2016

RESEARCH REPORT

UNIVERSITY OF JOHANNESBURG

@go2uj

www.uj.ac.za

Youtube/universityofjohannesburgstrategiccommunication

Facebook/universityofjohannesburg

Instagram/go2uj

2016

RESEARCH REPORT

2016
RESEARCH REPORT

VISION

An international university of choice, anchored in Africa, dynamically shaping the future.

MISSION

Inspiring its community to transform and serve humanity through innovation and the collaborative pursuit of knowledge.

VALUES

IMAGINATION
Shaping the future
Thinking independently
Developing a cosmopolitan identity
Exhibiting ambition and drive
Adopting entrepreneurial approaches

CONVERSATION
Learning together from our diversity
Making wise decisions collectively
Engaging meaningfully with one another
Displaying mutual respect
Leading consultatively

REGENERATION
Developing sustainably through creative contribution
Introspecting for renewal
Innovating for the common good
Making positive change
Taking advantage of overlooked opportunities

ETHICAL FOUNDATION
Treasuring academic freedom
Seeking balance in the pursuit of knowledge
Facing challenges with courage and earning trust
Acting responsibly by being fair, consistent and transparent
Participating in and helping the community (ubuntu)

Contents

Professor Ihron Rensburg
Vice-Chancellor and Principal, University of Johannesburg

Research productivity outcomes in 2016 show that UJ has continued to make great strides in enhancing its research profile and in training the next generation of graduates.

VICE-CHANCELLOR AND PRINCIPAL'S MESSAGE

A strong research and postgraduate community is essential for the University of Johannesburg to achieve its long-term research and graduate targets as set out in the UJ Strategic Plan 2025. Research productivity outcomes in 2016 show that UJ has continued to make great strides in enhancing its research profile and in training the next generation of graduates.

The University's achievements for research continue to surpass the ambitious goals we set at the time of development of our long-term strategy. The UJ academic staff continue to be recognised for their excellent research and expertise, both in South Africa and beyond, and during 2016 they received more than 20 prestigious awards. Professor Esther Akinlabi from the Faculty of Engineering and the Built Environment and Professor Catherine Ngila from the Faculty of Science were, respectively, awarded the Young and the Established Women in Science Awards in the category Physical and Natural Sciences.

In terms of Scopus-listed publications – an important global benchmark for the significance and impact of research – the number of UJ's listed publications has grown from 1 046 publications in 2012 to 1 661 in 2016, resulting in total output over this five-year period of 6 397 publications. Moreover, citations for these publications reached 35 500 citations or 5,6 citations per publication, while our average citation impact has now reached a new peak of 1,4 times that of the Scopus global average. Notably, 14,5% of publications are ranked in the top 10% of the world's most cited publications, while the greatest global research impact – significantly above the Scopus global average impact – was made in Physics and Astronomy, followed by Chemical Engineering and by Earth sciences.

I am also pleased to share the expansion of our research and innovation expertise with the establishment of exciting new research centres and institutes in 2016. These include the Institute for Pan-African Thought and Conversation, which aims to promote original and innovative Pan-African ideas and critical dialogue in pursuit of global excellence in research and teaching, and to contribute actively to building an international profile for the University of Johannesburg on Pan-African issues. Another is the Public and Environmental Economics Research Centre (PEERC) located in the Department of Economics and Econometrics, which was formed in 2016 and which focuses on the important area of resource management in the context of public and environmental economics. This centre covers important areas including equitable economic growth, sustainability of resource use, climate change and other environmental concerns, waste management, quality of life and public economic policy.

November 2016 also saw the creation of the Africa Centre for Evidence to support evidence-informed decision-making for the reduction of poverty and inequality in

The number of UJ's listed publications has grown from **1 046** publications in 2012 to **1 661** in 2016

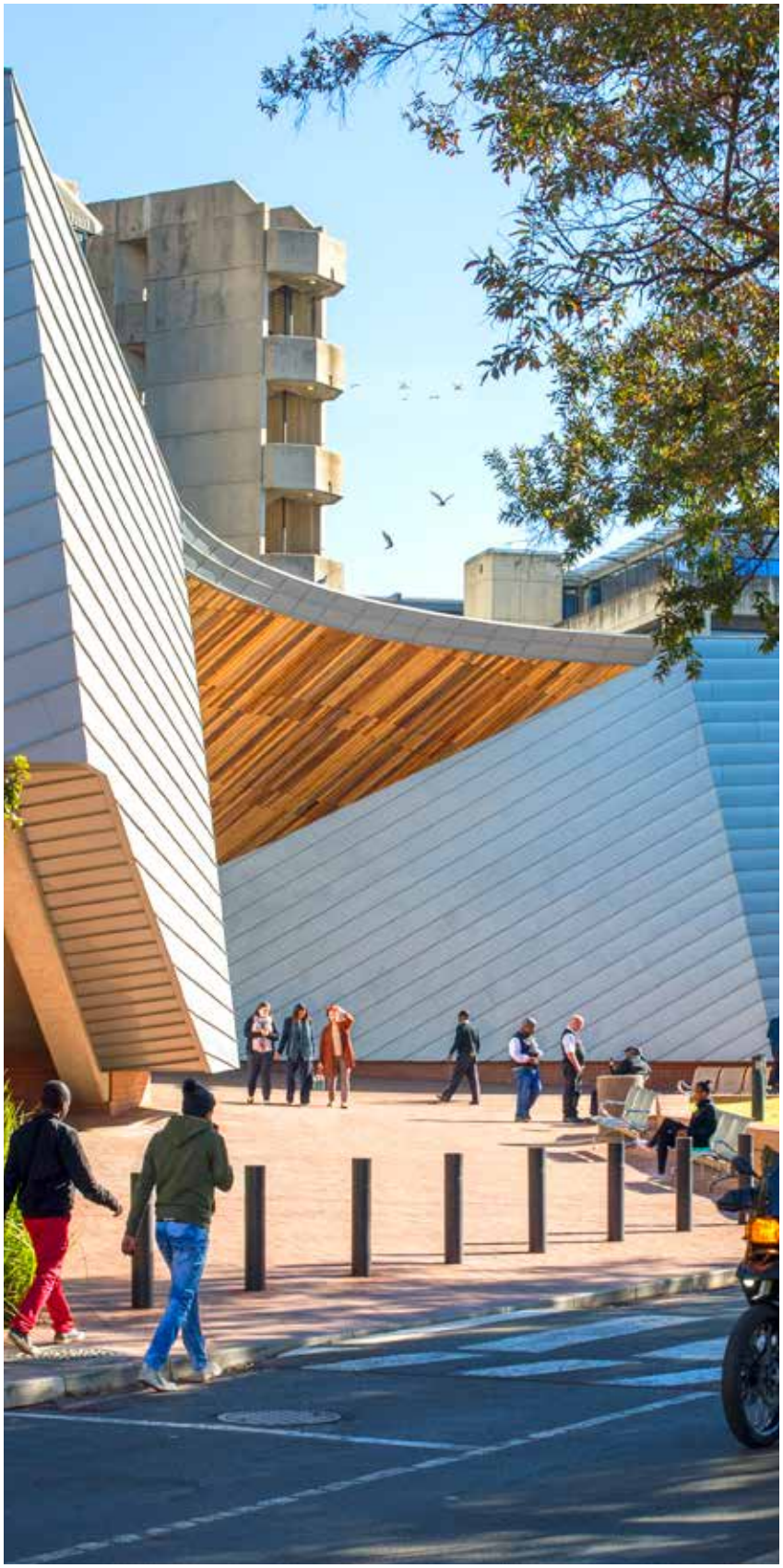
14,5% of publications are ranked in the top **10%** of the world's most cited publications

Africa. The centre also serves at the secretariat for the Africa Evidence Network, which has more than 1 000 members across Africa and beyond the continent.

Finally, the Sustainable Materials and Manufacturing Research Centre was established as a joint initiative between the Faculty of Engineering and Nanjing Tech University in China, further promoting collaborative research in sustainable materials and manufacturing.

The 2016 research and postgraduate activities and outcomes built on the successes of previous years, and we foresee a continued upward trajectory in performance across the board. Particular focused activities will centre on increasing external international research income, expanding emerging researcher support to build a strong sustainable cohort of academic researchers, improving postgraduate throughput, and leveraging national and international collaborations and partnerships in areas of strength.

Professor Ihron Rensburg
Vice-Chancellor and Principal



Professor Tshilidzi Marwala
Deputy Vice-Chancellor of Research and Internationalisation

OVERVIEW FROM THE DEPUTY VICE-CHANCELLOR OF RESEARCH AND INTERNATIONALISATION

I am pleased to report that the University of Johannesburg has continued to grow in 2016 and has delivered another great year of research and outputs. Further expansion and strengthening of our research and postgraduate community is essential for us to achieve our long-term goals and targets as set out in our Strategic Plan 2025.

The overall stature of researchers at UJ has risen, as seen by the increase in the number of NRF-rated researchers by 12,8% to a total of 176 in 2016; the appointment of 36 international Distinguished Visiting Professors under the Global Excellence and Stature initiative; the increase in the number of academic staff members with doctoral qualifications; and a steady cohort of just over 200 postdoctoral fellows.

The faculties, research centres and institutes, research and innovation support departments including the UJ Postgraduate School (UJPS), the Library and Internationalisation departments, all contribute to ensuring an enabling environment for research, innovation, postgraduate and postdoctoral training and global reach. Research productivity outcomes in 2016 show that the University has continued to make excellent strides in enhancing its research profile and in training the next generation of graduates. There was an overall increase of 19,1% from the previous year's accredited research publication output of 1 074,91 units to 1 279,9 units, and the submission of the 2016 report shows further growth of approximately 26%.

External research income reached R196,9 million for the year, and most impressively, funding for postgraduate students and postdoctoral fellows grew by 64%. Our postgraduate enrolments have grown, with an increase of 9,3% in master's student enrolments and of 11,1% for doctoral studies.

Our range of support for postgraduate students and emerging researchers expanded significantly with the Research Capacity Development (RCD) and Statistical Support (Statkon) units in the Postgraduate School delivering more than 70 workshops to 1 355 participants comprising 629 staff and 726 postgraduate students. Statkon consultants provided analytical support for 189 projects.

The UJ Library commenced in January 2016 with an extensive training programme for postgraduates in the various faculties to provide them with the support available from the library throughout their postgraduate research journey.

I congratulate and thank my fellow executive members, the deans and faculty leadership, academic staff, scholars, fellows, students and support staff for their work. They have all been instrumental in our continued success in growing the quantity and quality of our research, innovation, and postgraduate education

Professor Tshilidzi Marwala
Deputy Vice-Chancellor: Research and Internationalisation

RESEARCH HIGHLIGHTS

UNIVERSITY STANDING

- QS World Rankings: in the **601–650** group;
- **63rd** in the QS World University Rankings in BRICS countries;
- Times Higher Education Young University Rankings: in the **151–200** group;
- UJ as the only African university member of **Universitas 21**.

RESEARCH ENTITIES

- National DST Centre of Excellence for Integrated Minerals and Energy Resource Analysis (CIMERA);
- **30** research centres and institutes;
- **2** Technology Stations:
  - Metal Casting Technology Station, and
  - Process, Energy and Environment Technology Station (PEETS).

RESEARCHER BASE

Leading and established researchers

- **176** – the total number of NRF-rated researchers:
  - **6** A-rated researchers,
  - **1** P-rated researcher,
  - **34** Y-rated researchers;
- **36** Distinguished Visiting Professors.

Research chairs

- **12** South African Research Chair Initiative (SARChI) chairs;
- UNESCO Chair in Values Education;
- City of Johannesburg Chair in Green Innovation;
- UJ Teaching and Learning Research Chair.

Emerging researchers

- **205** postdoctoral research fellows;
- **13,3%** increase in doctoral graduates compared to 2015;
- **11,1%** increase in doctoral enrolments compared to 2015;
- **36,13%** increase in master's graduates compared to 2015;
- **9,3%** increase in master's enrolments compared to 2015.

RESEARCH ACHIEVEMENTS AND IMPACT

- **1 279,8** DHET accredited units for 2015 research publications (**19,1 %** increase over the previous year);
- **1 638** DHET units submitted for 2016 research publications (**26,5%** increase over the previous year);
- **71%** of UJ-authored research publications published in international journals;
- **50,9%** of UJ publications featuring international collaboration (Scopus);
- **5,6** average citations per publication (Scopus);
- **20** awards and prestigious recognition;
- **R196 million** external research income earned;
- **46%** of academic staff with doctoral qualifications.

INNOVATION

- **30** invention disclosures;
- **6** provisional patents;
- **8** patents;
- **2** licences.

