ANNUAL REPORT
Faculty of Engineering

2021

Fakulteit Ingenieurswese
JAARVERSLAG

Stellenbosch
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ENGINEERING
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Overview

Dr Philani Zincume executes an exuberant Zulu dance move on the Endler Hall's stage at his doctoral graduation.

Establishing itself as an agile teaching and research environment, the Faculty of Engineering met the demands of the pandemic in 2021 by adapting its practices to enhance students' learning. Stellenbosch University (SU) introduced Augmented Remote Teaching, Learning and Assessment (ARTLA), a hybrid teaching model with online classes and contact tuition in smaller groups. The University's Extended Learning Spaces project supported the Faculty by fast-tracking audiovisual equipment and systems installation in 16 venues, enabling lecturers to stream their classes while teaching in a lecture hall. Students and staff showed remarkable resilience in adapting to the new teaching model.

The Faculty completed the academic year successfully. It significantly contributed to the engineering profession by adding 594 graduate engineers, 223 master's graduates and 57 doctorates, the most doctorates of all the University's faculties.

In hindsight, we realise that the pandemic's challenges sharpened our educational skills as we adapted our modules for online teaching and developed new ones. We have much to celebrate. A few highlights are summarised below, organised according to the University's core strategic themes.

A thriving Stellenbosch University

Our Engineering Campus Renewal Project upgrades our facilities to meet the new teaching and research demands. Work started on the renovation of the Engineering complex's Civil Engineering wing. Despite the inevitable disruptions, the adjacent laboratories have continued functioning at full capacity.

The refurbishment of the Department of Electrical and Electronic Engineering continued with the construction of a final-year student work and study area. The state-of-the-art facilities feature two modern lecturing venues, an undergraduate robotics laboratory and a small breakaway area for student collaboration and study. This new area reflects the Department's focus on ensuring transformative education delivers world-class results.

New growth was a theme for 2021, with the Department of Mechanical and Mechatronic Engineering having its largest first-year intake ever of 306 students. The Department of Industrial Engineering extended the Faculty's postgraduate offering by launching its new hybrid mode MEng in Engineering Management degree programme, attracting more than 80 students worldwide.

A transformative, inclusive student experience

To ensure all students receive the best possible educational experience, the departments were agile in responding to the COVID-19 pandemic. The Department of Mechanical and Mechatronic Engineering used ARTLA to bring students back into laboratories. Through hands-on learning experiences, students could grow vital skills. It is essential to acknowledge that our staff's efforts made the complex coordination of the increased number of small practicals possible.

The Process Engineering Postgraduate Student Council arranged a variety of events designed to enhance the experience of postgraduate researchers. These included hosting social events to help students connect and running workshops and seminars such as Women's Month and Heritage Month panel discussions.

Department of Civil Engineering academics incorporated audiovisual material into their modules, improving the overall quality of their teaching. The Department of Electrical and Electronic Engineering offered learning material online and conducted in-person tutorials and practicals on campus. While acknowledging that ARTLA supports the University's theme of a transformative student experience, their experience emphasises the value of in-person teaching and peer learning.

Networked and collaborative teaching and learning

The most exciting learning opportunities are created when different fields and disciplines are brought together. A new module, Intercultural Communication for Engineers, replaced the Professional Communication module that had been compulsory for all first-year engineering students. The well-attended new module, presented by the Stellenbosch University Language Centre, prepares students for a diverse study and work

environment by introducing effective intercultural communication.

Groups of third-year Industrial Engineering students participated in a real-life business simulation on an online collaborative learning platform, demonstrating the interactions between their decisions and the business outcome. Under the guidance of Dr Joubert van Eeden, one group made it through the annual Global Student Challenge qualification rounds among 16 international universities to the final in 2022.

Research for impact

Real-world application is a strategic focus for the Faculty's research. For example, Dr Isobel Brink, Department of Civil Engineering, investigated low impact sustainable technologies in water quality. She received the Research Excellence Award for Emerging Researchers from the National Research Foundation (NRF). Likewise, the National Fire Protection Agency awarded the Department the Harry C Bigglestone Best Paper Award to recognise its excellence in the communication of fire protection concepts.

Prof Andries Engelbrecht, jointly appointed in the Department of Industrial Engineering and Division for Computer Science, is one of 15 A-rated leading international researchers at Stellenbosch University. His A rating was reconfirmed for another five years in 2021.

Purposeful partnerships and inclusive networks

The Faculty is a trusted problem-solver for industry partners who sponsor research projects. The newly established research programme with BMW's ZA Hub brought different Mechanical and Industrial Engineering research groups together. The Department of Electrical and Electronic Engineering made a series of appointments that strengthened collaborations with international and local industry, including partners such as ABB and Eskom.

The Stellenbosch Hydraulics Laboratory completed several specialist consulting projects under the guidance of Prof Gerrit Basson. Notably, their work on the Xhora Off-Channel Storage Dam in the Xhora Water Supply Scheme contributed to a SAICE Commendation award for the Most Outstanding Civil Engineering Project.

The Internet of Things Chair, a joint venture of the departments of Industrial and Electrical and Electronic Engineering, became vacant recently. The departments appointed Prof Thinus Booysen, whose research activities dovetailed with the chair's intention of encouraging collaboration between research groups that use connected technologies to solve real-world problems.

Mechanical and Mechatronic Engineering welcomed the establishment of the Virtual Reality Laboratory and The Digital Twin Pump Laboratory. The latter supports the Rand Water Research Chair, whose incumbent Prof Annie Bekker and her research group continued testing the South African polar research ship, the SA Agulhas II.

Stellenbosch University as employer of choice

In a year when teaching and learning were fraught with obstacles, industry awards speak to the high esteem of the Engineering Faculty. The Institution for Structural Engineers awarded the Department of Civil Engineering the IStructE award for excellence in structural engineering education. Professor Jan van Vuuren received the South African Institute for Industrial Engineering (SAIIE) Award for Best Industrial Engineering Excellence in Teaching and Learning. This award particularly recognises innovative teaching methods, course designs and assessments.

SU awarded a Teaching Fellowship to Prof Debby Blaine of the Department of Mechanical and Mechatronic Engineering to design inclusive and transformed curriculums for our diverse student body.

Three newly appointed professors presented inaugural lectures, namely Prof Celeste Viljoen, Vice-Dean: Teaching and Quality Assurance, Prof Johan van der Spuy, Chair of Mechanical and Mechatronic Engineering, and Prof Natasha Sacks, Industrial Engineering.

Looking forward

The Faculty's six professional undergraduate engineering programmes are closely controlled and assessed by the professional body, the Engineering Council of South Africa (ECSA). Despite the uncertainties and restrictions brought about by the pandemic, the departments' staff maintained the processes required for the ECSA accreditation of our degrees. All our programmes are fully accredited until the next visit by ECSA.

Under the capable leadership of Prof Celeste Viljoen, Vice-Dean: Teaching and Quality Assurance, the departmental chairs and programme coordinators have started preparing for ECSA's five-yearly accreditation visit in 2023. Meeting the past year's challenges brought strength and agility to our teaching and learning practices. With an eye trained on the future, we are working at making our world a better place.

Prof Andries Engelbrecht, Industrial Engineering and Computer Science, received an A1 rating from the National Research Foundation.

Prof Andries Engelbrecht, Bedryfsingenieurswese en Rekenaarwetenskap, ontvang 'n A1-gradering van die Nasionale Navorsingstigting.

Oorsig

Die Fakulteit Ingenieurswese het hom as 'n veerkragtige onderrig- en navorsingsomgewing gevestig deur sy onderrigpraktyke aan te pas om studente se leerervarings te verryk. So oorkom hy die uitdagings van die pandemie in 2021. Die Universiteit Stellenbosch (US) het na aangepaste afstandsonderrig, -leer en -assessering (ARTLA) oorgeskakel, 'n hibriede onderrigmodel waarvolgens aanlyn klasse en kleingroep-kontakonderrig aangebied is. Die US se ELS-projek (Extended Learning Spaces) het die Fakulteit ondersteun deur die bespoedigde installering van oudiovisuele toerusting in 16 lesingsale. Lektore kon toe hul lesings in hierdie sale terselfdertyd aanlyn stroom. Personeel en studente het met merkwaardige behendigheid by die nuwe onderrigmodel aangepas.

Die Fakulteit het die akademiese jaar suksesvol afgehandel en 'n aansienlike bydrae tot die ingenieursberoep gemaak met 594 gegradueerde ingenieurs, 223 magistergraduati en 57 gedoktoreerdes, die meeste gedoktoreerdes onder al die US-fakulteite.

Terugskouend besef ons dat die pandemie se uitdagings ons opvoedkundige vaardighede verskerp het toe ons die modules moes aanpas en nuwes ontwikkel vir aanlyn aanbieding. Ons het baie om te vier. Vervolgens word 'n klompie hoogtepunte kortliks aangebied, ingedeel onder die Universiteit se kern strategiese temas.

'n Florerende Universiteit Stellenbosch

Die Ingenieurswese-Kampusvernuwingsprojek gradeer die fasiliteite op om aan die nuwe onderrig- en navorsingseise te voldoen. Daar is weggespring met die herinrigting van die Ingenieurskompleks se Siviele Ingenieurswese-vleuel. Desnieteenstaande die onvermydelike ontwrigting het die naburige laboratoriums volstoom aanhou werk.

Die herinrigting van die Departement Elektriese en Elektroniese Ingenieurswese is voortgesit met die konstruksie van 'n werk- en studiearea vir finalejaarstudente. Die ultramoderne fasiliteite spog met twee lesingsale, 'n voorgraadse robotikalaboratorium en 'n klein wegbreekarea vir groepwerk en studie. Die nuwe area weerspieël die Departement se strewe om met transformerende opvoeding wêreldgehalte resultate te lewer.

Prof Celeste Viljoen, Visedekaan: Onderrig en Gehalteversekering, by haar intreerede "Risiko-gebaseerde infrastruktuurontwerp en assessering" in September 2021.

Nuwe groei was 'n tema in 2021 met die Departement Meganiese en Megatroniese Ingenieurswese se registrasie van 306 eerstejaars – hul grootste inname nog. Die Departement Bedryfsingenieurswese het die Fakulteit se nagraadse aanbod uitgebrei met hul nuwe hibriedemodusprogram, die MEng in Ingenieursbestuur, wat hul met meer as 80 studente wêreldwyd afgeskop het.

