18.

Odora, R.J. and Matoti, S.N. 2015. The Digital Age: Changing roles of lecturers at a university of technology in South Africa. *Journal of Social Sciences*, 42(1, 2): 165-173.

Odora, R.J. and Matoti, S.N. 2015. The nature and prevalence of cyber bullying behaviours among South African high school learners. *International Journal of Educational Sciences*, 10(3), 399 – 409.

Phindane, P. 2015. The structural analysis of Sesotho folktales: Propp's approach. *Southern African Journal for Folklore Studies*, 24(2), 122-133.

Phindane, P. 2015. Verbal alternations in Sesotho: A case of lexical semantics. *Journal of Sociology and Social Anthropology*, 6(2): 303-314.

Phindane, P. 2015. Learning in mother tongue: Language preferences in South Africa. *International Journal of Educational Sciences*, 11(1): 106-111.

Ramohapi, S., Maimane, J.R. and Rankhumise M.P. 2015. Investigating factors contributing to learner performance in Mathematics: A case study of some selected schools in Motheo District. *International Journal of Educational Sciences*, 8(3): 445-451.

Rankhumise, M.P. 2015. Comparing the performance of National Curriculum Statements and Old Curriculum

Students' in Electric Circuits. *International Journal of Educational Sciences*, 8(3): 453-460.

Segalo, L. 2015. School learner behavioural management: context and practices in a South African school setting. *Journal of Psychology in Africa*, 25(2), 139-142.

Toni, N. and Makura, A. 2015. Using reflective practice for a more humane higher education. *South African Journal of Higher Education*, 29(3), 42-55.

Book Chapters

Odora, R.J. and Matoti, S.N. 2015. Geophagia: Historical and cultural perspectives. In: G. Ekosse, V.M. Ngole, L. de Jager, E. Fosso-Kankeu (Eds.) Human and enzootic geophagia: Ingested soils and practices. Saarbrücken. Lambert Academic Publishing. Chapter 2 pp. 5 – 15. ISBN 978-0-620-64308-5.

Odora, R.J. and Matoti, S.N. 2015. General health implications of eating geophagic soils and clays. In: G. Ekosse, V.M. Ngole, L. de Jager, E. Fosso-Kankeu (Eds.) Human and enzootic geophagia: Ingested soils and practices. Saarbrücken. Lambert Academic Publishing. Chapter 17 pp. 268 – 280. ISBN 978-0-620-64308-5.

Matoti, S.N. and Odora, R.J. 2015. Educating people about geophagia. In: G. Ekosse, V.M. Ngole, L. de Jager, E. Fosso-Kankeu (Eds.) Human and enzootic geophagia: Ingested soils and practices. Saarbrücken. Lambert Academic Publishing. Chapter 23 pp. 393 – 415. ISBN 978-0-620-64308-5.



A message from Emeritus Research Professor: Academic Development and Support and Faculty of Humanities



Professor Ntshoe is leading a research project on curricula design and pedagogical practices of professional and sectoral fields of practice offered by traditional universities and universities of technology, and technical and vocational education and training (TVET) institutions. In particular, the research is seeking to nuance research on curricula design practices and pedagogy of the professional and sectoral fields of practice. Accordingly, the research encompasses firstly, investing the nature of knowledge produced by traditional universities vis-a-vis knowledge produced

by universities of technology. This focus has been extended to cover technical and vocational education and training (TVET) colleges, previously known as further education and training colleges. The TVET sector has been included because of overlaps between the types of knowledge produced by universities of technology and those produced by TVET Colleges. Secondly, the focus of the research is on the purposes and mandates of traditional universities compared to the purposes and mandates of universities of technology and the TVET sectors.

Thirdly, Prof. Ntshoe focuses on research into the distinctiveness and overlaps between the nature of knowledge produced by traditional universities and knowledge provided by universities of technology and the TVET sectors.

This research also covers research on the scholarship of teaching and learning (SoTL) aspect of the Department of Higher Education and training (DHET) Teaching Development Grant (TD) grant. The purpose of this project is to capacitate staff working in SoTL to develop conference presentations and develop articles for submission to academic journals. More importantly, the project advances knowledge on the curriculum and pedagogy (teaching and learning) of specific disciplines highlighting the nature and distinctiveness of curricula of the different fields of practice,



PART 7

FACULTY OF
MANAGEMENT
SCIENCES

FACULTY OF MANAGEMENT SCIENCES

A message from the Dean

Prof. A.J. Strydom



The Faculty of Management Sciences is fully committed to reach the targets set out in CUT's Research and Development Plan 2014 – 2020. The year 2015 was another good one where we reached our target in terms of publications in accredited journals. In fact, if the growth rate is calculated over the past eight years, it is more than 160%!

Three new research units were approved and implemented in the faculty in 2015:

- The Unit for Enterprise Studies;
- The Unit for Public Management;
- The Unit for Tourism Destination Management.

We believe that the abovementioned units will contribute substantially towards focusing our research activities according to our strengths. Our senior researcher, Dr Patient Rambe, received NRF-rating in 2015 and we are extremely proud of him as the only rated researcher in the faculty.

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 and improvement in staff qualifications. We will continue to address these challenges in an attempt to position the faculty as a role-player to be reckoned with in the global arena.

My sincere appreciation to the Research Manager and all contributors to a successful 2015!



A message from the Research Manager

Prof. C. Chipunza



In 2015, research and development in the faculty has been good generally, with workshops for postgraduate students taking centre stage. Two workshops were successfully held in February 2015: one on language (14 February 2015), and the other one on academic writing (7 March 2015). One workshop was held during the third quarter of the year focusing on article writing, facilitated by Professor S. Keengwe, from North Dakota University USA (31 August to 4 September 2015). A total of 25 staff members attended, from both Welkom and Bloemfontein campuses. It is interesting to note that our postgraduate students started participating in national and international conferences in numbers in 2015. Notable are two students from Business Support Studies who presented papers in the Philippines and in Canada. Some of the conference attendances were FRIC and departmentally funded. Staff participation in research outputs has been good the during the year (2015) in a wide range of research-related activities such as student supervision, article writing, national and international conference attendance, external examination, conference proceedings and book writing. This is remarkable and a movement away from just article publication. There was a marked increase in publications in accredited journals by novice researchers, from both Welkom and Bloemfontein campuses.

Twenty-three postgraduate students' proposals were approved at the University Research and Innovation Committee (URIC) and these were allocated university grants to the value of R517 180. In terms of student graduation, a total of seven (7) students graduated, three (3) with doctoral degrees, and four (4) with master's qualifications. Co-supervision is evident in the faculty, with senior supervisors providing support to novice researchers in almost every student proposal presented before the FRIC.

A number of staff members from the Departments of Accounting and Taxation (2), Business Management (1), and Tourism and Event Management (1) applied for sabbatical leave to complete their qualifications in 2016. One staff member (the Faculty Senior Researcher) was awarded the NRF Category C2 rating. Applications for external funding, though still a challenge in the faculty, has started taking shape, evidenced by the number of applications submitted by both students and staff. Three (3) staff members applied for the NRF KIC Programme, three (3) for the NRF Sabbatical Grants to complete doctoral degrees in 2016, one (1) Thuthuka application, and one (1) for NRF rating.

The 2014/2015 DHET grants allocated to staff who are studying have not been used as anticipated. The remaining money has been allocated to purchasing of data analysis software, the Statistical Package for Social Sciences and Atlas.ti. From 2016, the faculty will

only allocate the DHET grant to those staff members who are able to use the money within the year they are allocated the funding. In 2015, the new modus operandi for the Prestige Research Seminar for the faculty, which was implemented in 2014, witnessed an increased number of novice and postgraduate students participating in the 2015 event. The seminar was also attended by international visitors from Stanford University, as well as local entrepreneurs.