AWARDS

UJ researchers continued to be recognised for their excellent research and training in South Africa and beyond our borders. University staff received more than 20 awards as well as prestigious recognition in 2016.

INTERNAL AWARDS

2016 Vice-Chancellor's Distinguished Award for Outstanding Researcher

This award recognises established full-time UJ employees with significant research activity and outputs.

Professor Christian M. Rogerson

Professor Rogerson is an economic geographer whose research straddles geography, tourism studies and local development issues. His research engages three key inter-related themes: local and regional economic development, small enterprise development, and the nexus between tourism and socio-economic development. His focus is on informality, pro-poor tourism and inclusive development, and the impact of innovation and local development. Throughout his time at UJ he has been extensively involved in researching tourism and poverty reduction, as well as the developmental potential of urban tourism. He is a member of the Academy of Science South Africa and an NRF B-rated researcher.

2016 Most Promising Young Researcher of the Year

This award is for a full-time staff member who has obtained a doctoral degree in the last five years and is in the early stages of an academic career.

Dr Llewellyn Howes

Dr Howes is a full-time researcher with lecturing responsibilities in the Department of Religion Studies in the Faculty of Humanities. He is currently the co-supervisor of one doctoral and two master's students. His publications include 16 peer-reviewed articles in accredited national and international journals of which 14 were published while at UJ. He has also authored one peer-reviewed book published in 2015 and has written two book reviews by invitation from the publisher. Six of his 15 conference presentations have been by invitation, including one international conference in South Korea and one in the US. Among Dr Howes's social engagements are his contributions to the establishment, development and operations of Scriptorium: Research and Storytelling Centre (a non-profit company and research facility) and his participation in the launch of the 'My Constitution' exhibition at the Nelson Mandela Centre of Memory.

Vice-Chancellor's Distinguished Award for Global Excellence and Stature

This award celebrates and honours an individual's outstanding contributions in promoting international scholarship and global collaboration in advancing UJ's goal of Global Excellence and Stature.

Professor Bertil Andersson

Professor Andersson is the President of Nanyang Technological University (NTU) in Singapore and a renowned plant biochemist from Sweden with a longstanding association with the Nobel Foundation, which includes chairing its chemistry committee. He has pioneered research on the artificial leaf, a promising area of sustainable energy research that uses sunlight to produce clean, low-cost sources of energy. He has also authored more than 300 publications in basic photosynthesis, with more than 14 000 citations, covering topics from photosystem structure to biological membranes and light stress in plants.

Professor Andersson has served on the boards of several Swedish and international foundations and distinguished scholarly societies, including the Royal Swedish Academy of Sciences, European Molecular Biology Organisation, Australian Academy of Science, Academia Europaea, Royal Swedish Academy of Engineering Sciences, the Swedish Foundation for International Cooperation in Research and Higher Education, and Austrian Academy of Sciences. In 2016, he was elected a Fellow of the Singapore National Academy of Science for his distinguished contributions to the development of science in Singapore and for leading NTU to global distinction; he also received the Singapore President's Science and Technology Medal, the highest national honour for lifetime achievement given to individuals including top scientists and engineers who have made exceptional contributions to the development of the country.

Professor Andersson has expanded NTU's global partnerships with leading institutions and companies across the globe, including the University of Johannesburg. The successful Global and Excellence Stature Johannesburg Institute for Advanced Study (JIAS) is a joint initiative of NTU and UJ.

EXTERNAL AWARDS

African Union Kwame Nkrumah Science Regional Award and Department of Science and Technology (DST) 2016 South African Women in Science Award (WISA)

Professor Jane Catherine Ngila

Professor Ngila was one of five winners of a Regional award for her research on water resource management in the field of analytical-environmental chemistry. This prestigious award by the African Union recognises the scientific achievements of top African scientists. She was also awarded the 2016 Distinguished Woman Researcher Award (Physical and Engineering Sciences) by Minister Naledi Pandor of the National Department of Science and Technology. The Women in Science Award recognises outstanding contributions of female scientists and researchers in science and technology education, training and employment in South Africa.

An NRF rated researcher, Professor Ngila's current research focuses on nanotechnology for water treatment, water quality monitoring, and the development of analytical methods of detecting substances in various environmental matrices. She has successfully supervised 17 doctoral, 22 master's and 21 honours students, and has mentored 13 postdoctoral fellows.

Professor Ngila is a member of the South African Chemical Institute and the Kenya Chemical Society, and was previously a member of the American Chemical Society, the Royal Society of Chemistry, and the Royal Australian Chemical Institute.

Distinguished Young Women Researchers (Physical and Engineering Sciences)

Professor Esther Akinlabi

Professor Akinlabi, in the Faculty of Engineering and the Built Environment, received the Distinguished Young Women Researchers (Physical and Engineering Sciences) award in 2016.

An NRF rated researcher, Professor Akinlabi works in the field of advanced and modern manufacturing processes such as laser additive manufacturing, in particular friction stir welding and laser material processing.

Professor Akinlabi has authored and co-authored more than 160 peer-reviewed publications and has filed two patents. She leads and supervises a research team of 28 postgraduate students and 7 postdoctoral fellows, and has successfully supervised four PhD and 12 master's students.

She is a member of the South African Young Academy of Science and is registered with the Engineering Council of South Africa.

Dr Lindy Esterhuizen

Dr Lindy Esterhuizen, lecturer in the Department of Biochemistry in the Faculty of Science was awarded the 2016 Bayer 'Science for a Better Life' South African National Seed Organisation (SANSOR) 2016 Award for her research on Brassica Stunting Disorder, a problem that has affected farmers across South Africa. This SANSOR award recognises lead agricultural scientists making a positive contribution to agriculture and in particular the seed industry.

Professor Ian Dubery

Professor Ian Dubery, also with the Department of Biochemistry, was awarded the prestigious Gold Medal by the South African Society for Biochemistry and Molecular Biology (SASBMB) in 2016. This award recognises researchers who have displayed a consistent record of national and international research excellence in a number of areas including an internationally recognised standard of academic research, academic scholarship and dynamic leadership, high-impact scientific publications, and a track record of training postgraduates.

Professor Annemarie Oldewage

Professor Annemarie Oldewage in the Department of Zoology in the Faculty of Science was bestowed with the Medal of Honour by Die Suid-Afrikaanse Akademie vir Wetenskap en Kuns in 2016 for continuing to excel in the advancement and development of her profession.

RESEARCH AND INNOVATION @ UJ

The 2016 DHET report on the evaluation of the University's 2015 research publications submitted in May 2016 for accreditation confirmed that a total of 1 279,8 units were awarded to UJ. This represents a 19,1% increase over the previous year, and is by far the highest number awarded to UJ since the University's inception. Most notable is that 71% of the 2015 publications appeared in international (ISI- and IBSS-listed) journals. The high proportion of UJ-authored or co-authored articles in these journals contributes to our vision of global excellence and stature and also speaks to the increasing visibility of our research across borders.

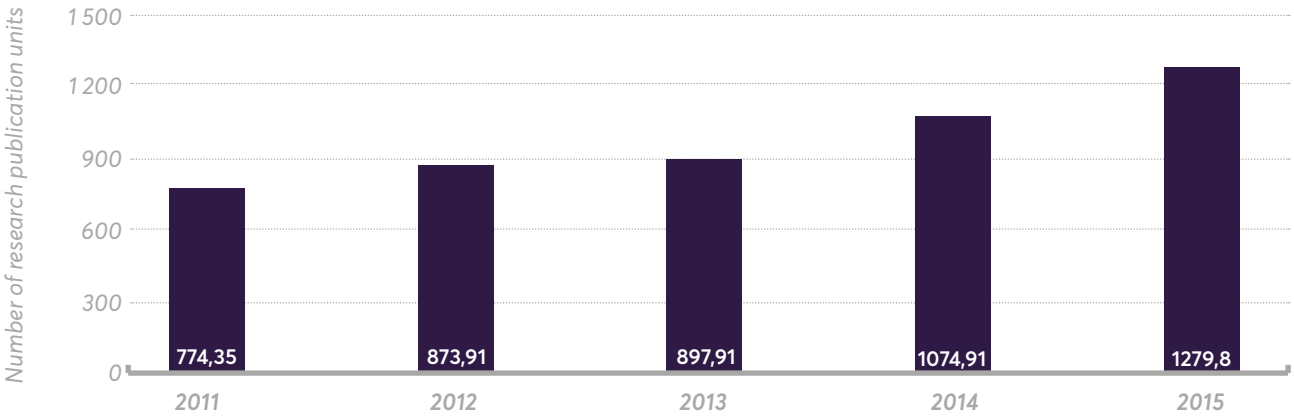
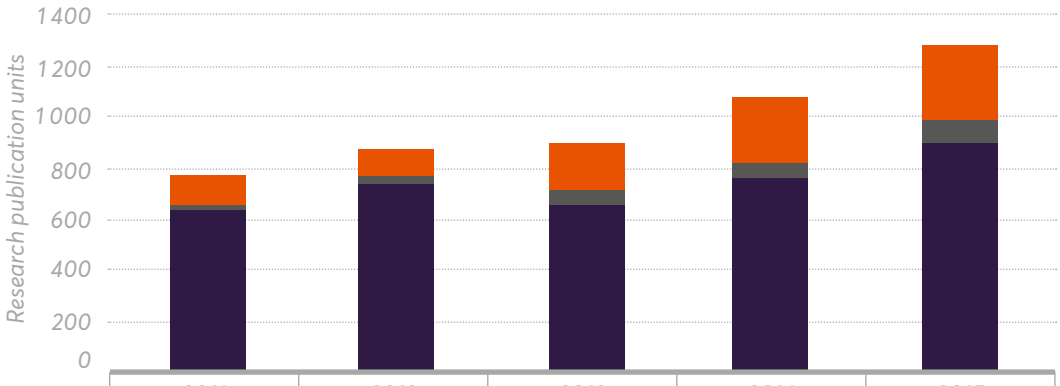


Figure 1: *Number of DHET research publication units for all UJ publication types.*

There were twice as many book and book chapters, authored by UJ's academics and researchers and approved by DHET, as the number in the previous year's submission for these publication types. In addition, the number of 2015 journal articles and conference proceedings rose by 17,99% and 13,79%, respectively, over the previous year (Figure 2).



	2011	2012	2013	2014	2015
Conference Proceedings	118,07	103,91	182,5	253,47	288,44
Book & Chapters	18,29	31,36	58,83	59,52	92,37
Journal articles	637,99	738,64	656,09	761,92	898,99

Journal articles Books & Chapters Conference Proceedings

Figure 2: *DHET research publication output units awarded per publication type.*

CO-AUTHORED PUBLICATIONS AND COLLABORATIONS

Co-authored research publications and collaborations are important for widening the university's global footprint and networks and increasing the visibility and citations of UJ researchers. The range and global spread of co-authored publications as drawn from the Scopus database are presented in Table 1.

Table 1. *Extent of collaborations through co-authored papers over five years*

Collaboration	Proportion of overall co-authored publications (%)	No. of publications	No. of citations	Average no. of citations per publication	Field-weighted citation impact
International	44,4	3 421	33 537	9,8	1,99
National	14,7	1 131	3 694	3,3	0,83
Institutional (UJ)	21,6	1 666	3 550	2,1	0,53
None (single-authored publications)	19,3	1 485	2 987	2,0	1,07
Industry	0,5	36	1 965	5,5	1,32

Aligning with the university's global excellence and stature goals, at 44% the majority of co-authored publications are with international collaborators, which contributes to higher citations than those published entirely by UJ co-authored papers. The main regions in which the institutions of collaborative partners are based are in Europe, followed by the Asia-Pacific region, North America, and to a lesser extent the Middle East, Africa and South America. The top 10 specific international institutions in these regions are listed below (in descending order of total number of publications, together with citations to this date).

1. French National Centre for Scientific Research (660 publications; 19 974 citations), Europe;
2. Italian Institute for Nuclear Physics (648 publications; 17 900 citations), Europe;
3. Université Paris Saclay (631 publications; 19 726 citations), Europe;
4. University of Oxford (627 publications; 18 901 citations), Europe;
5. Rutherford Appleton Laboratory (625 publications; 16 851 citations), Europe;
6. University of Wisconsin (624 publications; 18 524 citations), North America;
7. University College London (618 publications; 18 455 citations), Europe;
8. University of Melbourne (616 publications; 18 304 citations), Asia-Pacific;
9. University of Edinburgh (612 publications; 18 525 citations), Europe;
10. Lund University (611 publications; 18 337 citations), Europe.