'n Transformerende, inklusiewe studente-ervaring

Om te verseker dat alle studente die beste moontlike opvoedkundige ervaring kry, het die departemente rats op die COVID-19-pandemie gereageer. Die Departement Meganiese en Megatroniese Ingenieurswese het ARTLA gebruik om hul studente terug laboratoriums toe te bring. Deur eerstehandse leerervarings kon studente noodsaaklike vaardighede ontwikkel. Alle eer kom die personeel toe wat die ingewikkelde koördinering van die groter aantal klein praktiese sessies moontlik gemaak het.

Die Nagraadse Studenteraad vir Prosesingenieurswese het 'n verskeidenheid geleenthede gereël om nagraadse navorsers se belewenis te verryk. Hierby ingesluit was sosiale geleenthede, waar studente mekaar kon ontmoet, en werkswinkels en seminare soos Vrouemaand- en Erfenismaand-paneelbesprekings.

Akademici van die Departement Siviele Ingenieurswese het oudiovisuele materiaal by hul modules ingesluit en so hul onderriggehalte oor die algemeen verbeter. Die Departement Elektriese en Elektroniese Ingenieurswese het leermateriaal aanlyn aangebied en hul studente tutoriale en praktika op die kampus laat bywoon. Alhoewel ARTLA die Universiteit se tema van 'n transformerende studente-ervaring ondersteun, het ervaring hul die waarde van kontakonderrig en eweknieleer opnuut laat besef.

Genetwerkte en samewerkende onderrig en leer

Die mees opwindende leergeleenthede word geskep wanneer verskillende studievelde en dissiplines byeengebring word. 'n Nuwe module, Interkulturele Kommunikasie vir Ingenieurs, het die oue, Professionele Kommunikasie, wat vir alle eerstejaarsingenieurstudente verpligtend was, vervang. Die goed bygewoonde nuwe module, aangebied deur die US Taalsentrum, berei studente voor vir 'n diverse studie- en werksomgewing deur hulle vertroud te maak met effektiewe interkulturele kommunikasie.

Groepe derdejaarstudente van Bedryfsingenieurswese het deelgeneem aan 'n realistiese sakesimulasie op 'n aanlyn saamwerkleerplatform wat die interaksies tussen hulle besluite en die sake-uitkoms demonstreer.

'n Stellenbosch-groep onder dr Joubert van Eeden se leiding was een van die 16 internasionale universiteite

wat in die jaarlikse kwalifiserende uitdaging kon deurbreek na die globale finaal in 2022.

Navorsing vir impak

Navorsing oor uitdagings in die praktyk is 'n strategiese fokus vir die Fakulteit. 'n Voorbeeld is dr Isobel Brink, Departement Siviele Ingenieurswese, se ondersoek na volhoubare laeïmpaktegnologieë vir watergehalte. Hiervoor het sy die Nasionale Navorsingstigting (NNS) se Navorsingsuitnemendheidstoekenning vir Ontluikende Navorsers ontvang. Insgelyks het die Nasionale Brandbeskermingsagentskap die Departement vereer met die Harry C Bigglestone toekenning vir die beste referaat ter erkenning van kommunikasieuitenemendheid in brandbeskermingskonsepte.

Prof Andries Engelbrecht, gesamentlik aangestel deur die Departement Bedryfsingenieurswese en Afdeling Rekenaarwetenskap, is een van 15 A-gegradeerde voorste internasionale navorsers aan die Universiteit Stellenbosch. In 2021 is sy A-gradering vir nog vyf jaar herbevestig.

Doelgerigte vennootskappe en inklusiewe netwerke

Die Fakulteit waardeer sy bedryfsvennote wat hul uitdagings bring en die navorsing daarvoor borg. Die onlangs gevestigde navorsingsprogram met die BMW ZA Hub het verskillende Meganiese en Megatroniese en Bedryfsingenieurswese-groepe betrek. Die Departement Elektriese en Elektroniese Ingenieurswese het weer 'n reeks aanstellings gemaak wat samewerking met plaaslike en internasionale bedrywe verstewig het, insluitend vennote soos ABB en Eskom.

Die Stellenbosch Hidroulikalaboratorium het verskeie spesialiskonsultasieprojekte onder leiding van prof Gerrit Basson voltooi. Hul werk aan die Xhora buite-rivierkanaal-opgaardam van die Xhora Watervoorsieningskema het tot 'n SAICE aanprystoekenning vir die mees uitstaande sivieleïngenieursweseprojek gelei.

Die Internet van Dinge-leerstoel, 'n gesamentlike onderneming van die departemente Bedryfsingenieurswese en Elektriese en Elektroniese Ingenieurswese, het onlangs vakant geraak. Die departemente het prof Thinus Booysen aangestel omdat sy navorsing netjies aansluit by die leerstoel se oogmerk om samewerking tussen navorsingsgroepe wat slim tegnologieë inspan om praktiese probleme op te los, te bevorder.

Meganiese en Megatroniese Ingenieurswese het 'n Virtuelerealiteitslaboratorium en Digitaletweelingpomplaboratorium bygekry. Laasgenoemde ondersteun die Rand Waternavorsingsleerstoel, waarvan die bekleër, prof Annie Bekker, en haar navorsingsgroep die toets van die Suid-Afrikaanse poolnavorsingskip, die SA Agulhas II, voortgesit het.

Universiteit Stellenbosch as voorkeurwerkgewer

In 'n jaar soos die afgelope een waarin onderrig en leer voortdurend hindernisse moes oorkom, is bedryf-toekennings sprekend van die Fakulteit Ingenieurswese se goeie reputasie. Die Instelling vir Struktuuringenieurs het die IStructE-toekenning vir uitnemendheid in struktuuringenieurswese-opleiding aan die Departement Siviele Ingenieurswese oorhandig. Prof Jan van Vuuren het die Suid-Afrikaanse Instituut vir Bedryfsingenieurs (SAIIE) se toekenning vir Bedryfsingenieurswese-uitnemendheid in onderrig en leer ontvang. Hierdie toekenning vereer veral innoverende onderrigmetodes, kursusontwerpe en assesserings.

Die US het 'n Onderiggenootskap aan prof Debby Blaine van die Departement Meganiese en Megatroniese Ingenieurswese toegeken om inklusiewe en transformerende leerplanne te ontwerp vir ons diverse studenteliggaam.

Drie nuutaangestelde professore het intreeredes gehou, naamlik prof Celeste Viljoen, Visedekaan: Onderrig en Gehalteversekering, prof Johan van der Spuy, Departementsvoorsitter van Meganiese en Megatroniese Ingenieurswese, en prof Natasha Sacks, Bedryfsingenieurswese.

Toekomsblik

Die Fakulteit se ses voorgraadse ingenieursprogramme word streng deur die professionele liggaam, die Ingenieursraad van Suid-Afrika (ECSA), beheer en geassesseer. Ondanks die onsekerhede en beperkings wat die pandemie meegebring het, het die departemente se personeel die prosesse volgehou wat deur die ECSA-akkreditasie vir ons grade vereis word. Al ons programme is ten volle geakkrediteer tot ECSA se volgende besoek.

Onder die bekwame leierskap van prof Celeste Viljoen, Visedekaan: Onderrig en Gehalteversekering, het die departementele voorsitters en programkoördineerders reeds begin voorberei vir ECSA se vyfjaarlikse akkreditasiebesoek in 2023. Die afgelope jaar se uitdagings het ons meer aanpasbaar gemaak en ons onderrig- en leerpraktyke versterk. Met ons oog op die toekoms, werk ons daaraan om ons wêreld 'n beter plek te maak.

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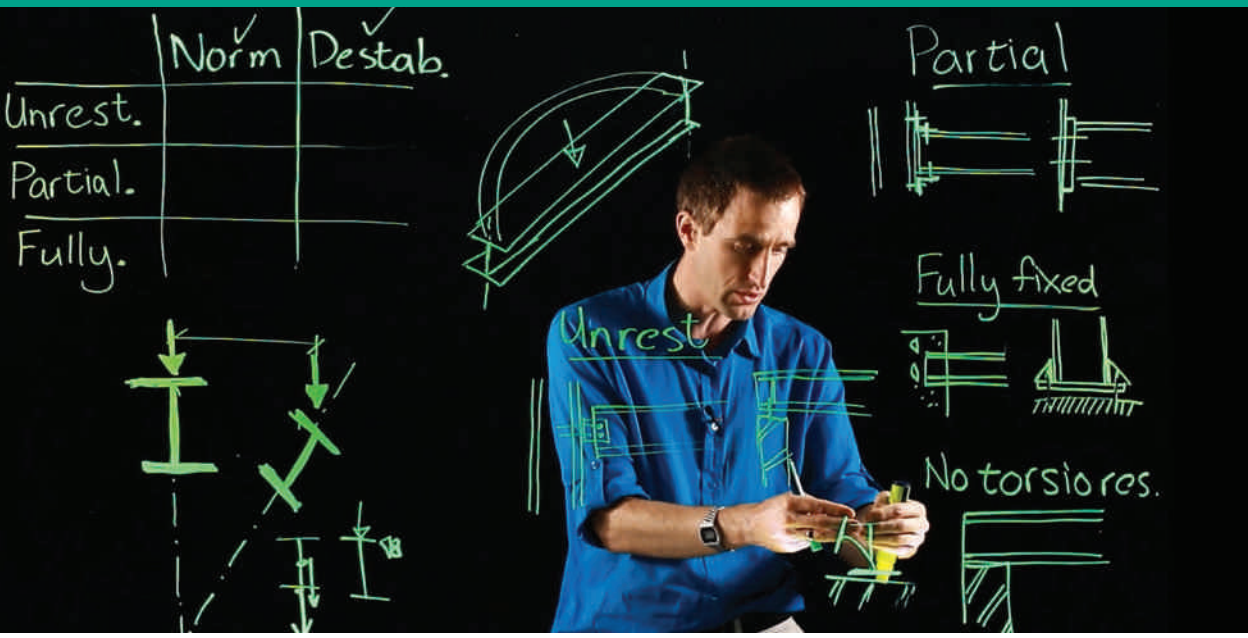
Civil Engineering

The fast-changing industry of civil engineering requires engineers who can keep abreast of new technology and changing requirements. The Department of Civil Engineering strives to produce graduates capable of meeting these challenges by keeping its academic offering relevant to present-day trends and fostering the development of creative solutions in specialised fields of civil engineering. For instance, our Stellenbosch Smart Mobility Lab, demonstrated to students by transportation engineering lecturer Ms Megan Bruwer above, provides a world-class platform for research and the development of smart mobility solutions that promote sustainable, safe and optimised transport.



Prof Richard Walls uses innovative techniques to help students visualise structural mechanics.

