

A year in the life of the NWU FACULTY OF ENGINEER ING 2022





MESSAGE FROM THE DEAN

Prof Liezt van Dyk

At the NWU Faculty of Engineering we change the world for the better. We do this, first, by educating and developing exceptional engineers who can and want to change the world and, secondly, by finding answers to current and future real-life challenges of our industries and communities, through our cutting-edge as well as applied research.

We value our industry, academic and community partners, who enable us to develop relevant, sustainable, multi-disiciplinary solutions, as well as engineers with the ability and attitude to do the same.

This is not an annual report of our Faculty, it is a 2022 narrative. In this publication you will find selected stories from 2022 that bear testimony to our dream and mission. It is stories of new exciting, innovative technologies, knowledge and solutions, but it is above all stories of the people of the NWU Faculty of Engineering who work together towards achieving our dream.

This publication is dedicated to each and every member and partner of our Faculty - those who are explicitly featured here, but also and more importantly, those who made these stories happen behind the scenes. I am looking forward to write the 2023 story of our Faculty together with all of you.



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NWU ENGINEERING STUDENTS' INNOVATIVE VENDING MACHINE SECURES A WIN IN SAIIE COMPETITION

The South African Institute of Industrial Engineers (SAIIE) held its first annual student competition this year, and two students from the North-West University's (NWU's) Faculty of Engineering walked away with the spoils.

The competition was open to all tertiary students in industrial engineering who are members of the SAIIE. Nine entries were submitted, and the top three teams presented their solution to a panel of SAIIE members.

According to winners Njabulo Mhlungu and Nosisa Ngcaba, the competition focused on "Solving the problem of plastic bottle lids that reach our beaches and oceans", and required participants to solve a real-life problem using industrial engineering (IE) skills and tools.

They came up with the idea of a vending machine that can be placed on or near beaches to encourage the public to do their part in conserving and protecting our beaches. People should pick up bottle caps and lids from the beach, clean them and then insert into the vending machine that will weigh it. A certain price will then be allocated according to the density and quantity of the bottle caps, and the individual will receive a voucher/coupon/beverage equivalent to their contribution.

Nosisa says the competition provided her with the opportunity to put some of the IE skills she gained so far into practice and to engage in extracurricular activities. Since she grew up on the coast, the issue they were attempting to resolve was one that she had experienced first-hand and frequently.

"Having taken part in numerous beach clean-ups, I was aware that our answer needed to be more practical, long-lasting, and sustainable for future generations. These issues are undoubtedly covered by our vending machine solution. It would be a fantastic opportunity for us to actually build our vending machine and see it in use throughout the coastlines and perhaps even inland," she adds.

As the winning team, Njabulo and Nosisa had the opportunity to attend and present their solution at the SAIIE annual conference that took place from 3 to 5 October in Durban.

"The conference consisted of numerous research presentations, workshops and keynote presentations. We presented our solution at the gala dinner to all SAIIE members, and we are pleased to say that it was received very well and we are currently awaiting assistance and funding to implement our solution," says Njabulo.

MORE ABOUT THE SAIIE AND ITS STUDENT COMPETITION

The South African Institute of Industrial Engineers (SAIIE) draws upon specialised knowledge and skills in the mathematical, physical, behavioural, economic and management sciences and fuses them with the principles and methods of engineering analyses and design to find optimal and practical solutions. This contributes to the success and prosperity of an industrial undertaking, thereby making a fundamental contribution to the creation of wealth.

The SAIIE student competition provides an excellent opportunity for students to network with both experienced industrial engineering professionals and their peers. It is also a platform to demonstrate innovation, knowledge and skills on the big stage.



Njabulo Mhlungu and Nosisa Ngcaba present their winning solution at the SAIIE annual conference.



SOLAR TRAINING A PRIORITY AT THE NWU

Renewable energy constitutes an increasingly important part of our country's energy package while we move away from fossil fuels. This, together with an attitude of becoming more environmentally friendly, means that renewable energy like solar and wind power will definitely continue to play a bigger role in power generation.

That is why the North-West University's Faculty of Engineering presented a five-day short learning course from 3 to 7 October, which was facilitated by the NWU's Unit for Continuing Education.

SUNCybernetics was contracted to present the training and practical lessons were offered at the NWU's solar farm on the Potchefstroom Campus. This short learning programme was accredited by the Engineering Council of South Africa and was aligned with the PV GreenCard programme of the South African Photovoltaic Industry Association (SAPVIA). SUNCybernetics is an independent company that specialises in solar-related consultation and training services. This company, which celebrates its tenth anniversary in 2023, has delivered several solar projects that include network or hybrid systems and the training of hundreds of installers of solar power and municipal staff. SUNCybernetics is supported by their international parent company, SUNfarming, which is located in Germany.

The short learning programme was open for attendance by any person.

"Participants who attended the training learnt about the basic concepts of solar power and solar systems, how to optimally design a solar system, install it in practice, and to do everything according to the most recent national standards an international best-practice guidelines".

Anybody who is interested in entering the solar industry, wants to refine their existing knowledge on solar power, or even just want to learn more about solar power for a solar system that they already have or want to install soon will benefit from this training. There are no prerequisites for attending the training, but being able to do basic maths and understand electricity concepts will be beneficial," Faure van Schalkwyk, head of training at SUNCybernetics, said.

Willem Mostert, Senior Specialist: Business Development and Corporate Relations, expressed his gratitude to the dean of the Faculty of Engineering for helping to make the event a reality: "We would like to thank Professor Liezl van Dyk for her leadership and support in helping to facilitate this arrangement between both parties."



NWU lecturer walks away with prestigious engineering award

Meelan Roopa, a lecturer in the North-West University's (NWU's) Faculty of Engineering, received the award for Best Industrial Engineering Excellence in Teaching and Learning at the Southern African Institute for Industrial Engineering's (SAIIE's) 2022 awards ceremony.

Meelan received this prestigious award in recognition of his teaching prowess in business engineering, a capstone module for final-year industrial engineering students.

"This award has made me conscious of the direct impact we as lecturers can have on our students and respective communities. It has inspired me to ensure that my lecturing challenges future NWU industrial engineers to seek out new knowledge every day and remain inquisitive," says Meelan.

"I am honoured to receive such a prestigious award. This award will always mean a lot to me as I continue to develop my academic career."

He says in this module, students learn about the world of business, Industry 4.0 technologies, business design, strategies and tools, Enterprise Resource Planning (ERP) platforms, value engineering, and ethics. "Most importantly, it challenges them to create innovative business ideas through a gamified competition similar to Shark Tank or Dragon's Den," Meelan adds.

"In a group setting, this process generates innovative business ideas that are supported by a solid business plan and Minimal Viable Product (MVP). A key component of these ideas is that students design businesses with the goal of uplifting society through job creation and direct societal gains enabled by Industry 4.0 technologies," he adds.

According to Meelan, societal upliftment forms part of what the industrial engineering profession seeks to achieve. Students develop a core value proposition through intricate business design. "These technologies are meant to bridge societal gaps and empower a workforce, not replace them."