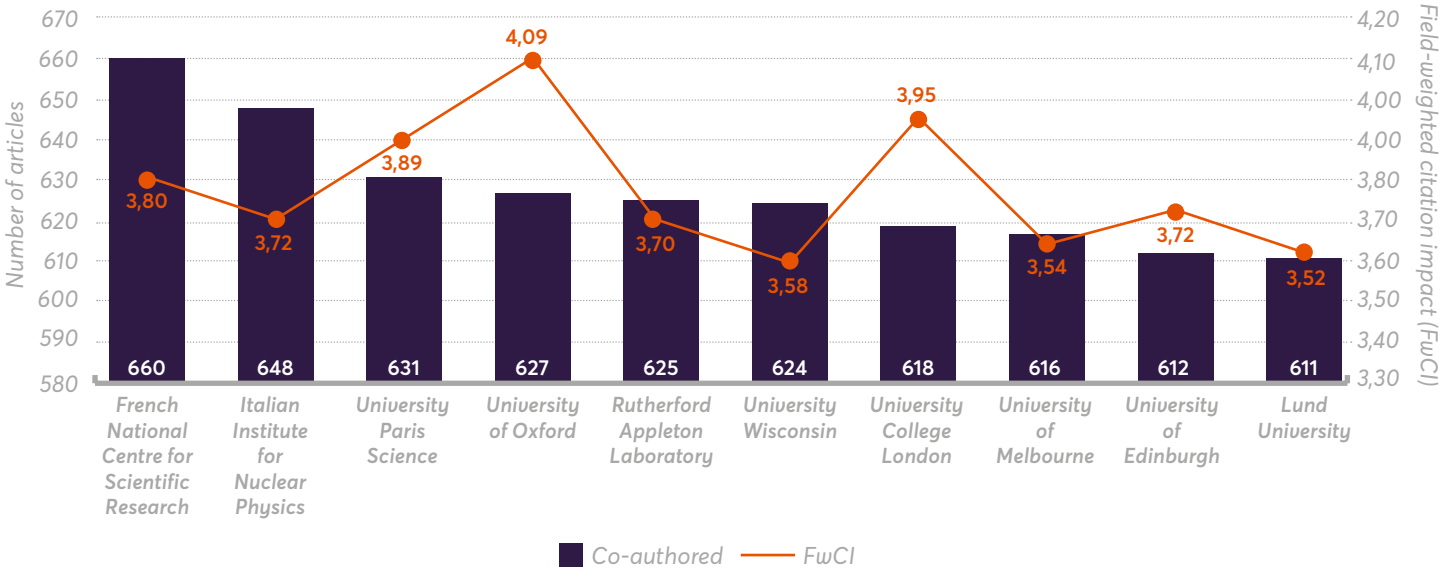


Figure 3: *UJ's Top Ten International Collaborating Institutions.*

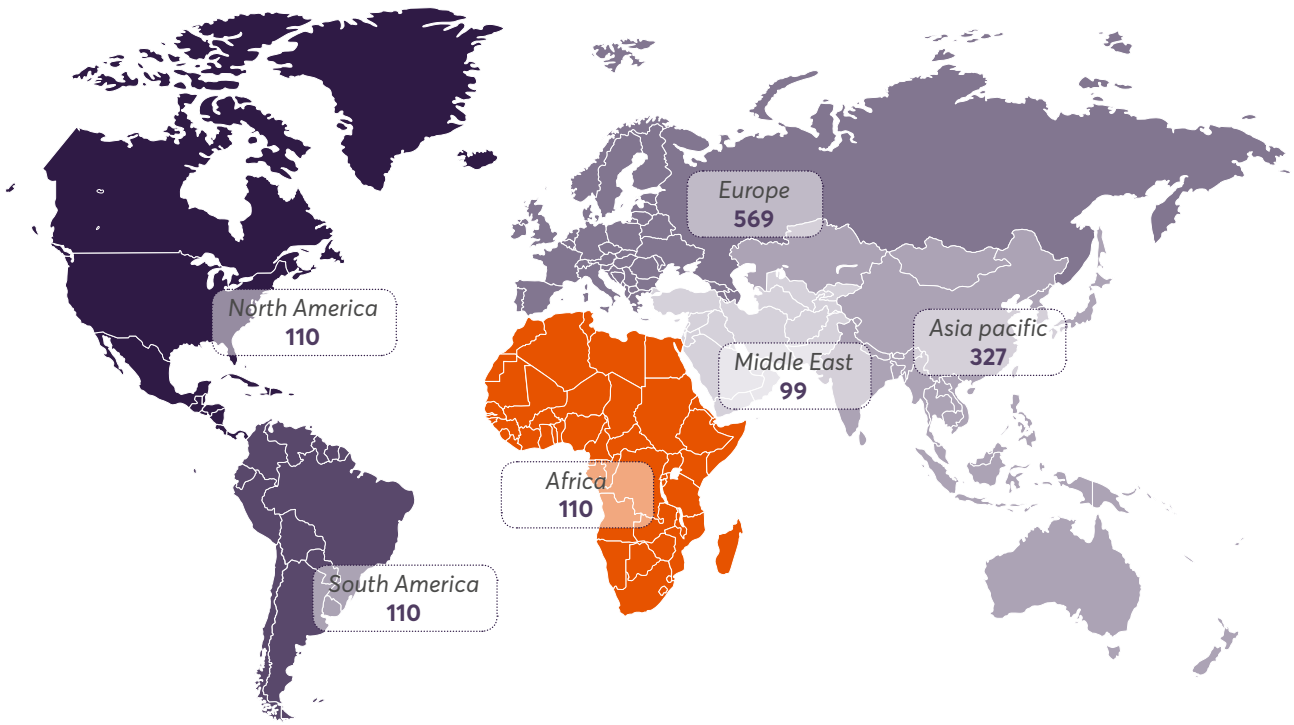


Figure 4: *Overview of global collaborations in terms of co-authored publications.*

UJ'S RESEARCH LEADERS

NRF-rated researchers

The NRF rating system is a valuable benchmark for assessing the quality of our researchers in comparison to the best in the world. The NRF ratings are allocated on the basis of a researcher's recent research outputs and impact as perceived by international peer reviewers. The rating system encourages researchers to publish high-quality outputs in high-impact journals/outlets. The ratings are awarded in the following categories:

A – Leading international researchers;
B – Internationally acclaimed researchers;
C – Established researchers;
P – Prestigious awards;
Y – Promising young researchers.

By the end of 2016 UJ took pride in having six NRF A-rated researchers, recognised by their peers and international leaders in their fields.

UJ's NRF A-rated researchers:

- Professor Nicolas Beukes,
- Professor Hendrik Ferreira,
- Professor Bill Harris,
- Professor Mike Henning,
- Professor John Maina,
- Professor Thaddeus Metz.

Overall, the number of UJ NRF-rated researchers rose by 12,8% in 2016 (from 156 in 2015 to 176 by the end of the reporting year). Most important was the growth in the number of UJ researchers with international standing, as seen by the addition of five new B-rated researchers and the growing number of our young Y-rated researchers.

Table 2. *UJ's NRF-rated researchers per category (2014–2016)*

Year	Rating category					
	A	B	C	P	Y	Total
2014	6	32	77	1	26	142
2015	6	33	86	1	30	156
2016	6	38	97	1	34	176

RESEARCH CHAIRS

Research chairs are important for leading research programmes in the direction of knowledge production, finding solutions to problems, forging research collaborations and partnerships and the training of research fellows and postgraduate students.

Externally funded research chairs

South African Research Chair Initiative (SARChI) chairs

The South African Research Chair Initiative (SARChI) aims to strengthen scientific leadership and research capacity development in South African universities and supports established scholars to focus on advancing the research and training, in their respective fields, of the next generation of research leaders.

UJ now hosts 12 SARChI chairs:

- Education and Care in Childhood (Faculty of Education);
- African Diplomacy and Foreign Policy (Faculty of Humanities);
- Social Change (Faculty of Humanities);
- International Law (Faculty of Law);
- Geometallurgy (Faculty of Science);
- Indigenous Plant Use (Faculty of Science);
- Nanotechnology for Water (Faculty of Science);

- Integrated Studies of Learning Language, Mathematics and Science in the Primary School (Faculty of Education);
- Industrial Development (Faculty of Economics and Financial Sciences);
- South African Art and Visual Culture (Faculty of Art, Design and Architecture);
- Laser Applications in Health (Faculty of Health);
- Welfare and Social Development (Faculty of Humanities).

CoJ Chair in Green Innovation

This chair focuses on sustainable development as well as on the City of Johannesburg's aim of a resilient, liveable, sustainable urban environment underpinned by infrastructure support for a low-carbon economy.

UNESCO Chair in Values Education

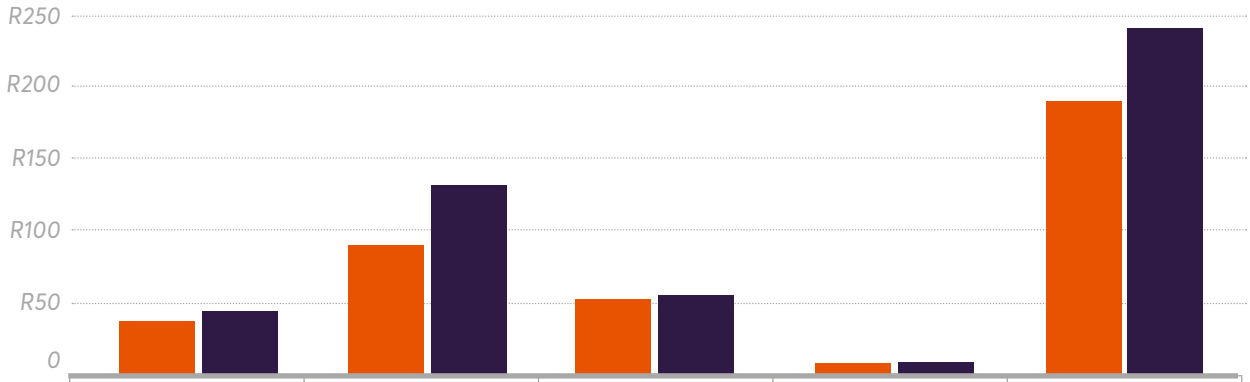
The purpose of this chair is to promote an integrated system of research, training, information and documentation in the fields of education, and in particular to help young people to live together in an atmosphere of peace, respecting self and others, and contributing to sustainable development.

Internally funded research chair

As holder of the Teaching and Learning Research Chair, Professor Leibowitz's key role at the University is to research and support the scholarship of teaching and learning amongst academics.

RESEARCH INCOME AND INVESTMENT

Overall, UJ's research investment through internal and external funding increased by 26%, from R189,45 million in 2015 to R240 million in 2016 (Figure 5). The NRF was the major external funder and provided about 70% of the funding.



	Internal funds	NRF	Contract and other Research	International Research	Total
2015	R37,80	R90,13	R52,89	R8,63	R189,45
2016	R44,19	R131,20	R55,66	R8,98	R240,03

Figure 5: *Internal and external research investment in R million, 2015–2016.*

The University of Johannesburg is a vibrant urban university located at the heart of Johannesburg – South Africa's and Africa's greatest industrial and commercial centre. In its first decade of existence, the University's research and innovation has directly been addressing national and international priorities, including those outlined in the National Development Plan and the UN's Sustainable Development Goals (SDGs). More specifically, our research and innovation contribute to education, infrastructure, poverty alleviation, healthcare and inequality issues as well as other key areas of importance for the country and globally. Here we present a sample of research programmes and projects based at UJ and carried out by our researchers and students, including some of the related innovations. In addition, of great importance are our collaborative activities with the private sector, government, civil society and international partners.

THE GLOBAL EXCELLENCE AND STATURE INITIATIVE

The Global Excellence and Stature (GES) initiative was launched in recent years as an integrated and structured approach to catalyse institution-wide change for enhanced effectiveness and efficiency across the University's missions and administration support functions. The ultimate goal of the initiative is to support the University in sustaining academic excellence for global competitiveness and prominence, while remaining relevant to the Pan-African agenda.

The GES Initiative has interlinked catalytic interventions, whose objectives are aligned with and support the goals of the UJ Strategic Plan 2025. More specifically, these interventions aim to strengthen academic and research capacity within the University, with an ultimate goal of increasing research outputs and impact. These include the following:

- Flagship Institutes and programmes;
- Distinguished Professors and Distinguished Visiting Professors programmes;
- Postdoctoral research fellows;
- Postgraduate students (at master's and doctoral levels).

GES Flagship Institutes and Programmes: Strategic Research Areas/Themes

The University recognises that its identity, competitiveness and relevance depend, to a great extent, on the nature and quality of its research and research performance. To this end the University has identified and invested in the development of strategic research areas, listed in Table 2, through which it seeks to drive research and scholarly excellence and distinctiveness. The University, through these areas, seeks to realize its strategic objective of strengthening its Global Stature and positioning itself as a Pan-African Centre for Critical Intellectual Inquiry.