Professor awarded for innovative teaching

Professor Richard Walls, a full-time professor at the Faculty and head of the Fire Engineering Research Unit, won the 2021 Excellence in Structural Engineering Education Award (ESEEA). This award celebrates innovative and effective teaching techniques that improve student learning at the tertiary level.

In his entry, Prof Walls put forward evidence of his team's innovative approaches to developing technical competency in structural engineering and associated fields when teaching undergraduate and postgraduate courses at Stellenbosch University. These courses include Structural Steel Design, Advanced Concrete Design, Final-Year Design Project, and Investigational Projects. Prof Walls' educational videos on structural and fire safety engineering appear on two YouTube Channels with roughly 5 500 subscribers and almost 400 000 collective views. The team led the design of Africa's first postgraduate degrees in structural and fire safety engineering, including developing the first university fire research laboratory in Africa, where MEng and PhD students produced extensive research.

Prof Walls' educational work, unusual in structural engineering, revolves around improving the safety of homes in underprivileged communities and refugee camps. Through research, experimentation, and engagement, Prof Walls and his team produced the world's first fire engineering guideline for informal settlements.

Known for his innovative teaching demonstrations, Prof Walls always carried some teaching prop to class before the COVID pandemic or made his students' lives difficult with bending moment diagram questions. "Over the past seven years, our team has developed various tools for teaching structural engineering concepts in the hope that students will be able to visualise structural mechanics and apply the correct first-principle procedures to problems," remarked Prof Walls.

Holsloot weir river project in full flow

A new diversion works and weir on the Holsloot River for irrigation replaced weirs that washed away during the 2013 flood. The Holsloot Diversion Works, located about 10 km south-east of Rawsonville and 11 km downstream of the Stettynskloof Dam, had to replace several temporary rockfill diversion weirs as part of a more sustainable river management plan.

According to Prof Gerrit Basson, a specialist in river hydraulics, sedimentation and hydraulic structures, "Diversion works are typically faced with sedimentation issues whereby sediment deposits block intakes or are abstracted while downstream erosion threatens the structural integrity of the weir, particularly in this case where there was no rock as a foundation for the weir."

Determined to find a sustainable solution, the Western Cape Department of Agriculture appointed the Department of Civil Engineering's Hydraulics Laboratory (HL) as the principal consulting engineer for

the project's hydraulic design and physical model study. Ingerop consulting engineers were the sub-consultants for the geotechnical and structural design and site supervision.

The HL consulting team took part in the project's lifecycle, from feasibility study to construction completion and commissioning. Prof Basson, the team leader, remarked, "When training students, it is particularly fulfilling to see a design come to life and compare prototype river flows with those tested in the laboratory."

The study resulted in a 55 m long and 3,4 m high weir, with a concrete roller bucket for energy dissipation. The intake structure, designed to be self-scouring during floods, has a flushable gravel trap and two sand traps. Uncommonly, the design includes a pedestrian bridge over the roller bucket for safe accessibility. The piers were designed to resist hydraulic forces and debris accumulation in the roller bucket.

Formally handed over to the Holsloot Water User Association, with CASIDRA acting as the implementation agent for the Western Cape Department of Agriculture, this R78 million project improves the economic outlook for about 150 farming households with 4 000 ha of wine grapes under irrigation.

Winning big at the Greenovate Awards competition

The Greenovate Awards, a joint initiative between Growthpoint Properties and the Green Building Council South Africa (GBCSA), was launched in 2015. This student programme seeks to encourage the young minds and future leaders of South Africa to learn more about green building and sustainability, reward them for environmentally innovative thinking in the built environment and introduce them to industry leaders.

The programme consists of two streams, each with an attractive prize pool of R55 000. Thirty-one finalists from six South African universities competed for the top honours.

Entering the Greenovate Engineering Awards stream since 2017, the Department of Civil Engineering has consistently managed to achieve a top-three result. However, for the first time, the Department not only won the competition but placed first, second and third!

Congratulations to the following students and their study leaders for the excellent results:

1. Mr Jean-Pierre Mostert, supervised by Dr Jacques Kruger, investigated the topological interlocking for 3D printed concrete (3DPC) to enhance "cold joints" bond strength. Via finite element analysis and simulation, he could improve bond strength significantly with a comb-like nozzle that made grooves in the 3DPC while being placed.
2. Ms Rue Munemo, supervised by Prof Gideon van Zijl, studied the thixotropic (time-dependent shear thinning) characteristics for robust interlayers in 3DPC to improve its interlayer bond strength. She discovered the likelihood of a positive relationship between the concrete's thixotropy and its bond strength, warranting further testing.
3. Ms Monique Scheepers, supervised by Prof Jan Wium, investigated the challenges faced by emerging contractors and the success of current training programmes in the South African construction industry. Discovering that many contractors have difficulty with the accurate costing of projects, she developed an effective training programme and application.

Continuing with their master's studies, these students will enter the market as passionate advocates for green building.

Research Output

Subsidised journal articles	62
International proceedings	39
Chapters in books	6
Doctorates	12
Master's graduates	41

Prof Nico de Koker
Chair: Civil Engineering

SAICE lavishes praise on the Xhora Off-Channel Dam Project at its National Awards

Holsloot Diversion works and weir viewed from upstream.

Holsloot Diversion works and weir viewed from downstream.

When a large civil engineering project comes to fruition, it improves many lives, but it is truly satisfying when a challenge produces outstanding results. The Xhora Water Supply Scheme in the Amathole district was to supply 70 000 people with potable water. However, building an off-channel storage dam to assure water supply to the Scheme presented a seemingly insurmountable challenge: its geographical situation left little room for a spillway and stilling basin in times of flooding.

Turning to the Faculty's competent research engineers for an optimal solution, Hatch Africa consultancy firm contracted Prof Gerrit Basson and Dr Jeanine Vonkeman from the Department of Civil Engineering's Water Division as specialist sub-consultants for the Xhora Off-Channel Dam Project.

Besides customising the hydraulic components, they had to find a way to minimise the environmental impact on the surrounding rivers and streams, seek innovative solutions for the shortage of suitable embankment materials, and ensure minimum leakage.

Prof Basson and Dr Vonkeman designed a nonstandard stilling basin to fit into the limited space before the flow turns 90 degrees and enters the river downstream. To optimise the design, they tested a physical model with an undistorted scale of 1:30 in the Department's Hydraulics Laboratory, currently the largest of its kind in South Africa.

They succeeded in improving the energy dissipation by diverging the 5-meter-wide chute to 9,3 meters at the stilling basin, starting 52 meters upstream. For uniform supercritical flow, the lower chute curved vertically. To shorten the hydraulic jump length, they narrowed the stilling basin width from 27,5 meters to 14 meters by implementing a custom chute and two rows of baffle blocks, adding a concrete lining that extends 19,3 meters from the chute to the last row of baffle blocks. They positioned riprap above the terrace with a one-meter-high concrete kicker wall for erosion protection.

Hatch Africa implemented the final design, which clinched the SAICE Commendation Award at the annual SANRAL SAICE National Awards for the Most Outstanding Civil Engineering Project: Xhora Off-Channel Dam, Eastern Cape. These awards celebrate and reward outstanding projects that advance innovation and good practice in the development of civil engineering. The Faculty applauds Prof Basson and Dr Vonkeman for their work and its contribution to their field of study and the communities of the Amathole district, who now have access to potable water for the first time.

Structural Engineering

We research smart and green construction materials, steel and concrete structures, structural reliability, fire engineering, sustainability of the built environment and digital construction. Structural reliability covers the probabilistic load and resistance provisions that inform structural design. Research in fire engineering includes the computational and experimental investigation of structural performance during a fire and the spreading of fires. Sustainability of the built environment considers the durability of materials and structures, objective modelling and subsequent minimisation of environmental impact. 3D construction printing develops printing equipment and suitable materials while designing and testing 3D printed structures.

Civil Engineering Informatics

This theme covers the needs of the civil engineering practice in an information-driven environment. The application of information technology is concerned with collaborative engineering, intelligent modelling of the design process in structural engineering, the support systems for engineering management and the technical aspects of urban engineering. We develop real-time data processing methods for decision making and modelling complex engineering problems with inherent uncertainties.

Water and Environmental Engineering

Enabling stewardship of our natural resources while developing infrastructure for the functioning of our society is central to modern-day civil engineering. An example is our efforts to ensure reliable and sustainable water supply to human settlements. Research on water resource development regards environmental water requirements when designing large hydraulic structures such as dams, river abstraction works and bridges. Our design-centred research in fluvial and coastal processes minds severe weather events associated with flooding and erosion. A key concern is the medium-term effects of climate change on the continued design suitability of hydraulic and coastal structures.

Geotechnical and Pavement Engineering

Large and impressive structures invariably require advanced support structures to ensure stability. Our Geotechnical Engineering researchers face the challenges of problematic soils, such as the Cape Flats sands, with robust geotechnical analysis methods and the design of high-specification structures.

Our Pavement Engineering research group is concerned with designing resilient, sustainable, and long-lasting roads for the heavy traffic carried by our world-class network of national highways. From the perspective of materials science, the group looks at the performance evaluation of secondary materials (crushed concrete, masonry, glass) for roads, accelerated testing of asphalt and environment-friendly bitumen stabilised materials, developing a performance-related seal design method for bitumen and modified binders, and a mix design and analysis system for asphalt bases.

Transportation Engineering

Transportation Engineering considers the design of transportation systems for safety and efficiency, notably by considering road safety and intelligent transport systems (ITS). Our road safety research includes road crash causation, the influence of human factors and the role of geometric design. Further interests include public transport safety and pedestrian safety. Our ITS research covers public transport user information, multimodal database development, appropriate technology applications in developing countries and freeway management information applications for travel-time estimation and incident management systems.

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Electrical and Electronic Engineering

The Department of Electrical and Electronic Engineering's researchers create a better future by turning science-fictional what-ifs into real-world solutions. Working on cutting-edge nanofibre-based biosensors, PhD candidate Alexander Lloyd investigated the quantification of CD4+ cell count. For the final tests, a version of the COVID-19 South African variant's antigen, the surface spike glycoproteins targeted by our antibodies, will be bound to the biosensor's conductive nanofibre substrates. However, antigen-binding changes the resistance of these substrates, and further research will focus on resistance sensing for cost-effectiveness at the point of care.

Minibus taxis, a popular form of transport in Africa's developing cities, require some forethought to transition to electric vehicles in keeping up with future decarbonising trends.