The course is presented using various videos, case studies, research papers, and guest lectures that guide students throughout this journey.

"Class discussions help foster and reinforce students' understanding of pertinent concepts that are applied. Within the module, students can motivate how their businesses could satisfy specific human needs and form sustainable mechanisms that can remedy inequalities, create jobs and promote a profitable future for all."



Photo: The NWU's Meelan Roopa proudly display his SAIIE award for Best Industrial Engineering Excellence in Teaching and Learning. With him is Jacques Fauré, president of the SAIIE.

DOUBLE THE SUCCESS FOR FIORITA TWINS

North-West University (NWU) students and twins Andrea and Marco Fiorita, recently received their degrees in computer and electronic engineering with distinction.

"Growing up, we were inseparable and always in cahoots. We made smoke bombs, took apart electronics around the house, build crazy contraptions and watched endless YouTube videos on how to make cool gadgets at home," says Marko.

All these activities created an interest and stirred a love for creating and learning, and it came as no surprise when they decided to enrol for a degree in engineering.

The siblings have a passion for electronics, and are in the process of starting their own business, specialising in product development with a focus on electronics.

"We are glad that both of us could complete our degree together and achieve roughly the same average over the four years," says Andrea.

Marco adds that they are extremely proud of themselves for enduring the tough times and all the late nights they spent working.

"This achievement gives us the confidence to know that any problem we may face is a steppingstone to a higher level and not just a stumbling block," said Marco.

Currently the twins are registered for their master's degrees in computer and electronic engineering at the NWU.

"Upon completion of our master's degree, both of us want to gain some experience in the field and may start working for a company, while running our business on the side.



Andrea and Marco Fiorita



WAITING TIMES IN HEALTHCARE ARE UNDER THE MICROSCOPE

WAITING FOR MEDICAL TREATMENT CAN BE A LIFE-OR-DEATH MATTER.

"Waiting times in healthcare are a significant problem that occurs across the world and often has catastrophic effects - as we have seen during the Covid-19 pandemic," says Maria van Zyl, a lecturer in the School of Industrial Engineering at the North-West University (NWU).

While various terms are used for waiting times to access healthcare, such as "sojourn" and "throughput," Maria says there is no consensus on how these terms are defined. For example, is the time spent by a doctor waiting for a patient to arrive for an appointment regarded as waiting time?

"Ambiguous definitions of waiting time make it difficult to compare and measure the problems relating to waiting times and delays in healthcare" she explains.

To understand why waiting time in healthcare is a confusing concept, Maria is looking at different scenarios in her studies.

She says part of her study is to propose a taxonomy/framework according to which waiting time in healthcare can be defined from an operations-research and operations-management perspective.

"Different types of delays in healthcare as defined in the taxonomy can be due to different scenarios. With this taxonomy/ framework in place, the next step of my research is to solve real-life problems relating to waiting and access times in four different private hospitals in South Africa," says Maria.

Different waiting-time problems are addressed using mathematical modelling. One such problem is the turnaround time of pathology tests, taking into account the type of pathology tests, the location where the pathology tests are conducted and the urgency of the results. "This, in turn, can provide an answer to pathology laboratories at a specific site on how best to deploy their phlebotomists (staff tasked with taking blood samples) and the best schedule to use when collecting blood samples."

Maria is looking beyond blood tests and is hoping to make a difference throughout the sector: "An additional problem that I hope to solve is operating room (theatre) scheduling according to the case mix of a hospital to reduce the waiting time of patients for both elective and emergency surgery. Both operations-management and operationsresearch techniques can be used for this."

ABOUT THE RESEARCHER

Maria van Zyl is a staff member and lecturer in the School of Industrial Engineering at the NWU. She is completing her PhD through the University of Twente in the Netherlands. Her studies require her to solve real-world problems while also making an academic contribution.



Maria van Zyl





Jacques Beukes

Jacques Beukes of the MUST Deep Learning research group at the Faculty of Engineering is the 2021 winner of a North-West University (NWU) Vice-Chancellor's Medal for his dissertation "Interpretability of deep neural networks for SYM-H prediction".

Eight vice-chancellor's medals are awarded annually to the best master's degree students at the NWU. Jacques was awarded the medal for Engineering. The awards are given in recognition of excellent work done by master's degree students at the NWU, and to celebrate the continued efforts of study leaders and other academics in creating and sustaining a nurturing environment for these students.

Jacques's study was a collaborative effort between MUST and the South African National Space Agency (SANSA). MUST director, Prof Marelie Davel, was his supervisor, with co-supervision provided by Dr Stefan Lotz, a research scientist at SANSA in Hermanus and an extraordinary researcher at MUST, also based in Hermanus.

Jacques wrote his dissertation about space weather and improving geomagnetic solar storm predictions by using deep learning techniques. Deep learning is a fast-growing area of machine learning that can deliver complex models capable of solving complex tasks. Specifically, the research focused on developing a model that could be more easily interpreted. By changing the internal architecture of the model, Jacques created a system capable of showing which features are important when space weather is being predicted and do not affect prediction performance. By creating a model that is easier to interpret, Jacques has shown that models can be altered to be more transparent in their operation without performance being affected. The transparency of deep learning networks is very important, as the complexities found in models make it difficult to implement them in applications such as healthcare solutions and self-driving cars, where explainability is critical to making justifiable, safe and unbiased decisions.

Jacques spent most of the first year of his studies learning the fundamentals of deep learning and space weather, along with the practicalities of machine learning research through reading, discussions and running small experiments, individually and as part of the research group. In his second year, he developed a reliable codebase on which to run the experiments that would ultimately turn out to be his VC-award-winning dissertation. During his studies, Jacques published two conference contributions and one journal paper, co-authored with his supervisors.

Jacques confesses that his initial objective with enrolling for a master's degree was to extend his student life, but his motives changed during his studies. "MUST allowed me to experience the world of research with world-class researchers. They taught me much more than how to write a good dissertation. Critical thinking, technical communication, efficient administration and best programming practices are some of the things that I will treasure always."



To those aiming for a distinction, Jacques advises that having a good support network and utilising it are extremely important for anyone aiming to achieve this level of success. Furthermore, Jacques states that *"asking the right questions and not fooling yourself"* is the most critical point of good research. From a technical standpoint, Dr Lotz states that in his opinion, a distinction requires that expectations regarding quality, readability and attention to detail should not only be met, but exceeded. The measure of novelty, while not a requirement for a master's degree, can also play a role in obtaining a distinction for research.

Prof Davel also believes Jacques fully earned his distinction. "The work performed by Jacques (and also his co-student in this domain, Dewald Krynauw) was creative and of an excellent technical standard and provided significant impetus for the ongoing spaceweather collaboration with SANSA." Prof Davel and Dr Lotz have since been awarded a grant from the National Institute for Theoretical and Computational Sciences (NITheCS) to continue this work in 2022.

Since completing his master's degree, Jacques has moved on to decentralised finance, where he is currently working as an engineer for blockchain solutions. He continues to utilise and grow his machine learning expertise.