A few grey areas however need some attention with regard to research and development. Firstly, there is a need for staff training in postgraduate supervision, and participation by staff members in NRF applications (though there is improvement). Secondly, the number of postgraduate students registered as full-time needs to increase. Thirdly, training of staff in statistical analysis and having robust debates on research related matters to further promote a culture of research are needed in the faculty. More effort should be made to ensure that the research focus areas are kept in view. Lastly, external linkages by staff are extremely low, and need further attention going forward.

NARRATIVES ON RESEARCH PROJECTS IN THE FACULTY

The TVET Bachelor of Technology HRM Blended Project

This project is housed in the Department of Business Management. It was launched in 2015 with an enrolment of 36 students. The value of the project is about R3.1million. The programme is offered in a modular didactical way/method. Facilitators are staff from the Department of Business Management, specifically, from the Human Resources Management programme.

As one of the most critical national imperatives, i.e. a call to address dire skills shortages, a consequence of the legacy of apartheid, the Central University of Technology, Free State has deliberately prioritised collaboration with the TVET sector as one of its prime focus areas, and this culminated in the signing of an MoU with this sector in the Free State province. Amongst the many areas of urgent need within this sector, the Department of Business Management proactively identified capacitation of the HR officials from this sector as one of its priorities. Once the idea had been adequately ventilated in the department and successfully vended to the principals of the sector and their buy-in secured, mobilisation of the formidable, competent and capable HR programme team was unleashed for the successful roll-out of the project.

Over a period of one year, six study schools were presented, approximately 6 weeks apart. The group was split into two smaller groups, to ensure more personal attention during the contact week. After the contact week, the students wrote online tests. At the end of each study school a Portfolio of Evidence was submitted. Thus far these students have completed Advanced Human Resource Management IV, Research Methodology I, Industrial Relations IV and Organisational Behaviour IV. The remaining study schools are Advanced Management of Training IV and Advanced Strategic Management IV. All students that have passed will graduate at the Spring Graduation in September 2016.

Entrepreneurial Games

CUT took a strategic decision to promote the concept of entrepreneurial education as part of their teaching and learning philosophy. In line with this approach, the Faculty of Management Sciences, in conjunction with Aalen University of Applied Sciences in Germany, developed a specific set of entrepreneurial games to foster entrepreneurship amongst students, communities and SMMEs.

The entrepreneurial games are based on the concept of a board game and exist on six different levels directly related to entrepreneurship, namely:

- Level One: Elementary economics
- Level Two: Basic accounting
- Level Three: Marketing
- Level Four: Project management
- Level Five: Sustainable development and business strategy
- Level Six: Business plan development

The entrepreneurial games are used to train CUT students in the Faculty of Management Sciences in an effort to Train-the-Trainers in the basics of entrepreneurship. They train members of the community, students, etc. accordingly, under the supervision of academic experts. A manual for the entrepreneurial games was launched recently and action plans are underway to roll out this wonderful concept not only in South Africa but also in the international arena.

Completed Master's Degrees

Maphakisa, M.D 2015. Effectiveness of ABSA business bank's customer relationship Management Practices in maintain loyalty among customers in the Eastern Cape Province. Central University of Technology, Free State.

De Lange, J.J. 2015. The effect of crime on the retail business sector in the Matjhabeng Municipality, Free State. Central University of Technology, Free State.

Malo, B. 2015. Organisational culture and job satisfaction among academic professionals at a South African university of technology. Central University of Technology, Free State.

Mopalami, K.C. 2015. A South African case study of the relationship between perceived fairness in human resources management practices and employees; psychological empowerment. Central University of Technology, Free State,

Swanwpoel, H. 2015. The relationship between workplace spirituality and work-related attitudes. Central University of Technology, Free State.

Thasi, M.E. 2015. Job satisfaction and work stress of engineers and artisans working at gold mines in the Lejweleputswa District, Free State. Central University of Technology, Free State.

Redlinghys, B.C.S. 2015. Emergency medical care practitioners in the North-West Province. Assessment of their understanding of the emergency services delivery management. Central University of Technology, Free State.

Taaibosch, T.A. 2015. Training competency challenges of municipal councillors in the Mangaung Metropolitan municipality in the Free State Province. Central University of Technology, Free State.

Van Der Walt, E.S. 2015. The study experience of second-year hospitality management students at selected South African higher education institutions. Central University of Technology, Free State.

Completed Doctorate Degrees

Chipunza, L.T. 2015. Driving innovation in small accommodation businesses: A comparative study of Zimbabwe and South Africa Free State. Central University of Technology, Free State.

Dzansi, L.W. 2015. An organisational justice perspective on the impact of human resource management practices on the quality of service delivery in municipalities in the Free State Province of South Africa. Central University of Technology, Free State.

Agbotame, L.A.K. 2015. The impact of selected aspects of globalisation on small-scale agribusinesses in a rural South African setting. Central University of Technology, Free State.

Chetty, M. 2015. An integrated debt management model for municipalities in the Free State Province. Central University of Technology, Free State.

Sithole, B.E. 2015. Municipal disaster management in South Africa intergovernmental relations as a planning instrument. Central University of Technology, Free State.

Departmental Funded – International Conferences

Nothnagel, J. 2015. Leadership: the case of the postgraduate supervisors at universities of technology in South Africa. Paper delivered at the EDULEARN15 conference in Barcelona, Spain. 6 to 8 July 2015. ISBN: 978-84-606-8243-1.

Olivier, C.D. 2015. Mechanisms to build public confidence in public administration: Are these mechanisms effective? A South African perspective. 2015 International Congress of IIAS in Rio de Janeiro, Brazil from 22 to 26 June 2015.

Rambe and Moeti. 2015. Disrupting higher education provision or entrenching academic elitism: Towards a model of MOOCs adoption at African universities. Published in the Joint Conference of the First Integrated South East Asian Research Conference on Higher Education and 2nd International Research Colloquium in Educational Technology, The Legend Hotel, Puerto Princesa, Palawan, Philippines, Nov 27-28, 2015.

FRIC Funded – International Conferences

Kokt, D. 2014. HIV and AIDS policy implementation: The case of a major South African hotel group. Advances in Hospitality and Tourism Marketing and Management Conference, 25-27 June, Le Meridien, Mauritius.

Makola, S. 2014. The effectiveness of using a multidisciplinary teams approach in a mental health care facility in South Africa. Hong Kong International Conference on Social Science 2014, 2-4 October, 2014.

FRIC Funded National Conferences

Van Niekerk, T. 2015. Talent management as a service delivery intervention in the South African Public Service. International Association of Schools and Institutes of Administration (IASIA) Annual Conference. Paris France. July 2015.

Kokt, D. 2015. Innovation management at universities of technology in the South African context. Advances in Business-Related Scientific Research Conference (ABSRC), 9 -11 December, Milan, Italy.

Makola, S. 2015. Find Meaning, Stop Wondering: How to assist youth to find meaning and achieve success. Paper presented at the Twentieth World Congress on Viktor Frankl's Logotherapy, June 2015, Dallas, Texas, USA.

Kokt, D. and Strydom, A.J. 2015. The importance of service delivery at festivals in order to ensure sustainability: a South African case study. First International Research Conference organised by the Midlands State University at the Victoria Falls from 14-16 July 2015.

Naong, M.N. 2015. Skills transfer development as a vital moderator towards self-rated performance – a case-study of five South African companies. A paper presented at the 16th International Academic Conference in Amsterdam, organized by International Institute of Social and Economic Sciences (IIES), 12-15 May 2015, held at Amsterdam American Hotel – Hampshire Eden, Amsterdam, Netherlands.