Ray of hope for sub-Saharan Africa's paratransit

Decarbonising paratransit in Africa through solar charging of minibus taxis poses a substantial challenge because of the lack of data on the mobility of minibus taxis. Unstructured, unregulated and demand-driven paratransit in Africa's developing countries differs substantially from developed countries.

Transporting more than 70% of the region's commuters, these ubiquitous minibus taxis in developing cities across South Africa will eventually transition to electric vehicles to keep up with future decarbonising trends, an urgent outcome of the United Nations' Sustainable Development Goals.

Recently, Profs Chris Abraham, Thinus Booysen and Arnold Rix from the Department of Electrical and Electronic Engineering and Dr Innocent Ndibatya from the College of Computing and Information Sciences, Makerere University in Uganda, joined forces to examine the impact of this inevitable evolution. Given the unique paratransit mobility patterns, they presented a generic simulation environment to assess the grid impact and charging opportunities.

Following a structured approach, the researchers used readily available GPS tracking data and a traffic simulator to evaluate the electrical demand requirements of minibus taxis and the proportion of the demand renewable energy could meet. The research used floating car data to assess the energy requirements of electric vehicles, which will have a knock-on effect on Africa's already fragile electrical grids. Spatio-temporal and solar photovoltaic analyses assessed the informal and formal stops the taxis would need to recharge from solar PV in the region's abundant sunshine.

For the first time, the energy requirements of a hypothetical electrical paratransit system in sub-Saharan Africa could be estimated. The results showed that energy demand would be quite high and the charging time relatively low.

The simulator and results will enable traffic planners and grid operators to assess and plan for looming electric vehicle rollouts, leading to a new funding model for transport in Africa.

Classifying your cough: Is it COVID-19-related or not?

Coughing can be a symptom of a range of respiratory diseases, not just COVID-19. However, people do not necessarily distinguish between COVID-19 positive and COVID-19 negative coughs. That is why researchers at Stellenbosch University (SU) developed a machine learning tool to distinguish one from the other.

Prof Thomas Niesler from the Digital Signal Processing Lab in the Department of Electrical and Electronic Engineering conducted the research with colleagues Drs Marisa Klopper, Madhurananda Pahar and Robin Warren. Respectively, Drs Klopper and Warren are

affiliated with the SAMRC (South African Medical Research Council) Centre for Tuberculosis Research and the DST-NRF (Department of Science and Technology-National Research Foundation) Centre of Excellence for Biomedical Tuberculosis Research in SU's Division of Molecular Biology and Human Genetics.

The team used data from two sets: Coswara, containing data of COVID-19 positive people and physically healthy people from all six continents; and Sarcos (SARS COVID-19 South Africa), a national dataset containing data of COVID-19 positive and COVID-19 negative people. Participants recorded cough sounds via a web-based data collection platform using their smartphones during or after the acute phase of COVID-19.

Cutting out the silences between coughs in the recordings, resource-efficient analysis of the cough sounds resulted in highly accurate classification.

"Our analysis shows that COVID-19 positive coughs are 15 to 20% shorter than non-COVID coughs. Since cough audio classification is cost-effective and easy to use, it is a useful and viable means of non-contact COVID-19 screening," says Dr Pahar, a postdoctoral research fellow at the Digital Signal Processing Lab.

This type of screening can reduce the workload in testing centres and limit transmission by recommending early self-isolation to those with a cough suggestive of COVID-19. Having published their study in the journal *Computers in Biology and Medicine*, the research team is currently building a smartphone application that can serve as a COVID-19 cough classifier.

Lecturer awarded for research paper

ISCA, one of the most influential organisations promoting research and teaching in speech processing, awarded Dr Herman Kamper, a senior lecturer in the Department of Electrical and Electronic Engineering, with the ISCA Award for the Best Research Paper Published in Computer Speech and Language (CSL) between 2016 and 2020. ISCA gives an annual award for the best research paper published in this journal over the last five years and presents the award at the annual ISCA Interspeech conference.

Research Output

Subsidised journal articles	77
International proceedings	67
Doctorates	15
Master's graduates	49

This year's Interspeech took place in Brno, Czech Republic, via a hybrid conferencing model to allow attendees from all over the world to join despite travel restrictions. Kamper presented his paper "A segmental framework for fully unsupervised large-vocabulary speech recognition" at the conference using their virtual platform. The paper draws on research Kamper started during his PhD at the University of Edinburgh and continued with his postdoctorate at TTI-Chicago.

"Much more prevalent in our everyday lives, automatic speech recognition systems are only available for a few well-resourced languages because current methods require thousands of hours of transcribed speech data," Kamper explains. The paper proposes a new method for speech recognition in the absence of transcriptions. The model learns word-like units directly from unlabelled speech audio. Since the model is not explicitly told what to recognise, it is an example of unsupervised learning, an important focus area in machine learning.

Despite significant developments, there are still many challenges. Addressing these will provide more reliable speech technology, aid in better understanding of continuous signals, and tell us something about human learning.

Kamper's paper will be among many outstanding writings published in the CSL journal, one of the top three global journals investigating how machine learning can be applied to speech processing.

Prof Herman Engelbrecht
Chair: Electrical and Electronic Engineering

Doctoral research project keeps the lights on at schools

Stellenbosch University awarded a PhD to Jason Avron Samuels.

Phenomenal research led to a PhD, dramatic electricity cost savings at schools in Stellenbosch and Paarl, and the establishment of a spin-off company, GreenX Engineering. Being an entrepreneur and PhD graduate is an extraordinary feat for Dr Jason Avron Samuels.

For the last three years, Dr Samuels has worked tirelessly on his research project Electrical Energy in Schools with a Focus on Behavioural and Efficiency Interventions. His supervisors were Prof Thinus Booysen, a professor in the Department of Electrical and Electrical Engineering, and Prof Saartjie Grobbelaar, an associate professor in Industrial Engineering.

The idea for the research topic came from Prof Booysen and aligned with Samuels' goal to help communities by using his skills. Since many schools face budgetary pressures and infrastructure and resource limitations, improving their energy efficiency was a good place to start.

The pilot project kicked off by installing smart energy meters at schools to understand their energy usage. The analysis of this data showed where, when and how much electricity was used on the school premises. They then replaced high-power fluorescent lights with light-emitting diode (LED) lights with lower power consumption, a high-power factor, and better light quality.

By piloting his research assumptions, Dr Samuels proved that behavioural and efficiency interventions could result in an energy reduction of 11 to 14% and an increase in lighting efficiency of 21 to 39%. This effective intervention reduced school electricity costs, lowered the carbon footprint, and created a more green-friendly environment.

The success of the pilot project, funded by Stellenbosch University's Social Impact Funding Committee, has attracted various stakeholders and other funders, including the Western Cape Education Department (WCED). To build the capacity to roll out the project to more schools, Dr Samuels, as managing director, and Booysen and Grobbelaar, as non-executive directors, established GreenX Engineering.

When GreenX equipped Cloetesville Primary School in Stellenbosch with energy-saving technology, the school became the first in South Africa to receive an Energy Performance Certificate with an A rating for electrical consumption of 17 kWh per m^2.

Starting in 2022, the WCED wants to implement the project at another 100 schools in the province. To meet growing demand, the partners aim to capacitate GreenX Engineering with the help of Innovus, a division of the University responsible for technology transfer, entrepreneurial support and development.

The future shines bright for Dr Samuels. He is considering pursuing postdoctoral studies and developing GreenX to reach the rest of the country.

Robotics

In the Electronic Systems Laboratory (ESL), research, development and projects concentrate mainly on the control of remote sensing platforms. These platforms include satellites (e.g. CubeSats), manned and unmanned aerial vehicles (UAVs), as well as autonomous underwater vehicles (AUVs) and unmanned ground vehicles. As most of the research is part of a larger system, students gain first-hand experience of the full breadth of the management and technical activities required in complex system development.

Electromagnetics

Current activities focus on the following projects: RF and microwave antennas for communications and radar systems, FEM, FDTD and MoM modelling of antennas and wave propagation in complex electromagnetic environments, development of numerical methods and software for simulation of electromagnetic fields, free-space and near-field measurement techniques, optimising complex antennas and microwave components, the Karoo Array Telescope (KAT) and the Square Kilometre Array (SKA). Other activities involve superconducting elements, nanosensors, electromagnetic compatibility, microwave filters and non-linear circuits. An antenna and microwave laboratory, supported by sophisticated instrumentation and powerful computing facilities, provides the infrastructure for research work.

Electrical Energy

This division covers research on electrical energy in terms of conversion, distribution, control and management, and renewable energy. Specifically, attention is given to multilevel power electronic converters, electrical machine design and drive systems, energy efficiency, and the measurement and management of electrical energy. Renewable energy focuses on photovoltaic solar energy, wind generator systems, system identification and grid integration. Our facilities include world-class laboratories and instrumentation for prototype testing and measurement. The Department has the only high-voltage laboratory in the Western Cape for advanced insulator tests and research.

Telecommunications and Informatics

This division works in a variety of areas that involve the manipulation of information-bearing signals. The work comprises the extraction and embedment of information in the signal (digital signal processing), the transmission of such signals over large distances (telecommunication) and through complex networks (communication networks), and automatic learning and the recognition of the signal content (machine learning and deep learning) with particular focus on speech and image signals, and specialised sensor signals.

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Industrial Engineering

Industrial engineers optimise systems and processes by creatively designing solutions that integrate people, processes and technology. Our undergraduate programme in Industrial Engineering equips students to become technological pioneers in the business world. Students who wish to further their expertise have a choice of cutting-edge postgraduate specialisations. In 2021, we followed our two new postgraduate programmes in Data Science up with a module-based hybrid online master's programme in Engineering Management. The programme would appeal to working professionals who wish to enhance their undergraduate education with the additional leadership and management skills that their current workplace demands.

Prof Calie Pistorius, the academic coordinator of the new MEng in Engineering Management, and the programme's website published in 2021 (https://mem.sun.ac.za/).

Faculty welcomes first master's students in Engineering Management

The structured Master of Engineering in Engineering Management (MEM) degree programme is the latest addition to the Department of Industrial Engineering's postgraduate offering. The programme promises a broader reach thanks to the flexible hybrid presentation model, where students learn through face-to-face and online interaction.

The response in applications for the first intake of MEM students has exceeded all expectations. The programme is popular among local and international applicants. More than 80 students and working professionals have registered for the 2022 intake of the MEM programme, including students from Vancouver, Auckland, Antarctica, Amsterdam, and neighbouring African countries.