The MUST Deep Learning research group studies machine learning, with a specific interest in the theory and application of deep learning techniques. The application domains of the research group are varied, ranging from speech and language processing to industrial applications of deep learning. MUST collaborates with the Space Science Programme of SANSA to investigate the applicability of deep neural networks* for modelling various space-weather phenomena.

These phenomena include predicting geomagnetic disturbances from solar wind parameters, or predicting the eruption of solar flares from images of the sun. An important goal of this work is "knowledge inference": studying ways in which the developed models can be interpreted in novel ways in order to shed light on the underlying phenomena. *Internationally, deep neural networks (DNNs) have increasingly become the driving force behind breakthroughs in fields such as computer vision, natural language processing and bioinformatics. Deep learning models are particularly applicable when complex relationships must be inferred from large, high-dimensional data sets.

In specific application fields these systems can achieve and sometimes surpass human performance, making "narrow AI (artificial intelligence)" an increasing reality. These successes have inspired research into better algorithms, novel applications thereof, and a better understanding of DNNs.



Asimplified cross-section of Earth's magnetosphere, showing how the solar wind compresses the geomagnetic field's dipole shape on the dayside (left, facing the Sun) and elongates it on the night side (right, away from the Sun). L1 indicates the first Lagrangian point. (Adapted from Moldwin, 2012)



A graphical representation is shown with predicted and observed Sym-H (a space weather index measuring storm intensity) values during a geomagnetic storm. Model prediction results are shown both with and without phase and timeshifted inputs. The different storm phases are also indicated here.

Round of applause to finalists and winners of the Modiragatsi Youth Innovation Competition

On Women's Day this year, the Business School of the North-West University (NWU) had the privilege of honouring gifted young learners and students with great minds and the potential to shape a better future for all! The Modiragatsi Youth Innovation Competition finalists and winners were celebrated during a breakfast event at The Capital On The Park Hotel in Sandton.

The Modiragatsi Youth Innovation Competition, hosted by the NWU Business School in collaboration with merSETA and SIEMENS, is a community engagement project aimed at empowering the South African youth (especially female youth) to make a tangible difference in their communities.

Applicants, as individuals or in teams of two, are expected to identify a problem in their own community that they think might be resolved by means of a mobile app or an electronic product. They enter with nothing but an idea as a proposed solution and, following that, the 12-week training and mentorship programme is where the magic happens!



Learners and students are guided to reposition their view of these real-world problems in a user-centric way by developing their skills in product development, problem-solving through design and computational thinking, mobile app development (using the content of the Mendix university programme) and then building a business around that product. They are also trained in intellectual property protection (using material created by KISH-IP), start-up conceptualisation and pitching to potential investors.

The benefits of the Modiragatsi competition are far-reaching. Firstly, young South Africans are empowered with new skills and given the opportunity to change lives - including their own. We know of learners in the programme whose Mathematics scores in school rose from 1s to 7s as an incidental result of skills learnt in this competition and the fact that, for the first time, they realised that they had reason to believe in themselves. Secondly, learners and students identify and validate problems in their communities themselves, which allow the identification and potential solution of realworld, systemic problems to the benefit of all.





Ultimate winners Kevin Naylor and Jo Duvenhage (from Worcester Gimnasium)



Lastly, learners' and students' psychological and developmental milestones are gauged and developed. This year, the Care2Kids team of the NWU Centre for Health and Human Performance (CHHP) offered a programme that focuses specifically on learners' and students' mental and developmental wellness. This included a weekly personal development live stream for the duration of the competition.

As for the participating innovators themselves, one can only say that the judges were met with remarkable ideas and incredible talent. Overall, 81 teams (150 participants) were trained. From 42 high schools across the country, these teams included 68 high school girls, 36 high school boys and 33 teachers, as well as 13 undergraduate students.

To meet the competition criteria, they needed to propose an inspiring idea with the capacity to make an impact when implemented, demonstrate a passion for science and engineering, and communicate the idea clearly, concisely, and appropriately to judges from various backgrounds. The competition comprises six categories. The first category, Edutech, focuses on the use of technology to improve education. This category boasted six finalists, from whom joint winners were chosen. The idea of the first of the joint winners, Mphoentle Matloa (from Central Secondary School, Brits), was to use physical science to create a science lab in a box for each school.

The idea then evolved into creating a digital lab in a box in the form of an app that learners would use to complete science projects. The outcome of the project would be determined by the learner's input, information would be packaged using physics and the app would include things like quizzes to test users' knowledge on the content. How's that for innovative?

The second of the joint winners was the team of Arnold Dippenaar and Isabelle van Wyk (from Hoërskool Waterkloof), who want to create an online platform where learners can participate in Mathematics Olympiads, with the necessary preparation and examples to do so successfully.



The idea is to have learners from different educational levels compete and advance to higher leagues. This could be a the much-needed step up in terms of the effective means to "teach" and ensure learner success in Mathematics.

The second category, Food, Energy and Water, had four finalists. The winner, Omphile Choane (from Welkom High School), thought of a way of bringing safe drinking water closer to those in need. His idea was to fit out a bakkie with water purification equipment powered by solar energy. What an exceptional idea!

Ayeesha Kahn (from Star College Durban) also received an honourable mention in this category for her idea of bridging the gap between wastage of good food in restaurants and the hungry. This is done by means of an app that enables ondemand sharing of information, which allows for collection and provision of food to those in need. This is a great way to address the food crisis in communities. In the third category, Gender-Based Violence Prevention, the winner among six finalists was Ritsepile Sambo (from Star College Durban), who proposed a wearable device that one can activate when in a state of panic. This device would effectively collect evidence that the police could use to successfully pursue and prosecute perpetrators. The device would have a recording function, as well as a button to call for help.

The winner of the fourth category, Healthtech, was the team of Kevin Naylor and Jo Duvenhage (from Worcester Gimnasium). They want to develop a digital platform where teens can safely and anonymously share mental health-related questions and problems without feeling exposed. This not only provides a safe space for teens to talk and get help, but it also allows counsellors to identify and address systemic problems among the youth. Isn't this platform exactly what our youth need to achieve and maintain wellness in this day and age? In the Safety and Security category, winner Tyla Shepstone (from Somerset College) thought of using the internet to better manage and prevent cases of missing persons.

This not only includes the tracking of children, but also the identification of "green zones", meaning routes where children generally move, and then creating an alert whenever these zones are deviated from. Since one cannot be careful enough when it comes to the safety of loved ones and oneself, it would be modest to say that this is a brilliant idea.

The final category, Township Economy, had three finalists whose projects coincidentally complemented one another so well that it would make for an incredible business. The category winner, the team of Martin Maupa and Lenke Ernst (from the North-West University), proposed an innovative app that would act as an economic tool to create greater market access for small to medium enterprises in townships to formalise their business ideas. What a substantial need among these businesses, and what a way to meet it!

Choosing the ultimate winner among such remarkable ideas was a nearly impossible task. The judges were astonished at what these learners were capable of with nothing but the gift of their own minds. With no technical experience whatsoever, competitors came with just an idea, and with 12 weeks of stimulation in a structured programme, these ideas were transformed into relevant, innovative, implementable initiatives that address real-world problems.

