

NELSON MANDELA

UNIVERSITY

iDEATE

A publication of the Faculty of Engineering,
the Built Environment and Technology

Issue 2, 2022



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Foreword

By Professor Dalenca Pottas
Acting Executive Dean

Ingenuity, innovation and invention are abundant in the Faculty of Engineering, the Built Environment and Technology (EBET), not only in our curriculum, research and development, but also in our students and staff.

In this Faculty, we combine top facilities, state-of-the-art technology and stimulating training to produce highly sought-after graduates. They are equipped to have thriving careers in the fields of Civil, Electrical, Industrial, Mechanical, Marine Engineering, Mechatronics, Information Technology, Applied Informatics, Quality, Operations Management, Building and Human Settlement Development, Quantity Surveying, Construction Management, Architecture, Architectural Technology and Interior Design.

It is therefore an ideal time to highlight the academic team guiding these students, particularly our professors. This publication aims to give readers an overview of our academics, who have reached the prestigious status of professorship, ranging from the associate to distinguished and emeritus professors.

Their skills stretch across a broad spectrum as the Faculty comprises four schools, namely:

- School of Engineering
- School of the Built Environment and Civil Engineering
- School of Information Technology
- School of Architecture.

Apart from the academic departments, various institutes, centres and units are housed in each school to promote research, technology transfer, non-formal teaching, community service and outreach initiatives.

Their role extends beyond teaching to include research, development, scholarly publication, mentorship, professional duties and affiliations.

As a people-centred faculty, we offer internationally recognised academic programmes that develop sought-after graduates. We work in partnership with external organisations through our cutting-edge research and engage our students as partners in generating innovative solutions and services in communities of learning.

Our professors are at the heart of this endeavour. Their role in holistically developing a diverse student body to become confident, innovative and knowledgeable professionals is intrinsic to our vision to lead in professional technological education and innovation.

They are true ambassadors for the Faculty motto, "Innovating Tomorrow".

About Professor Dalenca Pottas

Professor Dalenca Pottas has been Acting Executive Dean of the Faculty of Engineering, the Built Environment and Technology since the departure of the previous Dean, Professor Barend Van Wyk, in 2021. Prior to this, she was Deputy Dean and head of the School of Information Technology (IT) at Nelson Mandela University.

Among other qualifications, Prof Pottas holds a PhD in Computer Science (University of Johannesburg). Before moving into academia, Prof Pottas was an analyst programmer, systems analyst, senior systems analyst, and group architect at the Sasol Group Information Division.

Her primary research interest is in the interdisciplinary field of health informatics with a focus on participatory healthcare and enabling technologies. She serves these interests through the research conducted by postgraduate students.

Professor Darelle Van Greunen

Distinguished Professor Information Technology and Director of the Centre for Community Technologies

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Professor Darelle Van Greunen leads the Centre for Community Technologies (CCT), a research, engagement and innovation group at Nelson Mandela University.

The CCT integrates transdisciplinary research and innovation with community engagement through developing and implementing apps and other smart technologies to advance education, health, and rural and social development, particularly in low-income communities. This is combined with training, networking and policy analysis and advice.

Prof Van Greunen is recognised as one of a handful of international user experience experts for developing countries, and is affectionately known as “the people’s professor” for her work introducing smart technologies to the man in the street.

She was the first joint-appointment as a senior researcher between a South African University and the German multinational software corporation SAP AG in 2006. A Fellow of the Discovery Foundation, she also holds an Honorary Professorship from Amity University in India.

Over the past six years, Prof Van Greunen and her team of change-maker researchers have won various awards and international acknowledgment for their ground-breaking research and application development within Africa. This goes towards realising her vision of “ICT solutions for Africa, by Africans, in Africa”.

Prof Van Greunen has published a number of well cited scientific papers, acts as external reviewer for a number of international journals, and actively assists with the formulation of policy for the South African Government. As such, she is recognised as one of the leading academics in advancing the Fourth Industrial Revolution (4IR) in education.

Qualifications

- PhD Computer Science (University of South Africa, 2010)
- MA Computer Aided Learning (Cum Laude) (University of Port Elizabeth)
- Further Diploma Educational Computing (University of Port Elizabeth)

- Higher Education Diploma (University of Port Elizabeth)

Certifications include:

- Microsoft Certified Professional (Integrated Technologies Institute)
- Novell Network Engineer (Novell Education)
- Advanced Network Administrator.

Awards and Achievements

Honorary recognition awards include:

- Honorary Professor, Amity University, India, in recognition of contribution to ICT in Society
- Lifetime Fellow of Discovery



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- Foundation for Rural Health Innovation
- Extraordinary Professorship at North West University's Optentia Research Unit.

International awards include:

- Commonwealth Digital Health Merit Award 2020
- United Nations Economic Forum – African Innovation Forum Award 2020
- IT Contributor to Society (Institute of IT Professionals South Africa [IITPSA], (2017)
- Ushoka U Award for the EU co-funded project Common Good First (2017).

National awards include:

- IT Contributor to Society (IITPSA, 2017)
- Finalist in the SAB Innovation Competition (Low cost hearing aid) (2016)
- Finalist in the SAB Innovation Competition (Biometric scanner for medical records) (2014)
- Health Innovator in Developing Countries, Bertha Centre for Innovators and Entrepreneurship (2013)
- Best Research Paper Health Informatics Conference Southern Africa (2013)
- Best Research Paper South African

Institute for Computer Scientists and Information Technologists (SAICSIT) (2012)

- NRF Rated Research – C2 since 2014.

Institutional awards include:

- Vice-Chancellor's Excellence in Engagement Award (2021)
- Vice-Chancellor's Research Excellence Award (2020)
- Nelson Mandela University Innovation Excellence Award (2020, 2018, 2017)
- Faculty Senior Researcher of the Year (2018, 2015, 2010)
- Nelson Mandela University Engagement Excellence Award STEM (2017/18)
- National Research Foundation Top Achiever Award (2007)
- Emerging Researcher of the Year (2006).

Professional Activities

Prof Van Greunen is a member of Special Working Group on ICT, Business Process Enabling South Africa (BPESA). Other professional activities include:

- Digital Economy and Grassroots Innovation, South African Department of Science and Innovation
- Board of Testing Standards in Africa
- Health Education Advisory Board – National Department of Health
- e-Strategies Advisory Board – SA Government
- Chair of Living Labs of Southern Africa Board
- International Development Informatics Association Board
- IEEE (Institute of Electrical and Electronics Engineers) Humanitarian Projects Board
- Strategic Advisor to Eastern Cape Department of Education
- Strategic Advisor to Eastern Cape Department of Health
- Provincial and Metro Coronavirus Command Council
- Chair of ICT Governance Committee in Office of the Premier (EC Government)
- Member of the Audit Committee in Office of the Premier (EC Government).

Teaching interests

Although not currently involved in undergraduate teaching, Prof Van



Professor Daniël G Hattingh

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Professor Danie Hattingh leads eNtsa, a research and engagement entity at institute level at Nelson Mandela University. Recognised as a hub of research and innovation, eNtsa provides engineering solutions mainly for the manufacturing, petrochemical, power generation and transport industries.

Prof Hattingh has been an academic in Mechanical Engineering at Nelson Mandela University (previously Port Elizabeth Technikon) since 1989 and was appointed as a full Professor: Mechanical Engineering in 2002. In 2012 he was one of the first five professors to receive a Distinguished Professorship at the-then Nelson Mandela Metropolitan University.

He is a National Research Foundation (NRF) B3-rated researcher with a Scopus h-index of 20 and more than 1250 citations, renowned for his work around solid state welding and efforts to establish this alternative joining technology in South Africa. Over the past 30 years Prof Hattingh and his team of researchers have won various national awards, and international acknowledgment, for ground-breaking research and real-life applications of technologies invented.

The NRF appointed Prof Hattingh as a member of the Specialist Committee for Engineering, responsible nationally for overseeing research rating applications.

Prof Hattingh is a member of the editorial board of the International Journal of Fatigue (Elsevier Science – impact factor of 45.186 and ranked 15/133 in Mechanical Engineering by Clarivate Analytics), as well as an editorial board member of the Research and Development Journal of South Africa hosted by the South African Institution of Mechanical Engineering (SAIMEchE).



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Significant experience acting as a failure analysis consultant has led to Prof Hattingh generating several reports over the last 30 years. This work has ranged over advising on fatigue design, through determining mechanisms and causes of failure in mechanical equipment, plant and structures. He has taken part in various international Residual Stress experiments at FaME38, the Facility for Materials Engineering at the Institute Laue-Langevin (ILL) and the European Synchrotron Radiation Facility (ESRF), in Grenoble, France.

Qualifications

PhD Mechanical and Marine Engineering.
Thesis title: The Fatigue of Spring Steel (University of Plymouth, 1998)
MTech Mechanical Engineering.
Dissertation title: Axial Flow Fan Selection

Program (Port Elizabeth Technikon, 1992)
National Higher Diploma Mechanical Engineering (Port Elizabeth Technikon, 1987)

National Diploma Mechanical Engineering (Port Elizabeth Technikon, 1985).

Awards and Achievements

2020 Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SA Academy for Science and Art) awarded Prof Hattingh the Honorary Medal of the Faculty of Natural Science and Technology

2019 Finalist – National Sciences and Technology Forum (NSTF) Engineering Research Capacity Development Awards
2016 Researcher of the year award: School of Engineering Nelson Mandela University

Distinguished Professor from 2012 to 2017 and 2018 to 2022
 2012 Awarded the Southern African Institute of Welding's Gold Medal in recognition of vision and leadership in developing a friction stir welding technology unit at the Nelson Mandela Metropolitan University
 2011 Led the WeldCore® research team which won the NSTF prize in the category: Research for Innovation by an individual or a team through an organisation or institution
 2010 WeldCore® research team won the National Innovation Fund Competition
 2008 Finalist for NSTF award for outstanding contribution to Science, Engineering, Technology and Innovation.

Professional Activities

- Member of Council of SAIMechE since 2019
- Member of SAIMechE since 1992
- Registered Professional Technologist with the Engineering Council of South Africa since 1995
- 2019 to 2022: NRF appointment as national reviewer, as member of specialist committee for engineering
- 2007 to 2015: Review panel member for Materials Research Group at the CSIR
- 2001 to 2003, 2005 to 2010, and 2020: Chairman: SAIMechE Eastern Cape Branch Member of the review panel for all *Technology and Human Resource for Industry Programme (THRIP)* applications in the field of Materials Sciences. THRIP Materials Review Panel Member from 2004 to 2009
- Elected to serve as an advisory member for the National Standards Generating body for Manufacturing in South Africa: NSB 06 SAQA/NQF from 2001 to 2004
- Member of the Advisory Panel for Economic Growth and International Competitiveness Focus Area of the Materials Sub-Focus Area in 2003.

Teaching Interests

Prof Hattingh is active in curriculum development and teaching undergraduate classes. His aim is to provide clearly structured stepping-stones of real-life engineering experience so students can assimilate an effective, but holistic, engineering outlook.

"I always attempt to incorporate advanced skills in problem definition, analysis, synthesis, and communication. Lately, some emphasis is placed on the human context in the form of social demands, ethical considerations, sustainability, and personal responsibility.

"I strongly believe in a circular linkage between teaching, research, and industrial engagement."

He started and led teaching and learning research initiatives at the University, funded by the Royal Academy of Engineering (UK) and Department of

Higher Education and Training (DHET) over the past four years.

From 2017-2019 a project between Nelson Mandela University, Walter Sisulu University, and the University of Plymouth was completed, looking at a "Collaborative network to enhance engineering pedagogy using phenomena-based learning and research-led teaching and mentoring". This offered engineering academics a powerful opportunity to engage with pedagogic techniques that may increase diversity in the classroom.



Teaching goals include to:

- Learn from direct interaction with UK National Teaching Fellows and Principal Fellows of the UK Higher Education Academy
- Benefit from research mentoring aimed at transferring research project leadership skills
- Develop enhanced paper writing skills via interactive seminars involving experienced Editors of International Journals
- Gain confidence from peer learning via an on-line platform providing web-based learning resources and mediated discussion of teaching and learning techniques and interventions.

Research Interests

Prof Hattingh's research interests are vested in Solid State Welding as a joining and repair technique and Small Sample Testing (both Static and Creep) as a methodology for assessing the remaining life of high value engineering structures.

His current research interest is a follow-on of completed work that was dominated by researching solid-state welding techniques. This was followed by developing a suitable sample extraction and repair technique now applied under the banner of WeldCore® which includes core sampling and a Friction Taper Hydro Pillar Process repair. Currently, research is focused on developing Small punch testing techniques for creating and understating within Static and Creep regimes of aged material extracted from operating plants.

Prof Hattingh is also active in the field of design for structural integrity, covering the fields of fatigue and fracture, residual stresses, fatigue life prediction and failure analysis.

"My research interest stems mainly from a focus on generating new knowledge that will assist industry with structural integrity, advancing reliability and safety, developing alternative, innovative ways to address pertinent engineering challenges.

"The secondary focus is to use this platform for establishing real-world research

opportunities for postgraduate students, from where they can grow as technological experts in a well-defined field."

The work at eNtsa is benchmarked through journal publications, primarily in mainstream and highly reputed international journals with high impact in the engineering materials field. The standing of publications by the research group and collaborators he is involved in, is high, with Scopus indicating that

top papers are cited 70-80 times (see personal ratings above).

Prof Hattingh has authored or co-authored numerous research publications in refereed international journals and conference proceedings. He also has presented invited plenary or keynote lectures at international conferences. His scientific papers are well cited and he also acts as external reviewer for a number of international journals.

My research interest stems mainly from a focus on generating new knowledge that will assist industry ... "

Professor Rossouw von Solms

Emeritus Professor

Centre for Research in Information and Cyber Security (CRICS)

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Professor Rossouw von Solms is an Emeritus Professor and, at the time of retirement, a Distinguished Professor at Nelson Mandela University. Prior to retirement, he was the Director of the Centre for Research in Information and Cyber Security (CRICS) at the University and before this he headed the Department of Information Technology for more than 17 years.

Prof Von Solms has been involved with the International Federation for Information Processing (IFIP) Technical Committee (TC) 11 since 1993. He was the chairman of IFIP Working Group 11.1, dealing with Information Security Management, from 1996 to 2001. Furthermore, he served as the vice-chair of IFIP TC 11 from 2007 to 2013.

He is a past-president of the South African Institute of Computer Science and Information Technology (SAICSIT) and has been a board member for a number of years.

Qualifications

- PhD (Rand Afrikaans University)
- MSc (Rand Afrikaans University)
- BSc Honours (University of South Africa)
- BSc (University of Port Elizabeth)
- HDE (University of Port Elizabeth)

Prof Von Solms also holds a Certified Information Security Manager (CISM) certification.

Awards and Achievements

In 2001 Prof Von Solms received an IFIP Silver Core Award from IFIP for outstanding services over a long period.

In 2003 he was named the ICT Person of the Year by the Computer Society of South Africa, Eastern Cape Chapter.

Prof Von Solms has been a rated researcher by the National Research Foundation (NRF) since 1995 and is currently in his third cycle as a B-rated researcher.

He received the Ernest Oppenheimer Memorial Trust research award for senior PE Technikon staff in 1995. Four years later in 1999 he received a Literati Award for Excellence from MCB University Press for a series of articles published in the journal Information Management and Computer Security on information security management.

He has also received the following awards and accolades:

- SAICSIT Pioneer Award for contribution to discipline of Information Security in 2013
- Honoured as a Fellow of the Institute for Information Technology Professionals South Africa (IITPSA) in November 2016
- Nelson Mandela University Lifetime Research Excellence Award in 2017
- IITPSA – Distinguished Service in ICT Award 2019.

Research Interests

Prof Von Solms has been researching information, cybersecurity and IT governance for more than 30 years. His research has mostly focused on the human and management aspects of information and cybersecurity.

Cybersecurity has become a matter of global interest and importance. Several nations have recently published documents outlining their official stance regarding cyberspace, cybercrime, and cybersecurity. The White House has outlined a cyber-strategy which not only provides the stance of the US on cyber-related issues but which also provides a unified approach towards its engagement with other countries on these issues. The UK also lists cybersecurity as a top priority and has committed significant funding (£650-million over four years in 2000) for a transformative National Cyber Security Programme.

Information and cybersecurity have become critical to any government, enterprise and individual today. From a governmental point of view, all national services and infrastructures such as provision of electrical power, water,



transport, health care and so on, depend on critical information and cyber services and infrastructure. This also applies to any enterprise which gathers, stores, processes and transmits valuable and sometimes confidential and private information.

From a personal perspective, notes Prof Von Solms, all of us hold and use critical information such as user-IDs and passwords, bank and credit card numbers and access codes. All these information sources and cyber infrastructures need to be protected, usually by a combination of technical, operational and administrative safeguards.

Information and cybersecurity is a discipline that continues to protect all of these valuable resources and assets, through developments in information and cyber technologies.

Prof Von Solms has successfully supervised 67 students to master's (50) and doctoral (18) degrees.

He has edited or co-edited nine conference proceedings, has edited or co-edited 10 technical reports and serves, or has served, on the editorial board and review panel of several conferences and journals, including Computers and Security, and Information and Computer Security.

He has published and presented more than 230 peer-reviewed research papers. By the end of 2021 his academic work had attracted more than 9800 citations. Most of these papers were published and presented in the field of Information and Cyber Security as well as IT Governance.



... all of us hold and use critical information such as user-IDs and passwords, bank and credit card numbers and access codes. All these information sources and cyber infrastructures need to be protected ... "

Professor Fanie Buys

Professor

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Professor Fanie Buys is an Emeritus Professor within the Department of Quantity Surveying. He has extensive professional experience, both prior to and following his appointment to the academic staff in the Department of Quantity Surveying at the University of Port Elizabeth (now Nelson Mandela University) in 1985. He was appointed as Professor and Head of Department Building and Quantity Surveying in 2007.

Prof Buys has acted as external examiner at the University of Natal, University of the Witwatersrand, the former Port Elizabeth Technikon, the University of Pretoria and the University of Cape Town.

He has authored and co-authored several technical and professional reports, articles and papers published and read at national and international conferences allied to the construction industry.

Apart from lecturing and research, Prof Buys is well known in South Africa among quantity surveying and construction management students and practitioners for his support of the profession through guidelines published in several books. Significant examples of these include: Measuring Building Work – Worked Examples, Quantity Surveying, Pre-contract Administration and Quantity Surveying, Post-contract Administration.

Qualifications

- PhD Construction Economics, thesis title: *Maintenance Management Systems in South African Tertiary Institutions*
- MSc Quantity Surveying
- BSc Quantity Surveying, BSc Building

Professional Activities

Prof Buys is a registered professional Quantity Surveyor (South African Council for the Quantity Surveying Profession), professional member of the Association of South African Quantity Surveyors and member of the Royal Institution of Chartered Surveyors.

He has served as an alternate member of the Education Advisory Committee, and of the Education, Standards and Research Committee of the SACQSP. He also consulted to QS Edutech Centre (Technical/Professional Advice Centre), and was a member of the Advisory Committee at the then Port Elizabeth Technikon Department of Building.

At one stage, Prof Buys was registered with the South African Council for the Architectural Profession as a Professional Architectural Draughtsperson.

Teaching Interests

With a background of professional experience, Prof Buys is equipped to present a wide range of courses to undergraduate and postgraduate students at all levels. This applies to quantity surveying and construction management courses including Quantities (Measurement), Quantity Surveying (Professional Practice), Building Drawings, Information Technology and Research Methodology.

In most of these courses, his lecture material includes a large library of building construction images to ensure that students get a clear image of “real life” construction.

Research Interests

Prof Buys’s research interests include Maintenance Management and Quantification, and he has supervised several honours, master’s and doctoral students.

He has an extensive list of presentations and publications in his field, both in South Africa and internationally.



Prof Khaled Abou-El-Hossein

Professor

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Prof Abou-El-Hossein obtained his MSc Engineering and PhD from Ukraine in the areas of machine building technology and advanced manufacturing. During his academic career, he has occupied a number of administrative positions and formerly was head of the Department of Mechanical Engineering at Curtin University Malaysia. He has also been the Head of Mechatronics Engineering and Director of the School of Engineering at Nelson Mandela University.

Prof Abou-El-Hossein is a National Research Foundation of South Africa (NRF SA) C-rated researcher.

He has published extensively in the areas of machining technologies and manufacturing optical elements using ultra-high precision diamond turning technology. He is responsible for the Precision Engineering Laboratory (PE Lab), the only one of its kind on the continent aimed at making optical components for aerospace applications.

Qualifications

- PhD Manufacturing Engineering (National Technical University of Ukraine)
- Master's Manufacturing Engineering (National Technical University of Ukraine)
- Certificate in Tertiary Teaching (Curtin University, Australia)

Awards and Achievements

- Teaching award (Students' Choice), Curtin University (2007 and 2008)
- School of Engineering Researcher of the Year, Nelson Mandela Metropolitan

University (2011) and 2018 Research Excellence Award, Nelson Mandela Metropolitan University (2014)

- Professional Activities Professional Engineer, Engineering Council of South Africa (ECSA)
- Member of the SA Technology Programmes Accreditation Committee (TPAC) of ECSA since 2014
- Chair of School of Engineering Research, Technology and Innovation Committee
- Member of Steering, Management Committees and Advisory Board of Centre for High Resolution Transmission Electron Microscopy
- Member of Capital Resources Allocation Committee
- Member of European Society of

Precision Engineering.

Teaching Interests

Prof Abou-El-Hossein starts and finishes his lectures with open-ended questions.

"In addition to sharing technical experiences in the class, I discovered that creating a teaching and learning environment where the students have more questions spinning in their minds than answers is absolutely effective.

"When I start a new topic, for example, I always try to show the student pictures and short videos of the applications of the knowledge that they are about to be exposed to. I find that this makes

// ... creating a teaching and learning environment where the students have more questions spinning in their minds than answers is absolutely effective."

the students feel the importance of the subject and gets them thinking deeply. I judge this by the kind of questions pouring in by the end of the lecture."

Besides the subject matter, Prof Abou-El-Hossein strives to help students appreciate the career importance of "softer" skills such as presentation, management and negotiation.

"I always highlight the extreme importance of integrity and frankness in professional engineering. I strongly believe that students, especially those working closely with me for their final-year projects, are a reflection of me and the University. Therefore, I try my best to help them strengthen their positive values and views about the University in particular and professional society in general."

Research Interests

Prof Abou-El-Hossein is rated by the National Research Foundation of South Africa. He has established an optics manufacturing laboratory that is the only one of its kind on the African continent.

His research interests include:

- Machining and general cutting of engineering materials
- High precision manufacturing of optics
- Precision hybrid machining technologies
- Artificial intelligence in manufacturing
- Materials processing robotics
- Materials characterisation.

Prof Abou-El-Hossein has published extensively in manufacturing and materials engineering journals and publications, with around 150 scientific articles in different research forums and publications.

// I always highlight the extreme importance of integrity and frankness in professional engineering."



Professor Brink Botha

Professor

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Professor Brink Botha is the immediate past head of the Construction Management Department and the immediate past co-director of the MSc Built Environment programme jointly hosted by two departments. He conducts, publishes and promotes built environment and real estate related research and is active in innovation, teaching and learning, and engagement.

He is also active in industry as a professionally registered construction projects manager with the South African Council for the Construction and Project Management Professions. He acts as project manager to put into practice research, innovation, teaching and learning, and engagement initiatives related to the built environment.

Prof Botha owns various entrepreneurial ventures, primarily positioned in the areas of the built environment and real estate. He shares a passion for property development, a niche discipline in which he is active both as an academic and industry practitioner, and also as an entrepreneur and professional consultant. He has been involved in academia, the built environment and related disciplines since 1995.

Qualifications

- PhD Thesis title: "Property Development: A Business Process Model"
- MSc Built Environment, specialising in property economics and valuation
- BTech Construction Management (Cum Laude)
- BTech Quantity Surveying (Cum Laude)
- NDip Building (Cum Laude)

Awards and Achievements

Among other achievements, in 2019 Prof Botha was appointed to serve on the Alfred Nzo District Municipal (ANDM) Planning Tribunal (DMPT) for a three-year period.