The programme would appeal to working professionals who wish to enhance their undergraduate education with the additional leadership and management skills that their current workplace demands. Ultimately, the MEM enables graduates to perform rigorous critical thinking and analyses and have innovative decision-making abilities and modern engineering management skills to stay ahead of industry trends.

The Department developed the coursework and learning materials for the programme in conjunction with Stellenbosch University's Hybrid Learning Group, supported by a grant that the University made available. Each academic year consists of two semesters, with two modules per semester. Every module's lectures, group sessions and webinars are conducted over 15 weeks. The curriculum is future-focused, innovative, industry-relevant and designed to suit the profile of the part-time student, wherever in the world that student may be.

"We are delighted with the number and diversity of the first cohort of our new master's degree in Engineering Management. The degree's hybrid online delivery mode and focus on early to mid-career working engineers and scientists have struck a chord," says Prof Calie Pistorius, academic coordinator of the MEM programme. "We are looking forward to engaging with industry partners to explore how they can benefit from this exciting offer."

Pioneering researcher achieves the highest rating

The National Research Foundation (NRF) awarded an A1 rating, the highest achievable rating on its rating system, to renowned computer scientist Prof Andries Engelbrecht. Peers recognise researchers in this category as leading international scholars in their field.

Prof Engelbrecht's PhD studies in Computer Science at Stellenbosch University (1999) introduced him to artificial neural networks (NNs), opening the gateway to his current research in computational intelligence (CI). Inspired by his passion for research, he broadened his focus to other CI areas and has since positioned himself as a leading researcher in particle swarm optimisation (PSO), an emerging technology.

In 2019, after an illustrious career at the University of Pretoria, Prof Engelbrecht accepted a joint appointment to Stellenbosch University in the Voigt Chair in Data Science (Department of Industrial Engineering) and Computer Science Division. He has since developed and taught new undergraduate and postgraduate modules and the Industrial Engineering Postgraduate Diploma and master's degree in Data Science.

SAIIE Award celebrates outstanding teacher

The Southern African Institute for Industrial Engineering (SAIIE) annually honours and celebrates outstanding contributions to industrial engineering in Southern Africa. In 2021, Prof Jan van Vuuren, a B2-rated researcher and founder of the Stellenbosch Unit for Operations Research in Engineering (SUnORE), received their Best Industrial Engineering Excellence in Teaching and Learning Award. The award recognises excellence in education and celebrates innovation and novel teaching methods, course designs and assessments over the past two years.

Dr Stephan Nel, a lecturer at the Department of Industrial Engineering who recently received his doctorate under the supervision of Prof Van Vuuren, nominated him for the award: "Prof Van Vuuren inspires and enriches his students through mathematical rigour and analytical intuitiveness."

Developing his teaching style over many years by trial-and-error rather than flashes of inspiration, Prof Van Vuuren has built lasting friendships with most of his postgraduate students. They appreciate his frankness, genuine respect and sincere interest in them as whole persons.

Chancellor's Award recognises excellence

Once a year, Stellenbosch University recognises 14 leading academics and professionals for excellence in their service field by honouring them with a Chancellor's Award. Crowning 22 years of selfless dedication and professionalism as senior secretary, Ms Karina Smith received this prestigious award.

Colleagues, industry partners and students praise her willingness to listen and assist. Highly innovative, Ms Smith initiated an online method to overcome the artificial barrier the new mode of teaching placed between her and the students during the COVID-19 pandemic. This exceptional individual has contributed significantly to the Department's success.

Contract appointment initiative pays off handsomely

An ongoing Faculty-wide initiative provides opportunities for engineers and professionals to pursue a career in academia through a five-year fixed-term contract. Thanks to this initiative, Imke de Kock and Wouter Bam joined the Department of Industrial Engineering in 2015 as lecturers. They have since completed their PhDs and been promoted to senior lecturers. Proving their mettle, Bam clinched the Upcoming Researcher of the Year Award in the Engineering Faculty, and De Kock received the Vice-Rector's Award in Research Excellence. The Department of Industrial Engineering recently promoted both to associate professors.

Research Output

Subsidised journal articles	81
International proceedings	35
National proceedings	14
Chapters in books	3
Doctorates	12
Master's graduates	34

Doctoral research blossoms in a neglected field

An electronic engineer for some years, Dr Philani Zincume (see photo on page 2) realised that he was more passionate about people than machines. His interest in engineering management practice and human factors drew him to industrial engineering. When he joined the Department of Industrial Engineering as a doctoral candidate, they appointed him as a full-time lecturer. He found his niche in teaching and supporting students on their research journey.

His choice of topic originated from his industry experience as a production manager of frontline supervisors. According to his supervisor, Dr Wyhan Jooste, his research about frontline supervisor effectiveness enablers, a neglected field, will help engineering organisations unlock organisational value.

Prof Corne Schutte
Chair: Industrial Engineering

BMW and Stellenbosch University partnership offers new opportunities for postgraduate students

SU Rector Prof Wim de Villiers (front left) signs a framework agreement with Mr Klaus van der Osten-Sacken, BMW Group South Africa's Director of Digital and Global Solutions.

Also present are Dr Andreas Hees (front right), BMW IT Hub Head of Business Management, and (back row) Prof Corne Schutte, Chair: Industrial Engineering, Prof Wikus van Niekerk, Dean: Faculty of Engineering, Mr Alexander Buresch, Senior Vice-President: BMW Group, and Dr Carsten Sapia, Vice-President IT Strategy, Governance, and Security: BMW Group.

The Faculty of Engineering joined forces with BMW Group South Africa, specifically the BMW IT Hub, to develop a homegrown IT talent pipeline for the company. The initiative aims to promote skills in artificial intelligence and data analysis, ultimately creating a pool of talented students that will support BMW in growing and maintaining software in the scope of their IT business.

The partnership involves a framework agreement of five years, starting in 2022 with ten master's students working on solving business problems and streamlining operations. BMW will sponsor bursaries for selected postgraduate students in machine learning, natural language processing (NLP), prescriptive analytics, product data traceability, AI reporting and new methods of cloudification. These students will have the opportunity to research product integration and conformity of the product (PICOP) and digital vehicle file (DVF). The agreement specifies that BMW has full rights to the intellectual property created in this way, enabling the transfer of material to their ZA Hub for exploration and refinement. The expectation is that consigned students will graduate as well-versed professionals in BMW IT topics and solutions, paving the way for new technologies, techniques and innovative thinking.

The project leader at the University, Prof Corné Schutte, had structured the overall project as a collaboration between various research groups in the Faculty. Research groups in Industrial Engineering and Mechanical and Mechatronic Engineering currently participate in the project. "Having a reputable international company such as BMW as a research partner in the Faculty creates exciting opportunities for the University and its students. We are excited to be part of BMW's future expansion in South Africa, delivering talent for their ZA Hub talent pipeline and conducting leading research that will help keep BMW at the forefront of technology. We have been impressed with the seriousness and professionalism of the BMW stakeholders involved in South Africa and Munich," said Prof Schutte.

Prof Wikus van Niekerk, Dean of Engineering at Stellenbosch, said that this exciting collaboration between Stellenbosch University and BMW would add significant value to the teaching and research programmes. "Industry collaboration is one of the three main strategic objectives of the Faculty; it is seen as a critical enabler to ensure that our teaching and research programmes are relevant to and support the industry as a key stakeholder. This collaboration will offer a unique opportunity to achieve this objective".

Engineering Management

Our research aims to improve value creation in technology-based enterprises by focussing on the following:

- *Enterprise Engineering:* Analysing enterprise design, implementation and operation to improve knowledge, innovation, financial and technology management.
- *Sustainable Systems*: Enabling the transition to sustainability by enhancing systems and technology evaluation, development, planning, design and management.
- *Health Systems Engineering*: Finding engineering solutions for challenges facing the healthcare sector.
- *Innovation for Inclusive Development*: Analysing, developing and evaluating inclusive innovations and systems.
- *Industrial Policy and Beneficiation*: Enabling mineral-rich countries to achieve sustainable development.
- Management of technological innovation, innovation strategy, dynamics of technological change and the impact of emerging technologies.

Manufacturing

Our research covers the development of resource-efficient process chains for the sustainable and smart manufacturing of products through digital, economically-sound process chains that minimise negative environmental impacts while conserving energy and natural resources.

Additive and subtractive manufacturing; reverse engineering, materials design and development; prototyping, ergonomics (human factors); commercial readiness; micro-manufacturing; novel biocompatible alloy development.

Operations Management

Operations and supply chain management focus on process excellence from both intra-organisational and inter-organisational points of view in the following areas:

- *Asset Management*: Improving the coordinated activities of an organisation to realise value from assets.
- *Supply Chain Management*: Leveraging the impact of 4IR technologies to improve operations and supply chains through digitalisation.
- *Sustainable Freight Transport*: Facilitating decarbonisation of freight transport activities by focussing on modal shift and vehicle technology.

Systems Modelling, Operations Research and Decision Support

This theme covers the development of mathematical models and their incorporation into computerised systems to support effective decisions in the industry. These models draw from applied mathematics, statistics, industrial engineering, and computer science and apply to complex problems with many trade-off solutions. Examples include:

- Routing and scheduling decisions for delivery vehicle fleets.
- Employee duty roster/timetabling construction.
- Optimal production facility layout.
- Simulation.
- Spatio-temporal modelling using machine learning.
- Sentiment analysis.

Data Science

Research produces novel, efficient and robust data science technologies by developing machine learning and optimisation techniques.
Data science techniques are applied to data sets to reveal patterns, trends and associations. Examples include:

- Forecasting customer demand from millions of retail transactions to understand demand patterns.
- Determining optimal segmentation of customers to customise service delivery and develop targeted marketing strategies.
- Using machine learning to predict order delivery times in a distribution scenario.
- Analysing imaging data for real-time inventory decision making.

Fourth Industrial Revolution and the Internet of Things

This theme focuses on automating industry and society using large-scale machine-to-machine communications, sensors, actuators, and other connected devices (the "Internet of Things"). Automatisation enables autonomous interaction between machines and humans. Examples include:

- Smart systems in transport and agriculture.
- Intelligent management of energy and water in education and health sectors.
- Real-time digital modelling of devices and industrial processes, using this "digital twin" for monitoring, diagnostics and prediction.

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In memoriam

Prof Theo von Backström, Senior Researcher and Emeritus Professor in the Department of Mechanical and Mechatronic Engineering at the Faculty of Engineering, passed away on 21 April 2021. Prof Von Backström was a celebrated academic and prolific researcher in fluid mechanics, thermodynamics, turbomachinery and renewable energy.