Van Niekerk, T. 2015. Talent management as a service delivery intervention in the South African Public Service. International Association of Schools and Institutes of Administration (IASIA) Annual Conference. Paris France. 6-10 July 2015.

Van der Walt, F. and De Klerk, J.J. 2015. The experience of spirituality in a multicultural work environment. WARES Conference Proceedings, 129-146. ISBN 978-0-9943178-2-7. 21-24 July, Bangkok, Thailand. Paper 12.

Van der Walt, F. and Swanepoel, H. 2015. A study of the relationship between workplace spirituality and job involvement in South Africa. WARES Conference Proceedings, 244-255. ISBN 978-0-9943178-2-7. 21-24 July, Bangkok, Thailand. Paper 28.

Strydom, A.L. and Kokt, D. 2015. The importance of service delivery at festivals in order to ensure sustainability: a South African case study. First International Research Conference Organised by the Midlands State University at the Victoria Falls from 14-16 July 2015.

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Kokt, D. 2015. The influence of corruption on psychological capital: The case of a large government department in the Motheo District, Free State Province. *SAIMS Conference*, hosted by UCT (31 August to 2 September), Cape Town, South Africa.

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Van der Walt, F. and Swanepoel, H. 2015. A study of the relationship between workplace spirituality and job involvement in South Africa. In: G. Ogunmokin (Ed.). Proceedings of the World Academy of Researchers,

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Conference, South African Association of Public Administration and Management. Pretoria. March 2015. (Promoter: Van Niekerk, T. and Co-promoter: Olivier, C.D.). Paper was published in *Journal of Public Administration Conference Proceedings*. March 2015. ISSN 0036-0767.

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Jacobs, H. and Dzansi D.Y. 2015. Finding a work-integrated learning strategy that enhances the employability of graduates of South African

Universities of Technology: A Research Agenda. *Journal of Economics*, 6(2): 102-109.

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Khoaeane, T.J. and Naong M.N. 2015. How to overcome challenges for meaningful implementation of inclusive education in Lesotho. *Journal of Social Sciences*, 42(3), 289-297.

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Makola, S. 2015. Daily Dialogues: Using social media to promote purposeful living. *The International Forum for Logotherapy*, 38 (1), 24-29.

Fostering Strategic Partnerships

In 2015, the faculty managed to initiate two institutional MoUs with African higher institutions of higher learning from Zimbabwe and Nigeria, respectively. Another MoU was initiated with the Free State Legislature.

Post-Doctoral Fellow

The Faculty of Management Sciences was allocated one postdoc in 2015, who is now working on a joint project on sustainability with the Faculty of Engineering, Information Technology. The postdoc outputs are reported under Faculty of Engineering and Information Technology.

Research Units

Unit for Enterprise Studies: Besides publications (more than five) in accredited journals by staff linked to the unit, two doctoral and three master's students graduated in 2015. The unit successfully applied for a DST NRF Internship Programme in 2015. The appointed intern will commence work on 1 May 2016. Plans which started in November 2015 for hosting an international conference, are at an advanced stage. The conference will be hosted in April 2017.

Unit for Tourism Destination Management: Data were collected from 400 respondents at OR Tambo airport in Johannesburg. This exercise was completed in November 2015. In January 2016 the data were

captured. Currently (April 2016) the data are being analysed statistically from which a number of articles on destination management will be written to be submitted for publication in accredited journals by the end of 2016.

Unit for Government Management

Prof. T. van Niekerk conducted research during 2015 and at the beginning of 2016 in the municipalities of the Free State province about the role of the Municipal Public Accounts Committees and the Audit Committees to promote accountability. A paper with the title: Mechanisms to strengthen accountability and oversight within municipalities within the Free State Province was presented by Prof. T. van Niekerk at the 15th Winelands Conference, 29 March 2016 to 3 April 2016. The paper will be reworked and an article will be submitted for possible publication in an accredited journal.

Attached to the Research Unit for Governance and Accountability studies, two D Tech Public Management students obtained their qualifications during 2015, namely Mr M. Chetty, with the title: An integrated debt management model for municipalities in the Free State Province; and Mr B.E. Sithole, with the title: Municipal disaster management in South Africa: integrated relations as a planning instrument. Two master's students attached to the Research Unit for Governance and Accountability Studies obtained the M Tech Public Management during 2015, namely Mr T.A. Taabosch, with the title: Training and competency challenges of municipal councillors in the Mangaung Metropolitan Municipality in the Free State Province; and Mr B.C.S. Redlinghuys with the title: Emergency Medical Care practitioners in the North-West Province: Assessment of their understanding of the emergency service delivery environment.

In addition to the above, one D Tech Public Management student attached to the Research Unit for Governance and Accountability Studies, namely Mr T.S. Bothloko with the title: Promoting effective financial accountability in local government in the North West Province: developing operational guidelines for Municipal Public Accounts Committees, is in the final stages with his doctoral studies.

Three D Tech Public Management research proposals attached to the Research Unit for Governance and Accountability Studies were approved by the research committees during 2015/2016 namely:

- Mr L. Munsamy with the title: The development of a disaster risk management model for municipalities in the Free State Province.
- Mrs M.J.A. Tshilo with the title: The impact of government procurement practices on the socio-economic conditions of suppliers within the district municipalities of the Free State Province.
- Mr J.K.T. Sebakamotse with the title: The development of a framework to promote accountability and oversight within municipalities in the Free State Province.

PART 8

TECHNOLOGY
AND
INNOVATION

Prof. J. Jordaan



Director: Technology and Innovation

Generally, good progress has been made with the following major challenges addressed by Technology and Innovation during 2015:

- Recruitment of qualifying participants for the TIA Seed Fund programme and management of the execution of such.
- Expanding the Intellectual Property portfolio of CUT through the registration of additional products and maintenance of running registrations.
- Securing CUT's participation in the SAB KickStart Ignite programme and local roll-out of this initiative.
- Securing a new management structure and process for CRPM.
- Preparing for an international ISO 13485 certification visit for CRPM during 2016.

Both the PDTs and the CRPM are financially still in relatively strong positions and functioning at a satisfactory level. The FabLab is doing very well and the replacement of its laser cutter, certainly the most critical piece of equipment used in the FabLab, was an important contribution. The functioning of the incubator is still not ideal, but substantially better than before the present group of six tenants moved in, and the functioning of Technology and Innovation with regard to intellectual property and its protection is satisfactory.

The following significant achievement for the year under review can be highlighted:

CUT's participation in the Collaborative Programme in Additive Manufacturing

The Collaborative Programme in Additive Manufacturing (CPAM) of DST, which started in January 2015, is an extensive, systematic research programme that provides the opportunity for in-depth research into the AM process characteristics and the resultant material properties of parts, including microstructure, physical, chemical and mechanical properties. The initial characterisation work is planned for the first two and a half years of the programme. Subsequently, based on the insight and data acquired in this national programme, CUT and its collaborators will be able to embark on the full qualification of selected medical implants, which is planned for the next three years of the programme. The total value of this contract allocated to CUT (period March 2015 to March 2017) is R6 272 052 (incl VAT). The Department of Mechanical

and Mechatronics Engineering and CRPM execute this project collaboratively.

Launch of Research Chair in Medical Product Development through Additive Manufacturing

The Central University of Technology, Free State (CUT) is proud to have been awarded a Research Chair under the South African Research Chairs Initiative which is funded by the Department of Science and Technology (DST). The focus of the Research Chair at CUT is on medical product development through additive manufacturing, better known as 3D printing. The Research Chair is awarded in recognition of the leading role that CUT is playing in this exciting field as well as to stimulate the generation of new knowledge to better the lives of South African citizens.