After much deliberation, the team of Kevin Naylor and Jo Duvenhage (from Worcester Gimnasium) walked away as ultimate prizewinners, with their exceptional idea of a mental health communication platform for teens.

The grand prize includes a bursary for these learners to study at a South African university.



Category winners, 2022

The winners will also be visiting Germany in December 2022 on a technology tour, facilitated by SIEMENS Digital Industries.

The success of this competition and of each participant is both exciting and humbling, and a cornerstone of this that cannot be left unmentioned is the incredible mentorship of the teachers, whose dedication went above and beyond all expectations.

A single example is the KZN floods in June, which could have direly impacted learners from Durban Star College in the competition. This impact was warded off by teachers who called times without count to ensure that learners knew what was expected of them and did not miss a thing.

Their hands-on involvement in every step of this competition made all the difference and, against the odds, thanks to these teachers, Star College Durban proudly had two category winners in GBV and the Food, Energy and Water categories. The same can be said for teachers like Grace Djan from the Potchefstroom High School for Girls, who mentored 14 teams and did the interviews with each finalist team herself. No task was too much trouble for this teacher, who gave her all to see her learners thrive in the competition.

"It is nothing less than an absolute privilege to be partnered with SIEMENS, as they open doors in industry to our winners that hundreds of engineers can only dream to access. This truly is a once-in-a-lifetime opportunity," said Prof Leenta Grobler.



NWU'S SOLAR CAR WINS STRUCTURAL DESIGN AWARD IN SASOL SOLAR CHALLENGE '22



Naledi 2.0, the North-West University's (NWU's) solar car won the Structural Design Award presented by Euro Steel during this year's 2022 Sasol Solar Challenge.

The challenge took place from 9 to 16 September, covering an estimated distance of 2 500 km from Johannesburg to the finish line in Cape Town.

Engineers from around the world compete in South Africa's bi-annual Sasol Solar Challenge to cover the longest distance on public roads along the designated route. Over the eight-day event, teams put newly developed technology to the test as they pass through South African towns. It is a great sight for residents who watch in awe as the vehicles pass through.

The NWU team secured fourth place in the category Challenger, and team leader Danie Human says they are very pleased.

"I am very proud of my team members. Prior to the race, none of us knew each other well, and we overcame a lot of obstacles together through sheer determination. I could not have asked for a better team - we achieved comradeship and this victory together," he says.

In contrast to the competitors, Naledi is constructed of a variety of materials including kevlar, carbon fibre and aluminium. The solar array is mounted on a lightweight aluminium wing to improve cooling and therefore efficiency to increase energy production.

Danie says Naledi went through the paces with ease. "Our vehicle was very sturdy and could withstand the wind gusts very well structurally, especially when passing heavier vehicles such as trucks." He adds that Naledi's structural design also enabled it to save weight, so it performed well.





Another unique and impressive design feature of the vehicle is the rotating solar array, which allowed the vehicle to harness almost twice the solar energy at some points along the route in the morning and afternoon.

"With the rotating solar array, we were able to increase our performance because we could rotate the blades in the morning and afternoon to maximise the solar energy. Our performance was improved by this innovative addition to our vehicle," he says.

"I would like to thank the faculties of Engineering and Natural and Agricultural Sciences, and the Instrument-making department for making this possible," he says.

The Ilanga Cup, which is currently in the preparation phase for next year, could be Naledi's next challenge.

It would be a step in the right direction if more students from other faculties participated in the competition, says Danie.

"I think our students from related fields of study will gain great insight working on projects like these. It will also give them the opportunity to broaden their knowledge in the field of renewable energy and perhaps find innovative solutions to our current energy problems."



Residents watched in awe as the solar vehicles passed through, and here some of them are meeting the Naledi team.

NWU'S ENGINEERING IS NUMBER ONE IN SOUTH AFRICA

The North-West University (NWU) is the best choice among local universities for studies in the field of engineering. The latest subjects ranking by Times Higher Education (THE) places the NWU at the top of the ladder in this field, and highlights the NWU's other quality subject offerings.

According to THE's World University Rankings by Subject for 2023, the NWU is first among local institutions in engineering, moving up from third position last year. It places the NWU in the 401 to 500 category globally.

This is a great achievement, as THE ranks the NWU out of 10 top South African universities that offer studies in the field of engineering and measures the university against 1 306 institutions worldwide.

THE's subject ranking for engineering highlights the universities that are leading across disciplines that include general engineering, electrical and electronic engineering, mechanical and aerospace engineering, civil engineering and chemical engineering.

"We are proud of this excellent placing, as well as of our other achievements in the rankings. It clearly indicates that the university is a choice destination for studies in essential professions, paving the way for graduates to excel and thrive in the professional world," says Dr Bismark Tyobeka, principal and vice-chancellor.

Other top rankings are in both physical sciences (401 to 500 globally) and psychology (301 to 400), where the NWU is ranked third locally.

This is also the first year that the NWU is ranked in computer sciences. Locally the NWU shines in fifth position, and globally in the 601 to 800 ranking category. The NWU's other fifth place rankings are in the fields of business and economics (remaining in fifth position from last year) and clinical and health (301 to 400 globally).

Rounding out other top 10 positions are a seventh position in the fields of law (251+) and education (401 to 500), eighth in life sciences (601 to 800), ninth in social sciences (601 to 800 category), and tenth in arts and humanities (501 to 600 globally).

PERFORMANCE MEASURED ACROSS FIVE AREAS

THE measures performance in each subject area across five areas: teaching (the learning environment); research (volume, income and reputation); citations (research influence); international outlook (staff, students and research); and industry income (knowledge transfer).

Commenting on the rankings, Dr Tyobeka remarks that the rankings are a good indication of the NWU's quality subject offerings, both locally and internationally.

"They contribute to the NWU's dream of being an internationally recognised university in Africa and the world, known for excellence and quality education."

NWU RESEARCHERS HELP MAP THE WAY FORWARD FOR HYDROGEN IN SOUTH AFRICA



The Earth is in trouble. It is suffocating under clouds of carbon dioxide emissions from the use of coal and other environmentally damaging resources to generate energy. These emissions are the primary cause of global warming, and if humanity wants to avoid the worst consequences of global warming*, we must find alternatives for our energy needs.

Researchers at the North-West University (NWU) are constantly investigating new environmentally safe energy technologies. Hydrogen is a feasible alternative to fossil fuels, and with zero carbon emissions, it is excellent for the generation of safer and greener energy. This is acknowledged in the recently launched Hydrogen Society Roadmap for South Africa, to which NWU researchers made significant contributions.

Dr Blade Nzimande, Minister of Higher Education, Science and Innovation, officially launched the Hydrogen Society Roadmap on 17 February this year. This essential national document was developed as a partnership involving the Hydrogen South Africa Infrastructure Centre of Competence (HySA CoC) at the NWU, the Department of Science and Innovation (DSI), KPMG and other stakeholders.

The Hydrogen Society Roadmap points the way to a greener and environmentally safer South Africa. Its focus is on potential industrial growth areas that would benefit from the production, storage and distribution of hydrogen and related research development and innovation, as well as on the promotion of gender equality and social inclusion as important benefits of the hydrogen economy.