He graduated from the University of Pretoria with a BScEng (Mech) cum laude in 1967, whereafter he completed his MScEng (Mech) part-time in 1971 while serving as a pilot in 4 Squadron (Citizen's Force) in the South African Air Force, achieving the rank of Captain. Continuing his studies at Stellenbosch University, he obtained a PhD (MechEng) in 1980 and DEng in 2012.

In the 1980s, Prof Von Backström played a vital role in turbomachinery development in South Africa. He was the lead engineer in designing multiple axial flow compressors for South Africa's uranium enrichment programmes and also designed the compressor for the Apartment engine, a small gas turbine engine developed for target drones.

He taught undergraduate and postgraduate modules and served as Chair of the Department for seven years. Having supervised 18 PhD and 58 master's students, he was considered one of the Faculty's best postgraduate supervisors. Dr Brooks, a former student, remembers him as a wonderful teacher and supervisor who was uncompromising on quality but kind, patient, humble and generous with his time. Prof Von Backström, a B-rated researcher, was widely published and cited, with his work receiving national and international recognition and praise.

Prof Von Backström's colleagues remember him with fondness. Prof Johan van der Spuy praised Von Backström as a remarkable engineer with a unique ability to think out of the box. He could do fast isentropic calculations in his head and estimate a compressor's pressure ratio by simply looking at its cross-section! Mr Cobus Zietsman, a colleague of 36 years, friend and travel companion, mentioned his love of nature and camping, rating him a true gentleman.

The Dean, Prof Wikus van Niekerk, aptly stated: "Theo von Backström will be remembered as one of the giants of the Faculty of Engineering with his association that spanned over nearly four decades."

The late Prof Theo von Backström, Senior Researcher and Emeritus Professor in the Department of Mechanical and Mechatronic Engeering at the Faculty of Engineering.

Mechanical and Mechatronic Engineering

The Department of Mechanical and Mechatronic Engineering values its industry partners who fund research for their real-world challenges, presenting research students with hands-on experience to solve complex problems. Above, two master's students of the Sound and Vibration Research Group, Nicholas Bunn and Ben Steyn, are installing new cables and sensors on the port side propulsion motor of the SA Agulhas II. HealthProp, a two million Euro European Union MarTERA project with partners in Norway and Germany, will contribute a digital twin model for the propulsion bearings' oil temperatures and vibration in ice conditions.

The SA Agulhas II entering the sea ice during the 2020/21 SANAE relief voyage.

Nicholas Bunn and Karl Pferdekamper arriving at the Fimbul Ice Shelf, Antarctica, after a 12-day journey through the Southern Ocean.

SU research efforts pay off on SA Agulhas II voyage

The Department of Mechanical and Mechatronic Engineering's research efforts to evaluate the impacts of digital twins and machine learning on the efficiency and safety of the SA Agulhas II and her operations are starting to bear fruit, according to Prof Annie Bekker, leader of the Sound and Vibration Research Group (SVRG).

The group's PhD and MEng research students investigated dynamic ship responses, shaft-line and structural fatigue on the SA Agulhas II, fulfilling Stellenbosch University's commitment to HealthProp, a two million Euro European Union MarTERA project. This project aims to contribute a digital twin model for the propulsion system in ice with partners in Norway and Germany.

Despite COVID-19-related delays, the December 2020 voyage to Antarctica marked the eighth year of full-scale measurements by the SVRG. Four students helped the crew install 500 metres of cable and additional sensor wires in the ship's hull to measure oil temperatures and vibration.

When the first severe storm hit, the new instrumentation was ready to quantify the bow and stern slamming effect of giant waves on whipping, the jelly-like bending of the vessel. Ramming the ship through sea ice enabled researchers to quantify the impact of the vibration responses of the 30 metres long propulsion shaft.

Despite operating conservatively in ice, the extra power SA Agulhas II used in open water to gain additional speed almost doubled the amount of fuel burnt. As a result, using computational fluid dynamics and machine learning algorithms, power projections could be prototyped for a route based on weather and speed models.

"Development of a human digital twin and surveys of a vibration dose threshold for onboard comfort could influence future ship design," Bekker added. "In my mind, a ship will have a digital counterpart merged with innovative models, sensors and physical assets accessible to and driven by its business stakeholders."

Meet our new Teaching Fellow: Prof Debby Blaine

Prof Debby Blaine from the Department of Mechanical and Mechatronic Engineering (M&M) received one of four Teaching Fellowships funded by the Stellenbosch University (SU) Capacity Development Grants. She hopes her research project will allow intelligent young voices and ideas to be heard in classrooms and integrated into transformed curricula, Blaine says.

Blaine was motivated by her father, a mechanical engineer, to acquire a degree in Mechanical Engineering. Her interest in an academic career was kindled at Pennsylvania State University (USA), where she received a PhD.

Coming back to SU in 2007 from a position as deputy manager of Materials Research and Development at Bleistahl Produktions in Germany, the stint in the

industry provided her with the initial stimulus to improve curricula and the learning environment of engineering students.

While co-working on drafting the SU Council Decolonisation Report in 2016, she realised that intelligent and creative student voices were missing in classes and could help shape a better academic community.

In 2017 and 2018, she broke historic barriers by becoming the first female associate professor in M&M's history and the first female national president of the SA Institution of Mechanical Engineers. Blaine is a founding member and national president (2017–2019) of the SA Society for Engineering Education.

In 2018 she received an SU Teaching Award, followed by the Teaching Fellowship in 2021. Since its inception in 2009, the Fellowship has recognised teaching excellence, offering recipients a consistent period to focus on improving curricula and teaching practice in departments and faculties.

Her research project, Blaine says, will allow her to find ways to integrate her students' ideas into the design of collaborative and transformed curricula that meet the diverse needs of engineering students and staff.

New Virtual Reality Laboratory for Machine Design excites

The Department of Mechanical and Mechatronic (M&M) Engineering at Stellenbosch University recently introduced a state-of-the-art Virtual Reality Laboratory (VR Lab).

Prof Anton Basson explains the benefits of this academic resource for teaching third-year students Machine Design. The industrial use of VR in CAD model technology overcomes drawbacks of 2-D by enhancing the experience of sensing relationships and design scale in Machine Design.

Undergraduates receive numerous design problems to solve through projects that require the design of systems to meet user demands. Mr Gabriel da Silva of the Mechatronics, Automation and Design Research Group (MADRG) believes that a VR facility elevates students' learning experience. Designing, building and seeing the proportions of their systems on a life-size scale enable them to determine the feasibility of their solutions. Da Silva's postgraduate augmented reality (AR) research studies investigate the benefit of VR in data-driven decision-making processes to develop AR to its full potential.

Research Output

Subsidised journal articles	30
International proceedings	33
Patents	1
Doctorates	10
Master's graduates	35

Although VR in the video game industry is well established, new VR and AR functions are uncovered regularly and create commercial interest, says Da Silva. Virtual interactions with a physical model can simulate a real-life interaction, eliminating physical hardware in training. Virtual monitoring of remote systems eliminates travelling and allows strategy changes if required.

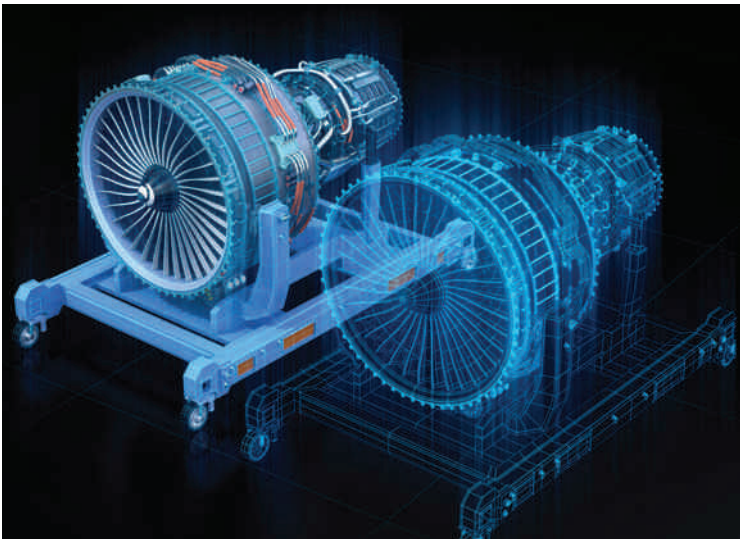
The main focus of the MADRG, under the guidance of Dr Karel Kruger and Prof Anton Basson, has been on the Fourth Industrial Revolution, the Internet of Things (IoT) and the ideas of cyber-physical systems (CPSs) and digital twins. All systems and components are connected and able to communicate with one another.

Da Silva believes that the new VR Lab will play a vital role in upskilling engineering students and aligning their skills with the ever-changing industry.

Prof Johan van der Spuy
Chair: Mechanical and Mechatronic Engineering

The Digital Twin Pump Laboratory tackles current challenges in the water sector

Prof Annie Bekker, incumbent of the Rand Water Research Chair, develops a digital twin model that simulates a real asset in its operational context. The model can detect differences between predicted and actual performance through real-time data analysis.



A new partnership between Rand Water and Stellenbosch University will investigate digital twin technology within the water network employing a simulation platform called The Digital Twin Pump Laboratory equipped with components similar to those found in a water distribution network.

Prof Anriëtte (Annie) Bekker, Rand Water Research Chair in Mechanical and Mechatronic Engineering, explains that a digital twin reflects the state and behaviour of a real asset in its operational context. Looking at a pumping station at Rand Water, the various levels of a pump station and distribution network – from single pump components to distribution network systems – can be represented digitally. Usually, engineers evaluate performance elements before designing and manufacturing a pump and never use the model again.

"With a digital twin, the model can be used in the operational phase beyond the design phase of an asset.

"Data-driven digital twin models allow engineers to take shortcuts by simulating the performance of a pump with machine learning techniques that generate a model from the pump operation data measured in different conditions without having to revisit the initial design. The models calculate quickly, are cost-effective and helpful in decisions that affect low-risk applications. Digital twin models detect behavioural differences between predicted and actual performance through real-time data analysis. Before they occur, they can head off problems by planning for future scenarios such as disaster management, population growth, and climate change," Bekker says.

Bekker acknowledges that digital twin technology is complex and expensive but may prevent redundant modelling expenses. It requires interdisciplinary knowledge and specialisation; nevertheless, it can become an aggregator with powerful cross-domain benefits, although the need for openness and sharing may create security and intellectual property concerns among manufacturers. Investment in digital twins relies on the period for which information is required (past, present or future). Understanding the users' needs concerning training, upskilling and affordability of the technology is essential.