These areas are intended to be nurtured through GES Flagship Research Institutes and programmes that are envisaged to be long-term and multidisciplinary research programmes. To this end the University has committed seed funding for a period of five years, with the expectation that they will develop towards being financially self-sustainable.

By end of the reporting year, all nine flagship programmes were operational. Two (*Intelligent Systems* and *Pan-African Thought and Conversation*) of the nine programmes are established as research institutes and another two (Johannesburg institute for Advanced Studies and Confucius Institute) are special Institutes whose aim is to create a space for deep thinking and to engage in critical research that seeks, amongst other things, to respond to critical issues in higher education; as well as to facilitate cultural exchanges, language training, and public diplomacy that deepen Sino-South African relations.

Table 3. GES Strategic Research Areas

Strategic Research Areas/Themes	Strategic research programmes
1. Intelligent Systems	GES Flagship Research Institute
2. Pan-African Thought and Conversation	
3. Confucius Institute	GES Special Flagship Institutes
4. Johannesburg Institute for Advanced Study	
5. International Commercial Law	GES Flagship programmes
6. Earth Sciences	
7. Childhood Education	
8. Nanotechnology and Water	
9. Architecture	Postgraduate School for Architecture

GES Distinguished Visiting Professors (DVPs)

GES Distinguished Visiting Professors are appointed on a five-year fixed contract and are required to work at least three months within a year at the University of Johannesburg. They contribute towards:

- the training of postgraduate students;
- publications with an emphasis on impact;
- the establishment of international collaborations and industry partnerships, in relevant cases;
- the mobilisation of funding for research activities.

Thirty-six DVPs were appointed by the end of 2016 from institutions around the globe.

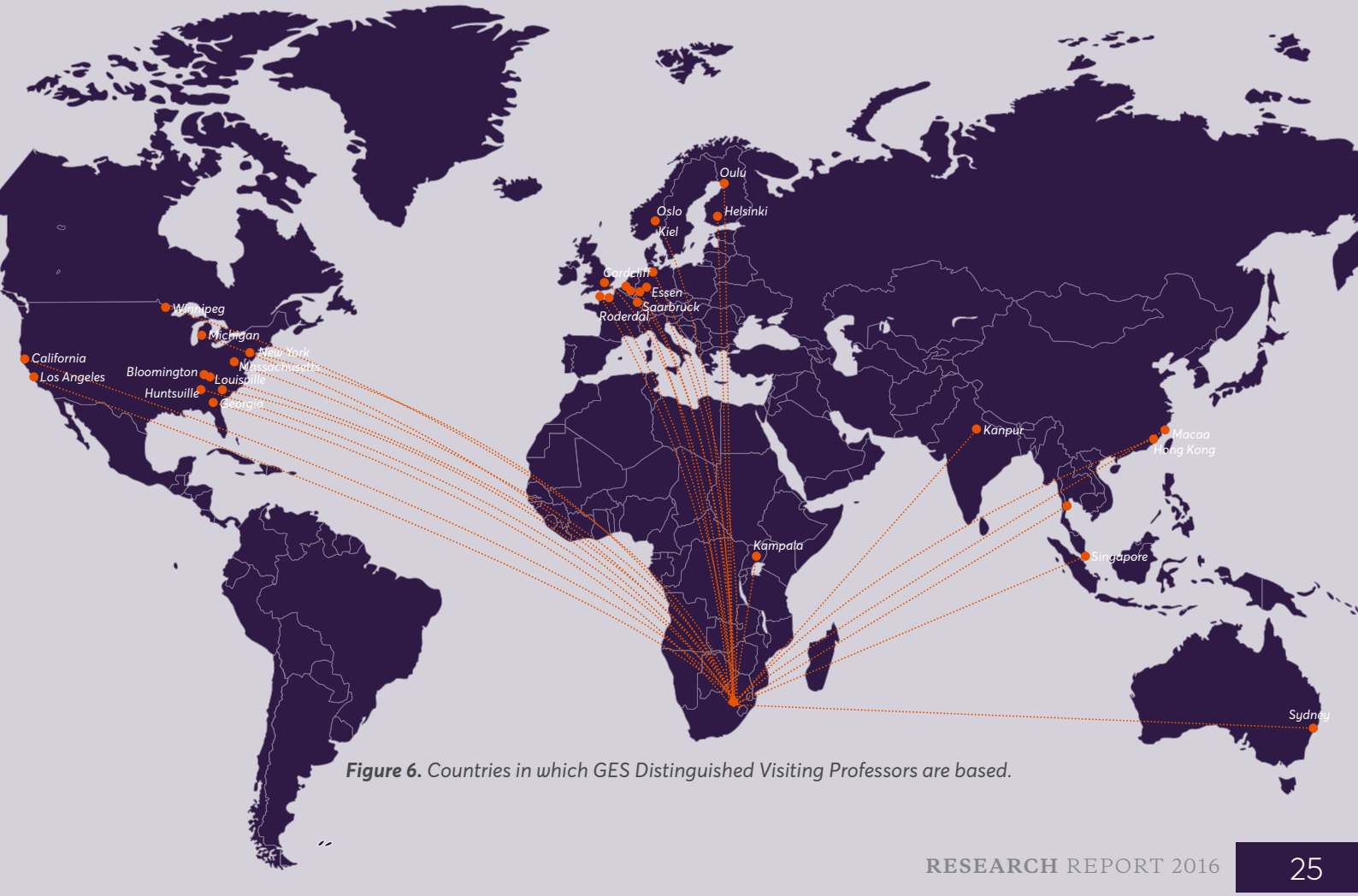


Figure 6. *Countries in which GES Distinguished Visiting Professors are based.*

Johannesburg Institute for Advanced Study (JIAS)

In the latter half of 2016, the Johannesburg Institute for Advanced Study (JIAS) hosted an academic colloquium on the human brain. Besides a range of expert presenters, all global authorities in their fields, it was attended by selected mid-career professionals, graduate students, and postdoctoral fellows from South Africa and abroad. Ultimately, the colloquium was attended by more than 50 core participants from 27 countries.

Established in 2015, JIAS is a joint initiative of the University of Johannesburg (UJ) in Johannesburg, South Africa, and Nanyang Technological University, Singapore. It is one of fewer than 100 institutes for advanced study globally, and the second established in South Africa. The colloquium on the brain is thought to be the first event of its kind organised in the country. It was convened by Professor Willem Hendrik Gispen, Professor Emeritus of Neuroscience and former Rector (Vice-Chancellor) of Utrecht University in The Netherlands. Besides planning the colloquium and engaging distinguished scholars as presenters, Professor Gispen remained at JIAS for the duration of the event, moderating the sessions and mentoring the participants.

The institute's main objective is to promote advanced research in the humanities and natural sciences beyond the regular teaching and research activities at institutions of higher learning. Its subsidiary goal is to act as an incubator of knowledge in a developing country setting in the broader context of the Global South.

In this context, the main purpose of the colloquium was to bring world-class scholarship in brain studies to Africa, bridge the gap and reduce disparities between brain studies in developed and developing countries, and promote neuroscience research and education in developing countries, particularly in Africa.

The colloquium was organised around four themes: History and Emerging Issues in Brain Research; the Cognitive Brain; the Creative Brain; and the Social Brain. Each theme ran for three weeks, comprising a fortnight of intense engagement, workshops and writing, and a week devoted to reflection, outreach and engagement.

In consultation with representatives of Nanyang Technological University, the JIAS director and colloquium convener invited a range of global experts to make the presentations. They included scholars from South Africa, the US, the UK, various other European countries, Australia and Singapore. The participants were mid-career scientists and promising young researchers or PhD students, selected on the basis of applications submitted in response to an invitation issued earlier in 2016.

The participants in the first two weeks of each session consisted of five to six experts, four to five mid-career scientists, and four to five young researchers. Many of the expert presentations were also attended by guests, resulting in audiences averaging about 20 people.

Childhood Education

This flagship programme explores the ways in which primary school children develop and learn, and what this means for educators. The research spreads beyond the

boundaries of teaching and incorporates developmental cognitive psychology and psychometry. This sets it apart from other local research and places it firmly in the heart of global trends.

The programme is a result of the combined skills and experiences of UJ's Department of Childhood Education (DCE), UJ's Centre for Education Practice Research (including a SARChI Chair) and the Funda UJabule School (which serves both as teaching school and research laboratory). The programme has attracted good funding and is conducted with international collaborators in areas of high impact for UJ. These areas include early mathematics cognition, language and literacy development, professional teacher development, and science education for the primary school.

The flagship hosts 21 researchers, including four postdoctoral research fellows, three distinguished visiting professors (from Harvard University, Helsinki University and the University of Duisburg-Essen) and 14 visiting professors and associates. In the latter half of 2016, emphasis was given to establishing collaborations with Universitas 21 institutions.

A new professional master's coursework programme has been submitted for accreditation and the DCE is in the process of putting together, for accreditation, an online programme in foundation phase teacher education. This is intended for students who are interns at schools that will be partnering with UJ.

The MARKO-D test for early numeracy development identifies the mathematical constructs with which a Grade R and Grade 1 learner struggles. It is the first of its kind in South Africa, where there is a dearth of suitable instruments for diagnosing early mathematics competence. The test was standardised in four local languages in a cross-cultural test design and adaptation from the German.

#Taximaths: how children make their world mathematical is complete and has been distributed, together with a workbook, to South African universities. *#Taxiscience: how children learn to see their world scientifically and Running the MARKO-D interview test* are in production.

Earth Sciences

Aiming to be the biggest national geology department – currently a status shared with the University of the Witwatersrand's School of Geoscience – the UJ Geology Department is young, diverse and well along the path of transformation. It aims to diversify academic choices for both graduates and postgraduates to cover more of the Earth system sciences, and to continue being the programme and research partner of choice to prospective students, nationally, internationally, and in industry.

The Paleoproterozoic Mineralization (PPM) research group was established informally in 1997, with a focus on sediment-hosted mineral deposits of the Paleoproterozoic, and became a UJ Research Centre in 2008. Visible coordination and cooperation between PPM and the Economic Geology Research Institute at the University of the Witwatersrand led to the establishment of the DST-NRF Centre of Excellence for Integrated Mineral and Energy Resource Analysis (CIMERA). The SARChI Chair in Geometallurgy falls under the PPM umbrella. Additional focus is on the Limpopo collaborative research project, emergent research fields (for example, medical geology), and new focus areas (for example, cave geology, recent landscape evolution, and Antarctic research) that are actively being developed.

Apart from a suite of standard analytical equipment (that is, x-ray diffraction, x-ray fluorescence, scanning electron microscope, and electron microprobe analyser), the geology programme has access to a range of specialized analytical equipment. The combination makes UJ Geology the best equipped geology department nationally, and positions it as a hub of analytical Earth system science.

Other than GES, there were several other research highlights within faculties and other research centres and institutes.

AFRICA CENTRE FOR EVIDENCE

Under the leadership of the director, Professor Ruth Stewart, the newly established UJ Africa Centre for Evidence (ACE) has a strong team that has grown steadily since 2010 from its beginnings as a research programme linked to the Department of Anthropology in the Faculty of Humanities. The vision of the Africa Centre for Evidence is to reduce poverty and inequality in the region by increasing the production and application of research evidence that is both useful and used.

The research team has an exceptional combination of expertise in the production of policy-relevant evidence and the use of evidence in decision-making. The work of ACE includes the production of systematic reviews and other evidence syntheses, and offering support for decision-makers in the use of evidence. Professor Stewart explains that "Our capacity-support work builds directly on the experience of our University of Johannesburg-led programme (UJ-BCURE) which we've successfully run over the last three years". Perhaps most significantly for the Africa Evidence Network (AEN), which has a total of more than 1 000 members within and beyond Africa, this new Centre has committed itself to the ongoing provision of the secretariat for this network, enabling UJ to continue to support the growth of the evidence-informed decision-making (EIDM) community across the continent. Funded by approximately R27 million of competitively won external funds, the team has:

- Published more than 29 papers and presented more than 25 papers at international conferences;
- Provided 400 training places for civil servants across the region, and contributed to UJ honours and master's-level courses and postgraduate supervision;
- Made valuable theoretical, methodological and practical contributions to evidence-based research; and
- Established three international networks, including the Africa Evidence Network (with 700 members in Africa alone), the Johannesburg Centre of the Collaboration for Environmental Evidence, and the University of Johannesburg-led programme to Build Capacity to Use Research Evidence within the governments of South Africa and Malawi.

Most significantly, the team has established a national and international reputation. Its members work closely with 19 significant partners, including three African governments, seven national government departments in South Africa, and eight universities around the world.