Prof Dmitri Bessarabov, director of the DSI's HySA CoC on the NWU's Potchefstroom Campus, says the National Flagship Programme HySA has brought research funding of about R421 million to the NWU over the past 11 years. As part of the project, 212 fully refereed publications were produced jointly with the Council for Scientific and Industrial Research.

TOWARDS A LOW-CARBON ECONOMY

"This project is great for the academic and public awareness of our achievements. It also highlights our significant presence in Africa as a key player in the hydrogen space," Prof Bessarabov says. "Furthermore, it enhances our reputation for potential collaborators overseas."

He says the funding is evidence of the commitment of the South African government to generate new technology and to train local experts and students towards achieving the climate CO2 regulations of the Paris Agreement.

"In order to implement a low-carbon economy or a carbon-free economy, hydrogen needs to be produced from renewable energy sources such as solar power, wind and water. As this is new technology, the Roadmap provides government guidelines and indicates the prioritisation of how these hydrogen codes and standards will be implemented and in which sectors of the economy it (hydrogen) will first be used. There need to be safety standards, regulations and guidelines for stakeholders and industry," says Prof Bessaraboy. According to him, more than 40 countries have already published hydrogen roadmaps, which are mostly country specific.

"We are very honoured and proud that the HySA CoC at the NWU was selected as a coordinator for the initial stage of the Roadmap development, which was followed by a long inclusive process until the final document was born."

Click here to see Prof Bessarabov talk about the NWU's involvement in the Hydrogen Society Roadmap for South Africa process and highlight some of the other projects the HySA CoC is involved in.

*Consequences of global warming and climate change include floods, droughts, rising sea levels, the extinction of animal species and vegetation and high temperatures.





Prof Dmitri Bessarabov says the involvement of the NWU's HySA CoC in the Hydrogen Society Roadmap is an important milestone in the development of hydrogen technologies at the university.



Machine and deep learning are a MUST at the NWU

Our world is speeding up, and never in human existence have we been able to search as fast, travel as far or delve as deep. The last century alone has seen a meteoric increase in the accumulation of data and we are able to store unfathomable quantities of information to help us solve problems known and unknown. At some point the ability to optimally utilise these vast amounts of data will be beyond our reach, but not beyond that of the tools we have made. At the North-West University (NWU), Professor Marelie Davel, director of the research group MUST Deep Learning, and her team are ensuring that our ever-growing data repositories will continue to benefit society.

The team's focus on machine learning and, specifically, deep learning, is creating magic to the untrained eye. Here is why.

"Machine learning is a catch-all term for systems that learn in an automated way from their environment. These systems are not programmed with the steps to solve a specific task, but they are programmed to know how to 'learn' from data. In the process, the system uncovers the underlying patterns in the data and comes up with its own steps to solve the specific task," explains Professor Davel. According to her, machine learning is becoming increasingly important as more and more practical tasks are being solved by machine learning systems: "From weather prediction to drug discovery to self-driving cars. Behind the scenes we see that many of the institutions we interact with, like banks, supermarket chains and hospitals, all nowadays incorporate machine learning in aspects of their business. Machine learning makes everyday tools - from internet searches to every smartphone photo we take - work better."

The NWU and MUST go a step beyond this by doing research on deep learning. "This is a field of machine learning that was originally inspired by the idea of artificial neural networks, which were simple models of how neurons were thought to interact in the human brain. This was conceived in the early forties! Modern networks have come a long way since then, with increasingly complex architectures creating large, layered models that are particularly effective at solving 'human-like' tasks, such as processing speech and language, or identifying what is happening in images."

She explains that, although these models are very well utilised, there are still surprisingly many open questions about how they work and when they fail.

"We work on some of these open questions, specifically on how the networks perform when they are presented with novel situations that did not form part of their training environment. We are also studying the reasons behind the decisions the networks make. This is important in order to determine whether the steps these models use to solve tasks are indeed fair and unbiased, and sometimes it can help to uncover new knowledge about the world around us. An example is identifying new ways to diagnose and understand a disease." The uses of this technology are nearly boundless and will continue to grow, and that is why Professor Davel encourages up-andcoming researchers to consider focusing their expertise in this field.

"By looking inside these tools, we aim to be better users of the tools as well. We typically apply the tools with industry partners, rather than on our own. Speech processing for call centres, traffic prediction, art authentication, space weather prediction, even airfoil design. We have worked in guite diverse fields, but all applications build on the availability of large, complex data sets that we then carefully model. This is a very fast-moving field internationally. There really is a digital revolution that is sweeping across every industry one can think of, and machine learning is a critical part of it. The combination of practical importance and technical challenge makes this an extremely satisfying field to work in."

She confesses that, while some of the ideas of MUST's collaborators may sound far-fetched at first, the team has repeatedly found that if the data is there, it is possible to build a tool to use it.

One can envision a future where human tasks such as speech recognition and interaction have been so well mimicked by these machines, that they are indistinguishable from their human counterparts. The famed science fiction writer Arthur C Clarke once remarked that any sufficiently advanced technology is indistinguishable from magic. At the NWU, MUST is doing their part in bringing this magic to life.



Marelie Davel

It is time for ESKOM to switch on private sector initiatives

It is time to buck the dusky trend. The national energy provider, Eskom, is haemorrhaging money at an unsustainable rate and is nearly R400 billion in debt. Equipment is failing, power outages have become the norm, while its energy availability factor (EAF) has fallen by almost 30% in just over a decade.

Up to 13 July, South Africa had lost 48 days, or 1 152 hours, of electricity usage in 2022 alone, passing the 2021 record number of load-shedding hours. In 2021 Eskom shed 2 521 gigawatt hours (GWh) in electricity, while 2022 has already seen more than 3 000 GWh being shed. In the prevailing darkness, this is a nightmarish scenario.

Corneels Schabort, an energy expert at the Faculty of Engineering of the North-West University (NWU), puts this loss in Eskom revenue in perspective. "Electricity production reduces by 168 GWh per week for each phase of load-shedding. Assuming a minimum selling price of electricity of 85c/kWh, the gross income loss for Eskom, which is only one small aspect, is R143 million per week, per phase. So, if one considers the entire loss of 3 000 GWh, the unrealised income equates to R2,5 billion for the first seven months of 2022.

In the same period, Eskom had to spend almost three times that amount on diesel to keep the open cycle gas turbines (OCGTs) online." Recently, Eskom committed itself to bringing back original equipment manufacturers to oversee maintenance duties. There is a renewed drive to recruit previous employees who either left Eskom or were forced to take early retirement packages.

According to Schabort, these two solutions are steps in the right direction. Still, there is only one viable path to keep the lights on: "If I could offer one solution, it would be a plea to the Minister of Mineral Resources and Energy, Gwede Mantashe, to allow the private sector to play an increasingly bigger role in the electricity generating game.

There is nothing better for South Africa than a decentralised electricity environment."

Although President Cyril Ramaphosa has increased the threshold for private selfgeneration to 100 MW from the initial limit of 10 MW, the playing field is still tipped in favour of state-owned energy production.