He also published a book in his discipline, *A Guide to Business Success in Sustainable Property Development*, in 2017.

Over his career, Prof Brink has been the recipient of more than 70 special awards, within the University and externally.

In 2011 and 2012, Prof Brink was named Nelson Mandela Metropolitan University (NMMU) Emerging Researcher of the Year in the Faculty of Engineering, the Built Environment, and Information Technology (EBEIT), and in 2011 in the Emerging Researcher of the Year: School of the Built Environment (SBE).



// Prof Botha has published more than 90 internationally peer reviewed papers, including chapters in books and full book titles ... //

Externally, among other accolades, he has won the National Home Builders Registration Council (NHBRC) Provincial industry award, and the NHBRC's National industry award.

Professional Activities

Prof Botha is registered with the South African Council for the Project and Construction Management Professions as Construction Project Manager.

He is also a member of:

- The Association of Construction Project Managers

- The Ergonomic Society of South Africa.

Teaching Interests

Prof Botha is passionate about advanced teaching and learning methodology, mentoring and life coaching as well as community renaissance. He has taught a wide range of courses to students and his interest in education extends beyond Nelson Mandela University.

He is involved with various community programmes which include addressing school learners on leadership, and motivating learners towards tertiary education. Within the University, he

introduced a vacation work and industry liaison programme in the Department of Construction Management to create opportunities for students to gain practical experience in the workplace.

"This highly successful initiative fulfils the objective and assists the students, industry and community to develop a more in-depth appreciation and understanding of the parallel between industry and academia."

Professor Botha mentors various junior staff members at Nelson Mandela University as well as at other institutions. He also mentors young graduates on their route to professional registration.

A musician and artist, Prof Botha also hosts a weekly radio programme on community radio station LFM90.6, with a focus on informing, educating, and entertaining the community.

Research Interests

Prof Botha has wide-ranging research interests in the fields of property development, real estate, the built environment, project management and related areas.

His current research focus is to develop an international Property Development Body of Knowledge (PDBoK) and publish a best-practice guidebook. This involves engagement or affiliation with international institutions over a spectrum of academic and engagement activities, including extensive research.

He also is passionate about building critical mass in property development research to move towards a National Research Foundation rating in his current field, where he works with a cohort of more than 30 postgraduate students.

On achieving this, a secondary milestone will be to contribute towards professionalising the discipline of property development.

Prof Botha has published more than 90 internationally peer reviewed papers, including chapters in books and full book titles, in addition to journal articles and conference proceedings.

Professor Reinhardt A. Botha

Professor of Information Technology

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Professor Reinhardt A Botha is a Professor in the School of Information Technology, and Director of the Centre for Research in Information and Cyber Security (CRICS).

He is a certified ITIL Expert as well as a certified IBM Application Security Specialist.

Currently he teaches database design and development to second year students. In addition, he supervises a number of research-focused master's and doctoral candidates within the field of information and cyber security.

He serves on the editorial board of Computers and Security, as well as Information and Computer Security.

Qualifications

- PhD Computer Science (Rand Afrikaans University)
- MSc Computer Science (Rand Afrikaans University)
- BSc Honours (University of Port Elizabeth)
- Postgraduate Certificate in Higher Education (Nelson Mandela Metropolitan University)

Awards and Achievements

In 2020 Prof Botha received the Nelson Mandela University Distinguished Teacher Award.

Prof Botha has held various NRF ratings, with Y from 2003 to 2008, and a C-rating between 2009 and 2014, and again from 2015 to 2020.

He also was recognised with a Research Merit Award in 2002 from the Port Elizabeth Technikon, and with a New Researcher of the Year Award in 2001 from the same institution.

He won the Sanlam subject prize for academic achievement in Computer Science at the University of Port Elizabeth in 1988, and the Alumni Merit Award for academic achievement in Computer Science, also at the University of Port Elizabeth, in 1987.

Professional Activities

Prof Botha is a member of the Institute of IT Professionals South Africa (IITPSA), the Association for Computing Machinery (ACM), the Institute of Electrical and Electronics Engineers (IEEE) Computer Society and ISACA.

Teaching Interests

His teaching includes a variety of subjects mostly aimed at senior students. This has ranged across several areas, and includes:

- Management Information Systems 2 (1996 to 1998)
- Research Methodology 4 (2003 to 2005)
- Project 4 (2003)
- Information Systems 3: Database Systems Module (1996 to 2002)
- User Interfaces 4 (1999 to 2002)
- Database Systems 4 (1999 to 2001)
- Knowledge Management 4 (2002, 2003; 2006 to 2008)
- Information Technology Management 1 (1996 to 1998)
- e-Commerce 1: m-Business Module (2005 to 2007)
- Installation Management III (2010, 2011)
- Information and Technology Management 4 (2008-2020)
- IT Professional Practice 1 (2019, 2020)
- Database Design and Implementation 2 (2022 onwards)

Research Interests

The bulk of Prof Botha's research focuses on Information Security and Privacy. He has research relationships with Prof Steve Furnell of the University of Nottingham, England, as well as with Prof Dr Kai Rannenberg, Chair of Mobile Business

// The bulk of Prof Botha's research focuses on Information Security and Privacy."

and Multilateral Security at the Goethe University in Frankfurt, Germany.

He has supervised six doctoral students and 32 master's students, and his current postgraduate students comprise five doctoral and five master's candidates.

Prof Botha has also published widely, with 26 journal papers and 75 conference papers published to date. Journals include publications such as the IBM Systems Journal, Computers and Security, Government Information Quarterly, Information Systems Management, Information Management and Computer Security, and the South African Computer Journal. He has also presented at several industry forums and workshops.



Prof Botha has also published widely, with 26 journal papers and 75 conference papers published to date."



Professor Gerrit Crafford

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0104g

Gerrit Crafford is a Professor in Construction Economics at Nelson Mandela University. He also chairs the Engineering, Built Environment and Technology (EBET) Faculty Postgraduate Studies Committee.

He is a results-driven, independent, determined, and resourceful academic who enjoys analysing problems and responding to crisis situations. He has an established domestic research track record and enjoys some international recognition for the quality and impact of his research outputs. With research interests in higher education teaching and learning and business strategy, he envisions himself driving strategic innovation in an international institution or organisation in his ideal future.

He has completed supervision on four PhD (Construction Economics) theses, 13 MSc dissertations and treatises in Construction Economics and in the Built Environment, and 111 BSc (Quantity Surveying) treatises, with 19 Distinction students.

Qualifications

- PhD Construction Economics (Nelson Mandela Metropolitan University, 2007)
- MPhil (Higher Education) (University of Stellenbosch, currently registered)
- Master of Business Management and Administration (Cum Laude) (University of Stellenbosch, 2016)
- MSc Quantity Surveying Cum Laude (University of Port Elizabeth, 2002)
- BSc Quantity Surveying (University of Port Elizabeth, 2001).

// **He is a results-driven, independent, determined, and resourceful academic who enjoys analysing problems and responding to crisis situations."**

Awards and Achievements

Prof Crafford was named Emerging Researcher of the Year, and Emerging Teacher of the Year, for the School of Built Environment in 2010 at Nelson Mandela University. He has, with co-authors, received various sought-after awards for papers presented at conferences over the years 2013, 2015, 2016, 2018 and 2019.

Recent accolades have included the best overall contribution to the quantity surveying profession award, for an analysis conducted with Dent, S, titled: "Predicting quantity surveying students' throughput rate: A cohort analysis" at the 11th Annual Quantity Surveying Research Conference in Johannesburg in 2019.

With co-authors Monyane, G and Emuze, F, he won an Excellent Paper Award at the 10th International Conference on Engineering, Project and Production Management in 2019 in Berlin, Germany.

The title of this paper is: "Evaluating a collaborative cost management framework with lean construction experts".

In 2021, Prof Crafford won Best Overall Presentation Award at the 12th Annual Quantity Surveying Research Conference. The paper title at the Virtual Conference was: "The causes and effects of skilled artisan shortages in South African construction firms".

Professional Activities

Prof Crafford is a member of numerous committees within Nelson Mandela University and externally:

- Member of the South African Council for the Quantity Surveying Profession (co-opted member) – Education, Research and Standard (ESR) Committee
- Member of the Nelson Mandela University Postgraduate Studies Committee
- Member of the Nelson Mandela

University Research and Engagement Committee (Secundus)

- Member of Nelson Mandela University Senate.

Prof Crafford is a past member of the University of Stellenbosch Council (elected by the Convocation) (2016-2018), and of the Nelson Mandela University REC-H (Ethics) Committee (2015-2018).

On a Faculty level, he is a member of the EBET Faculty REC-H (Ethics) Committee, and chaired this committee between 2015 and 2018.

Within the School of the Built Environment and Civil Engineering (BE & CE), Prof Crafford is a member of the BE & CE School Postgraduate Studies Committee and its Research and Engagement Committee.

Within the Department of Quantity Surveying, he is a member of the Departmental EB17 Finance Committee, and of the Quantity Surveying Departmental Advisory Board.

Externally, Prof Crafford's membership of associations and institutions includes:

- Associate Member of the Royal Institution of Chartered Surveyors – AssocRICS
- Incorporated Member of the Chartered Institute of Building – ICIOB
- Member of the Association of South African Quantity Surveyors – MAQS
- Member of the Institute of Directors Southern Africa
- Member of the Research Ethics Committee Association of Southern Africa.

Teaching Interests

Prof Crafford subscribes to Kolb's experiential learning theory (ELT) which is rooted in constructivism.

"Constructivism is a learning theory that is often subscribed to in the Quantity Surveying Department at Nelson Mandela University, since we rely heavily on the experiences that students have had on construction sites to teach them how to measure a building and control the costs of a construction project."

Prof Crafford advocates student-focused teaching where existing conceptions are the starting point of an interactive process, and students are assisted by the teacher's activities to construct their own knowledge. He takes a developmental approach to learning and teaching.

"Teachers, like myself, who have a student-centred belief may at times employ an approach not entirely aligned with their beliefs. Consistent reflection on teaching approaches is essential to stay consistent with beliefs. My teaching practices are characterised by concepts of criticality, student empowerment, emancipation, authenticity and self-discovery."

Research Interests

Prof Crafford's research topics of interest are those on which he focused in his postgraduate qualifications, namely:

- Factors that Influence Quantity Surveying Honours Students' Academic Engagement: An Interactive Qualitative Analysis
- A Strategic Architecture for Visual Art Start-Ups
- Clients' Views on Design Team Competencies
- The Design Team's Views on Quantity Surveying Competencies.

"During the initial years of my academic career, my research focused on the competency-based assessment of built environment

professionals. However, my research interest shifted towards business strategy and administration in the construction industry theme after completing my MBA.

"Subsequently, while enrolled for my MPhil (Higher Education) qualification, I developed an interest in learning and teaching research and started investigating student engagement. I, therefore, have a discipline-specific (business strategy in the built environment) and learning and teaching-specific (student engagement) research focus area."

Prof Crafford has an extensive list of publications which includes peer-reviewed journal articles, and published conference proceedings, several of which have received awards.



Professor Mariana Gerber

Professor

Department of IT Management and Governance

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Professor Mariana Gerber lectures in the School of Information Technology (IT) at under- and postgraduate level, where her primary areas of research include Information Security Management, Information Security Risk Analysis and Management and Corporate Governance of IT. Prof Gerber is a founder and senior member of Nelson Mandela University's Centre for Research in Information and Cyber Security (CRICS). She also has a keen interest in IT Research Project Management, Research Methodologies, Information Security-related Standards and Legislation. Her skills include teaching and learning, research and engagement.

Prof Gerber promotes professional collaboration and is an engaged member of the international professional body, Information Systems Audit and Control Association (ISACA). She is a Certified Information Security Manager (CISM) registered with ISACA, following successful examination and annual continued evidence of active participation in the profession. She further serves as an ambassador for ISACA by promoting the profession by facilitating talks to IT professionals in the Eastern Cape province.

Qualifications

- PhD Information Technology (Nelson Mandela Metropolitan University, 2010)
- MTech Information Technology (Port Elizabeth Technikon, 2002)
- BTech Information Technology (Cum Laude) (Port Elizabeth Technikon, 1998)
- NHDip Information Technology (Cum Laude) (Port Elizabeth Technikon, 1995)
- NDip Information Technology (Cum Laude) (Port Elizabeth Technikon, 1994)

Prof Gerber is a founder and senior member of Nelson Mandela University's Centre for Research in Information and Cyber Security (CRICS)."

- Internationally Certified Information Security Manager (CISM) by Information Systems Audit and Control Association (ISACA) since 2011
- Certified CISCO: CCNA3 Computer Network Instructor (CATC), CISCO, 2006
- Certified CISCO: CCNA1 Computer Network Instructor (CATC), CISCO, 2005
- Certified CISCO: CCNA2 Computer Network Instructor (CATC), CISCO, 2005

Awards and Achievements

Prof Gerber had the top-rated journal article in the Science Direct database on the international Top 25 list of journal articles in the field of Computer Science in 2005. This was from more than 2000 titles in the Science Direct database, or from any of 24 subject areas, for five consecutive terms or quarters.

Awards within the then Nelson Mandela Metropolitan University include:

- School of ICT Emerging Researcher of the Year Award, 2009
- Faculty Emerging Researcher of the Year Award - Faculty of Engineering, the Built Environment and Information

Technology (EBEIT), 2009

- School of ICT Excellent Teacher of the Year, 2013
- EBEIT Faculty Excellent Teacher of the Year Award, 2013
- Nelson Mandela University Excellent Teacher of the Year Award (Commendation Certificate), 2013.

Prof Gerber's co-supervised MIT student Pieter Delpont won the S2A3 Masters Medal (Bronze Medal), awarded by the Southern Africa Association for the Advancement of Science, October 2017.

She received the ISACA Contribution Award, the highest accolade awarded by the association for individuals' contributions to the profession, in 2019.

Professional Activities

Prof Gerber is a member of committees within Nelson Mandela University and externally.

Internally they include:

- Member of Senate
- Member of Research Ethics Committee-Human (NMU-RECH) from 2006 to 2014

- Member of EBET Faculty Postgraduate Studies Committee (FPGSC) since 2012
- Member of the EBET Faculty Research and Engagement Committee (FREC) since 2012
- Chairman of EBET Faculty Technology Research Ethics Committee-Human (F-RECH) from 2006 to 2014
- Chairman of the School of IT Postgraduate Studies Committee (SPGSC) since 2012
- Chairman of the School of IT Research and Engagement Committee (SREC) since 2012
- Chairman of School of IT Research Ethics Committee-Human (S-RECH) from 2006 to 2014.

External professional memberships and activities include:

- ISACA member since 2009
- ISACA internationally Certified Information Security Manager since 2011
- ISACA South Africa, Eastern Cape Chapter Ambassador, responsible for organising and hosting information security management and governance profession events
- Reviewer of international and national journal articles and conference articles since 2004
- External examiner of modules and research theses for other universities.

Teaching Interests

Prof Gerber supports a learner-centred approach and believes that teaching and knowledge transfer go beyond sharing of curriculum content. By enhancing the learning experience with opportunities for collaborative learning, problem-solving, critical thinking and reasoning while contextualising with real-life analogies, she strives to foster a long-term and deeper sense of learning.

"It is what we invest in others today that contributes to a greater tomorrow for all."

Prof Gerber's teaching interests lie primarily within the areas of Information Security Management and Governance, IT Research Methodology and IT Research Project Management.

She lectures a number of modules on IT Management and Governance over

multiple qualifications, at undergraduate and postgraduate level, including Bachelor of IT, Advanced Diploma in IT and Master of Philosophy in IT Governance. She also lectures and co-ordinates the research treatise module for the MPhil in IT Governance qualification.

Previously, she has lectured IT Research Methodology and co-ordinated the capstone project for the Bachelor of Technology in Information Technology.

Research Interests

Prof Gerber is committed to continuously improving her research profile in Information Security Management and Governance through supervising master's and doctoral students and publishing nationally and internationally in journals and conference proceedings.

Her research focuses on Information Security Management and Governance. It includes the areas of Information Security Requirements, Information Risk Analysis and Management, Legal and Regulatory aspects of Information Security Management and Governance, Corporate Governance of IT and Cybersecurity. Research contexts include organisations, SMMEs, schools, academic institutions, government, financial, banking and health environments.

With a multitude of information-related incidents and breaches occurring daily in organisations, it is of utmost importance to protect information and IT infrastructure to prevent disclosure, loss and modification of information. This is not only an IT function or duty as it has become important that boards of directors and

executive management realise they are accountable for corporate governance and exercise appropriate oversight.

Oversight can be achieved by ensuring the objectives of the IT function are aligned with the strategic objectives, and that directives and policies are complied with within an organisation.

Prof Gerber has an extensive listing of peer-reviewed national and international journal and conference publications and has contributed to a book chapter. She supervises master's and doctoral students, with a number of postgraduate students who have graduated under her supervision.



Professor Igor Gorlach

Professor, Isuzu Chair of Mechatronics

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Professor Igor Gorlach has led the Isuzu Chair of Mechatronics, an engagement entity at Nelson Mandela University, since it was established in 2009. The Chair has made a significant contribution to establishing the Mechatronics Bachelor degree, which has become a platform for collaboration between the University and industry. It provides opportunities for students of different academic levels to solve real industrial problems, and also contributes to developing human capital in the critical area of engineering and automation.

Prof Gorlach has established research collaborations and student-exchange programmes with international universities, including Aachen University in Germany and the University of Florida in the US. A number of South African students have been able to study and conduct research at these universities.

In South Africa, he has established a research collaboration in the field of power generation with the University of Cape Town, supported by Eskom. A number of master's projects have been successfully completed through this collaboration, providing tangible benefits to Eskom.

The Isuzu Chair in Mechatronics was initially sponsored by General Motors and later by Isuzu, with guiding priorities to:

- Identify mutually beneficial projects
- Engage with the company engineering departments and University staff to support joint activities
- Facilitate research, training and education, and knowledge transfer
- Provide guidance and support for students in their interactions with the company.

Qualifications

- PhD Mechanical and Materials Engineering, North West University, 2004
- MSc Industrial Engineering, University of the Witwatersrand, 1998
- BSc Mechanical Engineering, National Higher Diploma in Education.

Awards and Achievements

- Master's student Tim Light was awarded the SA2 medal for his academic achievements.

Professional Activities

Professional Engineer, registered with the Engineering Council of South Africa (ECSA) since 2000. Member of the South African Institute of Industrial Engineers (SAIIE) since 1998.

Teaching Interests

Prof Gorlach takes a scholarly approach to teaching determined by his interaction with industry through the Chair activities. For Isuzu, it is important that the Chair activities should contribute to the company's competitiveness. On the other hand, for the University it is important that students from various engineering streams obtain exposure to a highly advanced automotive industry and new technologies.

Regular interaction of University staff and students with the company staff is key and provides a successful long-term partnership with mutual benefits. He sees this university-industry collaboration as preparing young engineers better for their careers, and also increasing the number of graduates.

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activities."**

"The Chair also provides academic support for junior students to adapt to the university environment and mitigate any lack of knowledge in mathematics and science, typically due to poor schooling in the rural areas of South Africa. This has been identified as a major factor contributing to the high failure rate in engineering programmes.

"The Chair has implemented a tutoring programme where senior students help junior students to cope with foundation courses and acquire the learning skills to master advanced engineering courses. As a result of this initiative, the number of graduates in engineering has been constantly improving."

Research Interests

Over the years, Prof Gorlach, together with his students and colleagues, has published numerous well-cited scientific papers. He also acts as external reviewer for a number of international journals.

Robotic research involves international partner universities, such as Aachen University and Reutlingen University, both in Germany, and the University of Florida.

Automation research focuses on improvements and optimisation of the control system of power generation plants at Eskom, in collaboration with the University of Cape Town as part of the Eskom Power Plant Engineering Institute.

Some power plant controllers show large fluctuations in certain set points, including for some critical parameters, resulting in reduced efficiency, losses, and causes of plant trips. This could be attributed to the aging fleet and different control systems tuning and optimisation methods. Therefore, a study is required to establish the causes and develop a tool to optimise the performance of controllers of power plants.

// The Chair has implemented a tutoring programme where senior students help junior students to cope with foundation courses ... "



Professor Paul Makasa

Professor

Department of Architecture

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Room 317

Paul Makasa is a Professor in the School of Architecture at Nelson Mandela University, a member of the Zambia Institute of Architects, and a candidate member of the South African Council for the Architectural Profession.

He is also a member of four research networks:

- The GRUPHEL Gender Research network on Urbanisation, Planning, Housing and Everyday Life, administered from the National University of Lesotho and sponsored by the Swedish International Development Corporation Agency
- The ALPHA-IBIS network involving European, South American and African researchers, administered from Delft University of Technology, the Netherlands
- The European Network of Housing Researchers
- The African Network of Housing Researchers.

Since 2014, Prof Makasa has been supervising an average of three MArch (Prof) students per year in the School of Architecture. With professors Winston Shakantu and Sijekula Mbanga, he has co-supervised several master's and doctoral students on topics that range from innovative construction methods to address housing demand, sustainable spatial planning of human settlements in post-apartheid South Africa, a post-apartheid pro-poor housing delivery model and factors that influence the upgrading of informal settlements in South Africa.

Qualifications

- PhD (Delft University of Technology, the Netherlands)
- Master's Architecture Housing Policies for Developing Nations (Alvar Aalto University, Finland)
- Bachelor's Architecture (University of Zambia)
- Postgraduate Diploma (Poverty Alleviation, IHS-Rotterdam, the Netherlands)
- Postgraduate Certificate Housing Development and Management (Lund-Sweden)
- Postgraduate Certificate (Research Methods for Development, ISS-the Hague)
- Postgraduate Certificate Organised Self-Help Housing (San Jose, Costa Rica)

Teaching Interests

Prof Makasa recognises that his students are the future managers of the built environment. They therefore need to gain critical skills to understand – and ameliorate – man's impact on the built and natural environment at regional, national and global levels.

He adopts a scholarly approach to teaching that is globally driven but locally rooted, and determined by his research into environments which foster new ideas and solutions.

"I therefore strive to offer them architectural design approaches underpinned by architectural theory, construction technology, and history against a backdrop of housing, urban, and landscape studies.

"I believe in encouraging dialogue between students and myself to foster their synergies, considering that in the industry they will be the team leaders.

"In the studio, I like to use real-life scenarios to instill a real-life performative approach to architectural design, and the outputs always reflect real-life situations. This way I believe that architectural education reflects its essence of being a performance creative art, where ideas and strategic approaches are developed by the student, not given by myself."

Encouraging students to engage with the science and art of architecture, Prof Makasa favours innovative ideas and



**... I like to use
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design ... "**

creative problem-solving techniques over the delivery of pre-conceived existing solutions.

"In research, I teach my students practical approaches that enable them to establish individual strategic approaches, inspiring them to always probe deeper."

Research Interests

Prof Makasa's research interests include low-cost housing policy development and management, poverty alleviation, urbanism, and gender issues.

His PhD thesis was published as a book entitled, *The 1996 Zambia National Housing Policy*. He has also published, *Housing Economics and Policies in Zambia*, and, *Zambia's Urban Areas*. He has contributed chapters to other books and written study manuals for the Copperbelt University in Zambia.

**// In research,
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Professor Russell Phillips

Professor

Department of Mechanical Engineering

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North Campus, Block E, Room 7G

Professor Russell Phillips is Professor of Mechanical Engineering, and manages the Renewable Energy Research Group (RERG) at Nelson Mandela University, and Mandela Autonomous Operations (MAO).

He is a commercial pilot, flight instructor, test pilot and RPAS pilot who founded Whisper Aircraft and designed the Whisper line of aircraft.

Prof Phillips holds a number of patents in his research fields. Publications in collaboration with co-authors and co-researchers range across areas that include, but are not limited to, small wind turbine blades, performance prediction of composite wing structure, packed-bed, rock thermal energy storage for concentrated solar power, solar heating of air, emergency ventilator for breathing assistance, and the autonomous landing of a multirotor aircraft on a docking station, among others.