Professor Stewart has worked in the area of evidence-informed policy and practice for fifteen years and is internationally known for her contribution of methodologically sound and policy-relevant research, as well as for her leadership in building capacity to use research evidence amongst a wide range of stakeholder groups.

Evidence Conference 2016

A successful 'Evidence 2016' conference (sponsored by the City of Tshwane, 3ie and the DFID-funded UJ-BCURE programme) was held in Pretoria in late September 2016, with 145 delegates from across Africa. Delegates from 17 countries were able to enjoy 17 plenary presentations, 23 abstract presentations, 36 landscape maps and oral poster presentations, and 2 training workshops. There was critical engagement on the challenges of ensuring that evidence is both useful and used, and debate on the innovative solutions proposed by this 'made in Africa' network. The inclusion in the conference of public servants from 14 African governments, as well as members of national and international NGOs and of civil society groups, kept the discussion focused on real world problems. The keynote address on the first day was delivered by the Honourable Naledi Pandor, South Africa's Minister of Science and Technology. She reminded the delegates that "Africa is data rich, but analysis poor", putting into context her keen interest in the work that the Network is doing. She supported the view that the public should engage with evidence and that evidence should not be seen as accessible only to people in academic, commercial, or privileged contexts. She also highlighted the benefits, to policy as well as democracy, of openness in the scientific community and of embracing the rich indigenous knowledge systems in Africa.

CENTRE FOR SOCIAL DEVELOPMENT IN AFRICA (CSDA)

The CSDA was launched in 2004 with the aim of contributing to improvements in service delivery, policy debate and the expansion of cutting edge disciplinary and interdisciplinary research. Now with over ten years of experience, the Centre's diverse research portfolio contributes to social welfare and social development knowledge, strategic thinking, debate, dialogue and critical policy perspectives in government, civil society and in corporate social investment.

The CSDA research team carefully selects strategic, high impact areas of research in order to contribute meaningfully to social development knowledge, theory, practice and policy, locally and regionally with the view of contributing to knowledge building in the Global South. The research is strongly partnership driven, using a system of collaboration that marries the CSDA's research knowledge and expertise with the partners' local and field-based knowledge to ensure that research outcomes can be immediately and directly applied in appropriate ways. The CSDA currently has various research projects under way in the following areas of social development: Poverty and Vulnerability; Gender and Development; Children and Youth; Social Policy and Social Welfare; and State, Citizen, Private Sector Relationships for Development. The CSDA has an impressive track record of accredited research output and has a solid and ever increasing pipeline of published accredited journal publications. Increasingly, the Centre is involved in the Global South and North in international staff and student exchanges and in socially relevant research partnerships. Among studies and reports produced by the CSDA in 2016 were the *Youth Assets for employability: an evaluation of youth employability interventions* and *Investigating the feasibility of a national minimum wage for South Africa* reports.

YOUTH EMPLOYMENT

The **Tshepo 500000** initiative, a provincial youth employment strategy, contracted Nickey van Rensburg and her team in the UJ Faculty of Engineering and the Built Environment to identify 80 000 township enterprises across 9 township areas, employing 800 unemployed youth, and to survey these enterprises applying a sustainable livelihoods framework to evaluate their resilience profile.

The mobile, online platform developed to geolocate and monitor enterprises (ResearchGOTM) is now widely used at UJ as a research tool to measure and evaluate impact, conduct market research, support SMMEs and conduct surveys.

A Faculty of Engineering and the Built Environment programme, the **'Youth AgrInitiative'** – a collaboration with the City of Johannesburg and Harambee (a youth employment accelerator) – implements agroecology business solutions for urban and rural areas. The Youth AgrInitiative was designed to connect and expand an urban and rural food ecosystem to unlock opportunities and advance local economies. It exposed unemployed youth to training related to digital connectivity, co-creating solutions and community-driven research, research ethics, entrepreneurship training, agro-ecological practices, the food value chain, branding and market research, online networking and the use of a mobile data management tool (MDMT) which enables record-keeping of farming activities. This project is continuing and is now focused on renewable energy solutions to support small scale farming in urban and rural areas.

IMPROVING FOOD SECURITY AND SAFETY FOR SUSTAINABILITY IN AFRICA

UJ's Biotechnology and Food Technology Department partnered with the Human Sciences Research Council, Agricultural Research Council and the Department of Science and Technology to host a successful international congress on Food Security and Safety in 2016. Themed "Improving Food Security and Safety for Sustainability in Africa", the conference attracted wide media coverage and highlighted that food security is pivoted on four major aspects: availability, access, stability and utilization. In the same way, food safety implies "the absence of, or acceptable and safe levels of contaminants, adulterants, naturally occurring toxins or any other substances that make food injurious to health on an acute or chronic basis", the organizing committee explained. "The conference boasted high-level debates among key delegates around the food safety and (in) security nexus," co-chairperson of the organizing committee, UJ's Dr Patrick Njobeh said. The Executive Dean of UJ's Faculty of Science, Professor Debra Meyer, further stated during the welcome dinner that the future of the global food chain is largely determined by five major drivers: population growth and demography; availability, use of resources and the environment; innovation and technology; social attitudes; and public policy; and that Africa's knowledge generation requires the dissemination and exchange of knowledge and expertise through conferences and publications.

INNOVATIONS

Mineral PET is a novel and cost-effective way of identifying diamonds in Kimberlite rock. Diamonds that are not visible to the naked eye can be detected in rocks up to fifteen-centimetre-wide reducing the crusher cost due to larger size and reducing diamond breakages. This innovation provides the diamond industry with a fail-safe and economical method of detecting diamonds, with less crushing, lower energy and water needs, and less damage to larger diamonds.

Eyethenticate is a unique biometric identification technology using the eye. The accuracy and ease of use surpasses any biometric method currently available and can be used in banking and security sectors and related applications. UJ is a shareholder of the company that owns the intellectual property of this technology.

SUPPORTING SMALL AND MEDIUM TECHNOLOGY ENTERPRISES

Technology stations

The Technology Innovation Agency (TIA) funds technology stations to support industry and provide world-class engineering services, and to support small and medium technology enterprises. These stations also provide technical expertise and high-tech equipment or infrastructure. UJ hosts two technology stations linked to the Faculty of Engineering and the Built Environment.

Metal Casting Technology Station

The Metal Casting Technology Station (MCTS) is a technology transfer partner for the metal casting industry, which pioneers development through training, research and technology support. A non-profit initiative funded by the DST through TIA, the MCTS operates from UJ in partnership with the Department of Metallurgy in FEBE. Focusing on casting design and simulation, education and training, physical metallurgy, rural and emerging foundries, and sand technology, the MCTS supports and assists the industry – foundries, suppliers and related industries – to improve the sector's innovation ability for increased competitiveness and sustainability.

Process, Energy and Environment Technology Station

The Process, Energy and Environment Technology Station (PEETS) was established in 2010. The primary mandate for the PEETS is to contribute towards improving the competitiveness of industry through the application of specialised knowledge and technology and to facilitate the interaction between industry (especially SMMEs) and academia to enable innovation to take place. PEETS is the only organisation that serves as a catalyst to reduce the gap between academia and industry in the energy and environment space.

SUPPORTING EMERGING RESEARCHERS

The Akanya building

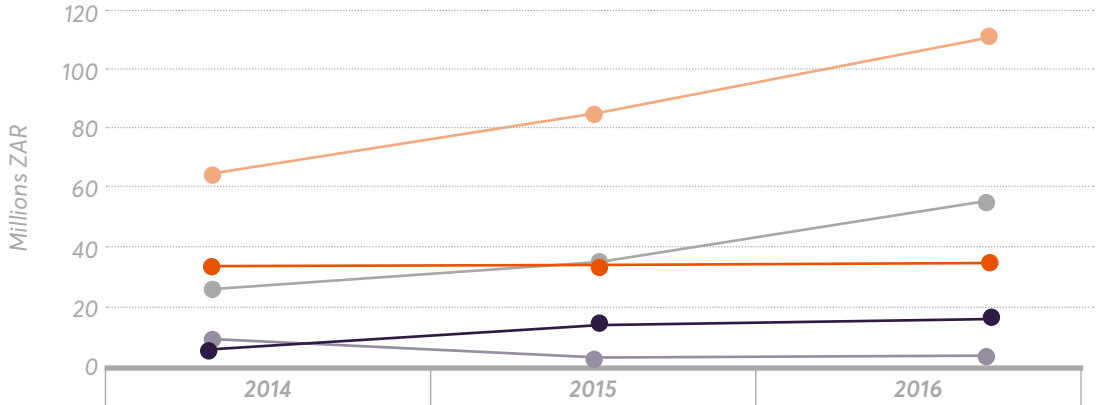
The University has, over the years, built a world-class research support environment to enable research and innovation, research mentorship and collaborations to flourish. The 2016 research and postgraduate activities and outcomes have been based on the successes of previous years and, with the firm establishment of the University of Johannesburg Postgraduate School (UJPS) and the Strategic Initiatives and Administration entities, we foresee a continued upward trajectory in performance across the board. Particular activities will focus on increasing external international research income, expanding emerging researcher support to build a strong sustainable cohort of academic researchers, improving postgraduate throughput, and leveraging national and international collaborations and partnerships in areas of strength.

The UJPS plays an important role in advancing the postgraduate portfolio at UJ in order to grow the institution's intellectual currency. An enabling environment is one of the core elements of ensuring postgraduate success and of attracting excellent postgraduate students and postdoctoral fellows. The UJPS has progressed significantly towards strengthening this enabling environment during 2016.

The UJPS building, Akanya, accommodates 56 postdoctoral fellows, and some of the space is currently being used by doctoral students. The building also has a training venue that has already been used for more than 65 research capacity workshops and other events to build the UJ postgraduate community.

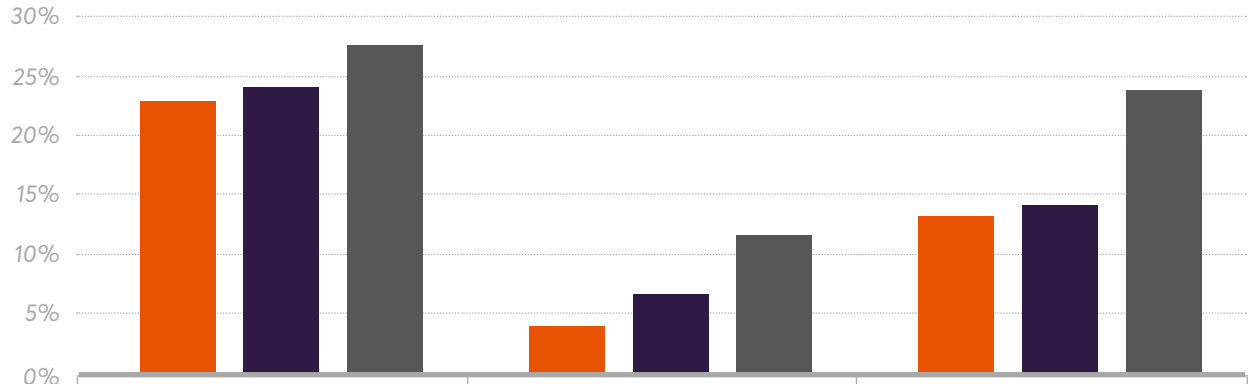
Postgraduate funding

Financial access is an important consideration in the overall focus on postgraduate quality at UJ. Postgraduate Fund Management, within the UJ Postgraduate School, has been successful in growing the available funding consistently over the last period (Figure 7). There is a deliberate focus to ensure that the change in the ratio between internal and external funding for bursaries and scholarships is continued.



	2014	2015	2016
UJ International Funds	32,90	33,74	35,14
UJ GES	5,02	14,12	16,38
NRF	25,15	34,64	56,03
External Funds	0,74	2,30	3,06
Total	63,81	84,80	110,61

Figure 7: *Postgraduate funding available as bursaries and scholarships for UJ postgraduate students.*



	Honours	Masters	Doctoral
2014	22,94%	4,17%	13,33%
2015	24,08%	6,84%	14,22%
2016	27,62%	11,76%	23,86%

Figure 8: *Bursaries and scholarships as a proportion of headcount.*

Although the growth in absolute value of available funding is positive, this has to be offset against the rapid growth in postgraduate student numbers and the associated growth in demand for funding. Figure 8 shows that UJ has been able to grow the support given to its postgraduate students and thereby offer greater financial access to its postgraduate degrees.