The Minister of Science and Technology, Mrs Naledi Pandor, unveiled a plaque to officially launch the Research Chair at a prestigious event on the CUT main campus on 14 August 2015. Among the guests were dignitaries from the Free State legislature as well as invited guests from the Free State Department of Health and the medical industry.

Professor Ihar Yadroitsau was appointed in 2014 to lead the CUT Research Chair. The Chair is funded for a period of five years, extendable to 10 years, with a total of R1.67 million awarded per year. The Department of Mechanical and Mechatronics Engineering and CRPM are jointly responsible for this project.

Technology and Innovation Unit

The following technology and innovation activities are reported under this unit:

Incubator

Three of the current group of incubator tenants have been accepted for a second year of incubation, whilst the lease agreements of other three entities are still active. All of these entities are functioning well and meeting all their obligations. In this manner employment has been created for 19 individuals through ownership of the incubated enterprises, appointments and a part-time appointment.

Incubation services, IP activities, as well as interaction with the University Research and Innovation Committee, is also taking place at the Welkom Campus. Seven (7) business clinic courses were offered to incubator tenants.

The recent appointment of a Business Development Officer for T&I has also added substantial capacity to the office.

Vision 2020 Innovation and Incubation Programme

The Vision 2020 Innovation and Incubation Programme has been terminated due to a lack of funds. Fortunately it was possible to continue with the Innovation Competition. A wide variety of topics were addressed by participants and Ms Yanga Sithole won the first prize. The title of her entry was "Protection over-current curve plotter with fault locator".

Technology Innovation Agency (TIA) Seed Fund

The TIA Seed Fund initiative was rolled out by the T&I Unit and eight projects to a total value of R 3 076 000 have been approved for funding by TIA. Execution of these projects is going well at present. All eight (8) of these projects are scheduled for completion before the end of 2016.

The TIA representative on the TIA Seed Fund Steering Committee recently advised that a further call for proposals should be announced soon.

Technology Transfer Office (TTO)

Two design applications for IP protection have been formally submitted to the Companies and IP Commission for final registration, whilst a further application is currently being prepared for registration by the TTO, with the assistance of patent attorneys. The registration of one application has been discontinued for technical reasons – the inventor made a public disclosure of his invention at an official meeting.

A funding application has been submitted to NIPMO for the appointment of a business development officer. The application was approved and an amount of R1 146 000, as well as a moderate amount for training and administrative expenses, is to be made available over a period of three years. The first tranche in this regard has been received and Mr Kareli has been appointed in this position for a period of three years.

The following additional activities were also undertaken under technology and innovation:

SAB KickStart Programme

A series of meetings and correspondence of the office have resulted in the CUT being invited as one of six educational entities to take part in the 2015/2016 SAB KickStart Ignite programme – the only other official educational institutions are TUT and the University of Limpopo. The roll-out of the programme has since commenced after 74 candidates were assessed by external assessors for possible participation. Eight have subsequently been admitted to the programme. The first cycle of the programme – which is expected to last for at least three years – is nearing completion.



A CUT candidate pitching his idea to the assessment panel for possible funding

SEDA Agricultural and Mining Tooling Incubator (SAMTI)

The purpose of the SAMTI unit is an element of the Science and Technology Programme of the Small Enterprise Development Agency (SEDA). It is funded by the Department of Trade and Industry and is aimed at the development of an enhanced technical capacity in tool making, with special emphasis on the agricultural and mining sector. The Director: Technology and Innovation is a director of the entity and functions as liaison between CUT and SAMTI.

The refurbishment of a recently acquired building is currently underway. This facility will be utilised by SAMTI and has resulted in a reduction of the current, serious lack of mechanical workshop space. SAMTI is considering the extension of its services to several additional sites in the region. However, limited financial means limits this possibility.

Fablab

The CUT Fablab was officially opened on 23 October 2006. Since the DST decided to terminate the national Fablab programme, CUT has financed this entity since April 2014. The Fablab receives large a number of users in a seasonal manner, depending on the academic calendar and due dates for the completion of academic projects.

The table below shows a typical distribution of Fablab users:

School Learners	15%
CUT Students	70%
UFS Students	10%
Private Individuals / Entrepreneurs	5%

A new trend has been started in Fablab on Fridays: trying to determine who can build the best LEGO robot. This is similar to the concept started called “code camp”. The process literally makes building a sophisticated robot child’s play. Our youngest user, Palesa Modusi, has already put her own obstacle avoidance robot together, and with minor assistance, it turned out very impressive. It is fun to see how LEGO (which has been around for more than a hundred years) draws young minds to technology and at the same time makes learning fun. Similarly Arduino systems are becoming increasingly popular for the manufacture and programming of basic robotic control systems. This links up perfectly with students’ educational experience in electronic engineering.

The functioning of the Fablab suffered as a consequence of the malfunctioning of its laser cutter. Fortunately a new, larger system was procured, which resulted in the Fablab being able to serve its visitors well again.

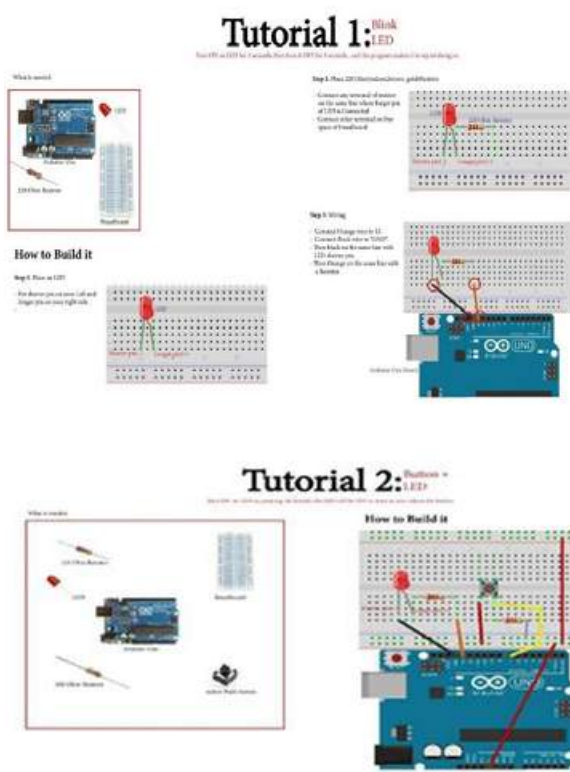
The Fablab has also entered into partnership with South African Breweries in order to identify and develop some of these bright minds. This gives these selected individuals a chance to experience what it feels like to be involved in all aspects of developing a product and managing a company. Decisions regarding the selection of participants were based on the viability and originality of the individual’s proposed concept, product or service. After this the participants were given a budget and access to the Fablab to help develop their ideas. These are also accompanied by weekly meetings with TTO and the Director for Technology Innovation in order to provide

assistance on issues of establishing a company, product marketing and technical issues regarding manufacturing. After a period of six months the deciding panel will be reassembled, and a final evaluation done in order to determine the winner. The picture shows a CUT candidate pitching his idea to the assessment panel for possible funding.

The following internal projects were also undertaken in the Fablab:

Programming and Robotics Made Easy

Dintwe Africa is currently developing a guide for Arduino as part of the SAB Kick-start programme. This guide will focus on explaining the exciting world of programming to the humble newbie. The guide contains a series of tutorials, starting at the basics and progressively working to an intermediate level. The kit also comes with hardware in order build a project and see it in action.



Prosthetics

Gustav Barnard has ventured into the realm of prosthetic design. These prosthetics are designed in the Fablab and then manufactured by the CUT's CRPM for patients. These prosthetics focus mainly on the facial area of patients, in order to help re-establish their identity after sustaining trauma. It just goes to show how diverse the areas are that Fablab can have an impact on.