Qualifications

- DTech Mechanical Engineering (Nelson Mandela University)
- M Dip (Mech Eng) PE Technikon
- NH Dip (Mech Eng) PE Technikon
- N Dip (Mech Eng) PE Technikon

South African Civil Aviation Authority Commercial Pilot Licence, Grade 2 Flight Instructor, Grade 2 Test Pilot rating, Remotely Piloted Aerial System Pilot licence

Awards and Achievements

- 2019 Department of Science and Technology top Intellectual Property Creator award for Nelson Mandela University

- 2013 Nelson Mandela Metropolitan University Innovation award
- 2011 Faculty of Engineering, Built Environment and IT (EBEIT) excellent teacher award
- 2010/2011 Golden Key lecturer of year awards
- 2010 EBEIT Teacher of year award

Professional Activities

Member of South African Institution of Mechanical Engineering Reg Engineering Technician, Engineering Council of South Africa

Teaching Interests

Since 2005, Prof Phillips has used novel approaches to effectively address

the challenge of teaching large undergraduate engineering classes (more than 200 students), to maximise their potential and enhance their throughput. These have included various real-time interactive methods designed to create a more "one-on-one" experience for the students.

He uses Friday assessments based on smaller parcels of that week's content. Students obtain their assessment results before starting new content on the following Monday.

Prof Phillips concedes that this unusual method of delivery and assessment will not necessarily be appropriate for all levels of undergraduate study. However, he has proved that it does



work effectively, particularly with first and second year learners in analytical engineering modules.

Most recently, as a result of the COVID-19 pandemic, Prof Phillips has developed a comprehensive suite of online tuition videos that achieve the sub 1Mb/minute threshold. This is vital for delivering content to learners who may not have access to uncapped or reliable connectivity.

Research Interests

Prof Phillips's research is directed into two fields, namely renewable energy and autonomous vehicles.

His research on renewable energy in the form of off-grid energy harvesting and storage systems focuses on:

- Novel vertical and horizontal axis wind turbine designs
- Solar thermal concentrators for heating rock
- Extraction of energy from the heated rock and generating electricity from this energy
- Battery-free solar photovoltaic applications such as industrial processes and motive power.

His research on autonomous vehicles such as fixed wing, rotary wing and vertical take-off and landing (VTOL) drones investigates:

- Heavy lift multi-rotor drones with hybrid power for long duration operations
- Heavy lift fixed wing aircraft for long-range operations
- VTOL aircraft for offshore scientific research and patrols.

Working with co-contributors, Prof Phillips has published research in these fields over several years and his work has appeared in numerous journals.



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Professor Winston Shakantu

Professor

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Professor Winston Shakantu is a Full Professor of Construction Management at Nelson Mandela University. He has been inducted into the South African Council for the Project and Construction Management Professions as a Professional Construction Manager (Pr.CM), and the Chartered Institute of Building as a Corporate Member, and a Chartered Construction Manager.

He has held the posts of Director: MSc in Project Management; Director: MSc in the Built Environment; Director of a Research Institute; Programme Convenor: BSc Quantity Surveying; Programme Convenor: BSc in Construction Management and Head of Department of Building and Director of School of the Built Environment.

Prof Shakantu has sat on high-level university committees including Senate; Faculty Management; Faculty Research; University Ethics – Human; Faculty Promotions; Faculty Equipment; Faculty Computer; Dean's Advisory; Faculty Strategic; Faculty Undergraduate Programmes; Faculty Postgraduate Programmes; Faculty Appeals and Re-admissions and Faculty Board.

In addition, he has undertaken programme development work leading to the introduction of new degrees in Quantity Surveying and Construction Management. Furthermore, he has championed programme accreditation and quality assurance work for both undergraduate and postgraduate courses.

Qualifications

- PhD (Glasgow Caledonian University)
- MSc Construction Management (University of Reading)
- BSc Building

He also has attended a postgraduate course in International Construction Management (Lund University)

Awards and Achievements

Awards have included two scholarships to study for a BSc in Building; a British Council Scholarship for a master's

degree; a Glasgow Caledonian University Scholarship to study for a PhD.

Prof Shakantu has also been awarded three NRF Focus Area Competitive Research Grants; six University of Cape Town Competitive Research Awards; two Nelson Mandela University FRTI Competitive Awards and two Construction Industry Development Board (CIDB) Best Paper at a Conference Awards.

Other awards include a R3-million CIDB Centre of Excellence award and a R1-million award from the Department of Human Settlements.



Professional Activities

Corporate Member of the Chartered Institute of Building (MCIOB; Chartered Construction Manager)

Professional Construction Manager (PrCM) with South African Council for the Project and Construction Management Professions

Teaching Interests

Prof Shakantu's teaching interests are in Construction Management in general with specific interests in innovative technologies in construction and how these are applied and affect materials and methods in construction.

Research Interests

Prof Shakantu's research interests stretch across the broad area of Construction Management. Specific areas of interest have been eclectic, ranging from Construction Cost Control through Risk Management to Supply Chain Logistics Management at bachelor's, master's and PhD level.

Completed research includes Construction Sustainability, Indigenous Construction Technology, Small, Micro and Medium Enterprise Contractors, Construction Logistics, Risk Management and Health and Safety. He was a member of the teams commissioned by the Construction Industry Development Board and the Western Cape Micro Economic Development Strategy (MEDS) to produce construction health and safety in South Africa and Western Cape construction industry development strategy reports.

His current research interest and work is on new developments in construction management such as information and communication technology, innovative technology and building information modelling. Much of the recent research has been in construction automation and digitalisation.

With regards to national research contributions, he was invited to serve on the NRF Technikon Research Development Programme (TRDP) Advisory Committee for the Cape Technikon to assist with the

Niche Area on Sustainable Urban and Housing Development.

Prof Shakantu was invited to serve on the Engineering Funding Applications Review Panel in 2007, 2013 and 2018; the Italy/Germany Panel Review in 2013 and the Thuthuka Engineering Panel Review in 2013. In 2015, 2016 and 2021, he was invited to review six NRF Rating Applications and in February 2018 was invited to serve on the NRF Research Chairs Initiative Review Panel.

He has supervised research projects for honours, master's and PhD students, and supervised 22 PhD candidates to successful completion.

Prof Shakantu has published more than 200 papers in book chapters, journals and at conference, and presented papers at conferences in Africa, Europe, North America, Asia and Oceania. He also has been invited to review papers and join the peer review panels for numerous international journals and conferences.

“ His current research interest and work is on new developments in construction management ... ”

Professor Farouk Smith

Professor

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Professor Farouk Smith is Director of the School of Engineering at Nelson Mandela University, and a past Mechatronics Head of Department. His areas of interest are in Embedded Systems, Hardware Evolution, Radiation Protection of Spacecraft Electronics, and Physics.

He is a National Research Foundation (NRF) Thuthuka grant holder, receiving this from 2011 to 2017. He also was awarded TIA Seed Funding from 2016 to 2020.

Prof Smith has had patents granted, notably:

- United States Patent 8,975,913 granted on 10 March 2015, on the topic of his published paper "Method and circuit structure for suppressing single event transients or glitches in digital electronic circuits"
- South African Patent 2012/06115, granted on 29 January 2014
- South African Patent 2018/01553, granted on 19 December 2018.

Qualifications

- PhD Electronics Engineering (Stellenbosch, 2007)
- MSc Engineering, Electronics (University of Cape Town, 2003)
- BSc Engineering, Electronics (University of Cape Town, 1996)
- BSc Physics (University of Cape Town, 1994)

Awards and Achievements

Within Nelson Mandela University, Prof Smith has received the following awards:

- School of Engineering Emerging Researcher of the Year 2011
- Innovator of the Year 2012
- Faculty of Engineering Emerging Researcher of the Year 2012

Professional Activities

Prof Smith is a Professional Engineer registered with the Engineering Council of South Africa (ECSA) since 2002. He has been a Senior Member of the Institute of Electrical and Electronic Engineers since 2014.

Teaching Interests

Prof Smith's teaching philosophy is centred on three main objectives:

- Conveying the overall idea of a particular problem first without relying on complex mathematical equations, and only thereafter introduce a mathematical analysis
- Providing real-world examples that explain the complexity of a problem

- Actively listening to students to ensure their engagement in the material.

For Prof Smith, innovative teaching involves rapid deployment of knowledge using various media including email and access to websites. He champions the use of different tools to ensure the quality of the teaching and learning environment.



He uses edutainment audio-visual facilities to help students further understand subject matter, for example, National Geographic videos and YouTube renditions of engineering simulations.

Research Interests

Current research focuses on the development of novel FPGA (field-programmable gate array) and microprocessor radiation mitigation schemes, and testing the effects of space radiation on spacecraft electronics.

Since starting at Nelson Mandela University, he has continued to pursue new solutions to the problem of space radiation effects, resulting in several journal and conference publications as well as several patents.

"I have strong links with the space industry, such as the Space Advisory Company (SCS) Aerospace Group, New Space Systems and SCS Space, and formed a research collaboration and partnership via the THRIP programme to enhance space related research at Nelson Mandela University.

"We had two master's students on the programme receiving full bursaries and a young staff member is doing his PhD in this related field under my supervision.

"As a result of our close partnership with SCS Space, the University was afforded an opportunity to run an experiment on the nSight Satellite that was launched in 2017. "

SCS Space also consults Prof Smith on radiation protection related issues for satellite electronics.

He has a strong research relationship with Stellenbosch University and the NRF iThemba labs in the area of space radiation effects on satellite electronics. The research collaboration resulted in a strategic allocation of dedicated space at the Cape Town iThemba labs facility for satellite electronics testing.

"Together with Stellenbosch University and iThemba labs, we have a collaboration with the Joint Institute of Nuclear Research (JINR), in Dubna, Russia, to

facilitate the use of the research facilities used by the Russian Space Agency at the JINR for radiation hardness testing.

"This will enable SA-based researchers and students to access state-of-the-art research facilities at the JINR and will contribute positively to the research output of the Nelson Mandela University. The collaboration will

enable us to do heavy ion testing at their facilities, a kind of test that is not currently available in South Africa."

Prof Smith has an extensive list of publications in South African and international journals, both solo and with other researchers, and has made numerous presentations at local and international conferences.



Since starting at Nelson Mandela University, he has continued to pursue new solutions to the problem of space radiation effects ... "

Professor Kerry-Lynn Thomson

Professor

Head of Department: Network Engineering

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041 504 3408

North Campus, Goldfields
Computer Centre, Room R103

Professor Thomson is a Professor in the School of Information Technology. She heads the Department for Network Engineering and is a senior team member of the Centre for Research in Information and Cyber Security (CRICS).

She chairs the International Federation for Information Processing (IFIP) Technical Committee 11 Working Group 12 (11.12) – *Human Aspects of Information Security and Assurance*. She has served as the Secretary and Vice-Chair of this Working Group for the past nine years.

Professor Thomson is a senior instructor in the Cisco Networking Academy Program and an industry certified Cisco Certified Networking Associate, and has achieved the CCNA Security certification.

Qualifications

- DTech Information Technology (Nelson Mandela Metropolitan University, 2008)
- MTech Information Technology (Port Elizabeth Technikon, 2004)
- BTech Information Technology (Port Elizabeth Technikon, 2003)
- NDip Information Technology (Port Elizabeth Technikon, 2002)

Certifications include:

- Cisco Certified Networking Associate (CCNA)
- Cisco Certified Networking Associate Security (CCNA Security)

Awards and Achievements

Prof Thomson is a National Research Foundation (NRF) C2 Rated Researcher and was an NRF Y2 Rated Researcher from 2012 to 2016. She received an

NRF Prestigious Scholarship for Masters' Studies 2003, followed by an NRF Prestigious Scholarship for Doctoral Studies from 2004 to 2006. From 1999 to 2002 she was awarded the NRF Scarce Skills Scholarship and Port Elizabeth Technikon Rector's Bursary. Prof Thomson also received a Nelson Mandela Metropolitan University Internal Research Bursary in 2006.

In the Faculty of Engineering, the Built Environment and Information Technology Prof Thomson was recognised as Emerging Teacher of the Year in 2009, and Emerging Researcher of the Year in 2010.

In 2009, at the Eighth Annual Security Conference in Las Vegas, US, her paper "Information Security Conscience: a Precondition to an Information Security Culture?" was given the award of Best Conference Paper.

Prof Thomson's accolades stretch back to her schooldays when she was voted Weekend Post (then East Cape Weekend) Matric of the Year in 1998, an award given to the top all-round Matric in the Eastern Cape.

Professional Activities

- Chair of IFIP 11.12 Working Group
- Member of the Institute of Information Technology Professionals South Africa (IITPSA)

Teaching Interests

Prof Thomson subscribes to the University's humanising pedagogical approach when it comes to learning and teaching, viewing this as building relationships between lecturers and students.

"I facilitate the learning and help students build knowledge through creativity,

**// Prof Thomson
subscribes to
the University's
humanising
pedagogical approach
... viewing this as
building relationships
between lecturers
and students."**

collaboration, critical thinking and problem-solving.”

To foster these skills, Prof Thomson uses the Flipped Classroom approach for some classes. With this method, students work through the learning material provided before class, at their own pace. Then, in class, the lecturer can answer questions, work through exercises, and discuss or debate.

Her teaching is focused on communication networks and cybersecurity, with topics such as network device configuration, troubleshooting and secure network design.

She has supervised more than 30 students to master's degree qualifications, in subjects that include IT and Clinical Psychology.

Research Interests

Prof Thomson's research primarily focuses on information and cybersecurity. It includes research into fostering a culture of information and cybersecurity through awareness, training and education to mitigate cyberthreats, by reducing the human attack surface.

This involves studies on the pervasive integration of information and cybersecurity into undergraduate curricula across multiple disciplines, including IT and Nursing Sciences. It also addresses security fatigue in organisations through user acceptance of cybersecurity. It further addresses cyberbullying through interdisciplinary campaigns at schools, cybersafety for school children, and investigations into the mitigation of social engineering.

Other strands of research concern the international WiFi internet access roaming service eduroam and the South African National Research Network (SANReN), and using a personal informatics approach for efficient internet self-regulation in universities.

Significant output from Prof Thomson's research includes a model for information security, using shared values to cultivate an information security culture and promote pro-social organisational behaviour.

In her capacity as a cybersecurity researcher, Prof Thomson has been invited as a guest speaker to address cybersecurity awareness topics at schools, career evenings and leadership academies. She has published several research articles in journals, presented papers at national and international conferences, been an invited contributor for a security encyclopaedia and is a member of a number of international conference programme committees.



Professor Theo van Niekerk

Department of Mechatronics
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North Campus, E Block, Room 22

Professor Theo van Niekerk is a senior lecturer in the Department of Mechatronic Engineering and a researcher within the Advanced Mechatronics Technology Centre (AMTC). The AMTC is an engagement unit within the Faculty of Engineering, the Built Environment and Technology with a focus on human capital development through education.

He manages and provides academic leadership to the Nelson Mandela University Siemens Certified Training Centre into Factory Automation and Drive Technologies. The training centre runs Siemens-accredited courses into Factory Automation, Drives and Control Systems to the manufacturing and related engineering industry within the Eastern Cape.

Since starting at the-then Port Elizabeth Technikon more than 30 years ago, his teaching and research interests have been within the field of Mechatronics.

Qualifications

DTech Electrical Engineering.
Thesis title: "Monitoring and Diagnosis for Control of an Intelligent Machining Process"

- MTech Information Technology
BEng Electrical and Electronic Engineering
- NHDip: Computer Data Processing
Professional Activities
Registered Professional Engineer.

Assessor within the ECSA University Accreditation Team into the Mechatronic Engineering programme.

Teaching Interests

Prof Van Niekerk teaches classical and modern continuous and discrete Control Theory, Process Control, Sensors and

Instrumentation. His teaching strategy is grounded in action research, a continuous systematic enquiry to help develop teaching actions that enable learners to improve learning engagement and professional development.

"My primary teaching challenge and interest is to guide engineering students to apply fundamental mathematics and science taught within their first two years of study to perform problem-solving,

analysis and design within a modern control systems engineering context.

"Modern control systems techniques advance fundamental knowledge to an advanced level, and it is both challenging and rewarding to experience the progress of learners."

While understanding the importance of complex problem-solving, a key practical component and learning strategy is to



blend engineering practice to prepare students for the real world. This is particularly important given the socio-economic challenges in the automotive engineering and related manufacturing environment.

Prof Van Niekerk's interest in German engineering programmes, applied teaching methodologies and university-industry collaborative models has led to collegial collaboration between German higher educational institutions. The institutions are Ingolstadt University of Applied Sciences, Ostfalia University of Applied Sciences, Reutlingen University and Siemens Cooperates with Education.

Research Interests

Prof Van Niekerk's research interests include factory automation, instrumentation and intelligent control systems, applied to Advanced Manufacturing and related Engineering Systems.

"Within our research team the concept of intelligent mechatronic systems is simply described as an electrical-mechanical device or system integrated with a microcomputer that has artificial intelligence-based capacity to analyse sensor data and take action. Artificial Intelligence (AI)-based techniques may include expert systems, neural networks, fuzzy logic and genetic algorithms."

He has an extensive list of representative publications, which include publications in research reports and journals. Prof Van Niekerk has also presented papers at numerous South African conferences as well as at international conferences in Africa, Europe, North America, the Middle East and the Far East.



Prof Van Niekerk's interest in German engineering programmes, applied teaching methodologies and university-industry collaborative models has led to collegial collaboration between German higher educational institutions."

Professor Peter Freere

Associate Professor

Department of Electrical Engineering

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North Campus, Building 203 (also known as Building B), Room B02

Professor Peter Freere has a PhD in power electronic control of motors from the University of Newcastle upon Tyne in the UK and a research master's degree on the control of wind turbines from the University of New South Wales, Australia.

Although currently at Nelson Mandela University in South Africa, he has worked in several universities around the world, such as Monash University, Kathmandu University and the University of Newcastle upon Tyne. He also spent short periods working in Germany, Korea and Cape Town.

Prof Freere enjoys multidisciplinary research such as the role of solar energy in food production in the Himalayas, wind turbine control, timber fatigue, semiconductor fatigue, optical fibre sensing, as well as the more purely electrical areas such as electric vehicles, photovoltaic and wind turbine system control.

Qualifications

- PhD Electrical Engineering
- MEng Electrical Engineering, Research
- BEng Electrical Engineering
- BSc Physics, Mathematics

Professional Activities

Member of IEEE. Professional Engineer, ECSA

Teaching Interests

Prof Freere aims to have each student achieve his or her potential, challenging them to understand and apply their understanding.

"When I am with the students, I would like them to be able to think about the field and apply it to build something that works.

"My particular interest concerns the control of power, both conventionally, using electric motors and generators (and) power electronics, and also using renewable energy.

"So they design and build their own voltage converters, and will soon be designing and building a simple electric motor. But as electronics and electrical

devices often interact with mechanical items, I want to introduce the 'how to think about the mechanical aspect' as well, so it all works well together."

Research Interests

Prof Freere enjoys working with renewable energy.

"It is often challenging not only intellectually but physically in the field with wind and rain, or scorching days. In one case, I was investigating the effects



of climate change and food security over a period of 50 years in one area of the Himalayan mountains. We had to walk for eight hours a day for seven days to get to the particular area. Yet, the residents were not perturbed by the climate and food challenges, as they had various options, and they came from somewhere even more remote and inhospitable."

In these areas, he supports the technology behind small hydroelectric schemes, and has had a patent application for one of the novel controllers developed. The team is currently working on designing and controlling wind turbines so that they can operate at normal wind speeds and in storms.

Prof Freere's research is often driven by problems experienced in the field.

"Every now and then, a major transistor fails and causes havoc, and so we have been investigating measuring the failing of the transistor so that we can have advance notice of its impending failure. Such a situation can be found in an electric car, for example, where if an inverter transistor fails, then the car may be immovable. This is just the type of situation we want to be able to avoid by using our work."

Prof Freere has contributed journal articles to several publications and he has contributed to numerous conferences both in South Africa and internationally.



Every now and then, a major transistor fails and causes havoc, and so we have been investigating measuring the failing of the transistor so that we can have advance notice of its impending failure."

Professor Lynn Futcher

Professor and Head of Department

IT Management and Governance

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Professor Futcher is currently an Associate Professor of the School of Information Technology (IT). Her primary areas of research include Information and Cyber Security Education and Secure Software Development and as such Prof Futcher is a key member of the Nelson Mandela University's Centre for Research in Information and Cyber Security (CRICS). She also has a keen interest in IT Project Management, Human Computer Interaction, User Experience and Usable Security.

Her key skills are teaching and learning, research and engagement. Prof Futcher strongly believes in building and developing relationships to foster valuable partnerships locally, nationally and internationally through committees, working groups and professional bodies.

She has been actively involved in the International Federation for Information Processing (IFIP) Working Group 11.8 (Information Security Education) since 2005, taking on several committee positions including Chair, Vice-Chair and Secretary. As such, she aims to help promote information security education, training and awareness in academia, government and industry by encouraging collaboration and engagement amongst these key stakeholders.

Qualifications

- PhD Information Technology. Thesis title: "An Integrated Risk-Based Approach to Support Undergraduate Students in Secure Software Development" (Nelson Mandela Metropolitan University, 2012)
- MTech Information Technology. Dissertation title: "SecSDM: A Model

for Integrating Security into the Software Development Life Cycle" (Nelson Mandela Metropolitan University, 2007)

- BTech Information Technology (PE Technikon, 2003)
- Higher Education Diploma (University of South Africa, 2002)
- BSc (University of Port Elizabeth, 1986)

Awards and Achievements

- IFIP Silver Core Award for Services Rendered to IFIP 2014
- School of ICT Emerging Researcher of the Year Award 2011
- Nelson Mandela Metropolitan University Teacher of the Year 2007
- EBEIT Faculty Teacher of year Award 2007
- School of ICT Teacher of the Year 2007

Current Professional Activities

- Specialist Member of IFIP TC11
- Chair of the Eastern Cape Chapter of the Institute of IT Professionals South Africa (IITPSA)
- Non-executive Board member of the IITPSA
- Professional member of IITPSA

Teaching Interests

Prof Futcher advocates a learner-centred approach as she sees the true value of teaching as lying in the learning it fosters. She believes it is vital to promote critical thinking and reasoning, and collaborative learning and problem solving to add real value to the teaching-learning process.



**Prof Futcher
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learning it fosters.**

"Teaching is not about stating facts and covering the content found in textbooks – it goes far beyond this. It should aim at changing the attitude and behaviour of learners in order to enhance their capabilities and develop them as 'whole' individuals, empowering them to reach their full potential."

Her teaching interests lie primarily within the areas of IT Project Management, including the management of Software Development projects, and Information Security Management.

Research Interests

Prof Futcher is committed to developing her research profile in Information and Cyber Security through supervising master's and PhD students, journal publications and conference proceedings.

She has edited or contributed to several books in the field of information security, and has an extensive listing of journal and conference publications. She also has supervised numerous MTech and master's IT graduate research students, including co-supervision.

**Teaching is not
about stating facts
and covering the
content found in
textbooks – it goes
far beyond this."**



Professor Bertram Haskins

**Associate Professor
Department of Software
Engineering**

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**North Campus, R-Block,
Room R102b**

Professor Bertram Haskins is an Associate Professor, holding a PhD from the former Nelson Mandela Metropolitan University (now Nelson Mandela University) and a number of industry qualifications and certifications.

Prof Haskins's research focuses on applied machine learning, with the most significant applications in the domains of health, education and security. He supervises a number of research-based postgraduate students focused on topics in these areas. As part of his duties, he chairs the Faculty of Engineering, Built Environment and Technology's ethics committee. As such, he represents the faculty on the Nelson Mandela University Research Ethics Committee: Human (REC-H).

Qualifications

- PhD Information Technology (Nelson Mandela Metropolitan University 2014)
- MTech Information Technology (Central University of Technology, Free State 2007)
- BTech Information Technology (Cum Laude) (Free State Technikon, 2004)

NDip Information Technology (Cum Laude) (Free State Technikon, 2003).