In collaboration with Rand Water, The Digital Twin Pump Laboratory at SU – complete with pumps, pipes, pressure sensors and valves to circulate water – provides a controlled environment for experimenting, evaluating ideas and piloting digital twin concepts and models. It is ideal for demonstrations and student training.

"Digital twins require courage and collaboration between different fields to get going. Fortunately, Rand Water is hungry to grow in this digitalisation era," concludes Bekker.

Energy and the Environment

In close collaboration with the Centre for Renewable and Sustainable Energy Studies, the Department contributes to fundamental research into a wide range of energy generation technologies. Addressing transport needs, the group investigates the performance and impact of biofuels and blends in compression-ignition and spark-ignition engines. Finding uniquely South African solutions for concentrating solar thermal power and energy storage systems, the group's world-leading research in air-cooled heat exchangers and cooling towers is well known.

Excellent experimental capabilities and strong computational expertise enable the group to develop custom-made fans, compressors and turbines for ocean current, wind, and solar energy exploitation, and air-cooled and hybrid (dry/wet) cooling systems. Research covering the energy-efficient design of ship propulsion, ship hulls and various turbomachinery is supported by the only 90 m long towing tank in southern Africa. The Department boasts the largest fan test facility (7 m diameter) in South Africa.

Mechanics and Dynamics

The group's activities consist of fundamental research on materials, the behaviour of structures and failure mechanisms and criteria. The materials research focuses on powder metal processing and products, material property extraction using digital image and volume correlation, characterisation of granular materials, and qualification of additive manufactured parts. The structures research looks for a fundamental understanding of the behaviour of structures under static and dynamic conditions and, in the case of vehicles, aircraft or ships, their impact on humans. Failure mechanisms and criteria cover composite materials and fracture and creep deformation of steels.

Mechatronics, Automation and Design

Diverse mechatronic systems such as reconfigurable manufacturing systems, machine vision applications, cyber-physical systems and digital twins, augmented/virtual reality and human-system integration. These systems are applied in diverse contexts, including manufacturing, mining, health care, renewable energy systems, motor vehicles production, facilities management and maintenance management.

Computational Modelling

The group's expertise in optimisation theory and algorithm development, finite element methods (FEM), computational fluid dynamics (CFD), discrete element methods (DEM) and continuum methods is world-renowned. The DEM work is applied to, among other things, mining and earthmoving equipment, particle dampers and conveyors. We often link optimisation methods with the FEM and CFD work in applications related to fluid-structure interaction, turbomachinery, combustion and various renewable energy technology applications. The group also has expertise in the modelling and simulation of metal casting processes, emphasising solidification analysis and segregation.

Biomedical Engineering

Technologies such as 3D printing, microcomputers and artificial intelligence are opening up new opportunities for engineering in the biomedical field. This group develops innovative minimally invasive devices to collect healthcare information, mechatronic devices for telemedicine, customised solutions for treating specific diseases, and develops and tests medical sensors for in vivo testing of the human knee's biomechanical properties.

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Process Engineering

The Department of Process Engineering's research contributes to a circular economy by unlocking the potential of biowaste for renewable, biodegradable and non-toxic products. Above, postdoctoral student Dr Lalitha Gottumukkala uses a bioreactor to optimise microbial processes to produce prebiotics, enzymes, biofuels and valuable chemicals. A bioreactor, designed and operated to provide the environment for a chosen product, is the heart of many biotechnological systems for agricultural, environmental, industrial and medical applications.

Dr Lindleen Mugwagwa

Wheat straw and mango peels report for duty in renewable food packaging

Wheat straw and mango peels are usually disposed of in landfills or used as compost and animal feed. However, Dr Lindleen Mugwagwa's doctoral research, supervised by Prof Annie Chimphango, has unlocked the potential for renewable, biodegradable and non-toxic active food packaging as a replacement for polythene with its cancer-causing artificial antioxidants.

"We should consider using agricultural residues like wheat straw and mango peels, which are rich in natural polymers and antioxidants, as alternative raw materials to petroleum-based packaging materials," says Dr Mugwagwa, a postdoctoral fellow in the Department of Process Engineering.

Dr Mugwagwa's study was the first to develop processes for extracting the natural polymers and antioxidants from wheat straw and mango peels. For the first time, these products were integrated to form a biocomposite film (a material consisting of biodegradable polymers and bio-based reinforcing agents) and tested in a food environment with low-density polythene as the benchmark.

According to Dr Mugwagwa, the properties of these films could be tailor-made during extraction to suit their application in food packaging. The bio-based films that she developed were stable when in contact with food and released more antioxidants when compared to polythene plastic.

Remarkably, active packaging helps keep perishables fresher for longer because it responds to temperature and time changes in food storage by releasing antioxidants into food. These act upon free radicals and microorganisms, which may develop in food when stored improperly or for extended periods.

Her research will benefit biorefineries, the food packaging industry, farmers and consumers by providing cheap, sustainable and biodegradable polymers for food packaging.

Dr Mugwagwa's study received financial support from the Organisation for Women in Science for the Developing World, the Swedish International Development Cooperation Agency (SIDA), the NRF, the DST Council for Scientific and Industrial Research Waste Road Map and SU's Department of Process Engineering.

Alumnus wins prestigious engineering innovation prize

One of sixteen shortlisted participants, alumnus Noël N'Guessan won the Royal Academy of Engineering's 2021 Africa Prize for Engineering Innovation with compact equipment that ferments farmers' organic waste into compost or biogas to generate an income.

The Ivorian says his innovation, Kubeko, was inspired by his desire to increase smallholder farmers' income and broaden their access to opportunities in his homeland. He credits Sellenbosch University and the Engineering Faculty, where he obtained a BEng (Chemical Engineering) degree in 2012, for his development as an innovator and entrepreneur. He met people there who profoundly influenced his adult life, including his wife and business partner, Louise Bijleveld, studying international development, sociology and the promotion of gender.

His Bachelor's final-year project was his first experience of biowaste processing, being the recommissioning of a pilot biodiesel production line with used cooking oil as the feedstock. He saw what it took to develop a new process from fundamental research to prototyping and piloting. He was impressed with how ambitious the University was regarding technology with global relevance.

After obtaining his Master of Biosciences at the University of Ghent, Belgium, in 2015, N'Guessan and Bijleveld moved back to the Ivory Coast, where they farmed to familiarise themselves with the challenges. They then started LONO, a company that manufactures fertiliser and biogas from organic waste produced by communities and agro-industries in West Africa. His team, with whom he designed Kubeko in 2018, consists of his wife and other Ivorian engineers and finance and marketing professionals.

Receiving £25,000 in prize money, N'Guessan said the real reward was the expert sessions over eight months. These covered strategic business and product development, including a product mentor who helped reduce the production costs of Kubeko and scale the sale of hardware products to low-income groups. This expertise will stand LONO in good stead since the Ivory Coast's Ministry of the Environment and Sustainable Development commissioned them to conduct a study and outline recommendations on best practices as part of its national composting and biowaste strategy.

Suchet triumphs in fierce innovation competition

The 27th Jac van der Merwe Competition for Innovation, sponsored by MultiChoice, saw the top final-year projects of the Faculty's six BEng programmes battling it out for the most innovative product, process or service.

The judging panel, headed by Prof Thinus Booysen, had the demanding task of selecting a winner and runner-up from these highly innovative students. MultiChoice representative Mr Werner Strydom, who leads the Advanced Technology, Enterprise Architecture and Innovation teams at Irdeto, joined the panel.

A Process Engineering student, Leah Suchet, snapped up the competition's grand prize of R10 000 with her project Chemical and Enzymatic Hydrolysis of Alginate, completed under the supervision of Prof Robby Pott. She investigated the industrial application of kelp waste valorisation. South Africa's bourgeoning seaweed concentrate industry weekly produces 10 tonnes of kelp waste. The primary structural component in the cell walls of brown macroalgae, known as kelp, is alginate. Alginate, rich in bioactive compounds, is in demand for food, pharmaceutical and agricultural applications. Suchet proved enzyme hydrolysis superior to chemical methods, boding well for further investigation.

New appointee excels in mentorship

The Department of Process Engineering welcomed a new staff member, Prof Prathieka Naidoo, who brings 17 years of experience as an academic to her position as a professor. She knows that the first year of the demanding four-year BEng degree is daunting for a young student. Nevertheless, she has successfully attracted many students, especially female students, with good undergraduate support, mentorship and guidance to postgraduate studies.

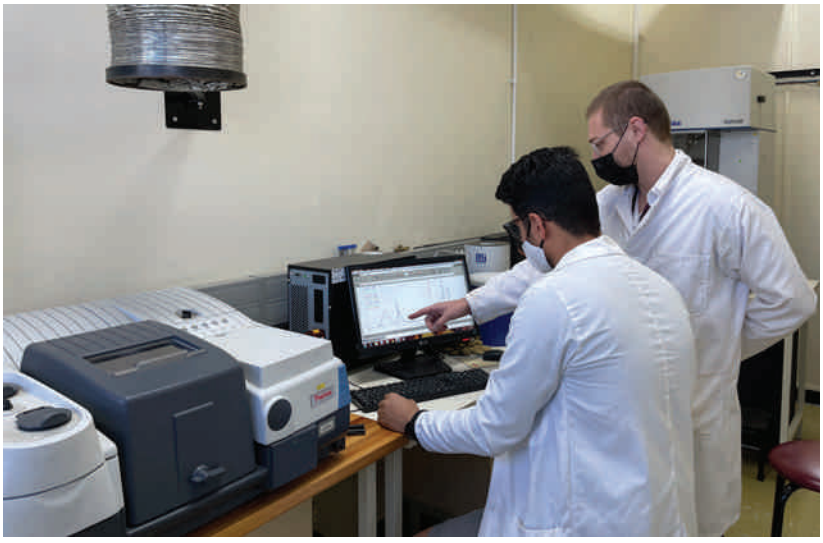
"Engineering programmes must adapt to a transforming environment, making curriculum changes inevitable," said Prof Naidoo. "I am looking forward to working on this and a more multidisciplinary approach to teaching and research."

Research Output

Subsidised journal articles	60
International proceedings	1
Chapters in books	4
Doctorates	8
Master's graduates	28

Prof Christie Dorfling
Chair: Process Engineering

Thuthuka funding supports the quest for knowledge



Aiden Burgess and Dr Fariborz Shaahmadi analyse spectral data generated by the Fourier transform infrared (FTIR) spectrometer. Processing this raw data will ultimately aid model development.