Other Fablab activities:

From the highly technical to the most simple and even sometimes the strange, Fablab is still the simplest way in which to get that million dollar product or concept from paper to reality. Generally South Africans are fairly inquisitive, always interested in expanding their knowledge and capability of technology. CUT's Fablab is a testament to this and has become a popular spot for school learners wanting to build projects or even just to get general advice.

A big thank you must be given to Central University of Technology for supporting the Fablab.



Centre for Rapid Prototyping and Manufacturing (CRPM)

Executive Summary

The Centre for Rapid Prototyping and Manufacturing (CRPM) had a satisfactory 2015. However, there was a downturn in the South African economy, especially in the manufacturing sector, which affected the growth in the Centre's turnover. The exchange rate weakened by 25% during 2015, which had a direct impact on the price of imported materials. As a result, we were forced to increase our prices. On the positive side, we have noted an increase in enquiries for medical implants.

The value of the 499 projects completed at the CRPM during 2015 was R4 357 924, which was a decrease of 4.7% compared to 2014 (project value of R4 562 838). *Approximately 4000 parts were manufactured for the 499 industrial and research projects.* Furthermore, a total of R572 860 was spent on 52 research projects compared to R350 530 which was spent on research projects during 2014.

Regarding external funding received, CRPM was successful in three applications (with a total value of R1 215 000) for Technology Innovation Agency (TIA) seed funding.

Table: Summary of operations for 2015

	Number of industrial projects	Value of industrial projects	Number of research projects	Value of research projects
Quarter 1 – 2015	113	R1 020 269	13	R101 755
Quarter 2 – 2015	135	R1 157 115	7	R39 690
Quarter 3 – 2015	148	R1 171 545	28	R184 465
Quarter 4 – 2015	103	R1 008 995	4	R246 950
Total 2015	499	R4 357 924	52	R572 860

Figure shows the actual monthly monetary values compared to the targeted amounts.

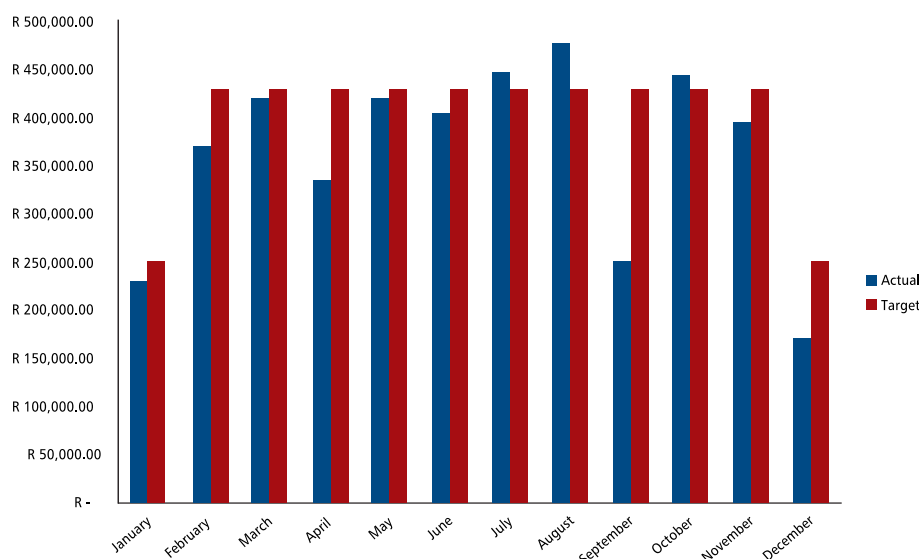


Figure: Monthly values of industrial projects: Actual vs Target

Results from Communication and Marketing Events

CRPM staff attended numerous national meetings for projects, research and strategic alignment sessions. Some of the meetings attended were:

Collaborative Programme in Additive Manufacturing Workshop – CSIR
CUT NRF Flagship Programme Seminar
International Labour Organisation - Valerie Flanagan

A number of national and international visitors from universities, industry and governments visited the CRPM during this period. Some of the visitors were:

Dr Wim Ravensbergen from Hanze University of Applied Sciences, The Netherlands
Prof. Laszlo Koczy, President of the University Doctoral and the Research Councils at the Széchenyi István University, Győr in Hungary
Severin Wandji, Regional Director, International Business Development & Strategic Analysis, Boeing Commercial Airplanes
Carol Spence – Selective Surgical
Barry Critchlow – Rolls Royce
The Department of Small Business, Economic Development, Tourism and Environmental Affairs hosted 30 Grade 11 children from the rural areas. During this two-day programme which formed part of the Cell C "Take a Girl Child to Work" programme, they visited the CRPM as well.
Etienne Snyders - Section Head: Nuclear Materials NECSA

The CRPM promoted its services by doing presentations and exhibiting at national trade fairs and shows. Some of the presentations done for this purpose are mentioned below:

Dr Jonee Zunega,- Element Six Group
Bennie Jacobs – SAAB (JHB) 3D printing of Gripen E parts
Aletta Karsten - Section Head: Acoustics, Ultrasound and Vibration, National Metrology Institute of South Africa
SASOL Polymers, Johannesburg - Advances in 3D Printing: A CRPM perspective
National Science Week (SCIEX), George - Changing lives using 3D Printing, The annual NMMU and Glenwood House School Science Expo.

The CRPM exhibited at the following events:

Exhibitions attended in 2015

Afrimold, Gallagher Convention Centre, 20-22 May 2015
3rd Annual Transnet Young Entrepreneurs Conference & Expo, President Hotel, Bloemfontein, 4-5 June 2014
KZN Industrial Technology Exhibition, 9-12 June 2015
Global Investors Trade Bridge 2015, 5-7 October 2015, Bloemfontein
Young Entrepreneurs Conference and Expo, 28-29 October 2015, Kimberley
RAPDASA, Roodevallei Conference Hotel, Pretoria, 4-6 November 2015

International exposure: Prof. Cules van den Heever and Mr Gerrie Booysen made a joint presentation called Additive Manufacturing and Design: Key Points in developing Patient-Specific Maxillofacial Prostheses at the Materialise World Conference 2015 in Brussels. This presentation was attended by approximately 130 delegates, including surgeons, doctors, medical device manufacturers and academics. The feedback received after the presentation was extremely positive and people from as far as Columbia, Mexico, Argentina and the USA congratulated the presenters on the case studies that were shared. The conference was held at The Square in Brussels. This event was divided into 4 different summits: industrial, biomedical, clinical and consumer, and there were more than 1000 delegates, 100 presentations and 15 different nationalities represented.

Teaching and Research

Accredited papers

- Yadroitsava, I., Els, J., Booysen, G. and Yadroitsev I. 2015. Peculiarities of single track formation from Ti6Al4V alloy at different laser power densities by SLM. *SAJIE*, 26 (3): 86-95.
- Du Plessis, A., Le Roux, S.G., Els, J., Booysen, G.J. and Blaine, D.C. 2015. Application of microCT to the non-destructive testing of an additive manufactured titanium component. *Case Studies in Non-destructive Testing and Evaluation*. pp. 1-7 DOI information: 10.1016/j.csndt.2015.09.001.

Presentations as invited speaker

- Booyesen, G. Overview of AM in South Africa: growth, new applications and markets. International Wohlers Conference, 23 September 2015, Dusseldorf.
- Booyesen, G. Quality inspection of additive manufactured medical implants by means of x-ray tomography. National Imaging with Radiation conference (IMGRAD 2015).
- Booyesen, G.J. and Van den Heever, H. Advances in maxillofacial prosthodontics utilising AM technologies. 16th Annual International RAPDASA Conference, 4 – 6 November 2015, Pretoria.