Formalising postgraduate research supervision training

Research in South Africa has shown that one of the reasons for slow throughput of postgraduates is inadequate supervision. It has also highlighted the need for supervisors who are better able to support the development of master's and doctoral candidates who are underprepared for their studies as well as mature students who are studying part-time. It is now widely acknowledged that it cannot be assumed that a completed postgraduate degree is sufficient preparation for the supervisory role of guiding students in their research projects. To contribute to the professional development of academic staff as supervisors, therefore, the Postgraduate School, in collaboration with the Faculty of Education, has developed a series of seven short courses on different aspects of postgraduate research supervision. These Senate-approved courses are the product of a three-year project funded by the DHET Research Development Grant. The development of the course has been a collaboration that has drawn on the expertise of senior academics from UJ and the University of the Witwatersrand.

While the core course, 'Postgraduate research supervision', is aimed primarily at novice supervisors who wish to become familiar with practices, theories, policies, methodologies and strategies related to the supervision and mentoring of postgraduate students at all levels, it may also be of interest to more experienced supervisors who are rethinking research supervision and looking for innovative ways of engaging with the related challenges in the African context in which they work. In addition to the 'core' course, which should be completed first, two courses focus on research design: 'Supervising qualitative research' and 'Supervising quantitative research'. 'Assessment of postgraduate research' considers the practicalities of all aspects of formative and summative assessment pre- and post-examination at honours, master's and doctoral levels. It concludes with a consideration of technical aspects of and dilemmas in assessment, as well as their possible resolution.

'Current and emerging issues in postgraduate supervision' focuses on challenges faced in research and supervision in higher education institutions that are due to complexity and change. The purpose is to alert supervisors to current debates on decolonisation, knowledge systems and diversity in order to enhance their capacity to respond critically to these debates in their supervision practices.

As Bourdieu and Passeron famously observed, academic language is no-one's mother tongue. Therefore 'Academic

literacies in research supervision' focuses on the multilingual and multimodal resources that postgraduate students bring to the academy and on ways in which supervisors can support them with the academic literacies challenges experienced.

According to Albert Schweitzer, the first step in the evolution of ethics is a sense of solidarity with other human beings. While research ethics is formalised in university policies and processes, 'Ethics in research supervision' encourages consideration of many ethical dimensions that go deeper than bureaucratic compliance and contractual agreements. This course aims to assist supervisors and postgraduate student researchers to develop deep and systemic understanding of the current thinking, practice, theory and methodology related to the ethics of research, in order to develop their competence in designing, implementing and supervising ethical research.

All seven courses are offered in blended learning mode over three to four months and they are being piloted in 2017. Each course is worth the equivalent of 20 credit points at NQF Level 8. In time, the courses will become components of a UJ-branded Postgraduate Diploma in Research Supervision, a unique qualification that is currently with the Council on Higher Education for approval.

Research Capacity Development

The Research Capacity Development (RCD) Department and Statkon provide research training opportunities and specialist consulting services designed to meet the needs of postgraduate students, emerging researchers, and emerging supervisors. In meeting these needs, the intent is to contribute to reduce the postgraduate dropout rate and time to completion, and to improve supervision and postgraduate student satisfaction.

Both RCD and Statkon support UJ's strategic objectives to achieve Excellence in Research and Innovation (Objective 1), in Teaching and Learning (Objective 2) and an Enriching Student-Friendly Learning and Living Experience (Objective 4).

The focus for 2016 was on improving the impact and quality of research capacity development initiatives for postgraduates and academic staff. To this end, there has been a movement towards extending and deepening support from ad hoc once-off workshops to workshop series and short courses and from generic workshops to interventions tailored to the content and needs of specific faculties and departments, on request.

The 2016 Research Capacity Development (RCD) programme offered from the Postgraduate School, and serving all nine faculties, was the most extensive to date, with 70 events taking place during 2016, a substantial proportion of which was funded by the DHET Research Development Grant (RDG). A total of 292 staff members and 413 postgraduate students participated in Semester 1, while in Semester 2, 337 staff and 313 students participated. The total number of recorded participations in RCD events was 1 355, comprising 629 staff and 726 postgraduate participants.

Annual Postgraduate Symposium

The sixth annual inter-faculty Postgraduate Symposium was held on 14 October 2016 with the largest number of participants ever: 133 postgraduate students and staff members participated in the Symposium, 58 of whom presented their research on the day. Figure 9 shows some of the participants in the 2016 Postgraduate Symposium.

Figure 9: *Participants in the 2016 inter-faculty Postgraduate Symposium.*

RCD initiated and hosted UJ's Three Minute Thesis (3MT) Competition, and initiated faculty-based competitions leading to the main UJ competition. In 2016, master's students also had the opportunity to present their research in a two-minute presentation. Six faculties had their own competitions before the main UJ Two Minute Dissertation (2MD) and Three Minute Thesis (3MT) Competition. In total, 137 people (45 of whom were presenters) participated in these competitions.

Figure 10: *Participants in the 3MT and 2MD events of 2016.*

Research supervisor development

The 30-credit 'Strengthening Postgraduate Supervision' courses, accredited by Rhodes University, were offered in two iterations to UJ staff in 2016, with a total of 48 participants completing the course. A specific focus for the RCD Department is the development of UJ's own new short courses on aspects of postgraduate supervision that are not comprehensively addressed in the 'Strengthening Postgraduate Supervision' course.

By June 2016, all seven short courses, and the proposed Postgraduate Diploma in Research Supervision, had been approved at the Faculty of Education and Senate level. The Diploma is now with the CHE awaiting approval. To qualify for the Diploma, participants will be able to choose six of the following modules: PGRS@UJ: Rethinking postgraduate research supervision in the African context; Academic literacies in research supervision; Assessment of postgraduate research; Ethics in research supervision; Supervising qualitative research; Supervising quantitative research; and Current and emerging issues in postgraduate supervision.

A Postgraduate Supervision Forum entitled 'Strategies for addressing postgraduate throughput and time to completion', was held on 4 August 2016. The 57 staff members who participated in the Forum had the opportunity to learn more about the postgraduate throughput and time to completion data, and faculty representatives shared strategies for improving time to completion.

Research capacity development for UJ staff

As part of UJ's Excellence in Research and Innovation Strategic Objective, the University's 2020 and 2025 targets for the percentage of academic staff holding doctoral qualifications are 65% and 75%, respectively. UJ has invested in its staff though the SANTRUST pre-proposal doctoral programme, the Academic Accelerated Mentorship Programme (AAMP), and other initiatives. A series of eight workshops aimed at UJ staff studying towards doctorates ran over the year as part of the Postgraduate School's Research Capacity Development Programme.

To support strategic objectives regarding increased research output, RCD secured DHET Research Development Grant (RDG) funding for four intensive faculty-specific writing retreats. Four DHET RDG-funded Postgraduate Writing Fellows (PGWFs), who are PhD candidates, provided one-on-one consultations to assist staff and postgraduate students with their research writing. The PGWFs, who were housed in the UJ writing centres, had 477 consultations with 389 students in 2016.

The Statistical Consultation Service (Statkon)

During 2016, Statkon consultants contributed to excellence in research and increase in research output and throughput of students by providing research design support for 340 projects, and by providing analysis support for 189 projects. This support was predominantly requisitioned from the Faculties of Management, Health Sciences and Engineering and the Built Environment and from honours, master's and PhD students and staff members.

An additional activity contributing to UJ's objectives to increase research output and improve student throughput was support provided by Statkon for data capture, either by demonstrating the data capture procedure to individual students or facilitating data capture internally.

Statkon consultants contributed to development of staff and postgraduate research skills through facilitation of workshops on Research Design (including sampling methods and questionnaire design) and Statistical Analysis (including descriptive and summary statistics, statistical techniques for comparing groups, statistical techniques for examining relationships).

Postdoctoral research fellows (PDRFs)

Postdoctoral research fellows (PDRFs) play an important role in the University's research productivity. UJ has invested in its PDRFs and has seen a significant growth in numbers (Figure 11). The PDRFs are distributed across the institution and they come from South Africa, SADC, the rest of Africa and the rest of the world, demonstrating our Pan-African and global reach. The UJ Postgraduate School provides office space for 56 PDRFs in the Akanya Building and there is a vibrant atmosphere in these offices, with PDRFs working actively at all hours. While the number of PDRFs has increased, there has also been a focus on increasing the productivity of the PDRFs and this has been successful.

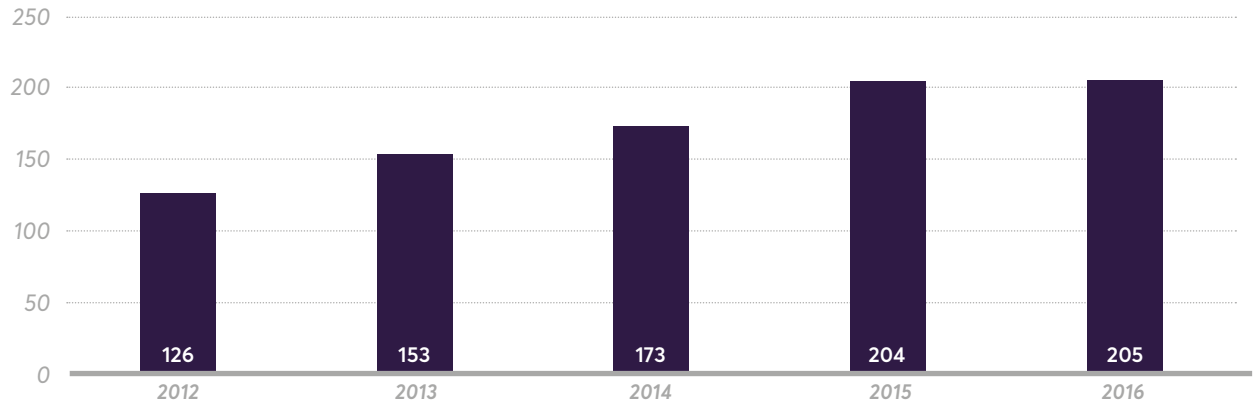


Figure 11: *Number of postdoctoral research fellows (PDRFs) at UJ.*

Here, we introduce some PDRFs who contribute to UJ research activity.

Dr Rosemary Matikiti

Dr Matikiti is examining service failure and recovery in the airline industry. She is supervised by Professor M Mpinganjira and Professor M Roberts-Lombard in the Department of Marketing Management at UJ. She holds a PhD in tourism management from North-West University, specializing in marketing, and her current research interest is in the fields of e-marketing in tourism, service marketing, and consumer behaviour in tourism. She is a member of the Marketing Association of South Africa. She has been productive as a UJ PDRF and, in that role, has published three articles and delivered one conference paper to date.

Dr Timothy Wright

Dr Wright is a postdoctoral fellow based in the Department of English at UJ. His current research focuses on representations of post-apartheid Johannesburg, especially in the genres of science fiction and fantasy, with a focus on imaginings of new forms of life in the fluid and unstable worlds of the changing city. Recent published articles have explored mutation (Neill Blomkamp's *District 9* and Lauren Beukes' *Zoo City*), HIV-positive vampires (the graphic novel *Rebirth*) and postmodern conceptions of black identity (Loyiso Mkize's superhero comic book *Kwezi*). For Dr Wright, "these works display imprints not only of desires and anxieties around historical change, but of speculative forms of being that have not found issue in an increasingly intransigent social realm".

Dr Admire Mare

Dr Mare is a fellow in the Department of Journalism, Film and Television, where he is supervised by Professor Jane Duncan. He is a Zimbabwean who obtained his PhD at Rhodes University. He is currently working on four interrelated research topics: communication surveillance, digital activism, political communication and the impact of new media on journalism. He has three publications accepted and in press to date for 2017. Dr Mare is "working on digital campaigning practices in candidate and party-centred systems in Southern Africa with an explicit focus on emerging political targeting, fundraising and digital listening practices".

Dr Rasheedad Mohamood

Dr Mohamood completed her PhD in 2014 at UJ. As a fellow in the Department of Mechanical Engineering Science, working with Dr Akinlabi, she has been productive in the area of additive manufacturing. She specifically focuses on laser-deposited titanium alloy and composite materials; 38 publications have been produced from this work. These include a filed patent, an authored book, an edited book, book chapters, ISI-listed journal articles, and conference proceedings. Dr Mohamood says that metal deposition by laser is an important additive manufacturing process of importance for the production of three-dimensional parts, as well as for the repair – not previously possible – of damaged high-value components. The research is highly relevant to the aerospace, orthopaedic and dental industries.

Dr Atheesha Singh

Dr Singh is a fellow in the field of water and health research at UJ. She investigated river water microbiology during her doctoral study at the University of KwaZulu-Natal, which was one of the first most comprehensive studies on human disease-causing bacteria and viruses in the Umgeni River. Her results raised much interest among public, local health and environmental authorities. Dr Singh is currently involved in several research projects including an investigation into the acid shock adaptations of pathogenic enteric bacteria, to gain a better understanding of the infectious doses of these bacteria associated with diarrheal outbreaks in humans. She has published several peer-reviewed articles and has presented research at national and international conferences as a UJ fellow.