Prof Haskins also holds numerous other qualifications in the field of qualitative data, assessment and learning, health and safety, in addition to ongoing Cisco training and workshops and training.

Awards and Achievements

In 2020, Prof Haskins won Nelson Mandela University Teaching and Learning Excellence Teacher Team Award.

He also was part of the team which won the top innovation award in 2020 in the category of High Social Impact at the United Nations Economic Commission for Africa, by Zimbabwe, for the Ncediso Mobile App. His role within the team was app developer.

Other awards and accolades before this include:

- 2018: Runner-up best paper award, with student Craig Mills, at the 2018 Conference on Information Communication Technology and Society (ICTAS)



- 2017: Nelson Mandela University Faculty of Engineering, the Built Environment and IT (EBEIT) Excellent Teacher of the Year
- Nelson Mandela University Excellent Teacher of the Year
- Cisco Networking Academy Advanced Instructor Award
- 2015: Nelson Mandela Metropolitan University EBEIT Emerging Researcher of the Year
- 2012: South African National Research Foundation Sabbatical Grant
- South African National Research Foundation Thuthuka PhD Grant (2012 to 2014)
- 2004: Best B Tech Information Technology Student (Central University of Technology, Free State)
- Best Overall B Tech Student in the Faculty of Engineering (Central University of Technology, Free State)
- 2003: Third-year NDip Information Technology Student Merit Award (Free State Technikon).

Professional Activities

Prof Haskins was the programme co-chair for the 2018 South African Institute of Computer Scientists and Information Technologists Conference and has served as a guest editor for a special edition of the South African Computer Journal. He is also a professional member of the Association for Computing Machinery.

Teaching Interests

"As a fully-connected cyber-citizen, I constantly seek out new ways to incorporate technology into my teaching. Being in a technological field, with a primary focus on teaching programming and project-based subjects, it comes naturally to include technology-driven approaches into my teaching practice."

He views the correct application of technology as having a humanising effect on education, streamlining the process and serving as "struts" to bridge the divide between lecturer and student.

"It helps to free me from the constraints of every-day administration and enables me to spend more time on the day-to-day interaction with, and education of, my students."

He advocates a holistic approach which includes providing students with the correct tools to further their education. This not only includes the provision of subject knowledge but also instilling a need for life-long learning.

"I try to always keep the following statements in mind when dealing with my students: Leave no-one behind, challenge them, be approachable and make it memorable."

Research Interests

Prof Haskins's sees machine learning as a disruptive technology for the broad implications it has to change, improve or augment the status quo in so many fields.

His current research interests are focused on applying machine learning techniques to the fields of health, education and security based on text, image and voice-based data. His current group of postgraduate students include one doctoral and seven master's candidates.

His extensive list of publications at conferences and in journals includes co-authored and individual work. It examines the use of technology in diverse fields which include but are not restricted to: blockchain, breast cancer, plagiarism, adventure sport, automatic speech recognition, mathematics, small livestock keepers and social media.

"As a fully-connected cyber-citizen, I constantly seek out new ways to incorporate technology into my teaching."

Professor Hannalie Lombard

Associate Professor

Department of Mechanical Engineering

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North Campus, Engineering Building 276, Room 0125

Professor Hannalie Lombard is an Associate Professor in the Department of Mechanical Engineering with a lecturing focus on Material Science, Heat Transfer, Thermodynamics, Matlab and Mechanics.

Her doctoral research investigated process windows of the influence of input welding parameters on the quality and mechanical properties of 5083-H321 aluminium alloy. The research was conducted to determine whether online monitoring systems' data could predict weld properties. This work contributed to advancing the ability in predicting optimised process conditions for Friction Stir Welding joints by linking residual stress state with the characteristic force footprint as well as dynamic fatigue properties.

Qualifications

PhD thesis title: "Optimised fatigue and fracture performance of friction stir welding aluminium plate: A study of the inter-relationship between process parameters, TMAZ, microstructure, defect population and performance" (Plymouth University)".

Awards and Achievements

Prof Lombard was named Emerging Researcher in the Department of Mechanical Engineering in 2007.

She submitted the Best Abstract by a student author for the Microscopy Society of South Africa (MSSA) conference in December 2004.

Prof Lombard was co-author of Residual Stresses and Fatigue Performance, an article in Engineering Failure

Analysis, Volume 14, Issue 2, for which Elsevier awarded the accolade "Most cited articles 2004 to 2008". Her co-authors were James, MN; Hughes, DJ; Chen, Z; Lombard, H; Hattingh, DG; Asquith, D; Yates, JR and Webster, PJ (2007).

Professional Activities

Prof Lombard has been registered as a Professional Scientist at the South African Council for Natural Scientific Professions since 2010. Other professional activities include:

- Associate Member of the South African Institute of Refrigeration and Air Conditioning.

Teaching Interests

Prof Lombard sees bridging the gap between theoretical content and practical real-life problems as one of the most important aspects of teaching engineering modules.

"It is an honour and privilege to share knowledge with student learners and assist them to understand difficult concepts in the fields of materials science, mechanics and heat transfer.

"I believe that real learning is achieved by active learning. My teaching is thus driven by providing students with the opportunity to actively engage with module content to expand their

// My teaching is ... driven by providing students with the opportunity to actively engage with module content to expand their knowledge and analytical abilities, to enable them to solve problems."

knowledge and analytical abilities, to enable them to solve problems. This is achieved by assignments and experimental work in groups or as an individual using online or face-to-face teaching modes."

Integrating writing practices remain an important component in training engineers or technologists. A study was undertaken to make explicit and enact language and discourse features in an assessment rubric. This was to enable respondents on the "inside" of disciplines (lecturers), as well as "outsiders" (language educators and students) to formatively assess and give different kinds of feedback – global and local (specific) – in different modes (oral and written) to drafts of laboratory reports in modules. The rubric provided a guideline to students on how to write a laboratory report.

Research Interests

Research interests include optimising weld performance, general materials characterisation and heat transfer.

Prof Lombard's research embraces the idea of weld performance optimisation as well as material property characterisation as key research activities. It presents her investigations into the application of any welding technology to produce welds with desired properties.

Themes of interest are focused mainly on two areas: modelling of heat transfer in welded plates and optimisation and characterisation of welding of dissimilar materials.

Prof Lombard has an extensive list of local and international journal and conference publications, dating back to 1995 and 1993 respectively.

**Prof Lombard's
research embraces
the idea of weld
performance
optimisation as well
as material property
characterisation as key
research activities."**



Professor Ann Lourens

Associate Professor

Department of Industrial Engineering
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North Campus, Building 204, Room C242

Professor Ann Lourens is an Associate Professor at Nelson Mandela University and Project Leader for the Women in Engineering Leadership Association (WELA). Prior to a career in academia at the-then Cape Technikon and at Nelson Mandela Metropolitan University, Prof Lourens worked in manufacturing industries in operations-related positions. As an academic, she has lectured a variety of undergraduate and postgraduate modules on Operations Management, Industrial Engineering and MBA programmes. She has a keen research interest in the development and retention of students, particularly women engineering students, and to this end has developed and managed several co-curricular interventions.

As former Head of Department and member of the Industrial Engineering team at Mandela University, Prof Lourens maintains close links with industry and several short learning programmes have been designed to develop employees from various industries in and around the Eastern Cape. Notably, one programme includes a leadership development programme for early-career men and women in the fields of Science, Technology, Engineering and Production (STEP).

Qualifications

- Doctor of Business Administration (Nelson Mandela Metropolitan University, 2011)
- MTech Business Administration (Cum Laude) (PE Technikon, 2001)
- BTech Business Administration (Cum Laude) (PE Technikon, 1998)
- National Higher Diploma Production Management (Cum Laude) (PE Technikon, 1993)

- National Diploma Production Management (PE Technikon, 1991)

Awards and Achievements

Prof Lourens has received the following awards at Nelson Mandela Metropolitan University:

- Teaching and Learning Best Team Award (2012)
- Emerging Researcher of School of Engineering (2014)
- Engagement Team Award (2014, for 2013).

She authored a chapter in the textbook *Implementing Lean in South African Industry* (2010).

In 2016, Prof Lourens was the only short-listed candidate from South Africa for the AIRBUS International Diversity Award.

In 2007, Prof Lourens was instrumental in securing funding for the unique Centre of Business Engineering in the Department of Industrial Engineering. This boasts a simulated working environment, an advanced manufacturing centre and a computer laboratory for computer





I believe a lecture room, where the lecturer is but a facilitator, must be a safe, open environment where students and the facilitator are able to learn from each other."

simulations, and the funding enabled the laboratory to be upgraded in line with Industry 4.0 principles.

Professional Activities

- Member of the South African Institute of Industrial Engineers (SAIIE)
- Member of the South African Society for Engineering Education (SASEE)
- Member of the American Society for Engineering Education (ASEE).

Teaching Interests

"I believe a lecture room, where the lecturer is but a facilitator, must be a safe, open environment where students and the facilitator are able to learn from each other. Ethics, responsibility and ownership must be embedded in the curriculum and students encouraged to develop, grow

and practise self-directed learning, to broaden their minds and thinking, and learn to look at things differently. They must be encouraged to practise lifelong learning and engineering-thinking as a way of life."

Part of Prof Lourens's approach is to challenge students with research projects, practical application and teamwork, in this way teaching valuable skills to prepare them for life and the world of work.

In 2011, she became the project leader for WELA, one of the five projects supported by the merSETA Chair of Engineering Development. WELA aims to develop and retain aspiring and working women engineers on a personal level, academically and professionally to improve success.

To achieve these goals, Prof Lourens and the WELA project team have designed and developed a set of co-curricular interventions which were formalised into a short learning programme at the University in 2013, namely the WELA Leadership Development Programme. Several conference proceedings and journal articles relating to this work have been published, in addition to technology strategy research articles.

In 2018, the WELA teams designed and offered the WELA STEP programme, a management development programme for early career males and females in the field of science, technology, engineering and production. The programme is offered to colleagues internally and to the industry externally.

Prof Lourens has an interest in developing co-curricular interventions to assist students, and this includes embracing a humanising pedagogy.

Research Interests

Her research interests have moved from operations-type questions, technology and strategy to engineering education. As part of this shift, Prof Lourens has developed and organised several co-curricular interventions such as the Early Identification System, the Workplace Orientation Workshop and the Part-time Students' intervention.

These have led to collaborations with colleagues from Student Counselling and the Centre for Teaching, Media and Learning, resulting in several conference papers and journal articles.

Prof Lourens was the Faculty representative for the Siyamphumlela project and involved in recruiting, and developing the portfolio of, the academic advisor. Together they have developed several questionnaires to better understand engineering students and to design interventions and activities to improve their retention.

Prof Lourens has an extensive list of publications that include journal articles and conference presentations, both in South Africa and abroad.

Professor Sijekula Mbanga

Associate Professor, Chair for Sustainable Human Settlements
Department of Human Settlements
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North Campus, C Block,
Second Floor

Prof Sijekula Mbanga is an Associate Professor and holds the Chair for Sustainable Human Settlements at Nelson Mandela University. He is a social scientist and development activist and a member of numerous professional and academic bodies.

He leads the programme for Human Settlements Studies, and is a member of the research group on environmental stewardship and sustainable livelihoods.

Before joining academia he held management positions in various infrastructure development agencies in the public sector while collaborating with higher education institutions and research councils. He thrives in research that straddles disciplines, sectors and nations, and his doctoral thesis focused on integrated development planning.

Prof Mbanga is actively participating in the Ndlambe EcoSUN Green Village project at Ekuphumleni Township in Kenton-on-Sea, in partnership with the University of Potsdam in Germany. This has emanated from the STINT (Swedish Foundation for International Cooperation in Research and Higher Education) science and technology transfer and exchange programme between South Africa and Germany.

Working with Professor Janet Cherry of the Department of Development Studies, he is also involved in a DAAD (German Academic Exchange Service) funded Participatory Action Design and Joint Action Project for Sustainable Development three-year exchange programme between the University and the HS Wismar University in Germany.

Prof Mbanga serves on the editorial board of the Urban Forum Journal hosted by the University of Cape Town and the Construction and Human Settlements Journal housed in the School of Built Environment and Civil Engineering at Nelson Mandela University.

He also participates in university academic and engagement committees

and South African national government Advisory Committees, including:

- DSI/CSIR Advisory Committee on Science and Technology Innovations for Sustainable Human Settlements
- South African Reference Group on the New Urban Agenda
- Southern African Cities Studies Network



- South Africa-Sweden Universities Forum Advisory Committee on Urbanisation
- 21st Century Cities NAHRO-US International Housing Research and Exchange Forum
- World Bank Inclusive Development Network
- Association of Housing Professionals in Africa.

Prof Mbanga is a Board Chairman of the Institute of Human Settlements Practitioners South Africa, a professional association that is home to those who study, teach and practise in the field of housing and human settlements in South Africa. He also serves on the Governing Board of the USA-Africa Collaborative on Affordable Housing and Sustainable Communities.

Qualifications

- PhD Public Administration (Nelson Mandela Metropolitan University)
- MA Administration (cum laude) with distinctions in Advanced Project Management, Advanced Public Policy Analysis and 100% pass in Integrated Development Planning modules.

Professional Activities

Prof Mbanga is a registered and active member of the:

- South African Association of Public Administration and Management
- South African Monitoring and Evaluation Association
- Geographic Information Society of South Africa
- South African Planning Institute

In addition to chairing the board of the Institute of Human Settlements Practitioners South Africa (IHSP-SA) he is also a board member of:

- USA-Africa Collaborative on Affordable Housing and Sustainable Communities
- Board of Association of Housing Professionals in Africa

Teaching Interests

Prof Mbanga teaches human settlement policies and implementation and research methods. He supervises honours level

Prof Mbanga focuses on integrated approaches to development management and human settlement management."

treatises in the four-year professional Bachelor for Human Settlement Development.

He also is a Programme Coordinator for the research-based Master of Human Settlement Development.

Research Interests

Prof Mbanga focuses on integrated approaches to development management and human settlement management. Research interests include housing

policy, informal settlements, housing and sanitation innovations, sustainable livelihoods, spatial transformation and urbanism, green settlements and neighbourhoods, human settlements policies and systems, local government capacity, and indigenous knowledge systems in infrastructure development.

Prof Mbanga currently guides and mentors 12 doctoral and 10 master's students.

He also hosts 4 postdoctoral research fellows.

Professor Nicky Mostert

Professor

Department of Software Engineering

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North Campus, J Block, Room J112

Prof Nicky Mostert is an Associate Professor in the Department of Software Engineering at Nelson Mandela University. Her research is mainly focused on health informatics, with a developing interest in areas related to social media and social networking.

Her involvement in the health informatics field on the African continent has most notably been as the editor-in-chief of the Journal of Health Informatics in Africa (JHIA) and the Scientific Programme Committee Chair of the Health Informatics in Africa (HELINA) conferences. HELINA is the Pan African Health Informatics Association and the African Region of the International Medical Informatics Association (IMIA). She was recently elected in the portfolio of secretary on the HELINA Board.

Qualifications

- User Experience Design Short Course (Passed with Distinction) (University of Cape Town, 2015)
- PhD Information Technology (Nelson Mandela Metropolitan University, 2012)
- Postgraduate Certificate in Higher Education (PGCHE) (Nelson Mandela Metropolitan University, 2011)
- Cisco IT Essentials PC Hardware and Software Course (Nelson Mandela Metropolitan University, 2008)
- Cisco IT Essentials PC Hardware and Software Instructor Course (Nelson Mandela Metropolitan University, 2008)
- MTech Information Technology (Nelson Mandela Metropolitan University, 2005)
- BTech Information Technology (Cum Laude) (Port Elizabeth Technikon, 2003)
- NDip Information Technology (Cum Laude) (Port Elizabeth Technikon, 2002)

Awards and Achievements

Nelson Mandela University awards and achievements include:

- School of ICT Emerging Researcher of the Year 2014
- Faculty of Engineering, the Built Environment and Information Technology (EBEIT) Emerging Researcher of the Year 2014
- School of ICT Emerging Teacher of the Year 2007
- Faculty of EBEIT Emerging Teacher of the Year 2007.

Professional Activities

Prof Mostert is an active council member of the South African Health Informatics Association (SAHIA) in the portfolio of

immediate past president. She has been a member of SAHIA since 2010. Other professional activities include:

- Board member of HELINA
- Member of the Institute of Information Technology Professionals South Africa (IITPSA)
- Member of the South African Institute of Computer Scientists and Information Technologists (SAICSIT)
- Member of the Southern African Computer Lecturers' Association (SACLA).

Teaching Interests

Prof Mostert sees enthusiasm for both the subject matter and the learning experience as extremely important to motivate students to realise their individual potential.

Prof Mostert sees enthusiasm for both the subject matter and the learning experience as extremely important to motivate students to realise their individual potential."

"By demonstrating a passion for the subjects that I teach, I hope to influence students to actively involve themselves in the learning process. I strive to create a classroom environment in which the students feel comfortable participating and taking an active role.

"Since the students come from diverse backgrounds and have different abilities and talents, I use several different techniques to accommodate their various learning styles. It is important that the students are able to use their knowledge of the subject matter, so I try to structure assessments in such a way that they test critical and analytical thinking skills and understanding of the subject matter, instead of an ability to copy answers out of the textbook."

Prof Mostert believes students learn a great deal from constructive feedback that encourages improvement and growth. She views this as helping students to learn from their mistakes and empowering them to take control of their own learning.

Research Interests

There are various Health Information Technologies (HITs) that can play an important role in improving informational continuity of care in the healthcare sector and contribute towards improved quality of care. Such technologies include, among others, Personal Health Records (PHRs), Electronic Medical Records (EMRs) and Electronic Health Records (EHRs).

"My research has mainly focused on these HITs and various aspects related to their lack of adoption and meaningful use in the South African healthcare landscape. Despite the well-researched benefits associated with the adoption of such HITs, it remains low due to various socio-technical factors.

"I have recently also started exploring research topics related to social media and social networking. Research projects

in this area relate to the awareness and compliance of stakeholders in the higher education sector towards social media policies at their institutions, as well as social networking addiction among students in higher education."

Prof Mostert also has published numerous papers in accredited journals, peer-reviewed international conference papers and posters.



Professor Karl van der Merwe

Associate Professor

Department of Industrial Engineering
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041 504 3431

North Campus, New Engineering
Building, Centre for Business
Engineering

Professor Karl van der Merwe has been a practising industrial engineer since 1989. After 15 years in the automotive sector, he moved to an academic environment to pursue a career in teaching, research and consulting. Prof Van der Merwe holds a doctorate from the-then Nelson Mandela Metropolitan University in Operations Management based on research completed in the field of Lean and Six Sigma operations. He currently oversees a number of continuous improvement research projects in collaboration with industry partners.

He has guest lectured on Lean Culture at the University of Mississippi, US, in 2012, and is a regular keynote speaker at events.

Prof Van der Merwe has been involved with postgraduate supervision, research and related projects of doctoral, master's, honours and MBA candidates. By the end of 2021, he had mentored just over 500 students.

"I moved from industry to an academic environment at the behest of my former lecturer who had become the head of department for Industrial Engineering at the Nelson Mandela Metropolitan University almost 20 years ago. At the time I had envisaged staying in academia for no more than two years – quite unexpectedly, I realised that I enjoy teaching and derive a lot of personal satisfaction from developing the minds of young engineers.

"My most important accolades come from past students who thank me for my contribution to their personal growth and development as they continue to achieve

// **My most
important
accolades come
from past students
who thank me for
my contribution
to their personal
growth and
development ... "**

their career goals and climb various corporate ladders."

Qualifications

- DTech Operations Management
- MTech Industrial Engineering
- BTech Operations Management
- National Higher Diploma Industrial Engineering

Awards and Achievements

Individual and departmental awards within Nelson Mandela University include:

- Lecturer of the Year, 2007
- Department of the Year, 2013
- Engagement Excellence Team Award, 2014
- School of Engineering, Emerging Researcher, 2017.

National awards include: Teacher of the year award (runner up) – South African Institute of Industrial Engineering.

Prof Van der Merwe has an extensive track record in the field of industrial engineering with projects including the Motherwell Urban Renewal Project (2006) and the Automotive Industry Development Centre (2007-2009).

Internally, Prof Van der Merwe was co-developer of the University's learning factory, and continues to lead the continuous improvement research group, and develop research orientation workshops.

Professional Activities

- Registered with the Engineering Council of South Africa (ECSA)
- Member of the Industrial Engineering Accreditation panel
- Associate member of the South African Institute of Industrial Engineering (SAIIE)
- Member of SAPICS, the professional body for supply chain management

- Member of the SA Society of Quality (SASQ) and the American Society of Quality (ASQ)
- Six Sigma Black Belt

Teaching Interests

Prof Van der Merwe has taught a range of subjects and modules, including:

- Work Study/Organisational Effectiveness
- Operations Research
- Production Engineering
- Materials Requirement Planning (MRP) and Enterprise Resource Planning (ERP) Systems
- Statistics
- Production Management
- Industrial Leadership
- System Dynamics (Simulation)
- Project Management
- Manufacturing Engineering
- Lean
- Quality Management.

He has developed a number of short learning programmes that include:

- Lean Practitioner
- Six Sigma (Green and Black Belt)
- Project Management for Engineers
- Value Stream Mapping
- Failure Mode Effect Analysis (FMEA)
- Statistics for Quality.

He has taught these courses at undergraduate and postgraduate levels for industrial engineers, operations managers and Business School MBA candidates.

“My philosophy on teaching is grounded in the belief that the role of the teacher is to guide students and allow them to discover solutions to problems following a systematic and logical process. To achieve this, I follow lean principles and develop my courses in such a way that students are engaged and challenged.

“One-way communication does not lead to learning. I believe that challenging students in a respectful manner clearly communicates my belief that they are capable of successfully completing the task at hand.”

Prof Van der Merwe has over the years

developed practical exercises for industrial engineers. This culminated in the development of a simulated working environment (sometimes called a learning factory) where students can experience a manufacturing environment and work out solutions to typical problems.

The industrial engineering programmes offered in South Africa include a significant practical component where students are placed in various manufacturing organisations to gain practical experience in real factories.

“I have co-ordinated and controlled these experiential learning semesters for engineers over the last 10 years or so, and have come to realise the positive nature of such training. Seeing students develop from slightly timid junior trainees into confident young engineers is a rewarding experience.”

Research Interests

Prof Van der Merwe's research interests centre on lean philosophy and associated tools, focusing on various industries ranging from automotive to aeronautical.

“Lean success hinges upon the ability to meaningfully engage employees and convert them to lean thinkers. Attaining this is influenced by many things, but leadership actions and behaviours remain the single most important factor.”

Value stream and process mapping have featured prominently in his research, as he views them

as extremely powerful tools for lean practitioners.

In addition to publication of numerous articles in journals, conference presentations and papers, Prof Van der Merwe has authored several books on topics that include project management, value stream mapping and lean operations, among others. He is also a reviewer for the South African Journal of Industrial Engineering.



Centre for Community Technologies develops app for schools

Research by Prof Darelle van Greunen

E-schools are the future. But are traditional South African schools ready for this?

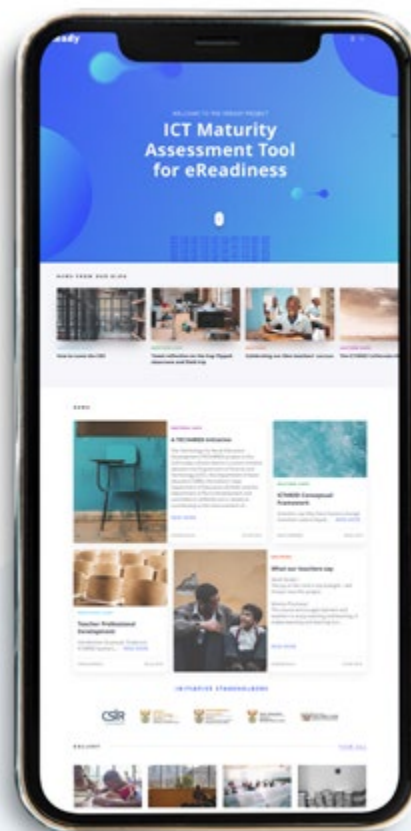
To evaluate and assess the e-readiness of all South African government schools, the Centre for Community Technologies (CCT) at Nelson Mandela University has helped to develop an easily downloadable app, the e-ready ICT Maturity Assessment Tool.