Recently, the president hinted at creating another state-owned public utility service to compete with Eskom. These sentiments are supported by high-ranking government officials such as the Minister of Labour, Thulas Nxesi, who said he vehemently opposed privatising Eskom, as it would result in higher energy prices and inhibit all South Africans' access to electricity.

"Despite many shortcomings in the IRP 2019 document, one existing, agreed-upon remedy could easily be implemented, and that is 'accelerating or bringing forward capacity proposed in the plan' in the case of the 'EAF deteriorating further'. Minister Gwede Mantashe can implement this mitigation, found in the IRP 2019 document, without lifting a finger. This action will unlock up to 15 000 MW of privately produced solar PV and wind power in as little as 18 months." Schabort says that this approach would make a genuine difference to South Africa's energy conundrum, reducing the burden on Eskom's failing infrastructure without costing the taxpayer a single cent.

"The solution to the load-shedding problem does not lie with Eskom. Sitting back and waiting for Eskom to resolve the issue will accomplish nothing. Eskom is but one role player in the bigger picture. Our hope of ending load-shedding lies with the private sector or, more specifically, independent power producers (IPPs). They, of course, have a generating limit of 100 MW, but the question is: Why should there even be a limit? What about electricity as a privately traded commodity and not exclusively state-owned and -distributed?

"As is the case in many countries, there will come a day when we will be able to decide where we want to buy our electricity. The energy landscape is moving towards privatisation. Eskom's future divisions, namely generation, transmission and distribution, will still play a role in electricity supply in South Africa, but it is hoped that the electricity monopoly will make room for healthy competition, resulting in cheaper, sustainable electricity. We do not need 100% privatisation. We need more role players and more competition."

AND NUCLEAR ENERGY?

"I am in favour of nuclear energy, but not in the South African context. Look at the two most recently built coal power plants, Medupi and Kusile. After 14 years, Medupi is still short of the flue gas desulphurisation units, and Kusile has two of its six units still under construction. If Eskom could not finish these two power plants in more than 14 years, how can we trust them to complete a nuclear power plant? There has also been an exodus of expertise from Eskom to foreign markets.

Our engineers are highly sought after abroad, and if you want to build a nuclear power plant, you need experts to run and maintain that plant. It takes a minimum of 15 years to build a nuclear power plant, so if we start building a new nuclear plant today, by the time it produces its first kilowatt-hour, it will be 2037."

The louder the public outcry over load-shedding becomes, the more significant role players will have to listen to possible solutions. Maybe a public problem needs a private solution?



Corneels Schabort



HARD AT WORK ADVANCING THE WORLD OF LANGUAGE TECHNOLOGY



Prof Febe De Wet, an associate professor in the School of Electrical, Electronic and Computer Engineering at the North-West University (NWU), has more than three decades of experience in her field, and her passion is the driving force in making a meaningful contribution to her industry.

She is working on several projects that deal with speech technology and language resources for native South African languages Her current project involves localising Mozilla Firefox's Common Voice platform for the 11 official languages recognised in the South African Constitution.

Besides researching the development of language technologies for South Africa's indigenous languages, she is also coordinating final-year projects, supervising vocational training and teaching digital signal processing. Despite her hectic schedule, the married mother of three says finding the right work-life balance takes a team effort, with her whole family involved to find ways that are suitable for everyone.

"Our strategy is not cast in stone, since things change, depending on where you are in life. With the birth of our first child, ideas that worked before had to be revisited. Similarly, arrangements made before my husband was promoted no longer worked.

"Also, I developed the ability to say 'no' to survive. Our enthusiasm often tempts us to take on too many commitments at once, resulting in us becoming overcommitted and unable to do anything properly. This is something I try not to do anymore," she explains.







When asked what advice she would give to young aspiring researchers and academics, her passion for languages is palpable when she reflects on Shakespeare's words in Hamlet: "to thine own self be true". "I think being true to yourself is good advice for any researcher, and if it means being a leader, then do not hesitate to take up the challenge."

Despite working on interesting problems with like-minded people, Prof De Wet reflects on one of her proudest career moments: co-supervising Rynhardt Kruger, the first blind person ever awarded a PhD degree in Electrical and Electronic Engineering at Stellenbosch University. "He is an amazing student with brilliant talent. It brings me great joy to know that he contributes to the advancement of our industry and makes a positive difference in other people's lives," she adds.

MORE ABOUT PROF DE WET

She completed her electronic engineering degree at Stellenbosch University, pursued a master's degree at the University of Pretoria, and earned a PhD from Radboud University in Nijmegen, the Netherlands in 2003.

Her research interests include statistical pattern and automatic speech recognition. Her interest is in educational applications of speech technology and developing speech recognition systems for children.

"I have always been fascinated by languages and linguistics. However, I also had a strong interest in mathematics and science, so when I found a field that combined these two interests, I knew I had found my niche. However, I am still more interested in human languages than computer languages," she says.

FROMZERO TOHERO - students taste the sweet fruit from hard work

Over the past few years, there were not nearly enough school-leaving applicants who met the minimum requirements for tertiary fields of study such as Engineering, Natural Sciences, Economic Sciences and Health Sciences.

This is according to Elza Hattingh from the Faculty of Engineering at the North-West University (NWU). She heads the faculty's Xcel programme - an initiative that offers a second chance to students who want to improve their previous Grade 12 Senior Certificate exam results in Mathematics and Physical Sciences.

In 2016, Hattingh welcomed the first 12 students who wanted supplementary schooling, with the aim of improving their matric results at the end of the year to get a better chance of admission to a university. Today, many students have reaped the rewards, with some students who have already graduated and are currently working in the industry or pursuing further studies.

According to the National Senior Certificate (NSC) Diagnostic Report 1 of 2021, only 35.6% of the total number of matriculants who enrolled for Mathematics in Grade 12 achieved scores higher than 40% in the NSC Mathematics exam in 2021. This means that 64,4% of the matriculants attained less than 40% in Mathematics. This group of school-leavers has no chance to consider a career in the sciences.

"The reasons for these students' poor school results in Mathematics and Physical Sciences range from inadequate school-level education, to difficult domestic conditions, unbalanced dedication to sports participation, illness or the lack of academic purposefulness during Grade 12. Of even greater concern is the small percentage of matriculants who meet the Engineering programme requirements. For example, only 3,8% of the matrics who wrote Mathematics and only 4,4% of those who wrote Physical Sciences met the Engineering programme requirements," Hattingh says.

After seven years, the Xcel programme proved itself to be a runaway success and achieved above-expected results. The NSC academic results from 2020 to 2022 were as follows:

Year	Mathematics				Physical Science			
	Previous NSC result	Xcel year: new NSC result	% Improvement	Student	Previous NSC result	Xcel year: new NSC result	% Improvement	Student
	8	9	8 8	2020	- 22	9	8	
2020 group average	56%	77%	21%		57%	72%	15%	
2020 best performer	53%	95%	42%	×	73%	94%	21%	×
2020 best improvement	53%	95%	42%	×	45%	89%	44%	v
				2021				
2021 group average	57%	77%	20%		53%	77%	24%	
2021 best performer	59%	91%	32%	2	66%	92%	26%	z
2021 best	38%	76%	38%	ь	48%	85%	37%	c

"We have a strict selection process for those who want to enrol for the Xcel programme, because we want to be sure that the selected



students are truly serious about improving their previous results. We also make sure their goals are realistic and emphasise the seriousness and hard work that the programme entails," Hattingh says.