Dr Mani Rajbhandari

Dr Mani Man Singh Rajbhandari completed his doctorate in 2013 at the University of Tampere, Finland. He is a fellow in the Department of Educational Leadership and Management, where Professor Coert Loock and Professor Pierre Du Plessis are his supervisors. His research is on leadership maintenance, leadership readiness, leadership elasticity, culture and climate and micro climate, in the educational context. He has several successful publications that include case studies from Finland, Nepal and South Africa.

RESEARCH COMMONS AT UJ CAMPUS LIBRARIES

The Research Commons are dedicated spaces for postgraduate students, research fellows and academic staff. These were established on all four UJ campuses to provide further facilities for the use of postgraduate students. In 2016, renovations were completed across the campuses and all the Research Commons spaces were refurbished with state-of-the-art technology installed including high-end computers and relevant research support tools and software such as *Amos, Atlas Ti, SPSS, Write-N-Cite* and *Mathematica*.

Research support at the UJ Library commenced in January 2016 with an extensive orientation and training programme for postgraduates in the various faculties. The aim was to familiarise postgraduate students with the support available from the library throughout their research journey. All the orientation and training sessions were aimed at them, from honours to doctoral level, with experienced and skilled information librarians and faculty librarians conducting the training sessions. Research-related events included discussions with prominent researchers at the University as well as opportunities for postgraduates to talk about their own work.

The following eight modules were implemented across the campuses:

- Introduction to the library;
- Conducting a literature review;
- Awareness of previous research;
- Plagiarism, referencing and RefWorks;
- Academic networking/researcher visibility;
- Getting published;
- Bibliometrics and research analysis and dissemination; and
- Technology and mobile downloads.

FACULTY RESEARCH HIGHLIGHTS

FACULTY OF ART, DESIGN AND ARCHITECTURE

Figures indicate that the faculty produced 38,08 DHET subsidy units in 2016. Despite an overall drop this year from its 2015 peak, the faculty is maintaining a modest but steady average growth of 10,9% per annum, with year-on-year increases in the number of articles published in international journals.

The 2016 submissions comprised 16,33 subsidy units from journal articles, as well as 2,25 conference proceedings units, 13 book units and 6,5 book chapter units.

The number of NRF-rated researchers rose to eight (from six in 2015). As befits a Faculty of Art, Design and Architecture, creative work continued to enjoy high priority among the artists, designers and architects on the academic staff. Five projects for the recognition of creative-work-as-research underwent a peer review process and were successfully submitted to the FRC and subsequently to an ad hoc committee of the URC. Collectively, these projects yielded 14 creative work units, as approved by the ad hoc committee.

In addition, the Faculty achieved several national collaborations with a variety of institutions, including the University of the Witwatersrand, the University of Pretoria, the University of Cape Town, the Tshwane University of Technology, the Central University of Technology, the Cape Peninsula University of Technology, and the Greenside Design Centre.

38,08
DHET subsidy units in 2016

2016 submissions comprised **16,33** subsidy units from journal articles, as well as **2,25** conference proceedings units, **13** book units and **6,5** book chapter units

The number of **NRF-rated researchers rose to eight**
(from six in 2015)

FACULTY OF ECONOMIC AND FINANCIAL SCIENCES

Subsidised publications in the Faculty for 2016 amounted to 61,51 units, comprising 54,35 journal article units, 5,66 book chapter units and 1,5 units in respect of conference proceedings. This represents a 39,8% increase from 44,01 units in 2015. Over the last five years subsidised output grew at an unweighted average rate of 21,3%. Apart from activities that resulted in accredited research output, staff members remain highly committed to scholarly activity in areas such as conferences, publications in non-accredited journals/media, non-subsidised books, involvement with professional bodies, and research projects.

Various measures that continue to stimulate research and scholarly activity in the Faculty include: appropriate capacity development initiatives at departmental level; departmental research seminars; appointment of visiting scholars and research associates; public lectures; an accredited journal hosted by the Faculty through which to engage the broader academic community; internal research funding; the activities of the Faculty's three research/training centres; four NRF-rated researchers (and one visiting professor who is NRF-rated), an NRF Chair in Industrial Development; and the Faculty biennial Value Conference. A fourth research centre, the Public and Environmental Economics Research Centre (PEERC), which was established towards the end of 2016, is expected to make an important contribution to research activity in the Faculty.

In line with its strategic focus to enhance its national and international position, the Department of Economics and Econometrics has maintained its ranking in the REPEC (Research Papers in Economics) classification as the fourth best Department of Economics in South Africa.

Publications in the Faculty for 2016 amounted to **61,51** units, comprising **54,35** journal article units, **5,66** book chapter units and **1,5** units in respect of conference proceedings

The Department of Economics and Econometrics has maintained its ranking in the REPEC (Research Papers in Economics) classification as the ***fourth best Department of Economics in South Africa***

FACULTY OF EDUCATION

The Faculty's research, conducted in academic departments, the Centre for Education Practice Research (CEPR), the Centre for Education Rights and Transformation (CERT), and by NRF Chairs and the Chair in the Scholarship of Teaching and Learning, is aimed ultimately at enriching and transforming the practice of education.

The programme of activities in the broad area of education in childhood is a strength of the Faculty. The two NRF Chairs are both related to the area of education in childhood, though with distinct foci. The bulk of the funded research projects of the Faculty are located in the CEPR and the Department of Childhood Education. These research projects involve postgraduate students, postdoctoral research fellows and staff, and they are conducted generally with international collaboration (for example, University of Helsinki and Harvard University). The Faculty is a leader in the country in research on primary school teacher education with the "teaching school" initiative at the SWC a unique example of practice-based teacher education.

Science education and research in educational support for children and youth who struggle are other prominent research areas in the Faculty. Research in higher education as field of study is an emerging strength.

The Faculty's research output, comprising articles in accredited journals, research based books and conference proceedings increased notably during the past few years, though there was a decrease from 100,11 units in 2015 to 90 research units in 2016. The decrease is due to fewer conference papers published in conference proceedings. The research units generated were 83,11 in 2014, and 63,83 in 2013.

90 research units in 2016

The numerous externally funded research projects bear further testimony to the vibrant research culture that has developed in the Faculty. Funders included the National Research Foundation (several projects); the Department of Higher Education and Training; the Foundation for Human Rights; the Rosa Luxembourg Foundation, the Education Policy Consortium, Ford Foundation, Hewlett Packard Company; National Institute for the Humanities and Social Sciences and the Zenex Foundation.

In 2016, the following academics were NRF-rated researchers in the field of education: Professors Jace Pillay, Chris Myburgh, Elizabeth Henning, Linda Chisholm, Brenda Leibowitz, Raj Mestry, Umesh Ramnarain, Shireen Motala, Juliet Perumal, Gert van der Westhuizen, Nadine Petersen and Salim Vally.

The Faculty serves the education research community through two accredited research journals, namely *Education as Change* (linked to the CERT) and the *South African Journal of Childhood Education* (linked to the CEPR).

In 2016, the following academics were NRF-rated researchers in the field of education:

- *Professors Jace Pillay,*
- *Chris Myburgh,*
- *Elizabeth Henning,*
- *Linda Chisholm,*
- *Brenda Leibowitz,*
- *Raj Mestry,*
- *Umesh Ramnarain,*
- *Shireen Motala,*
- *Juliet Perumal,*
- *Gert van der Westhuizen,*
- *Nadine Petersen and*
- *Salim Vally.*

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT (FEBE)

The growth of the postgraduate student profile of the Faculty has enhanced the Faculty's quest towards knowledge production. In this regard, FEBE served as home to 934 master's and doctoral students (as per unaudited HEMIS data, 31 Dec 2016).The pool of student enrolments originated from South Africa, and also regionally and internationally. With the goal of developing the stature of research and innovation, active strategies to support postdoctoral research fellows and emerging researchers also proved constructive. The Faculty was home to 38 postdoctoral fellows during the 2016.

The Faculty has also promoted the culture of innovation and entrepreneurship by providing a stimulating and supportive environment, especially in its two technology stations, for problem-solving research projects. Innovative achievements included those of the Metal Casting Technology Station, which in 2016 secured a number of projects with key stakeholders such as the Department of Science and Technology and the National Foundry Technology Network. Fruitful projects, which were exhibited at the 2016 Manufacturing Indaba, included the successful development of a high end speaker. This project in Applied Engineering, Design and Development has since been exported to countries including Norway, Denmark and Italy.

FEBE houses nine active research centres/institutes, in addition to its two technology stations. Research centres include the Hypervision Research Group, the Centre for Telecommunications (CfT), the Mineral Processing and Technology Research Centre, the Composite Materials Research Group, the Photonics Research Group and the Centre for Sustainable Energy Technology and Research (SeTAR), the Centre of Applied Research and Innovation in the Built Environment (CARINBE), Sustainable Materials and Manufacturing and the Institute for Intelligent Systems (IIS).

In view of the Global Excellence and Stature (GES) catalytic initiatives, the Council funding to the CfT was discontinued and the CfT was incorporated into the IIS. The Centre of Applied Research and Innovation in the Built Environment (CARINBE) was also constituted within

FEBE served as home to **934** master's and doctoral students

The Faculty was home to **38** postdoctoral fellows during 2016

Research centres include:

01 *Hypervision Research Group,*

02 *the Centre for Telecommunications (CfT),*

03 *the Mineral Processing and Technology Research Centre,*

04 *the Composite Materials Research Group,*

05 *the Photonics Research Group and the Centre for Sustainable Energy Technology and Research (SeTAR),*

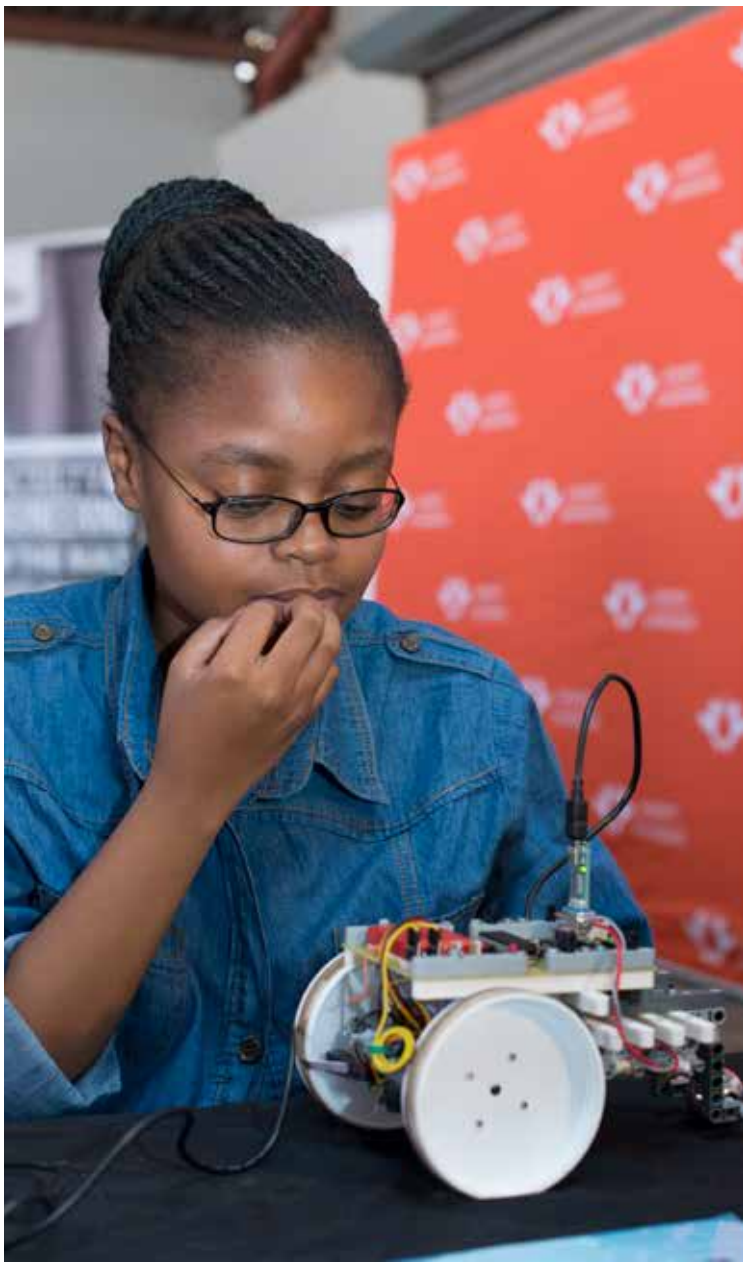
06 *the Centre of Applied Research and Innovation in the Built Environment (CARINBE),*

07 *Sustainable Materials and Manufacturing and the Institute for Intelligent Systems (IIS).*

the School of Civil Engineering and the Built Environment. It is intended that CARINBE become an internationally recognised think tank, established to provide credible information, which is to be supported by robust scientific research, to the built environment.