This app is an initiative of the Department of Science and Innovation and the Technology Innovation Agency (TIA) with input from the Department of Basic Education. It will be piloted in 1000 schools in nine provinces with a view to rolling out to every government school in the country and to independent schools if they choose to use it.

"Education can only be accessible to everyone if we enable access to education and learning through technology and make it affordable. The need for e-readiness is highlighted by the COVID-19 pandemic with people realising that learning should take place wherever students find themselves," says CCT Director Professor Darelle van Greunen.

"If the Fourth Industrial Revolution (4IR) is to deliver on the promise of economic growth, job creation through innovation, improved safety and security, better education, and skills transfer, South Africa has to rapidly and immediately change its education focus and delivery model to be ICT-responsive and e-ready."

The pilot aims to test the tool's efficiency in identifying a school's e-readiness. Five e-readiness levels are assessed according



to the ICT infrastructure of each school, namely: connectivity, curriculum and digital content, e-administration, teacher ICT readiness, and teacher development and support. The levels range from underdeveloped ICT capacity (digitally unaware) to advanced ICT capacity (digitally mature).

The completed assessment is sent to a central database, while in areas with no or low connectivity, the assessment is sent when the assessor regains connectivity. In addition to the self-evaluation, external evaluation is also conducted at each

school. The app generates the report on the device and, once the assessment has been completed, the findings and results of the report are available immediately. These can then be emailed to the person who completed the assessment and to the Department of Basic Education. This gives the department information about what needs to be done in each school to achieve e-readiness.

"The idea is that every school should achieve a high level of e-readiness and every single learner in our schools should have a device or tablet, as per

the president's statement a year ago, but teaching capacity is often an issue," says Prof Van Greunen.

Afikile Sikwebu, a computer application technology (CAT) teacher at Linkside High School in Gqeberha, was a member of the CCT when the data for the assessment tool was collected. He was involved in the data collection, data cleaning and verification.

"During my involvement, we collected data in rural, urban and township schools in Mpumalanga, North West Province, and Kwazulu-Natal. Depending on the school's quintile and availability of ICT resources, a large majority of the rural and township schools we visited were far from being ICT-ready," says Sikwebu.

"Some of the schools had outdated, obsolete technology and some did not have technology at all. At the same time, some of the schools were not in

a condition to accommodate any form of ICT due to factors such as crime and availability of electricity."

Sikwebu says that, with training and discipline, learners are ready to receive some form of teaching and learning through tablets. However, the pedagogy needs to change.

"Tablets cannot be used or seen as a replacement for a textbook. Lesson presentation would need to be digital and, in my observation, the majority of the teachers we previewed are not ready to make that transition. The schooling infrastructure in many cases also does not allow for these changes to take effect," he says.

The tool was piloted with some 8000 schools across South Africa. The project is set to continue into 2022/23 with the aim of rolling out to all 26 000+ schools in all provinces.



Electronic management system launched at second Gqeberha hospital

Research by Darelle van Greunen

An easy-to-use advanced electronic Hospital Management System (HMS), developed by the Eastern Cape Department of Health through the University's Centre for Community Technologies (CCT), has been put to use at more than one Nelson Mandela Bay hospital.

First used at the Rev Dr Elizabeth Mamisa Chabula Nxiweni Field Hospital during the height of the COVID-19 pandemic in 2020, the system was officially launched at the Elizabeth Donkin Hospital in October 2021.

When the pandemic was at its peak, the Department of Health learnt to monitor patients remotely, using data to detect symptoms.

CCT Director Prof Darelle van Greunen notes that this data was useful for patient care, potentially improving medical diagnosis and self-care. Patients' information and history of care are recorded, saved and protected via the system and stored in the cloud.

The CCT's involvement at the field hospital initially included providing basic digital literacy refresher courses, training on the system and ongoing end-user support. It was clear that other facilities needed the HMS and, early in 2021, the CCT started to put it into action at Elizabeth Donkin Hospital in Forest Hill.

"We rolled out phase 1, which primarily focused on patient registration and ensuring the patients' journey is well-captured to provide us with good data," says Prof Darelle van Greunen.

How does it work?

The provincial Health Department's IT department developed the system and its senior IT manager Anton Strydom, who is enrolled for his master's degree in Information Technology at Nelson Mandela University, has been one of the key drivers in rolling it out.

Because the facility is WiFi enabled, staff ranging from the CEO to caregivers use a cloud-based solution to capture patient details, order meals, issue scripts, order x-rays, capture patient care notes, clinical notes and more.

These solutions are having a practical impact on how those in the frontline are caring for their patients, enabling staff to access real-time data for reports.

Some of the primary modules of the system are:

- Patient administration
- OPD management
- Ward management
- Patient management
- Pharmacy sub
- Radiology sub
- Clinical support services sub
- Theatre sub
- Management reports
- System administration

The system creates an electronic medical record of the patient from point of registration into the hospital master patient index. After this, the patient's encounters are then electronically recorded and linked to the patient medical record, using the HNSF (Health Normative Standards Framework) unique patient registration number.

Benefits of the new system

According to Eastern Cape Department of Health Superintendent-General Dr Rolene Wagner, this system promotes continuity of care.

"If someone has been admitted at any hospital in the Eastern Cape, the system is able to pick that up. When patients are admitted, their records are available; it's not a case of having to phone different hospitals to find information," Dr Wagner says.

Eastern Cape Health MEC Nomakhosazana Meth, speaking at the Elizabeth Donkin Hospital launch in 2021, said the system would help the department reduce medico-legal claims. Patient folders would no longer be lost, as the information was stored in the cloud.



The integrity and remaining life assessment through small sample analysis

Research under Prof Danie Hattingh

The Faculty's engagement entity eNtsa started research on life extension and associated safe operation of high value engineering components in 2004, looking at in situ extraction and repair methodologies.

It is essential to evaluate the material condition during a plant's active life cycle continuously, to manage challenges around safely prolonging the life of high value engineering components. In certain instances, their use extends well beyond the originally intended design life. This is more so in industrial plants operating at high temperatures and pressures, as proper plant management could prevent catastrophic failures.

eNtsa director Prof Danie Hattingh says small sample analysis allows plant engineers to manage their workspace safely through risk-based inspection programmes. These programmes inform "remaining life" decisions based on analysis of small volumes of materials extracted *in situ*.

Prof Hattingh notes that this research and development work came after 10 years of research by a multidisciplinary eNtsa engineering team, with extensive technical support from international collaborators and engineers from Eskom and Sasol.

The total accumulated cost of the initial research was R32-million, with the main investors Eskom, the Technology Innovation Agency (TIA), Sasol and eNtsa.



The development of a small sample value proposition

The first phase of research was dominated by developing a suitable sample extraction and repair technique. To date, eNtsa has developed two approaches.

The first approach is "shallow sampling", where enough material is removed by Electro Discharge Machining (EDM) in such a way that no weld repair is needed.

The second is "deep sampling" or "coring" as per the WeldCore® methodology which includes a Friction Taper Hydro Pillar Process (FTHPP) repair.

With the acceptance of the WeldCore® FTHPP as part of American Society for Mechanical Engineers (ASME IX) welding code, the sample retrieval and repair process from components has become a regular engineering request.

Initially, small sample extraction was primarily performed for assessment of creep damage. However, with the developments around small punch static testing, both static and creep testing are actively pursued by industry to take full advantage of small sample testing.

The tangible value of small sample testing lies in the ability to obtain sub-surface metallurgical and material data to support engineering decisions from a small volume of material.

Typically, the removed sample will be carefully evaluated before removing a disc for testing. This is done to ensure all information in the area of the final disc extraction is known and can be included in interpreting the final results and recommendations.

eNtsa uses X-Ray tomography as a first step to help to identify the position of interest accurately before removing a disc.

Small punch test (static properties)

The small punch test (SPT) method was initially developed to derive “critical strain energy density” values to assist with investigating, qualitatively, the initiation fracture toughness on service exposed material.

eNtsa researchers found that the best use of the derived “critical strain energy density” was as a ranking tool for describing comparative degradation on a component or plant material sampled from different positions.

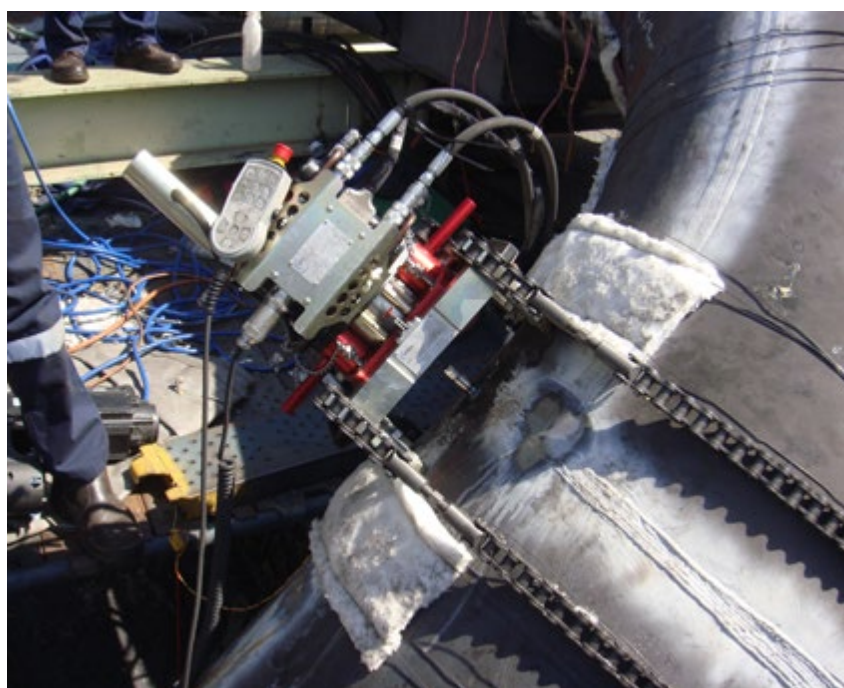
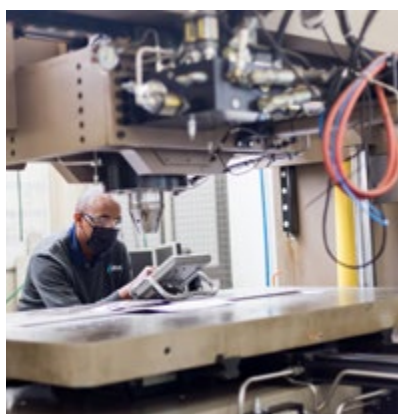
Additionally, eNtsa data revealed a good correlation between yield strength measured by traditional methods versus yield strength estimated by the small punch analytical approach.

Small punch creep test

eNtsa has developed a fleet of 11 small punch creep test (SPCT) platforms and, due to industry demand, this is being expanded to 17 platforms. Nelson Mandela University researchers believe this to be the largest fleet of SPCT platforms in the world.

eNtsa platforms use a ceramic ball-punch configuration with direct temperature measurement. Currently platforms are generating creep data for the petrochemical and power generation industries. Testing and analysis is aligned with CEN Workshop Agreement: CWA 15627 – Small Punch Test Method for Metallic Materials, soon to be replaced by an EN standard.

The main advantage of SPCT is embedded in obtaining useful load/



time/temperature dependent data from a small volume of material in a shorter time than conventional tests. The goal with creep testing is to reach a point where a remaining life can be estimated.

The small punch test methodology and associated analysis technique has proven to be highly useful in determining time independent and time dependent mechanical properties of materials used for high value engineering infrastructure. Small sample test data inform engineering decisions as it is extracted, *in situ*, in small volumes from operating plant at the point of interest. This allow engineers to make evidence-based decisions and

calculate mechanical properties as a function of observable microstructural or degradation phenomena. Emerging research relates to Impression Creep (IC), another accelerated technique that uses miniature-sized test samples. This is different to the SPCT test, as the IC test does not run to rupture, but merely until a steady state deformation rate has been achieved.

In conclusion, the ability to remove a representative sample and effect an accepted weld repair has highlighted small sample testing as an attractive methodology on which to base engineering decisions on component remnant life and integrity.

// Through the enhancement of innovative learning and teaching strategies, I aim to assist future generations with clearly structured stepping-stones to facilitate a holistic approach to use technology to enhance society ... "

Greunen is still actively involved in the strategic direction of learning and teaching at the University. She is also actively engaged in the development of lifelong learning programmes for the greater enhancement of society.

"Through the enhancement of innovative learning and teaching strategies, I aim to assist future generations with clearly structured stepping-stones to facilitate a holistic approach to use technology to enhance society at large."

Prof Van Greunen strives to integrate learning and teaching with applied research to advance skills in problem definition, analysis, synthesis and communication.

She also emphasises the human context of social demands, ethical considerations, sustainability and personal responsibility aligned with a strong value system. This goes with her belief in the link between teaching, research and innovation.

Prof Van Greunen has led University learning and teaching initiatives with successful proposals to the European Union, the South African Medical Research Council and the Department of Basic Education, among others.

"We have embarked on a journey of true interdisciplinary learning and teaching initiatives through the development of integrated technology solutions to offer courses ranging from the training of

Law Enforcement Officials to the overall Wellness Curriculum of schools. I also have an active interest in finding innovative ways to ensure the teaching and learning activities remain decolonised."

To date, Prof Van Greunen has successfully supervised 55 students to master's (40) and doctoral (15) degrees.

Research Interests

In her 25-plus years at the University, Prof Van Greunen has relished the opportunity to drive excellence and enhance the student and staff experience in using technology to address societal challenges.

For the past seven years, Prof Van Greunen has been responsible for the Centre for Community Technologies (CCT), establishing it with no funding and leading it to become a self-sustainable entity with a multi-million-rand per year turnover. The CCT is now an established hub for research, innovation and professional consulting in support of technology as an enabler in South Africa as well as internationally.

She has extensive experience of both academia and industry and, through her collaborative initiatives at international multi-partner and multi-national level, has become known as an innovative and creative individual.

Prof Van Greunen's research interests are of a multidisciplinary nature including user experience and interaction with technologies, the requirements of a high technology 4IR-mediated environment and infrastructure, virtual learning environments and innovative digital technologies to enhance healthcare on the African continent.

Her research has contributed to several national policy briefs, legislation and reviews and reports.

She has published and presented more than 150 peer-reviewed research papers, and is frequently invited as a keynote speaker at international conferences across the globe.

Research at eNtsa

At eNtsa, research and innovation (R&I) are key areas and focus on expanding research and technology transfer. Areas of speciality include the field of small sample material evaluation, friction hydro-pillar processing, heat treatment solutions and laser processing (complex cutting, welding and metal deposition).

The R&I drive at eNtsa is formulated to contribute new knowledge generation that will assist with managing engineering challenges. These are associated with safely prolonging the life of high value components; in certain instances well beyond the original design life.

Facilities include world-class research equipment and the eNtsa network expands beyond national borders. This enables its research team to operate at the forefront of knowledge generation interacting with technology and application experts. Through meaningful engagement with strategic partners, it aims to proactively identify important industrial engineering challenges to gear

industry and market readiness through R&I and engagements efforts.

eNtsa's research drive is grounded around the premise of creating a platform where academic and industrial research can interact in a synergetic relationship to contribute to socio-economic development within the engineering, power generation, automotive, advanced manufacturing, and petro-chemical or any other related spheres.

Academic postgraduate research activities

eNtsa has taken a stance to more actively pursue postgraduate and postdoctoral projects. R&I projects are closely linked to engineering expertise development, which over the last couple of years has demanded a more aggressive approach to recruiting students. eNtsa currently has 10 full-time and part-time postgraduate students.

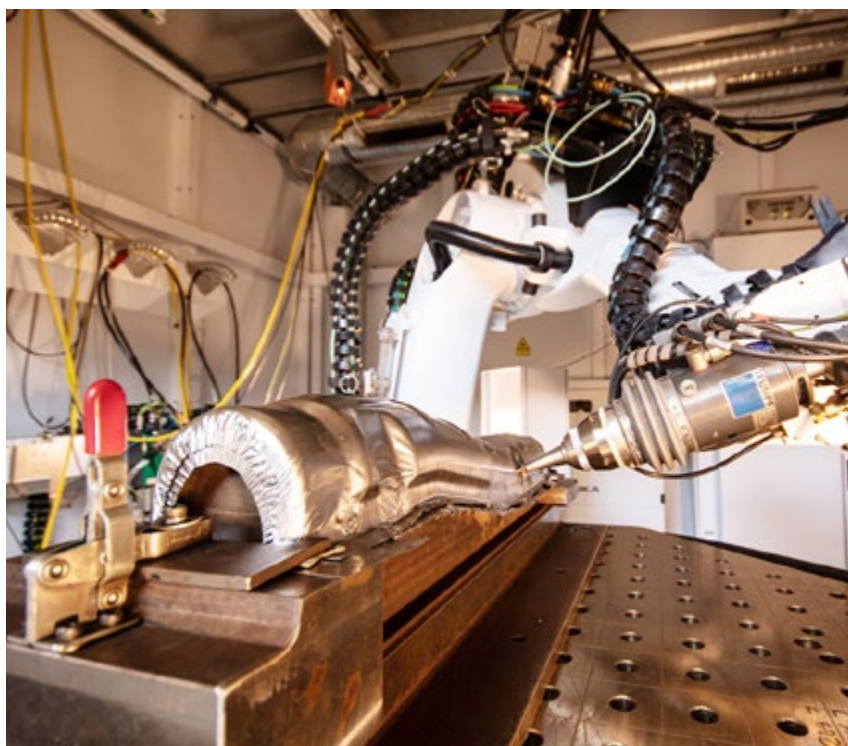
During the 2021 academic year, eNtsa hosted 13 projects (nine master's and four doctoral).

The following projects have reached maturity and are aimed to be concluded and graduates walk the stage during the University's April 2022 graduation session:

- Induction Heating as an alternative Localised Post Weld Heat Treatment for Friction Taper Hydro-Pillar Welds on thick-walled steam pipes
(MEng: Mechanical Engineering – Part-time).

The following six projects made significant progress in 2021 and candidates are in the process of capturing and interpreting data to pursue final inclusions and recommendations for project write-up:

- The use of Small Punch Testing to determine the static properties over the build height of Ti-6Al-4V laser metal deposition samples
(MEng: Mechanical Engineering, Part-time)
- Quantifying the influence of powder alloying additions of Cu, Ni, Ti on the welded joint efficiency of pulsed Nd: YAG laser welded 6061 aluminium by investigating the microstructure evolution and mechanical properties
(PhD: Mechanical Engineering: Part-time)
- Operational optimisation of a dry fermentation digester for biogas production, applying the Acacia Mearnsii as feed stock
(MEng: Mechanical Engineering, Full-time)
- Quantify the Shift in Critical Strain Energy Density of a Dynamic Loaded S355J2 Weld Section by Small Punch Testing
(MEng: Mechanical Engineering, Part-time)
- Encapsulation of flame retardant for lithium-ion battery
(MSc: Chemistry, Full-time)
- The effects of process parameters and weld interface geometries on the hot plate welding of high-density polyethylene components
(MEng: Mechanical Engineering, Part-time).



TruLaser 5020

// **eNtsa is fortunate to have as its greatest asset a competent, intelligent, diverse, multidisciplinary team."**



Andile Msimang, eNtsa Project Engineer inspecting a serration after a preventative grind cycle has completed.

Six new projects started in 2021, and their provisional titles are:

- Fatigue life and whip-peening process parameter interaction as applied to 21CrMoV5-7 turbine rotor steel (MEng: Mechanical Engineering, Part-time)
- Autonomous Underwater Vehicle with Autonomous Launch (MEng: Mechanical Engineering, Full-time)
- Machine Learning for Precision Control of RPAS near Moving Objects (PhD: Mechatronics)

- Micro Friction Stir Welding (μ FSW) of thin aluminium to copper for lithium-ion battery tab fabrication (PhD: Mechanical Engineering)
- Provisional: Adaptive Beamforming Array with Beam-Steering for Marine Robotic Communication (MEng: Mechatronics)
- An artificial intelligence solution that enables accurate and precise identification of organisms, assessments of abundances and measurement of size (PhD: Mechatronics).

Professional and industrial research activities

eNtsa is fortunate to have as its greatest asset a competent, intelligent, diverse, multidisciplinary team. This has enabled eNtsa to position itself as a sought-after and unique solutions provider to the power generation and petro-chemical industry, and ensure its relevance.

Technologies have been developed by eNtsa through internal research activities (self-funded) as well as contracted research projects, and these have further become specialised services that eNtsa now offers for industrial application. A prime example of this is the serration grinding and whip peening technology which was used on rotors for repair and preventative maintenance at Eskom.

Research associates

Engagement and interaction with engineering experts through the appointment of Research Associates is focused on strengthening R&I activities and collaboration with other professional and academic organisations. These include the following:



Dr Mark Newby
(new appointment)

Dr Mark Newby worked closely with the eNtsa team for many years while he was at Eskom. eNtsa's inception was strengthened by novel research in collaboration with Eskom Research, Development and Testing (Eskom RT&D) which led to the successful development of Friction Hydro-Pillar Processing (FHPP). Now retired, Dr Newby has since been appointed as a research associate within eNtsa as a project technical advisor for eNtsa's Small Punch Testing developments and the development of a strain gauge course with the eNtsa Training Academy team.

Dr Newby's latest work includes capacitive strain gauges that are used on high temperature, high pressure components. This technology allows for monitoring while the component is still online. Used within the power generation and petrochemical industries, the capacitive strain gauge provides information on how the material changes without the plant ever having to go offline. Strain gauge measurement works with metallurgical information and is then able to determine the life of high value components.



Dr Daniel Glaser
(new appointment)

Dr Daniel Glaser, from the CSIR, has been newly appointed as a Research Associate within eNtsa. He will be a technical advisor on laser-related research engagement projects as well as supervision of postgraduate students.



Prof Anton du Plessis
(existing appointment)

Prof Anton du Plessis joined the eNtsa team as a Research Associate at the end of 2019. He is based at Stellenbosch University and is an active research support to the eNtsa team on the subject of X-Ray tomography. Prof du Plessis is currently collaborating with eNtsa researchers to publish a co-authored publication.



Prof Axel Steuer
(renewal)

Prof Axel Steuer, of University West in Sweden, works with eNtsa through research and academic engagement. Prof Steuer also will be working with the eNtsa Training Academy team to develop knowledge transfer interventions within the X-Ray diffraction and also supporting R&I efforts through postgraduate research consulting.



Dr Annelize Botes
(renewal)

Dr Annelize Botes provides expertise in the skills development sphere in support of efforts within the Training Academy and the Technology Station Programme. Dr Botes also provides consulting services to support eNtsa engineering and testing services. She works closely with the team to present workshops to industry in the field of Metallurgy.



Dr Carlo van Zyl
(renewal)

Dr Carlo van Zyl, of Walter Sisulu University, assists in supervising Nelson Mandela University's postgraduate students and has two MEng: Mechanical students set to graduate by 2023.



Prof Neil M James
(existing appointment)

Prof Neil James from Plymouth University in England has been working closely with the eNtsa team for many years. He continues to work with eNtsa through research and academic engagement, including co-authoring journal articles for publication. Prof James is also working with the Training Academy to produce a short one-day webinar on welding and failure analysis.

Ultra-high precision diamond turning of advanced contact lens polymers

Research by Khaled Abou-El-Hossein

By Prof Khaled Abou-El-Hossein and Muhammad Mukhtar Liman

The demand for contact lenses (CL) is increasing rapidly among different age and race groups in Africa. In the global optical industries, the CL segment has witnessed a sweeping transformation from being considered lifestyle products to becoming common eye accessories sought as a convenient and fashionable replacement to glasses.