In 2020, 46 students were actively involved in the Xcel programme. No less than 65% of these students (30 students) were accepted for the Engineering programmes at the NWU and 30% (14 students) were accepted for BSc programmes at the NWU. Two students were accepted for Pharmacy and one for Law. In total, 26 distinctions were achieved. In 2021, 32 students enrolled in the Xcel programme. 81% (26 students) were accepted in the Faculty of Engineering, and 19% (six students) were accepted in the Faculty of Natural Sciences. Only two students in the Xcel group did not meet the minimum requirements for Engineering studies.

"Here the students have to decide how hard they are willing to work to gain access to a professional qualification. We have chosen the right lecturers for this great task and, I can honestly say, they are doing a phenomenal job. They make sure the students perform to the best of their abilities," she says.

Although the programme is offered at the NWU, the Grade 12 national preliminary examination and final Grade 12 Senior Certificate examination are conducted under the supervision of the Department of Basic Education at a neighbouring high school.

"It is so nice to go to work knowing you are doing something for someone that will turn their lives around. That is very rewarding! To see learners, with limited university admission, walk out here after a few years with a high-level academic qualification is an absolute privilege," Hattingh concludes.

TO FIND OUT MORE ABOUT THE XCEL PROGRAM, PLEASE VISIT:

Xcel information:

https://engineering.nwu.ac.za/engineering/xcelprogramme Video:

https://www.facebook.com/ watch/?v=178888907719925

The requirements to be considered for the Xcel program are the following:

- At least 40% for Mathematics and Physical Science in Grades 11 and 12
- must have passed matric with university exemption
- must have at least 60% for their language of study (Afrikaans/English) to be able to enrol for the subjects AGLE 111 and AGLE 121
- not older than 22 years
- did not write the NSC more than three years previously

HySA showcases groundbreaking exhibition at Green Hydrogen Summit

In a world grappling with the effects of pollution and global warming, hydrogen is a viable alternative in generating cleaner, "greener" energy to not only benefit humankind, but also the environment.

Hydrogen South Africa (HySA), a national flagship programme approved by the Cabinet, is at the forefront of hydrogen technologies in South Africa. The North-West University (NWU) and Council for Scientific and Industrial Research (CSIR) host a HySA Centre of Competence (CoC) of the Department of Science and Innovation (DSI) at the Potchefstroom Campus of the university and at the CSIR.

This HySA Infrastructure CoC, led by Prof Dmitri Bessarabov, DSI HySA director, recently showcased a groundbreaking exhibition to support the South Africa Green Hydrogen Summit (SAGHS) 2022.

Unique and pioneering exhibition

The NWU and CSIR team, led by Prof Bessarabov, developed a unique and first-of-its-kind exhibition focusing on local technology and intellectual property developed by the HySA Infrastructure CoC at the NWU. "The exhibition displayed locally developed components for hydrogen production by water electrolysis as well as related systems and storage technologies."

A large team of HySA Infrastructure CoC staff worked at the exhibition. Academics and staff from the NWU were Prof Bessarabov, Dr Phillimon Modisha, Samuel Mamathuntsha, Samuel Modise, Dr Neels le Roux, Dr Boitumelo Mogwase and Geoffrey Bantom. Prof Liezl van Dyk, executive dean of the Faculty of Engineering at the NWU, also attended the summit as a delegate.

More about the South Africa Green Hydrogen Summit

Infrastructure South Africa (ISA) hosted the inaugural South Africa Green Hydrogen Summit (SAGHS) in Cape Town at the end of November. "The SAGHS showcased South Africa's offering as an early-stage, large-scale, low-cost, worldclass green hydrogen production hub and total value chain investment destination," says Prof Bessarabov.

South Africa is one of the founding members of the Africa Green Hydrogen Alliance (AGHA), which seeks to promote continental green hydrogen cooperation.



Senior delegations from the other founding members of the AGHA - including Egypt, Kenya, Mauritania, Morocco and Namibia - were also invited to showcase their unique offering at the SAGHS.

The summit took place from 28 to 30 November in Century City. It included a keynote address by President Cyril Ramaphosa. High-level panels discussed the challenges and opportunities in implementing green technologies during the event.



Photo 1: Prof Dmitri Bessarabov, DSI HySA director, with delegates during the South Africa Green Hydrogen Summit (SAGHS) 2022. They are Dr Phil Mjwara, director general at the Department of Science and innovation, Dr Thulani Dlamini, chief executive officer at the CSIR, and Somila Xosa of the Department of Science and Innovation.

Part of exhibition stays in Cape Town

A part of the exhibition will stay in Cape Town as part of the World Science Forum (WSF) 2022 taking place from 6 to 9 December. Hosted by the DSI and themed "Science for Social Justice", the WSF will take place in Cape Town for the first time. The HySA exhibition will return to the NWU after this event.



Photo 2: Dr Boitumelo Mogwase from HySA Infrastructure, Higher Education, Science and Innovation Minister Dr Blade Nzimande, and Samuel Modise from HySA at the World Science Forum (WSF) 2022.

FRANCO TAKING STUDENT LIFE IN HIS STRIDE

It was love at first sight - boy meets campus

It was love at first sight - boy meets campus. In 2019, Franco van Dijk visited the North-West University (NWU) campus in Potchefstroom as part of a tour by his school choir.

"We saw a lot of the campus - it almost felt like an open day. I really liked what I saw and decided that this was where I wanted to go," says Franco, who matriculated from the Ligbron Academy of Technology.

Franco, who was born in Bethal, Mpumalanga, will be turning 19 in May and is enrolled in his first year of working towards a degree in Electromechanical Engineering.

"It is a difficult course, but I am enjoying it immensely. I have also made some good friends and my roommate and I are particularly close," explains the resident of Caput men's residence. "I was in a hostel in high school too. The difference here is that I have a lot more freedom and there is a real sense of camaraderie here - a sort of brotherhood. At school I went home every weekend, but now it will be more like two or three times a semester.

I am really enjoying the freedom, but there are also a lot of obligations. There is a big emphasis on taking initiative. You must determine how much time and effort you want to put in. Studying takes up a lot of my time, but I am also involved with sêr and debate competitions at Caput."

Franco was born with bones missing from his legs as well as other complications, resulting in both his legs being amputated when he was eight months old. "I cannot participate in certain sports, but otherwise it has not been a hindrance in my life."



Using prosthetic legs has been part of his life for as long as he can remember.

"As I got older, I had to get new prosthetic legs all the time, but now that I have basically stopped growing, the legs will be replaced a lot less. The legs actually last a long time - it is only the carbon-fibre feet that give in after a while. Maintenance only requires the components to be checked every two months to see if they are working properly."