Dr Jamie Cripwell received NRF Thuthuka funding for early career researchers intending to develop research capacity by promoting the attainment of an NRF rating by promising academics. The funding ensures that Dr Cripwell can pour his passion for learning into chemical thermodynamics research over the next three years, kicking off in 2022.

Chemical thermodynamics ultimately defines what is possible in chemical and metallurgical engineering. Whether that is the maximum yield of a valuable product in a chemical reaction, or the purity of a product leaving a process, chemical thermodynamics defines that limit. Because these tangible outputs result from interactions between atoms and molecules, thermodynamic models use theory from physics, chemistry and statistical mechanics to describe them.

Thermodynamic models were traditionally developed and implemented in petrochemical industries, such as SASOL, that have supported the research for many years. Likewise, the same fundamental interactions occur in biofuel production, carbon-capture applications, pharmaceuticals and water treatment.

Thermodynamic models are typically the first step in designing or building simulations of existing processes. Choosing the right model for the chemicals present in a given process is essential for realistic and accurate predictions. Accuracy in defining a process's limit allows chemical engineers to operate closer to that limit. They can assess viability in new or small-scale processes with greater confidence than was previously possible.

Dr Cripwell's current research looks at improving the generalisability of these models. "Most models are fit directly to data for specific components and chemical properties – but we do not want to be limited by what chemicals and properties have available data," says Dr Cripwell. "What if we have a new solvent that we want to gauge the effectiveness of? What if we do not have specialised equipment to take specific measurements?"

In answering these tantalising questions, the Separations Technology research group considers a different approach that lets them "build" their components to increase generalisability – much like using Lego blocks to make different structures. Four master's students work in the group: Alex Schulze-Hulbe is developing a fundamental model and parameterisation strategy (designing the Lego blocks themselves, so to speak); Aiden Burgess and Lebohang Mphono are looking at the novel application of spectroscopy for the general parameterisation of models; Francesca Middleton is applying machine learning techniques. Dr Fariborz Shaahmadi, an Iranian postdoc with relevant spectroscopic and modelling expertise, oversees the day-to-day running of these projects.

The group's contribution will enable engineers to consider hypothetical alternatives and bring these powerful modelling tools to previously limited spaces.

Extractive Metallurgy

The sustainable production of valuable minerals and metals from ore or metal-containing waste material is critical for a sustainable future. Extracting the metal values from natural ores bodies and complex engineered wastes requires various treatment processes. The group undertakes research into the fundamentals and application of such treatment processes. Key challenges include the changing characteristics of raw materials due to depletion of easy-to-process ore bodies, dealing with complex metal structures and associations in engineered wastes, and ensuring that new and existing extraction processes minimise energy and water use.

Waste Valorisation

The successful valorisation of wastes will allow closing the loop in the circular economy, moving closer to a sustainable future. Key challenges include the separation and concentration of valuable products and the functionalisation of relatively inert chemicals. Our focus areas include:

- Waste tyre and waste plastic conversion to high-value chemicals.
- Electronic waste processing for metal recovery (lithium, gold, copper).

Separations Technology

The Separations Technology research group focuses on understanding the fundamentals and thermodynamics of separation processes involving hydrocarbons and other chemicals.

Typical processes include distillation, liquid-liquid extraction, adsorption, supercritical fluid fractionation and membrane separation. Much of the work focuses on separating compounds where the underlying systems may exhibit azeotropy and association due to hydrogen bonding and where the systems may involve molecules with varying polarity and asymmetrical structure.

Bioresource Engineering

We can ensure a sustainable future by using biological resources optimally. This group focuses on developing industrial bioprocesses that are safe, sustainable and profitable, either by employing biological resources (e.g., live organisms or active biological molecules) to transform raw materials into valuable products or by using biological raw materials as inputs. A robust interdisciplinary approach leads to frequent collaboration with other disciplines at Stellenbosch University and leading foreign institutions.

Water Technology

The group focuses on research and development to address local and international challenges in water provision by improving existing water treatment technologies and developing new technologies. The group's strengths include membrane technology (microfiltration, ultrafiltration, reverse osmosis, forward osmosis, membrane distillation and Donnan dialysis) and technologies suitable for developing economies. Current projects range from investigation and modelling of basic phenomena to technology development leading to implementation in the field.

Process Monitoring and Machine Learning

Advances in online monitoring and data collection present an opportunity to enhance chemical engineering processes' efficiency, sustainability, and profitability. This group's expertise rests in applying machine learning techniques to improve the operation and control of chemical plants, emphasising industry-ready solutions. Applications include fault detection and diagnosis, causality analysis, operational state identification and actionable advisories.

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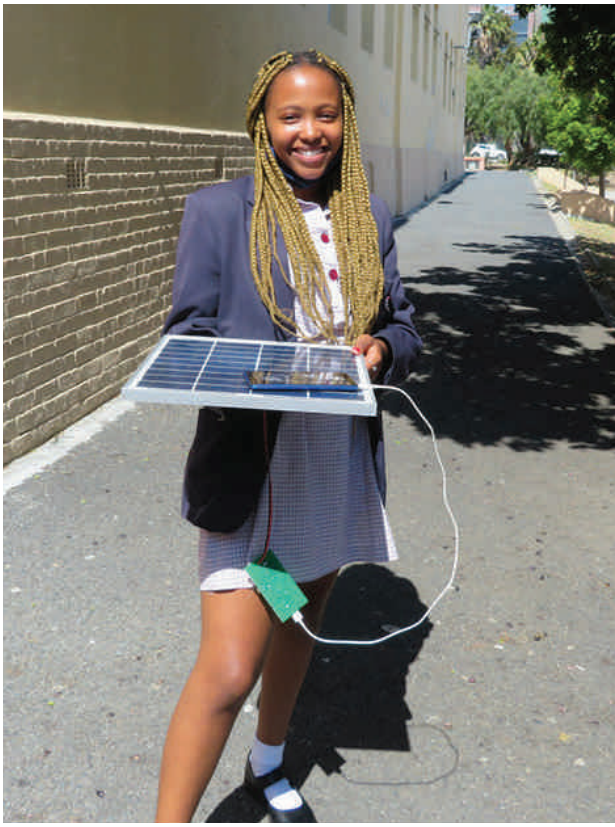
Outreach Programmes

Jaydn Loggenberg, a Cloetesville High learner, with his mentor and Physical Sciences teacher, Ms Caroline Bredell. His modified cell phone charger achieved bronze in the Western Cape Eskom Expo for Young Scientists competition and gold at the International Science Fair.



A Harold Cressy High School learner attended the SUNSTEP social impact project and made a solar cell phone charger that can charge iPhones and Android phones!

Open Day

The annual Open Day unlocks the fascinating world of engineers and its vast career opportunities for learners, parents and the general public.

Enquiries: Ms Tanya Ficker
Tel: +27 21 808 9403, e-mail: tanya@sun.ac.za

Women in Engineering

At the annual Women in Engineering afternoon, Grade 10 to 12 girls, who excel in Mathematics and Physical Sciences, find out more about engineering as a career for women when women engineers, lecturers and students address them. We had to cancel this event because of strict COVID-19 regulations in 2021. We plan to host it again during Women's Month in August 2022.

Enquiries: Mr August Engelbrecht
Tel: +27 21 808 4937, e-mail: august@sun.ac.za

Engineering Winter Week

During the annual Winter Week, Grade 11 and 12 learners get a clear picture of the work of an engineer through presentations by lecturers and engineers, as well as visits to industries and laboratories. COVID-19 lockdown restrictions prevented this event from taking place in 2021.

Enquiries: Ms Portia Adonis
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Top Achiever Sessions

During sessions presented in Stellenbosch and various major cities countrywide, top achievers (Grade 11 and 12) and their parents are informed about engineering as a career and the Faculty's degree programmes. Because of COVID-19 lockdown restrictions, we presented two online webinars in May and June 2021. Some departments followed up with programme-specific webinars to market engineering and increase registrations.

Enquiries: Mr August Engelbrecht
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First Generation Experience

Universities can be pretty daunting if you have no experience in academic or tertiary institutions. In 2018 the Faculty launched this outreach for Grade 11 and 12 top achievers whose parents have not had the opportunity to study at a university. During a day visit, they experience the exciting vibe of campus, hear about the Faculty's degree programmes and other SET fields of study and meet the Dean. This event did not occur because of COVID-19 lockdown restrictions in 2021. We plan to continue with this event in the second semester of 2022.

Enquiries: Mr August Engelbrecht
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Talent Development Programme

The national Department of Science and Innovation initiated this school holiday enrichment programme in collaboration with the national Department of Education and SUNCEP at Stellenbosch University. Offered to all nine provinces, Grade 11 and 12 (mostly black) learners are brought together per province and instructed by the relevant province's best Mathematics and Physical Sciences teachers. Our Faculty visits these centres for recruitment. However, because of COVID-19 lockdown restrictions in 2021, we have reached these learners through online presentations.

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An outreach to increase the registration rate of black, African speaking students in South Africa

An online webinar launched this project in October 2021. The project invited to the webinar students from nine vernacular language backgrounds (except English and Afrikaans) who received a provisional offer to study engineering at Stellenbosch University. Senior Matie students from similar language backgrounds participated in the webinar. Addressing the prospective students in their mother tongue briefly, they shared their own experiences as engineering students at Stellenbosch University.

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TRAC South Africa

TRAC, a community intervention program of Stellenbosch University, offers support in Mathematics and Physical Sciences to Grade 11 and 12 learners from disadvantaged and poor communities across South Africa. TRAC also provides vocational guidance to its beneficiaries, assisting them in applying to tertiary institutions and facilitating the process of funding applications for tertiary studies.

Enquiries: Ms Debbey Olivier
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Minquiz

Minquiz (organised by Mintek), a science and technology quiz for Grade 12 learners, promotes careers in science and technology, especially in mining, mineral processing and geology. The Department of Process Engineering assists in the Boland and the Western Cape.

Enquiries: Prof Christie Dorfling
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CRSES Schools' Programme

This programme, run by the Centre for Renewable and Sustainable Energy Studies, provides professional development and learning material (free of charge) to assist educators in teaching renewable energy topics. The learning material aligns with South Africa's Curriculum and Assessment Policy Statement (CAPS).

Enquiries: Ms Linda Joka
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SUNSTEP

The SUNSTEP programme allows learners to build working electronic circuits. There are also workshops for educators. Our flagship project, the programme's most popular one, teaches learners to make chargers for their cell phones, using a solar panel as a power supply. SUNSTEP offers an excellent way to learn about electronics and renewable energy.

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2022 Engineering Student Council led by Sandri du Plessis (front row, far right).

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