Research outputs in conference proceedings

- Du Preez, W.B. and Booysen, G. Advances in Ti6Al4V Additive Manufacturing in South Africa, The 13th World Conference on Titanium 2015, San Diego, California.
- Mosimanyane, K.D., Booysen G.J. and Van der Walt J.G. An investigation into conformal cooling of Alumide® moulds in plastic injection moulding. 16th Annual International RAPDASA Conference, 4 – 6 November 2015, Pretoria.
- Van As, B. Direct metal laser sintering, utilising conformal cooling, for high volume production tooling. 16th Annual International RAPDASA Conference, 4 – 6 November 2015, Pretoria.

Other conferences and workshops where papers were presented

Pre-Conference Seminar on Additive Manufacturing of Titanium Parts, 16th Annual RAPDASA International Conference, Roodevallei, Pretoria

Application into Medical Field – Cases

Case Study Anatomical model of part of the skull in nylon

A female patient presented with a tumour affecting the hemi-maxilla and orbital floor of her left eye which had to be removed (Fig 1a). Due to the extent and complexity of the defect, it was decided to fabricate an anatomical model of part of the skull in nylon through 3D printing to plan a framework for the patient, to be manufactured in titanium (Fig 1b). The CRPM had only two weeks to design and manufacture the titanium implant, due to the rapid spreading of the cancer.

It was decided to send the nylon model to the prosthodontist to cut where the bone resection was planned and to produce a wax model of the planned titanium frame (Fig 1c). The wax model and skull were reversed engineered using a Minolta 3D camera and Geomagic® software (Fig 1d). The implant design was transferred to the CRPM's EOSINT M280 DMLS machine and manufactured from titanium powder. The implant was manually polished and the fitment was checked on the pre-operative model (Fig 1f). A cutting guide was designed and manufactured in nylon through 3D printing which the surgeons used to cut the affected bone at the correct angles (Fig 1g). The titanium prosthesis was successfully implanted during a nine-

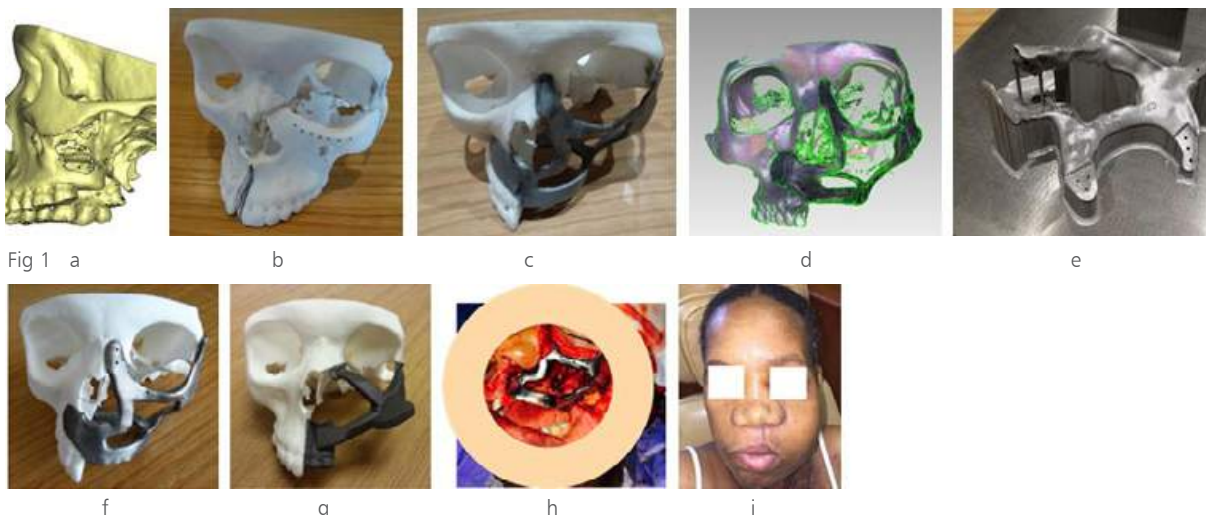


Fig 1 a

b

c

d

e

f

g

h

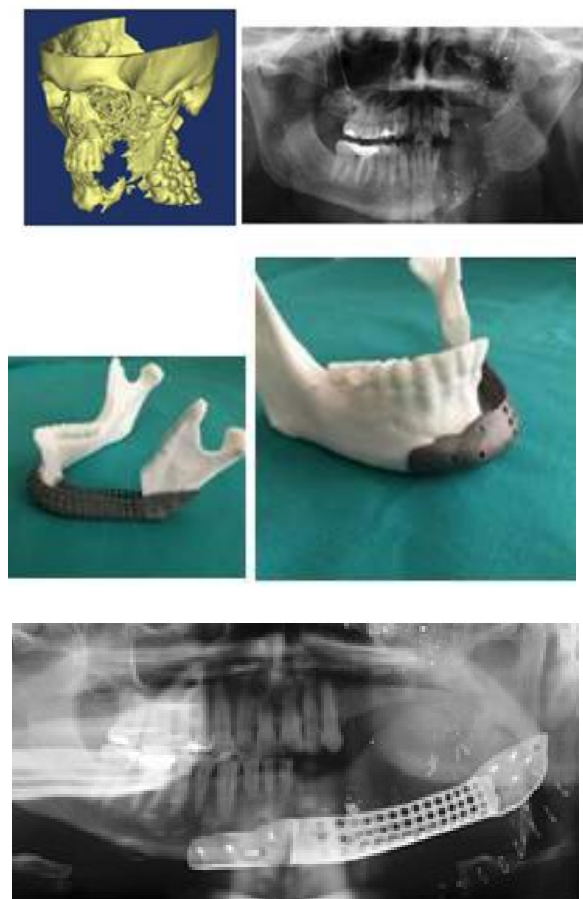
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hour operation (Fig 1h). A skin flap was removed from the patient's forearm and used to separate the oral and nasal cavities. The post-op review was good and after a week the patient was transferred from the Intensive Care Unit to a general ward. Fig 1i shows the patient two weeks after surgery with some swelling still evident. The operation was performed 14 days after the CT data was received which is significantly shorter than the five weeks that it would take to manufacture the prosthesis through conventional machining techniques.

Case Study Lower Jaw Reconstruction

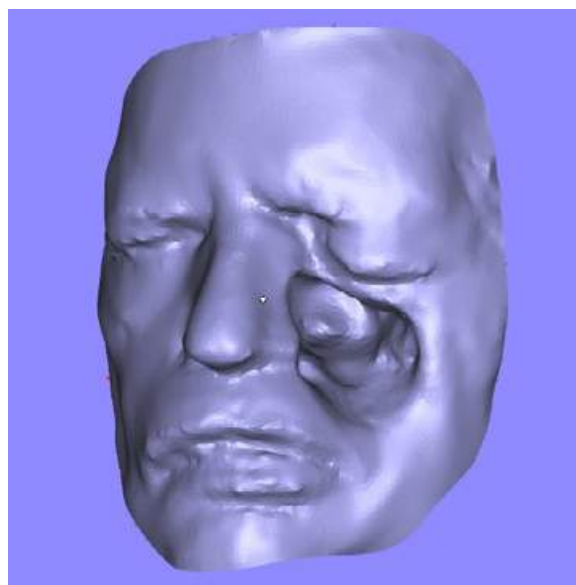
A shooting accident severely damaged a large part of a patient's lower jaw that needed to be reconstructed. Because of the extent of the damage, surgeons decided to remove part of the jaw and have a custom-made titanium prosthesis manufactured at the CRPM through 3D printing. The prosthesis was manufactured in a similar fashion to Case Study 1, with the exception that a hollow framework design was used.