Transparency Market Research estimates that the global CL market will expand at a 7.6% compound annual growth rate between 2016 and 2024. At this pace, the market, which had a valuation of US\$9.74-billion in 2015 in terms of revenue, is projected to rise to US\$18.70-billion by 2024. In terms of

volume, the market is expected to rise to 2,135-million units by 2024.

Due to the fast growth in optical industries, CL require high accuracy and a high surface quality. The demand for high-accuracy and minimal surface roughness (Ra) drives the development of ultra-high precision machining (UHPM) technology based on single point diamond turning (Figure 1). UHPM is an advanced manufacturing technique used to machine CL as it can produce high-quality optical surfaces with complex shapes and nanometric accuracy.

However, even with advances in UHPM, it is not easy to continuously achieve a high-quality surface finish when machining

polymers, as the adhesion of the tool chip around the tool dictates the presence of electrostatic charges (ESC).

The ESC encountered by a cutting tool when turning advanced CL are important as they reflect the quality and condition of the tool, machine, fixture, and sometimes even the finished surface, which is responsible for tool wear and poor surface quality.

For this reason, this study investigates the role of cutting parameters, namely cutting speed, feed rate and depth of cut on Ra and ESC, which determines machine economics and the quality of machining CL polymers.

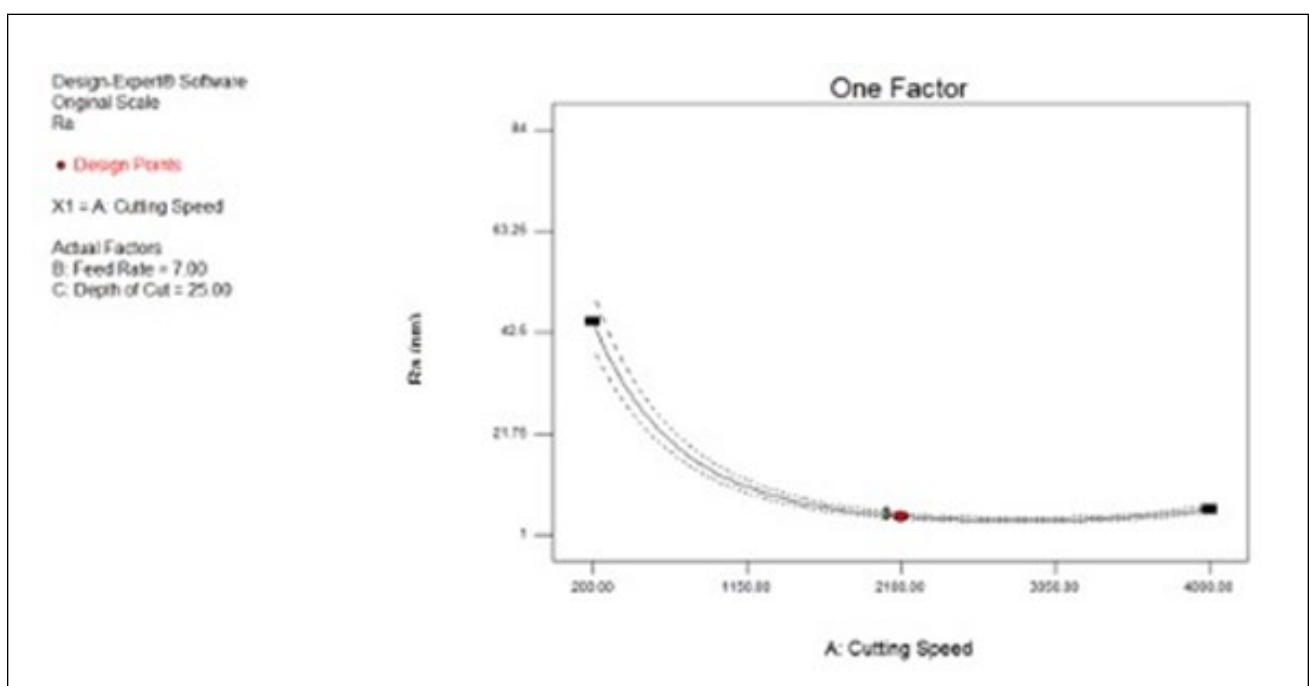


Figure 1: Experimental setup contact lens polymer

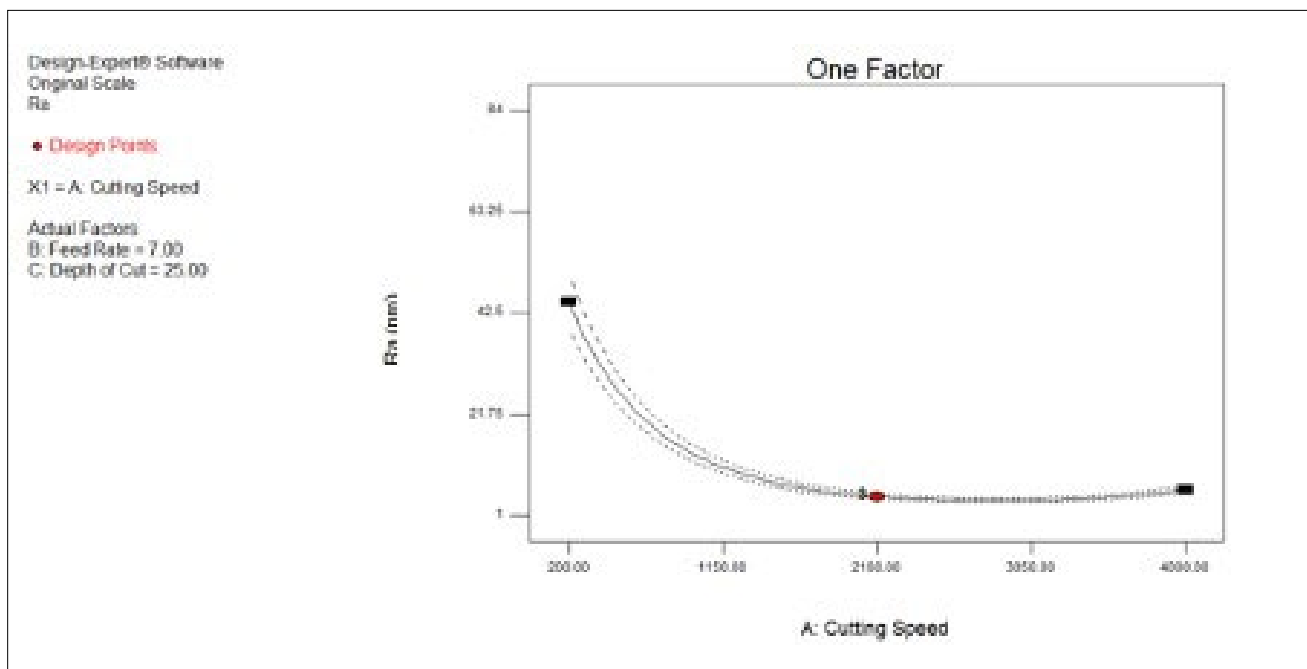


Figure 2: Ra versus Cutting speed [4]

Figure 2 shows Ra versus Cutting speed. Cutting speed was found to be the most significant factor affecting Ra, followed by depth of cut, while feed rate has no effect on Ra.

Also, analysis of variance results for ESC explained that the cutting speed is the most significant factor affecting ESC, followed by depth and feed.

Figure 3 depicts estimated contour plots for ESC (depth versus cutting speed).

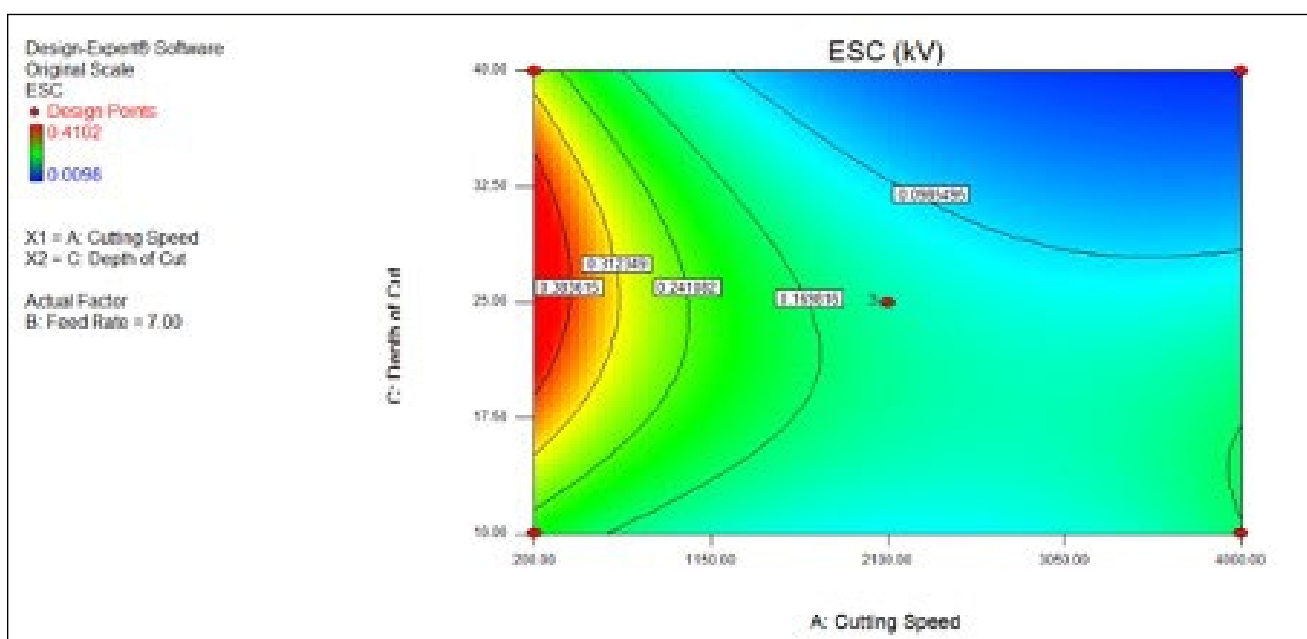


Figure 2: Estimated contour plots for ESC (d v v) [4]

Personal Privacy: Technology to the Rescue?

Research by Prof Reinhardt Botha

By Prof Reinhardt Botha

With the increased sharing of potentially private information through the Internet, protecting individual privacy has received increased attention. However, there is a privacy paradox as users report being concerned about their privacy, yet easily part with private information when given the opportunity. Users' lack of understanding of privacy implications and mechanisms partially explains this paradox.

Privacy legislation worldwide has seen the light and placed the burden of protecting private information on the corporate custodians of such data. In Europe, the General Data Protection Regulation 2016/769 (GDPR) became enforceable on 25 May 2018. In South Africa, the Privacy of Personal Information Act (POPIA) became enforceable from 1 July 2021.

POPIA, in line with information privacy legislation across the world, requires that organisations enforce information privacy rules in technology systems handling personally identifiable information (PII). While policies and procedures, if enforced and followed, can go a long way towards ensuring compliance with the legislation, in the long-run, technical assurances are also required to ensure that the law is upheld.

Protection of private information should thus not be merely an add-on, but an integral part of the system design and development. The research project of doctoral candidate Agbor Kande sets out to design a rule-based privacy engine through which privacy rules can be enforced. While the model aims to be generic, POPIA rules are used to demonstrate the usefulness of the model in the South African context.

The design makes use of Unified Modelling Language (UML) ontology language notations to represent software objects encapsulating the forward chaining business rules execution method to make inferences and conclusions based on PII data and metadata.

We are creating a prototype that will help organisational stakeholders such as information system operators and users, business owners, software system owners, and government authorities to understand and visualise the theoretical and practical constructs of such an engine.

This study showcases the primary software objects required to enforce

information privacy rules in a technology system, different scenarios (use cases) and interaction points, and the key actors. It proposes a business rules execution method and methodology suitable for handling both information privacy rules and PII data elements in the information privacy protection domain.

Legal and technical interventions cannot address all privacy concerns.

As such, we also study the behaviour of people, specifically behaviour related to privacy information, to better understand why people act the way they do. This type of work is done with the goal of being able to change behaviour through awareness and training interventions.

... there is a privacy paradox as users report being concerned about their privacy, yet easily part with private information when given the opportunity.

The foundation of university-industry partnership

Research by Professor Igor Gorlach

The Isuzu Chair in Mechatronics at Nelson Mandela University was established in 2009. Initially sponsored by General Motors and later by Isuzu, the main objective of the partnership is to co-facilitate cooperation between industry and academia with the aim to enhance human resource development (HRD) in support of the automotive industry.

To achieve its objectives, the steering committee established the Chair structure and developed the scope of its activities. The guiding priorities are to: identify mutually beneficial projects, engage with the company engineering departments and University staff to support joint activities, facilitate research, training and education, transfer knowledge, and guide and support students in their interactions with the company.

The Chair activities are regularly assessed by the steering committee, which consists of the University and company management. Detailed annual reports which evaluate the activities and provide strategic guidance for the future are provided to this committee.

The Chair is also actively involved in cutting-edge research, collaboration with international universities, hosting research seminars and providing support for student exchange. International exchange students who take their internship at the University are involved in design projects at Isuzu. The Chair activities include commercialisation of products and inventions developed by students. This is achieved by means of registering patents, developing business plans, running market surveys and establishing spin-off companies.



Figure 1: Designs of fuel tank loading devices

High impact projects

The following section highlights the success of the Chair through high impact projects.

Projects

Project 1 – Fuel tank loader

This project aimed to design a device for lifting and installing fuel tanks to the stuck chassis at the Isuzu truck assembly line. It commonly needs two operators to lift and install a fuel tank, which is unproductive and physically difficult. The students produced a number of viable solutions for a low-cost, semi-automated system to improve this operation, shown in Figure 1.

Project 2 – Semi-automatic station

Senior mechatronics students are assigned more complex projects which require in-depth knowledge of various engineering courses. Students were asked to design a specific station to assemble transmissions of pick-up trucks on the new line. The old assembly line had six stations, while one station was placed outside the line. This operation was for attaching a torque converter to an automatic transmission.

The goal was to design a semi-automated station in such a way that it would allow operations to be completed on the line. In designing the station, students were required to apply a multi-disciplinary approach, as well as important ergonomic aspects. In addition, they had to produce the complete detailed design of the station, shown in Figure 2.

The engineering staff at Isuzu evaluated the students' designs and selected the best, which was implemented at the company, as shown in Figure 3.

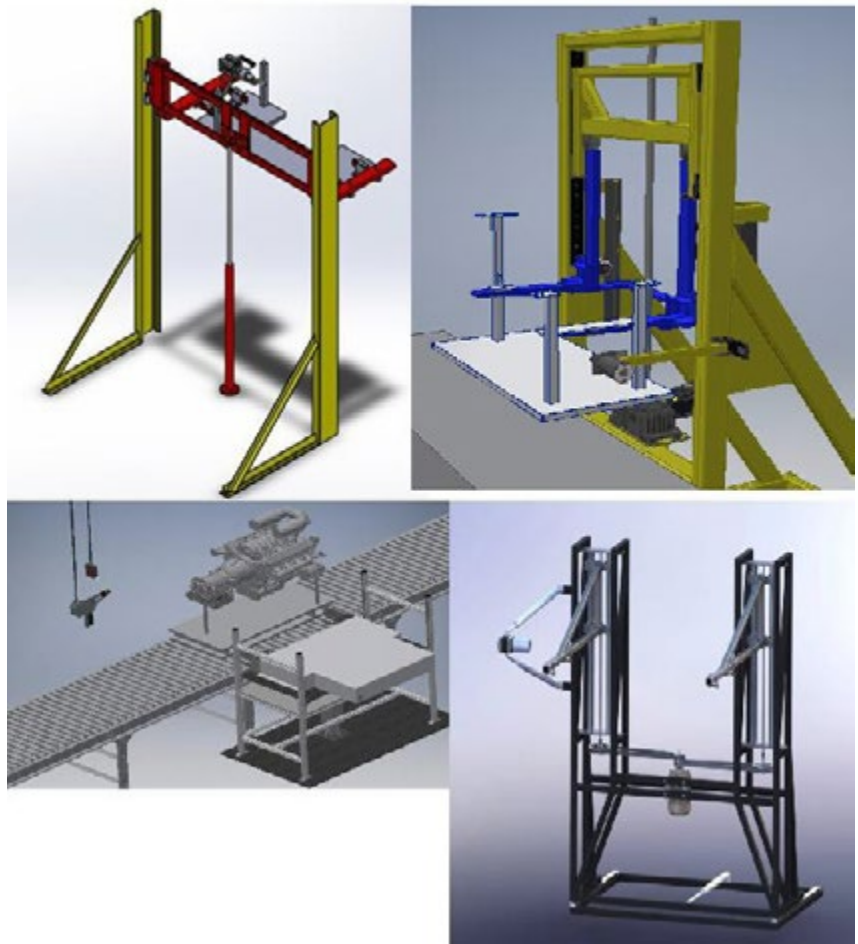


Figure 2: Designs of the semi-automated station



Figure 3: Implemented semi-automated station

Project 3 – Automated guided vehicle

One area particularly important for the company is the efficiency of material handling in assembly. The company required a low-cost solution for transporting parts between assembly

stations. This complex problem was tackled by master's students who developed a low-cost automated guided vehicle, shown in Figure 4, which was successfully introduced to the production facility at the firm's Struandale plant.



Figure 4: Automated guided vehicle

Project 4 – Foldable platform

When the assembly facility of Isuzu trucks needed to be relocated to a new plant recently, it called for new assembly lines, support systems and auxiliary equipment to be designed. The students took part in this process from the start and, together with the company engineers, designed fixtures and devices.

Following a thorough study and evaluation of viable options, a special conveyor was designed to facilitate assembly of trucks to achieve an efficient flow of materials and operations. The core of the material handling system is a special platform which was designed by students. The platform has foldable and adjustable elements that can accommodate trucks of various sizes, and support the truck chassis during the whole assembly process. The system was successfully implemented at the new facility, as shown in Figure 5.

Conclusion

The long-term collaboration between academia and industry makes a significant impact on HRD and benefits students, local industry, and the community at large. The case studies of industry-based students' projects clearly demonstrate how a university-industry partnership can be successful and mutually beneficial.

Both the University and the industry partner strive for sustainable long-term collaboration with a common aim to help bridge the gap between academia and industry, and to contribute to HRD. Since the partnership started, with guidance from industrial mentors and academic staff, students have accomplished a number of industry-based projects. The

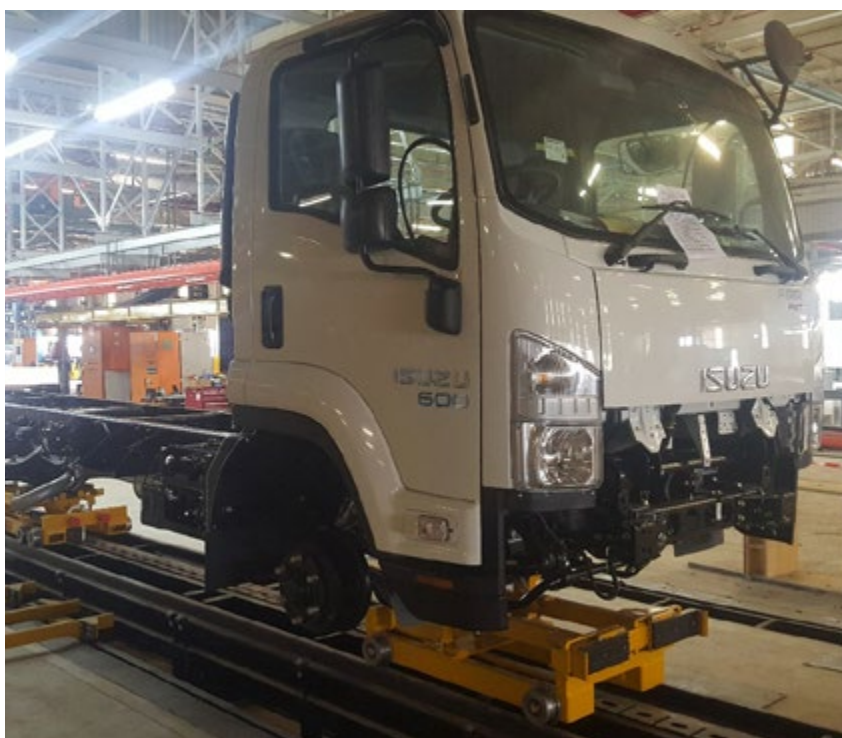


Figure 5: Foldable platforms supporting a truck on the assembly line

practical experience and exposure to the real-world industrial environment enhances students' skills and better prepares them for future careers in industry.

The relevance and complexity of projects are important factors as they might result in a success or a failure. Therefore, it is important when selecting projects to choose challenging but realistic goals, identify possible constraints, use clear communication channels, obtain regular feedback, and monitor and engage with all parties at all stages of a project.

Students from different engineering streams, and levels from undergraduate to postgraduate, are involved in solving industrial problems individually

or in groups, following the systems engineering approach, and are in regular contact with the company engineers and staff.

The four case studies show the benefits of combining the theoretical expertise of the University, student drive and enthusiasm, and practical expertise with a striving for competitiveness from industry. It can bring significant achievements for all parties involved.

Dynamic university-industry partnerships, where staff and students actively participate, can enhance engineering education and HRD, as well as drive innovation, improve company competitiveness, help create jobs and benefit society.

Stuttering towards 2030: the plight of Lusaka, a sub-Saharan African city

Research by Paul Makasa

Most world cities are inching closer to UN Sustainable Development Goal 11, “sustainable cities and communities”, by making themselves and their settlements inclusive, safe, resilient and sustainable. The Zambian capital of Lusaka, one of the sub-Saharan African (SSAn) cities which is stuttering towards, yet lagging behind in reaching, this goal, still has a sprawled and fragmented structure which imposes high costs on residents. The population of the city has increased from 138 000 in 1968 to 1 267 440 in 2019, with 45% living in upgraded housing.

This study identifies sprawl, segregation and fragmentation as patterns characterising the city of Lusaka. It also puts into context how the city can be made more competitive.

Lusaka was originally planned to an extended layout to preserve the structure and reduce initial capital outlay. Future developments were meant to be made through densification and the additions of suburbs. However, due to a technical oversight, the plans were non-statutory. Bylaws and lease clauses have ineffectively controlled development and the city has grown in a piecemeal, loosely structured way.

Different uses were permitted for different sectors, which established mono-functional and dysfunctional spaces. Racial segregation further exacerbated the sprawl and the city now covers an area once considered a region.

At the same time, Lusaka has inefficient transport infrastructures. In addition,

it has restrictive institutional and legal frameworks which are serious obstacles to its competitiveness.

Generally, a nation's capital city is a productive engine of growth in which management and power are increasingly centralised. It plays an important role in controlling the global economy, containing population growth, international trade and flow of capital, and the effects of globalisation. It also helps to bring economies of scale, develop markets, create jobs and encourage new economic activities to flourish. Globally, a city can trade competitively anywhere.

In the transition from mega to global cities, the role of cities changes from primary to industrial production and

services. They become nerve centres of finance, major global processes, information and people.

However, SSAn cities are failing to attain this, despite having been established as centres of trade and defence while exerting an influence on residents through their spatial forms. Their spatial form has become their main inhibitor.

These cities are urbanising rapidly but without matching growth of dense capital and infrastructure investments, so they fail to compete economically with other cities. They face inefficient land markets, overlapping property-rights regimes, sub-optimal and ineffective zoning regulations, all of which hinder their drive towards prosperity.

// In the transition from mega to global cities, the role of cities changes from primary to industrial production and services."

Resource-starved migrants may exert undue pressure on available services while recipient municipalities fail to cope and are unable to provide effective services.

SSAn cities are struggling with a horde of overwhelming challenges in managing young and unskilled populations; transportation and communication infrastructure deficiencies; inadequate housing institutions; unbalanced growth, low competitiveness and environmental problems. This overwhelms over-regulated municipalities which lack sufficient finance to permit expenditure on development plans.

Cities in Zambia are highly regulated and cannot compete effectively. Local economic and urban development policies are passed down to municipalities. While some gain from trade liberalisation, others have failed to adapt sufficiently.