The Sustainable Materials and Manufacturing Research Centre forms part of a joint academic collaboration agreement between FEBE and Nanjing Tech University, China. The purpose of this Centre is to promote international collaborative research in the area of Sustainable Materials and Manufacturing. Four major research areas have been identified as (1) Advanced Materials and Manufacturing, (2) Materials and Manufacturing for Renewable Energies, (3) Biomedical Materials and Manufacturing, and (4) Nano-Materials and Nano-Manufacturing. In addition, FEBE has commenced the process of establishing the Centre for Nanomechanics and Tribocorrosion.

The memorandum of agreement between FEBE and Dominovas Energy Corporation, "Dominovas Energy", has also served to enhance FEBE's Research and Innovation profile further.



FACULTY OF HEALTH SCIENCES

The Faculty has made strides in upholding excellence in research and innovation with respect to attracting outstanding students, engaging with outstanding academics, including eminent visiting professors, and accessing external funding.

The Laser Research Centre (LRC) more than reached its target for research excellence and innovation. It hosted 16 postgraduate students and five international postdoctoral fellows and contributed 14,89 units to the Faculty's research output. The Water and Health Research Centre (WHRC) had one patent registered in South Africa and another four designs registered for products.

The research target set for the Faculty in 2016 was 70 accredited units. The Faculty submitted 75 units for auditing purposes, with 69 units related to journal articles and the remaining units a combination of books, chapters and conference proceedings. This is an increase of 15,5% compared to the final audited figure of 64,91 units for 2015.

During 2016, two trademark registrations were submitted by the Water and Health Research Centre, which are presently awaiting approval. In addition, the WHRC focused on the development, testing and implementation of cost effective methods to analyse samples for the presence of various bacterial pathogens. Access to fast molecular analysis of these samples via international collaboration has assisted the process, and the Faculty looks forward to further strengthening ties with the Ruhr University (Bochum, Germany) and the University of Rhode Island (USA).

External funding for research was obtained from the NRF, African Laser Centre, WRC, UNICEF, Million-Gauteng Sport, CATHSSETA, Johannesburg Water, ESKOM, University of Venda, Knowledge, Interchange and Collaboration (KIC) and the South African Research Chairs Initiative (SARChI):

- The Laser Research Centre, which was allocated a SARChI Chair, and the Water and Health Research Centre generated R2 300 000 and R1 127 251, respectively, which translates to an increase of R596 210.
- Sport and Movement Studies received funding of R14 700 000 (an increase of R1 850 000).
- Optometry's NRF funding of R180 000, EMC's Erasmus+ funding of R162 000,00 and Human Anatomy and Physiology's Thuthuka funding of R51 000,00 (50% NRF and 50% UJ) resulted in external funding in 2016 of R18 520 251, which was an increase of 15,7% compared to 2015.

The drive internationally is to generate multi-disciplinary research and collaboration with other universities. The Faculty continued to participate in a number of national and international collaborative research projects. These included the ongoing collaboration by the Department of Emergency Medical Care (EMC) with Western Sydney University (WSU) on a study on student burnout and a project on success and harms in pre-hospital Rapid Sequence Intubation (RSI) (meta-analysis) with collaborators at Monash University and at the University of Pittsburgh. Links through a collaborative venture between the University of KwaZulu-Natal (UKZN), the State University New York (SUNY) and the Optometry Department have allowed postgraduate continuing education opportunities with possible research initiatives to be developed. In addition, an agreement with the Glasgow Caledonian University has been consolidated.

The Laser Research Centre (LRC) hosted **16** postgraduate students and five international postdoctoral fellows and contributed **14,89** units to the Faculty's research output.

The Faculty submitted **75** units for auditing purposes, with **69** units related to journal articles and the remaining units a combination of books, chapters and conference proceedings. This is an increase of **15,5%** compared to the final audited figure of **64,91** units for 2015.

In terms of attracting eminent visiting professors, the Department of Sport and Movement Studies re-appointed five visiting professors, and appointed an additional three visiting professors and three research associates. The Departments of Biomedical Technology, Emergency Medical Care, Nursing, the WHRC, LRC and Environmental Health collectively appointed eight visiting professors and three research fellows, all of whom contributed to the Faculty's research output. The eight rated researchers in the A, B, C and Y categories continued to significantly contribute to the Faculty's research output.

The Department of Nursing has identified Caring, a much needed field of research in the nursing profession, and the Department of Human Anatomy and Physiology has identified Physiology as future niche areas. The continued establishment of these new niche or focused research areas has increased research capacity and output.

FACULTY OF HUMANITIES

In the rating scheme of the NRF, Humanities continues to perform strongly. In the established researcher scheme, the Faculty has one A-rated researcher (17% of the University total), nine B-rated (24% of the University total), and 18 C-rated (18% of University total). In the young researcher scheme (awarded within five years of PhD), Humanities has one P-rating (100% of the University total) and three Y-ratings (9% of University total). We thus perform strongly in the top categories, but less strongly in the lower categories; this makes for a strong overall performance. This indicates qualitative strength and impact on both local and international scenes, alongside the strong quantitative performance, but may also suggest that a larger number of researchers with local reach could be encouraged to apply for C- or Y-rating.

The Faculty also gained a third SARChi Chair, held by Professor Leila Patel, and housed in the Centre for Social Development in Africa.

The Faculty has 178 academics on our books, of whom 32 (18%) are rated, a number that could definitely be higher. The Faculty is, however working on this, especially through mentorship initiatives.

The Faculty also gained a *third SARChi Chair*, held by Professor Leila Patel, and housed in the Centre for Social Development in Africa

The Faculty has one A-rated researcher, nine B-rated, and 18 C-rated

Centres

The Faculty established or revived five Centres:

Africa Centre for Evidence

African Centre for Epistemology and Philosophy of Science

Centre for African and European Studies (housing the SARChi Chair in African Diplomacy)

Centre for Social Change (housing the SARChi Chair in Social Change)

Centre for Sociological Research and Practice (renamed and revived from the former Centre for Sociological Research)

These join the following existing Centres:

Centre for Anthropological Research

Centre for Social Development in Africa

Institutes

IPATC

The Institute for Pan-African Thought and Conversation was set up during 2016, becoming fully operational with the arrival of its Director in 2017.

FACULTY OF LAW

The Faculty anticipates at least 60,16 subsidy-generating publication units in respect of articles published by members of the Faculty. It will also seek to submit claims in respect of one co-authored book, 11 chapters in books and seven conference proceedings. Faculty members were involved in editing several books and contributed numerous chapters to non-subsidy-generating books. Members of the Faculty have also been responsible for several other publications, which include articles in non-accredited journals and several book reviews.

Conferences, seminars and workshops

Annually, Faculty members present approximately 100 research papers at conferences, symposia, workshops and the like. The Faculty organises research workshops (indabas) and seminars and undertakes other initiatives such as facilitating the attendance and presentation of papers at national and international law conferences to enhance the publication and research output of staff members. It focuses specifically on the development of the research capacity of junior staff members. At these occasions, staff members present papers on research projects in progress, completed research before its submission for publication and, sometimes, for the benefit of all Faculty members, papers that have already been presented at national or international conferences.

In 2016, the Faculty decided to change the format of its research seminar programme by replacing the fortnightly seminars, at which only one paper per seminar was presented, with research workshops. In August 2016, the first research indaba was held. The Dean's Committee grouped academic colleagues (based on research areas of expertise and/or interest) in pairs of two for the purposes of preparing the paper. In most instances, a junior colleague was paired with a senior colleague. Where the senior colleague had acted only as mentor, the paper was published only by the junior colleague; in other cases, they prepared the paper as co-authors. The participants had almost three months to prepare a draft, which was circulated to all other Faculty members two weeks before the workshop. The authors then incorporated the feedback received at the workshop. Twelve papers were presented at the workshop. By the end of December 2016, four were still in the process of being prepared for publication. Seven had been submitted for publication of which six were still being considered by the journals involved and one would be published in May 2017.

Research structures

The Faculty has four active research centres, namely the Centre for Banking Law (CBL), the Centre for International and Comparative Labour and Social Security Law (CICLASS), the Centre for Private International Law in Emerging Economies, and the South Africa Institute for Advanced Constitutional, Public, Human Rights and International Law (SAIFAC). These research centres produce publications, arrange seminars and submit reports to national and international bodies.

Law Library

In the context of the renovations of the library at the beginning of 2016 a complete overhaul of the Law Library took place. Another positive outcome of the renovations was the erection of the two research offices for master's and doctoral students. These offices have been used extensively.

Nine student assistants were appointed in the Law Library for 2016 and, as in the past, continued to deliver a very important service to staff and students alike. These assistants form an integral part of the service offered by the Law Library when training undergraduate students. Training sessions were conducted for the first-year students in the following modules:

- Legal Skills (Law Library orientation): 38 sessions of one hour each;
- English for Law (research training): 12 sessions of 45 minutes each; and
- Introduction to Legal Studies (moot court research training): 11 sessions of one hour each.

A total of 780 book titles were added to the law collection in 2016, of which 670 were in print and 110 titles in electronic format. A total of 7 391 clients were assisted in the Law Library during 2016. This would not have been possible without a dedicated team of Law Library assistants.

FACULTY OF MANAGEMENT

Since 2012, the Faculty of Management has contributed a total of 1 288 accredited publications, worth 798 subsidised research credits. Accredited research output grew from 112 credits in 2012 to a record high of 209 in 2016 (a rise of 17% year on year). Contributions of books, book chapters, conference proceedings and journal articles grew by about 9% annually.

Emphasising quality research

An internal review of postgraduate programme efficiency in 2014 identified substantial variation among postgraduate programmes. This prompted a closer strategic review of the postgraduate portfolio, focusing on international and national competition, benchmarking and positioning. In response, the Faculty Higher Degrees Committee tightened postgraduate governance in terms of more rigorous selection and supervision practices, as well as further student monitoring and support measures.

Research productivity

In 2016, the People Leadership Hub contributed the largest number of postgraduates (324), accounting for 26% of postgraduate output. The Department of Public Management and Governance was the most productive department, contributing 7 credits per senior lecturer unit (SLU). The predominant group contribution (33% of all output) was from the research network coordinated by Professor Deon de Bruin in the Department of Industrial Psychology and People Management, which yielded an excellent 5 credits per SLU. An outstanding individual contribution of 13 credits per SLU was achieved by Professor Chris Rogerson (School of Tourism and Hospitality). About 28% of our research credits were generated in collaboration with visiting scholars.

Since 2012, the Faculty of Management has contributed a total of **1 288** accredited publications, worth **798** subsidised research credits

Accredited research output grew from **112** credits in 2012 to a record high of **209** in 2016

FACULTY OF SCIENCE

The faculty submitted a subsidy claim to the Department of Higher Education and Training for a total of 360 research units. This number represents an increase of more than one-third over the 2015 output of 270,02 units.

The total number of NRF-rated staff has steadily increased over the past three years, with a 13% rise over 2015.

- The three-year average of 2016 stands at 300,11 and shows an increase of 16% on the three-year average of 2015. This three-year average represents an increase of 201% over the 2009 three-year average and an increase of 59% on the 2012 three-year average. These indicators show that the Faculty of Science finds itself not merely in the midst of linear growth over time, but in a trajectory of accelerated growth.
- A remarkable achievement is that the total research output of subsidised units has increased by 354% from 2007 (79,57 units) and that the per capita output of permanent academic staff rose to 2,2 units in 2016, up from 0,52 in 2007.
- According to data from the Research Office, 97% of the units in 2016 were published in internationally listed journals, an improvement on 92,2% in 2015.
- The rising numbers of publications are also increasingly being cited internationally. The highest Scopus and Google Scholar H-indices associated with the faculty are 49 and 61, respectively.
- The units for 2016, according to the subsidy categories, make up a total output of 360,86 as follows:

Journal articles:	**315,43**
Proceedings:	**31,45**
Books:	**9,83**
Chapters in books:	**4,15**

97% of the units in 2016 were published in internationally listed journals, an improvement on **92,2%** in 2015

The total research output of subsidised units has increased by **354%** from 2007 **(79,57 units)** and that the per capita output of permanent academic staff rose to **2,2 units** in 2016, up from **0,52** in 2007.

Total of **360** research units. This number represents an increase of more than one-third over the 2015 output of **270,02** units.

NOTES

NOTES

NOTES