A drawback of the solid jaw design is that studs could not be attached to the frame which would protrude into the oral cavity for mounting artificial teeth. Previous experience has shown that bacteria start to grow at the interface between the metal and oral lining. This then spreads onto the prosthesis which will result in a catastrophic infection. The idea with the hollow framework is to introduce bone into the frame onto which the studs will be fixed. The bone should act as natural barrier to prevent bacterial spread onto the implant.

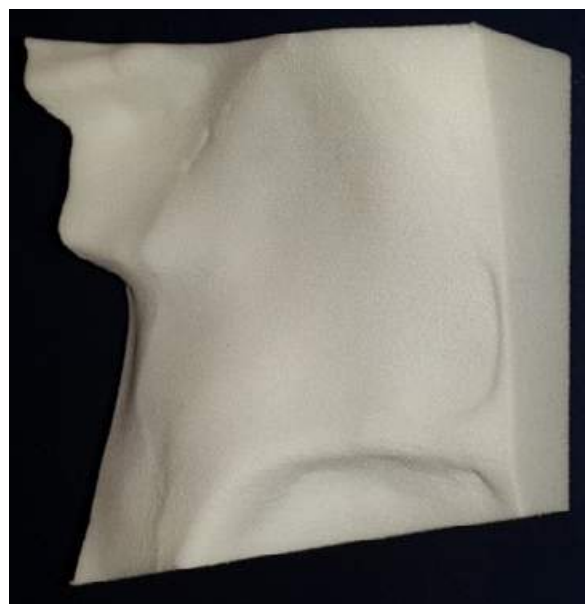


Case Study Malignant melanoma of the cheek

This was the case of a 78-year-old female patient with a large defect of the left cheek following resection of a malignant melanoma of the face. Malignant melanoma is a type of cancer that develops from the pigment-containing cells known as melanocytes. Melanomas typically occur in the skin. The primary cause of melanoma is ultraviolet light (UV) exposure in patients with low levels of skin pigment. About 25% develop from moles. The recommended treatment is wide excision of the tumour with a healthy margin of 0,5 cm. The patient's face was reverse-engineered by the Product Development Technology Station during October 2015 and a clip-on cheek was designed using the healthy side's geometry. A nylon tool was manufactured to form the new silicone prosthesis.



Planning model



Nylon press tool

Case Study Ameloblastoma of the left maxilla

A 54-year-old female patient was referred for resection of an ameloblastoma of the left maxilla. The tumour filled the entire left maxillary sinus measuring 60 x 50 x 40 mm. Ameloblastomas are rare, benign neoplasms of odontogenic origin involving the maxilla and mandible. These tumours are slow-growing and locally invasive. They most often present as a painless swelling of the involved jaw. The most common site of



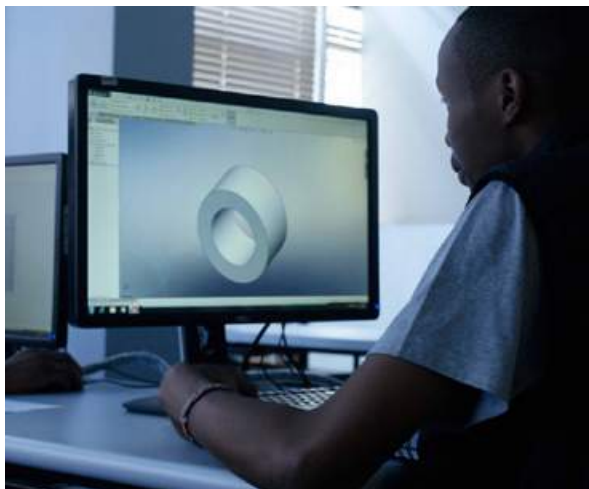
OBJET drill guide manufactured by 3D

involvement is the posterior mandible, however, when occurring in the maxilla they also have a predilection for occurring in the posterior regions. Radical surgical resection followed by reconstruction of any defects created by surgery is the treatment of choice. The CRPM had only two weeks to design and manufacture the titanium implant, due to the rapid spreading of the tumour. DHET funding was used to manufacture a drill guide for this project. This guide was used to drill holes precisely at various positions into the AM titanium prosthesis to attach the orbital floor plate.

The titanium prosthesis was successfully implanted during a nine-hour operation. A skin flap was removed from the patient's forearm and used to separate the oral and nasal cavities. The post-op review was good and the patient was transferred after a week from the Intensive Care Unit to a general ward.

Product Development Technology Station (PDTs)

PDTs is currently running smoothly and most of the targets for the financial year have already been achieved. PDTs received feedback from the yearly Monitoring and Evaluation session by TIA. All is well and the PDTs is one of the outstanding technology stations.



SolidWorks Course presented by Ishmael Hlanganiso and Allan Kinnear.

Staff Development

A course was organised on campus where the P2 students were trained in the use of SolidWorks CAD

software. The course was attended by four of the PDTs engineers at the CUT. The course was in sheet metal design and plastic simulation.

Currently, seven P1s, six P2s and eight Interns are employed at the PDTs. They all receive continuous training to improve their skills and employability in preparation for their careers in industry. Currently, the P1s and P2s are not paid by PDTs. Due to the budget cuts, PDTs does not have funding for them. This poses a problem as the station is unable to attract the best students as they are expected to do their WIL without remuneration.

Marketing

During the last quarter of 2015, PDTs undertook a number of marketing events.

Exhibitions – Q3 – 2015/2016

Global Investors Trade Bridge, Bloemfontein 5-7 October

SATN Conference, Vanderbijlpark 19-21 October

Transnet Young Entrepreneurs Conference & Expo, Kimberley 28-29 October

RAPDASA, Roodevallei, Pretoria 4-6 November

The PDTs received an email from Miss Elodi Naude thanking them for the assistance in the development of cheese tongs that have been commercialised.



Exhibition at RAPDASA



Figure: The cheese tongs that the customer has successfully commercialized and is now on sale on the internet.