Ever since the mid-1970s, when government's heavy and visible hand started to intervene, they have been performing badly.

The ensuing sluggish economic climate has pushed most urban poor into the informal sector, which does not add

tangible value to tradable goods and dampens competitiveness.

There are challenges in tax collection with informal traders. Municipalities fail to collect decent user-fees from clandestine trade but still have to use limited resources to clean up problems stemming from this trade.

Unsustainable informal activities thrive on unregulated social contacts, leading to poor living environments. This affects community water quality, sanitation and numerous health hazards which in turn creates ripe conditions for waterborne diseases and illnesses such as COVID-19 to thrive.

To change this, actors at different levels need to play their roles effectively to make Zambia's cities more competitive (figure 1 below).

Global actors at a strategic level should formulate and ensure that universal policies guiding national governments and commitments are adhered to. They also should finance and support feasible initiatives and ensure that good governance prevails. Regional bodies should adapt these into their regional policies.

Central governments at political and strategic levels should decentralise, mobilise capital, and facilitate others to act, only intervening to safeguard the interests of the poor while acting as watchdogs. If unchecked, the actions of firms may have a negative impact on residents.

Municipalities should strengthen their competencies, and source and finance LEDs. They also should permit public-private partnerships to generate enough resources to meet their inhabitants' aspirations. Land should be made available, along with a reform of land use planning to promote efficient use of urban land, and environmentally friendly economic ventures should be undertaken.

At a micro-level, policy makers should maximise economic options for city dwellers while guarding against exclusion, exploitation, unsanitary conditions and "externalities". Investors should compete effectively within a framework of minimum government standards.

The way forward in enhancing the economic potential of cities hinges on the capacities of municipalities to develop and operationalise well-focused urban management strategies.

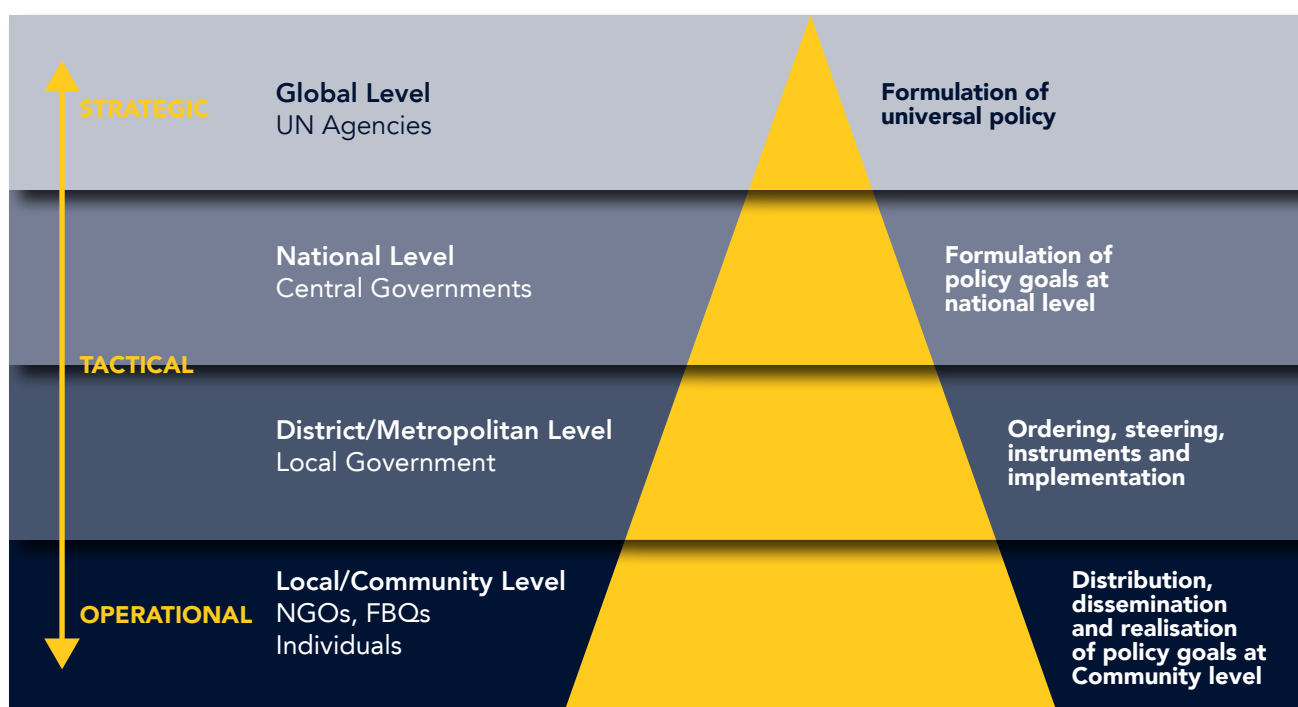


Figure 1: The role of different actors Source: Author

This involves significant transformation, requiring change and capacity building. Attention must focus on several actions to:

- Enhance capacity in generating robust economic activities
- Achieve growth and competitiveness
- Alleviate urban poverty
- Maximise direct employment opportunities capable of igniting multiplier effects.

Spatially, sprawl, separation and fragmentation, spurred by restrictive institutional and regulatory frameworks, characterise Zambia's settlements. Combined, these issues generate serious urban challenges which discourage investment. These need to be ameliorated, otherwise they will continue to dampen and even bar city investment.

Attempts at making Zambia's urban areas more competitive must involve all actors focusing on integrating their spatial structures and reforming urban development regulatory frameworks.

To rectify artificial functional divisions imposed by past planning inefficiencies and decentralisation, urban policy must integrate the colonial legacies of segregated mono-functional and dysfunctional city spaces.

**“ Attempts
at making
Zambia's urban
areas more
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structures ... ”**

Mandela Autonomous Operations Group VTOL aircraft patented

Research by Prof Russell Phillips

The configuration of a design of a vertical take-off and landing (VTOL) aircraft for high payload, extended endurance operations by the Nelson Mandela University's Mandela Autonomous Operations (MAO) Group has been patented and shows promise with regard to increased payload, durability and ease of operation.

The project

The MAO was approached early in 2019 to develop an aircraft capable of the following autonomous mission:

- 50kg payload
- Vertical take-off from an unprepared surface on land
- Flight to a point 50km offshore
- Five minutes of stable hover while taking ocean water samples using a probe lowered into the water
- 50km return flight
- Vertical landing

According to Prof Russell Phillips, manager of the Renewable Energy Research Group (RERG) and the MAO, existing multi-rotor aircraft are not capable of the required mission due to the constraints of current battery technology and the power requirements of rotor craft. Typically, multi-rotor aircraft have a maximum endurance of around 30 minutes regardless of their size.

During normal forward flight, a conventional fixed wing aircraft requires less continuous power to maintain altitude than a rotor craft lifting the same mass. Additionally, a high aspect ratio wing plan form further reduces power requirements.



Forward flight mode – central motors provide forward thrust. Outer motors switched off and locked.

Basis of design

The challenge faced by the group was how best to provide a high aspect ratio fixed wing aircraft with VTOL capabilities. A study of what other developers around the world are currently developing yielded a variety of configurations which formed a basis for the design.

A number of designs have demonstrated VTOL with transition to and from fixed wing forward flight. However, without exception, all designs suffered from compromises in both phases of flight related to the configuration of lift and thrust motors and the detrimental effect of their weight on payload.

Novel features unique to patented design

Nelson Mandela University's patented design has novel and unique features:

1. Central motors provide raw thrust during hover and do not require precise control, only simple throttle control. Central motors can be more powerful than external motors and thus provide the bulk of the thrust required for hover.
2. Central motors pivot. Front motor pivots upwards. Rear motor pivots downwards.
3. During hover, where most power is required, all six motors contribute to the total thrust, maximising payload.
4. During forward flight, when less power is required, only the central motors are powered. The four outer motors are switched off and their propellers locked in a low drag (fore/aft) orientation.
5. The central motors are electric or internal combustion. Because they do not require precise control, the option of internal combustion is possible. This will allow for extended range over purely electric power due to the energy density of fuel.



Nelson Mandela University prototype under construction (7,5m wingspan)

6. The four (or six or eight) external motors are electric (three phase-brushless) to allow precise torque and speed control necessary for hover stability using standard quadcopter/hexacopter control systems.

Patent Claims

Patent claims are that the configuration proposed will allow for greater payloads to be lifted when compared to other VTOL designs. Some of the increased payload can also be replaced with additional batteries and/or fuel, allowing for increased endurance when compared to other VTOL designs.

Successes to date

A reduced scale prototype with a 1,5m wingspan has been successfully flown and transitioned between hovering flight and forward fixed wing flight. Numerous fully autonomous flights have been conducted to validate the developed

A reduced scale prototype with a 1,5m wingspan has been successfully flown ... "

control software to safely transition fully and partially between flight modes whilst maintaining stability. Once completed, the testing performed should reduce risk in the upcoming testing phase of the full-scale prototype.

Advanced Mechatronics Technology Centre (AMTC)

Research under professors Russell Phillips and Theo van Niekerk

Although Nelson Mandela University's Advanced Mechatronics Technology Centre (AMTC) draws on the strength of many academics, Professors Russell Phillips and Theo van Niekerk are the two EBET professors most directly involved in its work.

The AMTC initially started 18 years ago to strengthen the practical components of the mechanical engineering academic programme and since then, the centre has grown into a multi-disciplinary engineering programme that serves academia, industry and the community.

The AMTC provides a platform, including infrastructure and administrative support, for research professors to engage in

research and project activities without an added administrative and financial burden.

It has a philosophy of empowering academic staff and encourages them to engage with students as a resource to commission projects. Today it supports numerous innovative projects, financially as well as in other ways.

Master's student Kabelo Mpurwana and his supervisor Prof Russell Phillips set off to gather in-flight data for Kabelo's research project on long-range autonomous control of maritime patrol aircraft

Prof Phillips, manager of the Renewable Energy Research Group (RERG) and Mandela Autonomous Operations (MAO), is

involved in more than one AMTC project, including the long-range autonomous control of maritime patrol aircraft.

"Research that is fun and funded flies. No pun intended!" says Prof Phillips. "Add in healthy budgets for equipment as well as bursaries that allow the students to focus on their studies and not on financial worries and one has a winning recipe."

Having research supervisors and promoters within a vibrant, well-funded and well-managed engagement entity, leads to many postgraduate students crossing the graduation stage.

"The AMTC has excellent leadership with a caring engineering team approach. It provides a supportive and enabling



Master's student Kabelo Mpurwana and his supervisor Prof Russell Phillips set off to gather in-flight data for Kabelo's research project on long-range autonomous control of maritime patrol aircraft



Prof Theo van Niekerk with intern Sivashani Pather and master's student Thabelo Mohlala

environment to conduct exciting research projects that solve current and challenging multi-disciplinary, real-world problems," says Prof Theo van Niekerk.

merSETA Emergency ventilator programme

The COVID-19 pandemic which disrupted the world in 2020 led to an urgent need for mechanical ventilators and, in response, the merSETA called for design and testing of emergency ventilators. The AMTC applied and was accepted for two projects, one of which was an emergency BiPAP ventilator to help patients to breathe.

Officially starting in October 2020, the Mandela University Viro-Vent Challenge team designed a ventilator to meet the WHO and RMVS 001 (UK) guidelines for a portable BiPAP machine. It was managed by Dr John Cawood, who at that stage was a doctoral candidate of Prof Russell. The project was supported by the Lab E7 team and mechanical workshop which

supplied draughting, laser profiles, 3D print services, precision machining and electronics design as well as build assistance.

The emergency ventilator uses a miniature blower to supply air. For safety and control, the airflow has bespoke limiting valves and is administered to the patient via an aspiration valve.

Controls are simplified, from limits prescribed by a medical practitioner, to allow ease of operation by lay persons. The final controls are blower speed, system pressure, maximum flow and peak inhalation pressure (PIP). Flow and pressure values are digitally displayed for rapid set up.

The two air-handling valves in the system are considered to be novel due to the design which uses the relatively low blower pressure and flow to be accurately limited at a lower level. These limiting valves help to control the pressure and flow delivered to a

breathing circuit which uses a positional control valve.

Dubbed shuttle aspiration valve (SAV), this device harnesses the patient's own biological breathing impulses to supply pressurised air through one circuit at specified conditions and allow exhalation through a second circuit at controlled and adjustable backpressure, post exhalation excess pressure (PEEP).

The excess airflow during exhalation is used to cool the electronics and lightly pressurise the enclosure to prevent contaminants from entering.

All three major components are under patent application individually, along with possible design registration for the system with a UK provisional patent awarded in 2021.

In keeping with portability guidelines, the system is powered by a Li-Ion battery pack which delivers a running time of three hours at maximum usage. The

system includes connection facilities to household single-phase outlets or automotive and ambulance DC supply, both of which can run the system while recharging the battery pack in the background.

Riemvasmaak Community Project

An AMTC team has been involved at Riemvasmaak in the Northern Cape for several years, and was able to provide the Damas Guesthouse there with its first off-grid facility in 2018 in the form of a 1kW portable solar pumping station.

After the success of the first pumping station, a second system was supplied and implemented in 2020. One of the two sites consisted of a 5.5kW submersible pump that can pump up to 21000 litres per hour, and an off-grid power supply for lighting in the guest house.

After further investigating the needs of the Namases family, who run the guesthouse, the AMTC sought funding from merSeta to develop an off-grid power supply unit to provide power to the family and their office building. The unit consists of batteries, an inverter, a solar tracking system for the PV modules



Dr John Cawood with the BIPAP Ventilator

and an online management system to control and maintain the system remotely. Funding was approved and installation was completed in October 2021.

Staff from eNtsa and students from RERG completed the upgrade and installation work. In addition to providing off-grid power, the project also aimed to develop a formal agreement between the family and the University.

The benefits of this agreement include:

- Power requirements for their home and office
- Improved quality of life for the family
- Research test site for the University with low cost overheads.

The next phase is to provide the Namases family with a solar powered fridge-freezer that will help to store fresh



The Nelson Mandela University team with Mrs Elise Namases at the off-grid power supply research site

produce from their farm. Students have started research towards development of an optimal solution.

WorldSkills

Nelson Mandela University has had a long-standing relationship with WorldSkills South Africa and provides training and support for participants in the areas of Mechatronics, Information Technology and Aerial Robotics. EBET Faculty members have been nominated and selected as South African Experts and representatives at WorldSkills's biannual event, considered to be the "Olympics" of industry skills, since 2019.

AMTC mechanical engineer Damian Mooney represented the University and the MAO group as the South African expert and mentor for aerial robotics at the WorldSkills Kazan Competition in 2019. Jacques Welgemoed, a fourth year Mechatronics student at the time, achieved the first ever medal for South Africa, placing third in Aerial Robotics behind Russia and China. Welgemoed is now enrolled for his PhD in Mechatronics Engineering with Prof Phillips and Prof Van Niekerk as supervisors.

Mandela University will represent South Africa at the 2022 WorldSkills Shanghai in October with:

- Thabelo Mohlala – Mechatronics (a master's student supervised by Prof Van Niekerk)
- John Fernandes – Industrie 4.0
- Damian Mooney – Industrial Design Technology.



WorldSkills experts, from left, John Fernandes, Thabelo Mohlala and Damian Mooney

**AMTC mechanical engineer
Damian Mooney
represented the
University and the
MAO group as
the South African
expert and
mentor for aerial
robotics ... "**

Intelligent Mechatronic Systems

Research by Prof Theo van Niekerk

Mechatronics focuses on the engineering of electrical, computer and mechanical systems. Intelligent systems may include Artificial Intelligence (AI)-based software systems, such as: expert systems, neural networks, fuzzy logic and genetic algorithms. Within our research team, the concept of Intelligent Mechatronic Systems is simply described as an electrical-mechanical device or system integrated with a microcomputer that has AI-based capacity to analyse sensor data and take action.

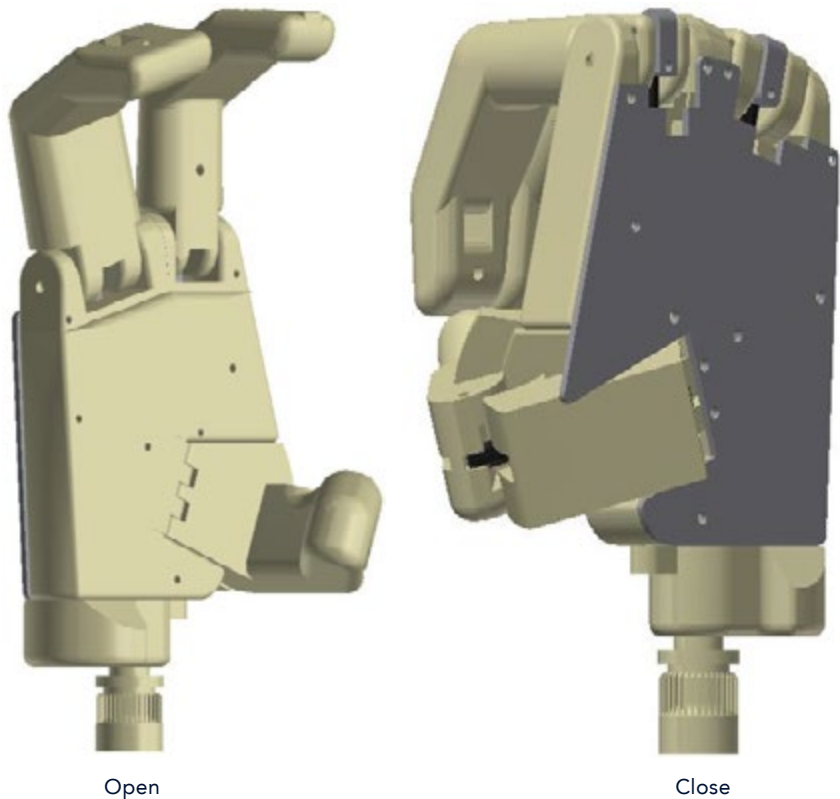
A functional prosthetic hand is an area of interest within the field of biomechanics. Worldwide, more than three million people live with upper limb amputations, and losing a hand drastically reduces a person's quality of life due to the inability to perform everyday tasks.

In response to this real-life challenge, Nelson Mandela University is involved in South Africa's first advanced mechatronics prosthetic hand research, specifically developing the Touch Hand (TH). This research is being conducted in collaboration with Touch Prosthetics (www.touchprosthetic.com) and Prof Riaan Stopforth of the University of KwaZulu-Natal. The Touch Hand is a myoelectric prosthetic hand aimed at giving back to the amputee the function of this body part.

Prosthetic hands are commercially available, but at a high cost and usually procured from overseas sources with significant time delays. The need is growing for a functional low-cost prosthetic device produced locally and made available for amputees in developing countries.

The Figure below shows a CAD model of Touch Hand 4 with static digits in the open and closed position.

CAD model of TH4 with static digits in the open and closed position.



CAD model of TH4 with static digits in the open and closed position.

Nelson Mandela University Mechatronics master's degree graduate Kiran Setty designed and developed the Touch Hand 4 (TH4) mechanical structure and sensor integration. He also conducted analysis and decoding of the surface electromyography (sEMG) signals to control the prosthetic hand as part of this research.

Kyla Purdon, another Nelson Mandela University Mechatronics master's degree graduate, included further feature extraction and identified signal thresholds of the sEMG signals, which the transradial amputee may be generating with actions they are trying to perform.

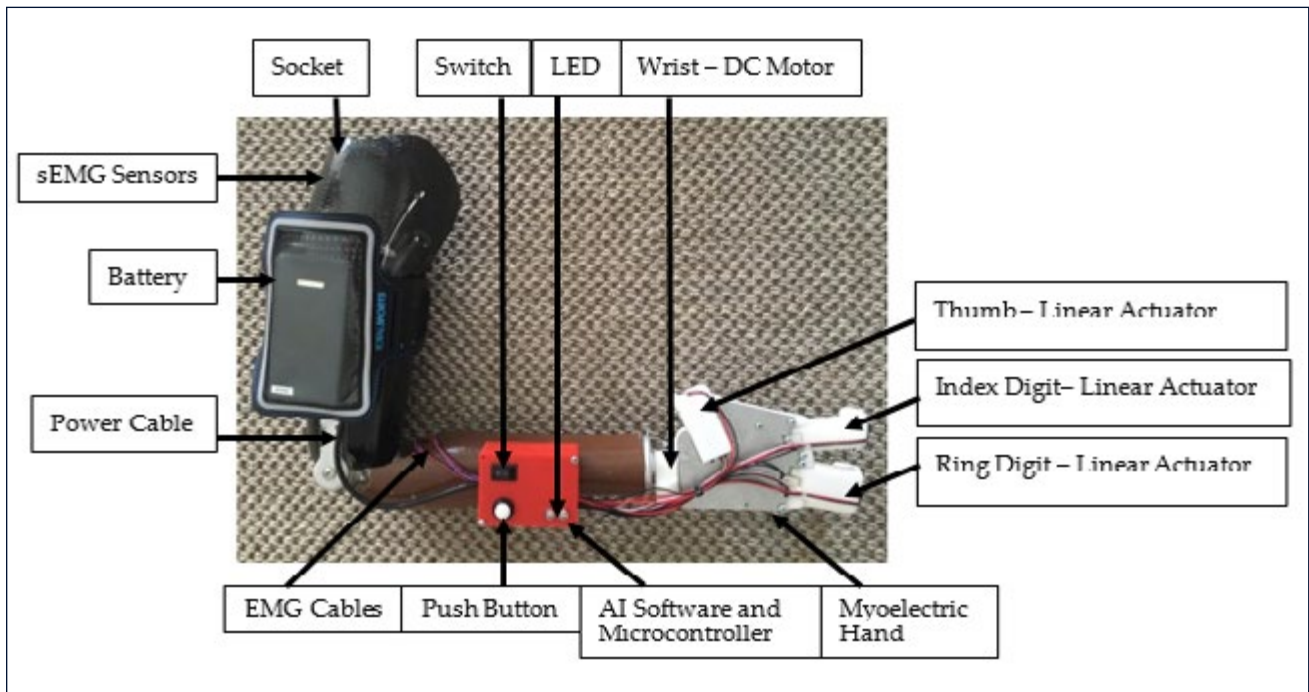
An example of a low cost transradial myoelectric prosthesis is shown below. Purdon developed the software and embedded hardware (red box) with a master's dissertation titled "Sensor Fusion

Based Machine Learning Algorithm for Bio-Controlled Gripper".

A low cost transradial myoelectric prosthesis with integrated TH4.

A myoelectric prosthesis uses sEMG signals recorded from the muscles in the residual limb. A microprocessor device, which interprets the muscle signals and controls the motors via the signal that is pre-processed, performs the feature extraction. These features serve as inputs to a machine-learning algorithm to determine the control of the motors embedded into the Touch Hand.

The sEMG sensors are placed on the transradial amputee's partial limb in the strongest muscle groups. These signal thresholds become the input to the support vector machine machine-learning algorithm that classifies the output of the



A low cost transradial myoelectric prosthesis with integrated TH4.

movements and drives the motors to rotate, open and close the hand.

The research contributed to the development of a process with improved signal feature analysis and threshold detection. The improvement was a result of the process of finding movements and muscles that gave the best signals, although it might not respond to the movement that the prosthetic hand performed.

Furthermore, the integrated machine-learning algorithm improved classification accuracy and overall response time. The algorithm has the added function of being universal, with only the thresholds needing to be updated through a calibration process.

The Advanced Engineering Design Group (AEDG) led by Clive Hands is involved in further structural and functional improvements of the existing myoelectric hand. See more of its work at: aedg.mandela.ac.za

The establishment of the Nelson Mandela University Medical School in 2021 and COVID19-related responses across the University have pointedly exposed the opportunity for the Engineering School and the Medical School to collaborate in areas of common need to benefit local communities.

The research contributed to the development of a process with improved signal feature analysis and threshold detection."