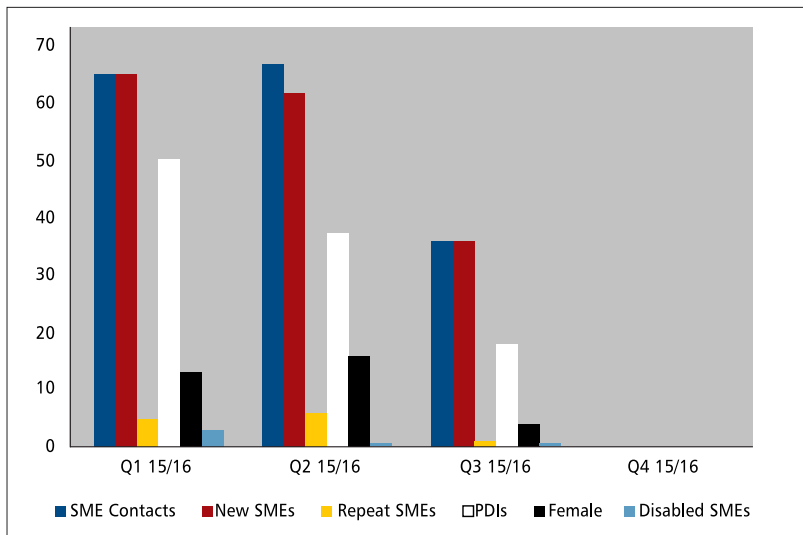


Figure: Number of clients seen by PDTs

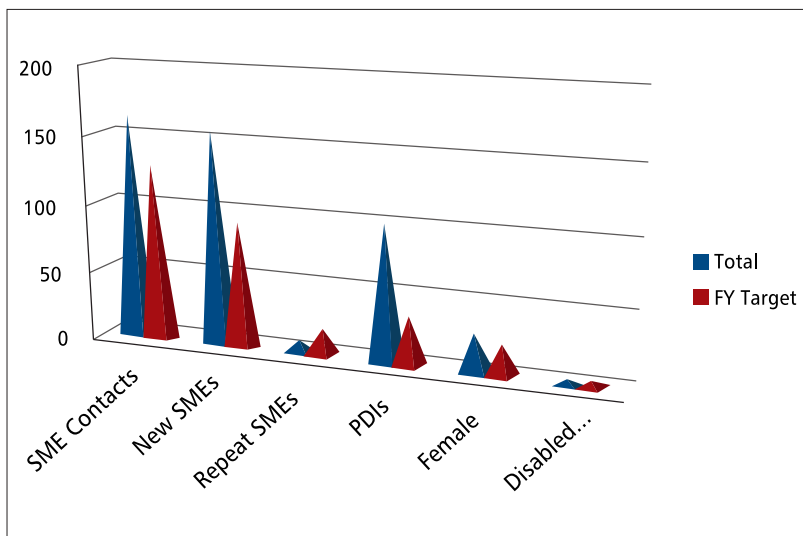


Figure: Number of clients seen by PDTs relative to target

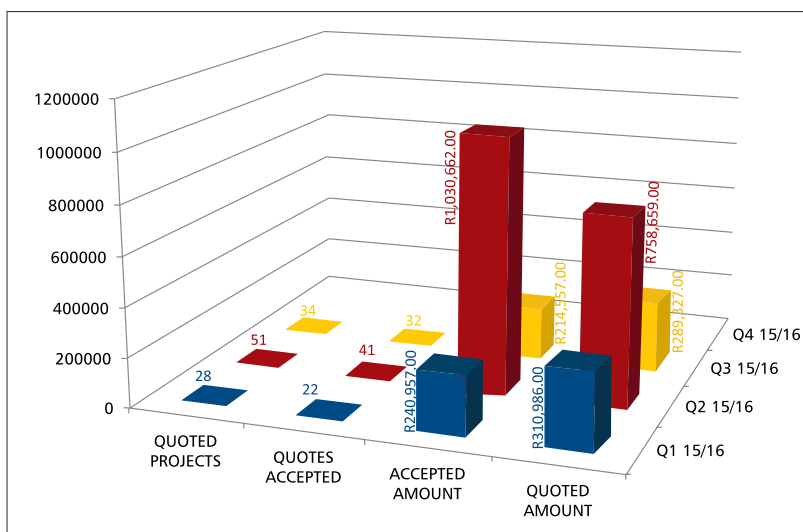


Figure: Summary of quotes issued and accepted

The following projects were undertaken:

Project 1 - Pesto Pot

The Pesto Pot project was executed by PDTS for a client in Cape Town. The client struggled to acquire a unit that would suit her needs, leading to the need to design and manufacture a new unit. The device is being used for the preparation of large quantities of herbs and spices for a food processing enterprise. The completed pot can be seen in Figures 1 and 2.



Figure: The Pesto Pot in an upright position.



Project 2 - Fish Bin Mould with Frames (15-452)

The PDTS assisted a fish drying company in Cape Town with the production of a rotational mould for plastic bins, a steel pallet and the frames for the bins for drying fish. The frames and pallets were galvanized in Cape Town before delivery to the client. The frames and plastic bins can be seen in the two figures below.



Figure: Plastic Bin in a steel frame

The part that was extracted from the rotational mould can be seen in the next figure.

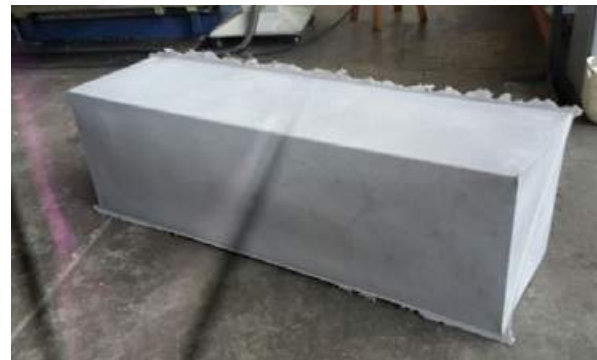
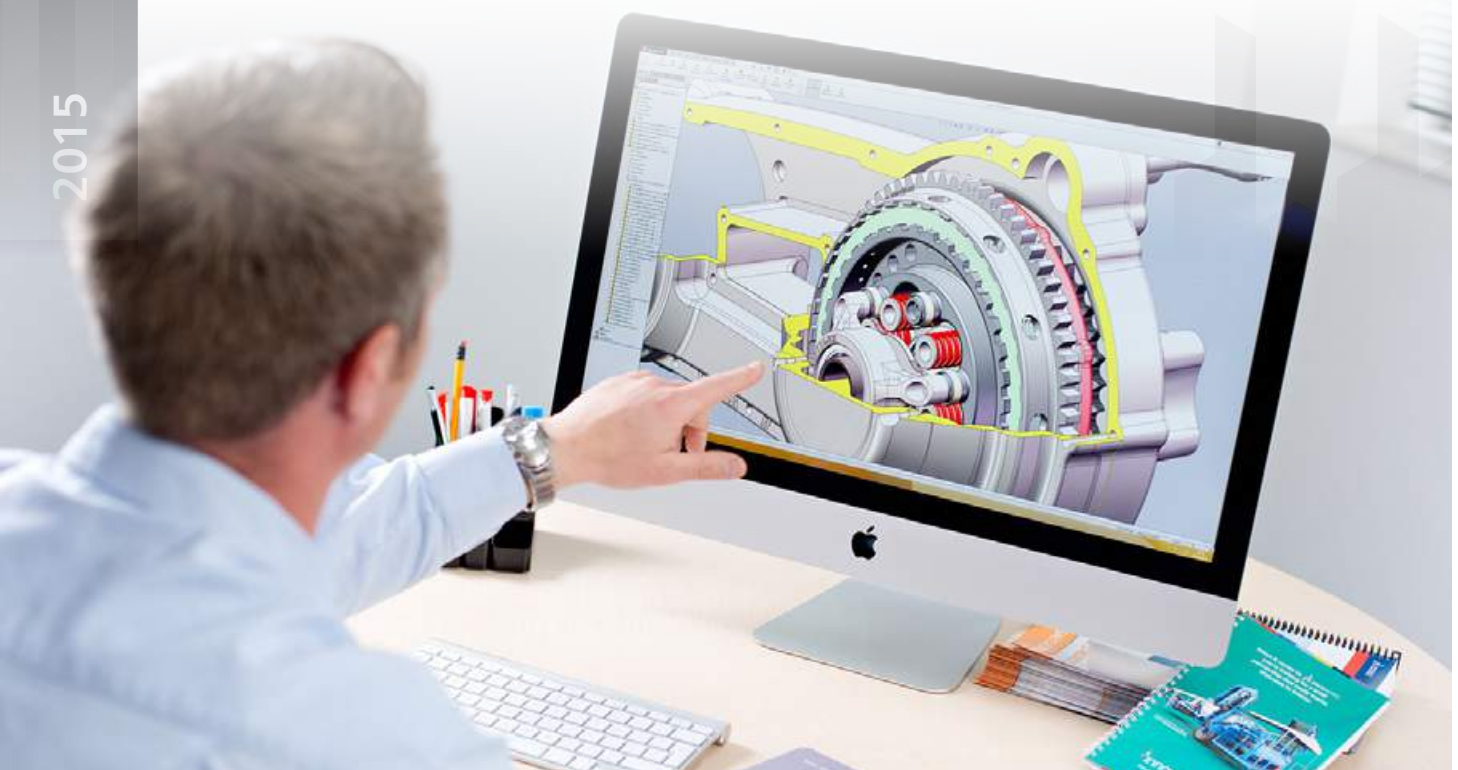


Figure: Plastic rotation-moulded part





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