Addressing the cybersecurity skills gap through the curriculum

Research by Prof Lynn Fletcher

The cybercrime epidemic has escalated rapidly with cyberattacks becoming increasingly sophisticated. They involve malware, phishing, machine learning, artificial intelligence and cryptocurrency, and place individuals, corporations and governments at constant risk.

New and evolving cybersecurity threats have placed cybersecurity as a top priority for businesses and nations. However, in both areas it has been a struggle to hire enough qualified cybersecurity professionals to guard against the increase in cybercrime.

According to Cybersecurity Ventures, the number of unfilled cybersecurity jobs globally increased from 1 million in 2013 to 3.5 million in 2021, a growth of 350%. To address this fast growing demand for cybersecurity skills, academic institutions worldwide are introducing courses and programmes to teach students about cybersecurity.

Among the main concerns for academics in computing, however, is which cybersecurity topics to cover, and in what depth, as most courses already cover a wide expanse of content.

Since no single curriculum can encompass the varying cybersecurity skills needed, a set of guidelines has been developed to enable institutions to introduce cybersecurity content according to their specific needs.

These guidelines, referred to as the Cybersecurity Curricular Guidelines (CSEC2017), have been published by a

Joint Task Force. This comprised members from the Association for Computing Machinery (ACM) Education Board, the Institute of Electrical and Electronics Engineers (IEEE) Computer Society, the Association for Information Systems Special Interest Group on Information Security and Privacy, and the International Federation for Information Processing's Working Group for Information Security Education (IFIP WG11.8).

As chair of the IFIP WG11.8, Prof Lynn Fletcher was co-opted to the Joint Task Force with her primary role that of chair of the Global Advisory Board.

Prof Fletcher saw the increased need for integrating cybersecurity into the

computing curriculum, specifically with respect to Software Security. Many of her postgraduate students have therefore pursued their research in this important area. This research has ranged from various approaches to teaching secure programming in undergraduate computing curricula, to using gamification to teach cybersecurity awareness in higher education institutions.

Currently, she has newly enrolled students who are specifically focusing on the cybersecurity skills gap in South Africa. She hopes that through an increased awareness of this, academic institutions can better prepare their graduates to tackle cybercrime in their future careers.

Prof Fletcher saw the increased need for integrating cybersecurity into the computing curriculum, specifically with respect to Software Security."

ICT challenges in South African local government

Research by Mariana Gerber

Research collaboration with Eden District Municipality in the Western Cape that Prof Mariana Gerber has been involved with over two years has delivered successful research outputs and achievements. These include:

- Five master's students have graduated, three of which were cum laude and for which one student received the S2A3 Masters Medal (Bronze Medal) award from the Southern Africa Association for the Advancement of Science
- Policies and implementation plans have been developed for, and implemented by, Eden District Municipality
- Supporting software tool-sets have been distributed to South African municipalities
- Nine conference and one journal article – a total of 10 research publications – have been published.

This Eden District Municipality research aimed to address challenges relating to ICT in South African local government. These challenges, identified by the Auditor-General of South Africa, include problems surrounding municipal corporate governance of ICT, information security, ICT continuity and ICT risk management.

Nelson Mandela University students and staff held multiple meetings and consultations with representatives of the Eden District Municipality, which helped to refine frameworks and software tool-sets to address the ICT challenges.

The University presented a set of documents containing policies and implementation plans to members of the Eden District Municipality's ICT staff. Policies were implemented due to a municipal corporate governance of ICT policy implementation directive from national and provincial government.

// Participating municipalities are able to keep the frameworks and software tool-sets for their own use and implementation ... "

Over and above Eden District Municipality, a number of other municipalities have been identified. They have been invited to evaluate the frameworks and software tool-sets which were developed from this research study. Participating municipalities are able to keep the frameworks and software tool-sets for their own use and implementation, as this is part of the University's research contribution towards the provincial and national municipal corporate governance of ICT policy implementation directive.

The research study further addressed various ICT-related challenges in South African local government by attempting to distribute the frameworks and supporting software tool-sets to other municipalities. The hope is that these municipalities may then improve their future audit ratings.

Optimising weld integrity

Research by Professor Hannalie Lombard

The function between the welding procedure, properties and effectiveness should be well-understood to sustain the structural integrity of welded components for the full life of its application. The quality of the welding procedure, weld properties and weld effectiveness is critical to enable safe welded structures operating under specific environmental constraints.

Engineering structures are often manufactured using materials with vastly diverse mechanical properties to minimise mass and save on costs. However, welded joints in metallic structures are at risk for crack initiation due to intrinsic metallurgical and geometrical imperfections, dissimilar mechanical properties and the presence of internal stresses induced after applying manufacturing processes.

Despite defined welding codes and procedures, there are still failures of welded components and this will remain an important aspect of research and development in South Africa and internationally.

Comprehensive knowledge of macro and microstructures of welds is essential to understand the influence of the parameters at which welds are made on the static and dynamic behaviour of the welds. The solidification or plasticised behaviour in the weld region, depending on the welding technique used, influences the size and shape of grains, the extent of disjoint, and the distribution of defects or flaws formed in the weld region.

Analysis of defects in welded structures could indicate if they are critical and whether or not the structure may be used without risk of failure.

Research Dissertation

Prof Hannalie Lombard briefly discusses one student project on the above topic.

Department of Mechanical Engineering master's degree student Saulos Jirani proposed investigating the influence and effect of process parameters, such as laser power output and welding speed, on the weld quality integrity of Cu/Ti dissimilar welds.

Jirani's dissertation title is: "Mechanical Properties of Titanium Grade 2 to Deoxidised High Phosphorous (DHP) Copper butt welded laser joints".

In this, he studied the effect of process parameters on laser butt welds of 3mm thick on commercially pure titanium and DHP copper plates. The study considered important process parameters such as laser power output and welding speed. An optical microscope was used to investigate the microstructure, and the quality of laser welds was inspected by considering the microstructure, micro-hardness, X-ray diffraction and tensile testing of the weld region.

There were many problems associated with joining these dissimilar materials using laser welding. The reflectivity

of copper for an incident laser beam wavelength of

10.6 μm (CO₂ laser) is up to 98.4%, leading to low absorption of supplied heat energy on the copper side. This could induce residual stress in the weld. The materials welded had different melting temperatures of the two materials, as DHP copper melts at 1083°C and titanium grade 2 at 1665°C. This could lead to incomplete mixing of joint materials due to large variations in melting points of the base materials, resulting in cracks in the heat-affected zone.

The difference in thermal conductivities of 382.6 W/mK (titanium grade 2) 16.4 W/mK and DHP copper 399 W/mK between the welded materials also has a major effect on the dissipation of heat during welding. A complex grain weld structure may be formed due to the different thermal physical properties of the base materials. This may lead to uneven distribution of stresses in the welds that may cause premature failure. Laser welding may result in phase transformation leading to excessive hardness in the fusion zone

"Analysis of defects in welded structures could indicate if they are critical and whether or not the structure may be used without risk of failure."

// From this research, new knowledge helped to increase the use of titanium/copper laser welded joints.

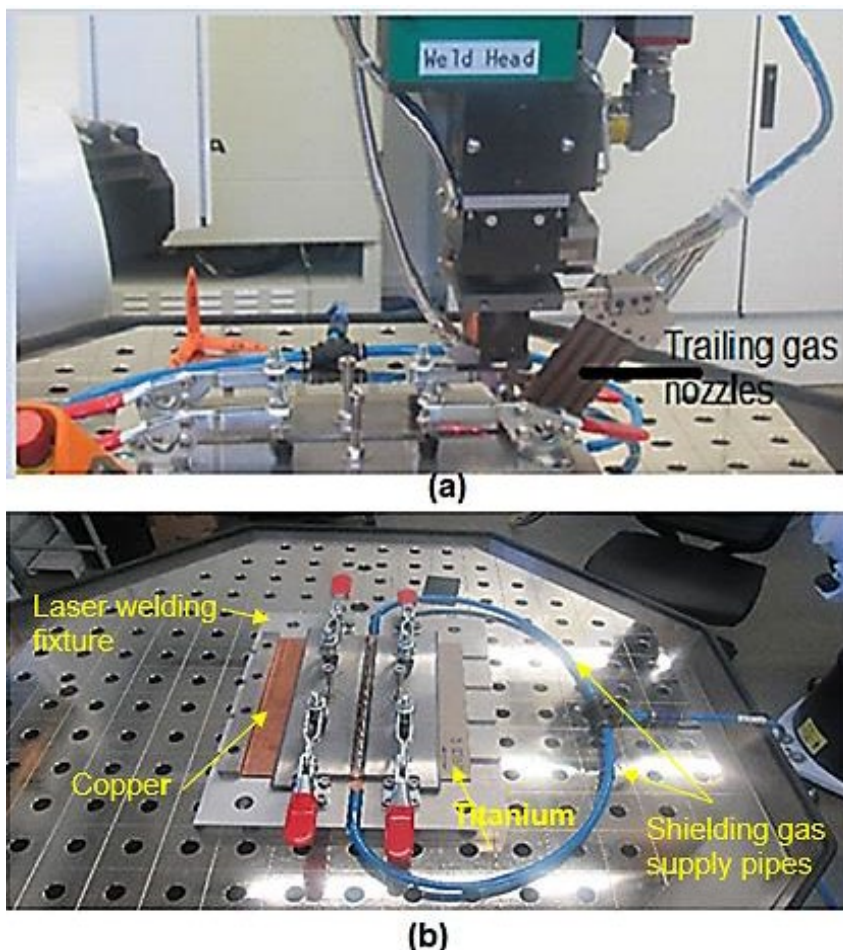


Figure 1: showing shielding gas supply system (a) top surface (b) bottom surface

created by various Cu/Ti compositions formed in the weld interface. Porosity could be caused by hydrogen gas which is highly soluble in copper and titanium in the weld pool.

This work attempted to resolve these problems by off-setting the beam focus from the joint interface. The porosity was avoided by sufficient shielding of the weld pool and weld metal against the harmful gases from the air atmosphere. A custom-made fixture was used to meet the stringent requirement of plate misalignment and to supply shielding gas to the bottom surface of the plates.

In this research, it was shown that titanium grade 2 and DHP copper could be joined in dissimilar laser welding in butt weld configuration. A titanium to copper dissimilar weld free of defects can be obtained when the melting of copper is very limited. X-ray Diffraction investigation revealed the presence of intermetallic compounds in the welds.

From this research, new knowledge helped to increase the use of titanium/copper laser welded joints. Component design opportunities in South African industries such as heat exchanger manufacturing, aerospace, automotive and shipping could be enhanced. The titanium/copper laser will also bring possibilities for new products and manufacturing avenues.

Acknowledgements

The National Research Foundation (NRF) funded this project.

Nelson Mandela University staff members in the Department of Mechanical Engineering who contributed include: Riaan Brown for the operation of the laser cell during the laser beam welding process, Kurt Jenniker and Dinah Koloi for metallurgy laboratory assistance and Stephen Dobson (Department of Physics) for the operation of the X-ray diffractometer measurements.

Modelling a green and smart village in Ekuphumleni

Research by Prof Sijekula Mbanga

Sustainability-oriented research for cities and settlements aims to forge new paths to solve complex societal problems that include the impact of climate change, poverty, inequality and urban pandemics. This research uses methods that promote co-creation and transfer of knowledge between the University, community organisations, industry and international partners.

An example of this is the Ndlambe EcoSUN Green Village project in Ekuphumleni Township in Kenton-on-Sea, which is in the Ndlambe Municipality of the Eastern Cape. It is a typical innovative community engagement research project, pursued in a trans- and interdisciplinary manner and anchored to a strong multi-sector engagement framework that includes international cooperation.

The EcoSUN Green Village promotes science and technology transfer between South Africa and Germany, facilitated by Nelson Mandela University and Germany's University of Potsdam. The Germany Department of Education and Research, the South Africa Department of Science and Innovation, Eastern Cape Department of Human Settlements, the National Home Builders Registration Council and the Council for Scientific and Industrial Research are co-operative participants.

The project tries to show how a climate change responsive settlement can be designed from scratch, using innovative technologies, multi-stakeholder participation, and streamlining internal and external funding sources to build sustainable communities in the Eastern Cape.

To do so, it applies innovative technologies for grey water recycling and renewable energy use, alternative sanitation

solutions, organic waste management, green landscaping, ecologically sound stormwater management as well as education, job creation, and enterprise development and support.

It has also sought to introduce, in the medium term, a new Community Green Village Technician professional with

research and curriculum development involving multiple stakeholders. These are the Berlin-Brandenburg Vocational Institute and Technical University of Berlin in Germany, the Port Elizabeth and East Cape Midlands TVET Colleges in South Africa, supported by European funding at Potsdam University, and implementation coordination by Nelson Mandela

// The project tries to show how a climate change responsive settlement can be designed from scratch ... "

Green Village Concept Description

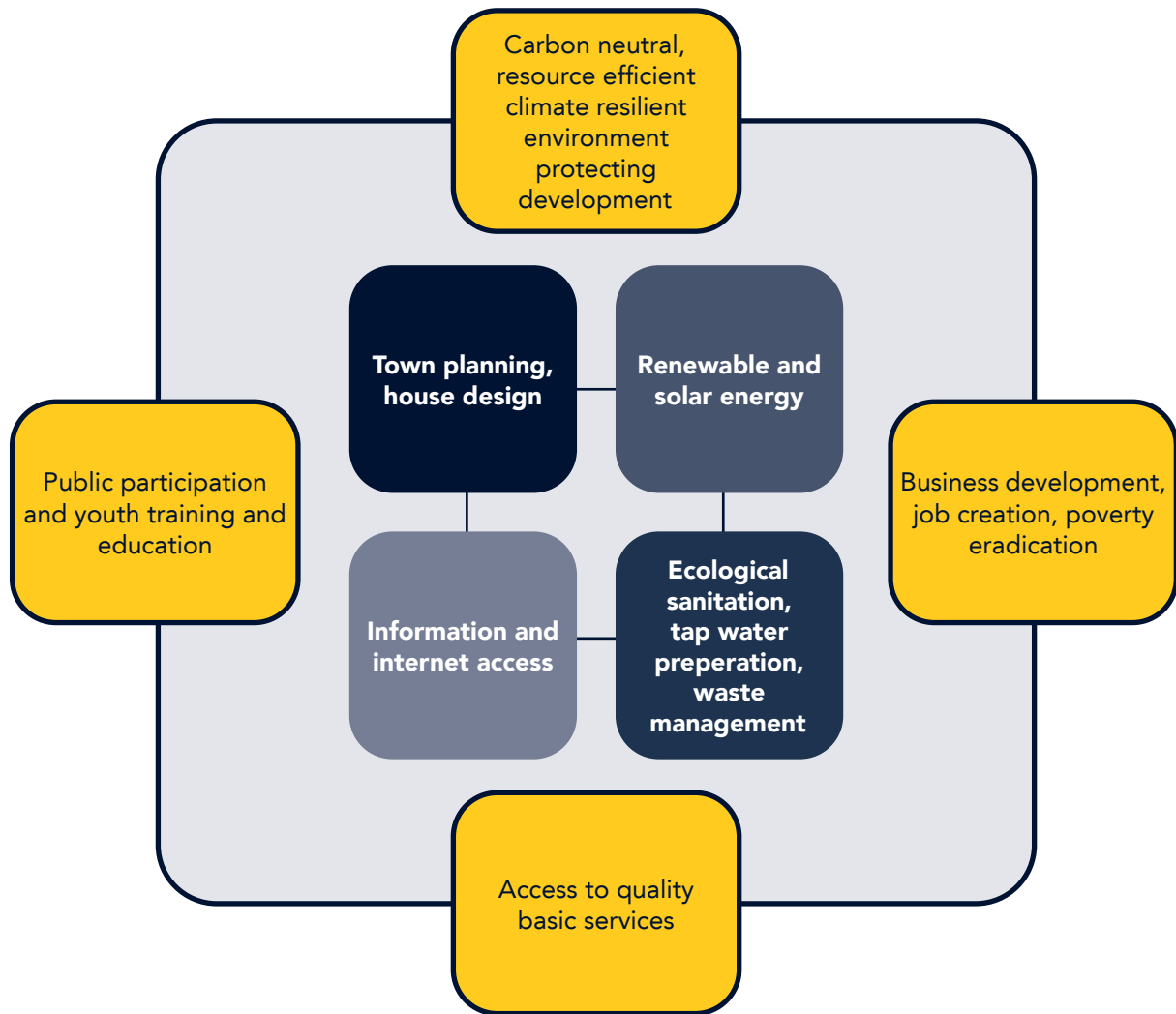


Figure 1: General components of the EcoSUN Green Village concept.

University and the Council for Scientific and Industrial Research.

Defining a 'Smart Green Village'

What is a Smart Green Village? And what are its development principles and outcomes?

Prof Sijekula Mbanga notes that green, and smart, village development is about:

- Natural places and spaces where people can live, work, and play
- Mainstreaming environmental issues in development programmes and projects
- Using natural resources without harming the natural environment

- Creating a win-win-win for the environment, economy and community
- Creating aesthetically beautiful living spaces (the built environment) where luxury and comfort fit into the natural landscapes, affecting each other in a positive and sustainable manner
- Integrating environmental sustainability principles, approaches and actions into development activities to achieve poverty reduction and economic transformation
- Raising awareness and training community members and beneficiaries to manage, own and sustain project benefits.

Smart Green Villages aim to achieve efficient, effective, equitable and sustainable use of natural resources through:

- Energy efficiency
- Water self-sufficiency
- Pollution reduction (increasing "fresh air")
- Sustainable solid waste management solutions
- Car-free zones (safe for the pedestrian, or using electric cars and e-hailing ride services)
- Sustainable land-use and agricultural practices
- Innovative materials and building systems
- Sustainable sanitation solutions.

In addition, they incorporate appropriate Information and Communication Technology (ICT) capabilities to benefit the local community.

Green Village development outcomes

One of the desired outcomes of the Ndlambe EcoSUN Green Village is that it should be sustainable and cost effective in its efficient use of energy.

It also should be user-friendly, and encourage technology transfer and uptake in infrastructure and social development. Principles of environmental and institutional management should be adhered to throughout.

Development principles

The key principles include but are not limited to conserving energy, water and other resources to preserve the environment, strengthen the local economy and promote the general well-being of citizens.

Developmental principles are transformational in character and demonstrational in evolution. They are also designed to be flexible, modular and scalable.

The idea is that they should be a catalyst for existing economic activities. Driven by strong community participation and acceptance, they should be appropriately aligned to the community's specific needs.

Project background

Stakeholders defined criteria to select the site to pilot and implement the model, choosing the Ekuphumleni community in Ward 4 of Ndlambe Municipality. It was selected due to challenges that technologies could address, such as poor infrastructure, as well as water and electricity supply shortages.

The growth rate per annum was 2% from 2011 until 2018. Farmworkers moving to the towns for opportunities for work and a better life contributed to this growth, putting pressure on the municipality to provide services.

The town of Kenton-on-Sea is also a holiday destination and numbers in certain areas can increase ten-fold during the season. This puts additional pressure on electricity and water resources.

Kenton-on-Sea and Ekuphumleni settlements had a population of 5194 in 1879 households with an average household size of three (2.8). Residents contribute 8.5% towards the total living in the Ndlambe municipal area. One quarter (24.7%) of the population in Ward 4 are under the age of 15, 13.2% are older than 64 and the remaining 62.1% fall within the 15 to 64 age bracket. At

General EcoSUN Modules

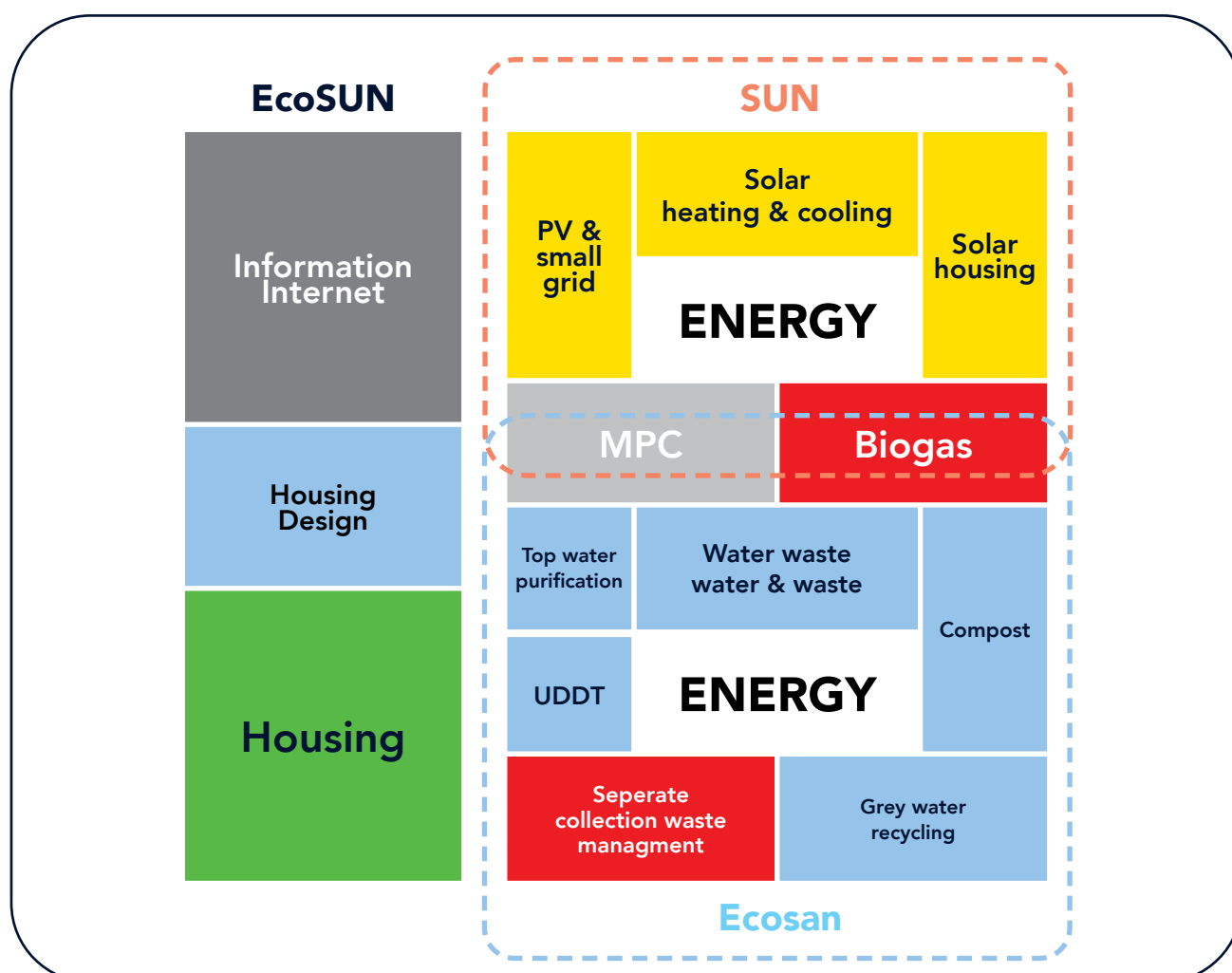


Figure 2: Technology options overview: EcoSUN modules.

least 8.2% of the inhabitants over 19 years of age in Ward 4 had not received any schooling and 31.6% completed or underwent some primary education. Further, 23.4% matriculated or received a higher learning degree.

This suggests that the ward has a mixed labour market, with a large component of elementary and semi-skilled workers. The municipality and sector departments therefore should promote labour-intensive development projects.

About 23.1% of the 5194 inhabitants are employed in the formal sector, 2.7% in the informal sector, 4.5% in private households, and the remaining 69.7% fell within the not-applicable category (pensioners and workers not active in the labour market).

Approximately 15.3% (287) of the 1879 dwellings in the ward did not receive any income and so, technically, one in every 6.5 households were impoverished. In addition, 37.1% of the population in Ward 4 did not receive a monthly income and a further 25.6% earned less than R801 a month, according to StatsSA 2011.

The project pilot site was therefore an ideal site to show how the EcoSun Green Village model could be used to provide socio-economic benefits to the Ekuphumleni Community.



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