For the next few years Franco will be focused firmly on achieving his career aspirations.

"I hope to get into the automotive or the aerospace industry." The latter especially excites him. "I would love to be part of the rocket development revolution that is currently underway."

AD ASTRA, FRANCO. TO THE STARS.



INDUSTRIAL ENGINEERING IN AGRICULTURE

"The agriculture industry needs more industrial engineers and engineers need to do more applied research with pragmatic value to industry," says Prof Rojanette Coetzee, from the School of Industrial Engineering.

The agriculture industry is no different from other industries in terms of production processes, supply chains, facilities and people.

Also, its challenges are no different: less-thandesired throughput, facility layout that is not conducive to flow, a need for better project management and business engineering, the need for improved quality management and much needed assistance with human resource planning and management.

The farmer is essentially a Jack of all trades and master OF ALL, required to have knowledge of various technical disciplines such as mechanics, hydraulics, electrical power, irrigation, structural design and, in recent years, electronics too.

Over and above these skills, farmers are required to understand how to run a profitable business, including management of a workforce and resources, for which they have probably had very little to no formal training. They are simply expected to do all of this to provide for their families and produce for the country, while facing unpredictable (natural) circumstances, increasingly inhibiting government policies in a less-than-desired economic environment and unsafe living circumstances. It is safe to say that farmers are nothing short of miracle workers.

Industrial engineers have an obligation to improve circumstances in the industry, for the farmer, as well as the rest of the value chain. Rojanette, together with final-year and postgraduate students, has focused on improving different processes in different industries by means of the Lean Manufacturing philosophy, which involves an approach where value is created for the customer by focusing on valueadding activities and removing waste from the process. Recently, however, Rojanette's focus shifted to the agricultural sector and Lean Agriculture.

One of the first Agri studies investigated why trained sheep shearers are leaving South Africa to work elsewhere. Looking at the current state of the South African sheep shearing industry, it is concerningly probable that the industry will, once again, experience a shortage of skilled shearers within the next few years. In a sub-sector skills plan, published by the Agricultural Sector Education and Training Authority (AgriSETA) in 2020, it was acknowledged that shearing is a scarce and critical skill in South Africa.

The study, led by Anri Klopper, indicated that the South African sheep shearing industry is not conducive for attracting and retaining sheep shearers, even if these shearers completed their training in the country. The bigger problem, however, is that the root cause of this phenomenon is neither understood, nor well documented. The aim of the study is therefore to investigate and collate, from different stakeholders, the root cause of low retention of sheep shearers within the South African sheep shearing industry.



While conducting the sheep shearer study, Rojanette explored the need for other applications of Industrial Engineering within agriculture. Reactions from industry, as well as from prospective students, were positive and excited. There is a need in industry and students jumped at the opportunity, with most of them living on farms themselves, experiencing the challenges on a daily basis, or realising (through the undergraduate studies) the positive impact that industrial engineers could make.

With the help of two research assistants, Herme Nel and Jorinda Marais, Rojanette established a structured research forum in the School of Industrial Engineering in 2022: Industrial Engineering in Agriculture (IE@Agri).

The vision of the group is to use proven industrial engineering techniques, as well as applied research, to develop pragmatic solutions that will assist farmers, organisations and the wider value chain with everyday challenges. Doing so will improve agricultural processes and make farms and companies more effective, efficient and profitable.

On 17 November, 2022, the first industry-research open day was held to showcase current and future research to different industry partners. The objective of the day was to match different industries (and their challenges) to research projects and students (both final years and postgraduates). The day was successful in that various new networks and collaborations were formed between researchers, students and industry partners. New research projects were formulated for 2023 onwards, wherein students will have the opportunity to conduct research in industry and develop pragmatic solutions that will assist farmers, organisations and the wider value chain within the agricultural sector.

Examples of future research for the IE@Agri research group include investigation of the Theory of Constraints, to improve throughput at livestock auctions in South Africa; combining flow- and Temple Grandin principles to improve cattle handling facilities of South African farmers; and using optimisation techniques to determine optimum strip grazing scenarios for South African farmers.

The research group is also involved with various Agri-companies, solving real-world problems by providing solutions for improved production schedules, facility layouts, etc. A few simulation projects will also be employed to investigate different "what-if"-scenarios for organisations. The dream is to have a positive impact on the agricultural environment by providing pragmatic solutions to everyday problems, and thereby making companies and farms more effective, efficient and profitable.

STUDENT TESTIMONIALS AND PROJECTS

Click on the video or scan the QR code to watch the video.







Click on the video or scan the QR code to watch the video.



Click on the video or scan the QR code to watch the video.





SOCIAL HIGHLIGHTS OF 2022

OUR YOUTUBE SECTION

NWU Engineers change the world for the better - Executive Dean Prof Liezl van Dyk







Online Open Day of the NWU Faculty of Engineering (2022)







NWU Mechanical Engineering flying high - Jonker Sail Planes:





NWU Mechanical Engineering involvement with SANParks initiatives:







NWU Faculty of Engineering: Impactful research







Student perspectives at NWU's School for Mechanical Engineering







Faculty of Engineering - What is Chemical and Minerals Engineering







Faculty of Engineering - What is Industrial Engineering







Faculty of Engineering - What is Mechanical Engineering





Faculty of Engineering - What is Computer and Electronic Engineering





Faculty of Engineering - What is Electrical and Electronic Engineering

















SAC CONTRIBUTIONS AND ACHIEVEMENTS OF 2022

It has been an exciting year filled with many events and triumphs for the Engineering Student Academic Chapter (SAC) of 2021/2022. The term 2021/2022 was the first year after Covid 19, where we as a student leadership body could participate and function without most Covid 19 restrictions.

One can imagine that it was quite challenging to get back to social interactions and having on-campus events with the majority of students not knowing what on-campus student life meant.

Nevertheless, we kicked the year off with a bang at our Engineering SAC camp at the Elgro River Lodge. During the camp, we did all the planning for the year and created better relationships among committee members. Once we got back to campus, we welcomed the first-year engineering students to the engineering faculty during R&O. It is such an exciting time of the year when the firstyear students are introduced to a new phase of their lives. We also provided them with guidance on software installation to help ease the adjustment from high school to university.



The year was jam-packed with events that all engineering students could attend such as a potjiekos tournament, volleyball tournament, quiz night, budgeting 101, speed dating, robotic hand arts and crafts, shazam night, informal, formal dine, final year dine, African indigenous games night, drive-in movie night and a self-defence night. We also held internal events such as class representative braais, a leadership workshop where Mr Steve Skarke from the University of Texas was the presenter as well as our transfer function at the end of the year.

We also participated in events where we competed with other chapters such as an amazing race and Word Wise Week where the Engineering SAC was the winner of both events. The Engineering SAC also hosted and participated in the Engineering faculty's community outreach programmes including Engenius Kids and Engineering Week.

We also participated in all the NWU events hosted by the Student Campus Council including open day, barefoot day, green week and health week.







The Engineering SAC of 21/22 gave their term their best shot and triumphantly achieved 2nd place in Current Affairs, 2nd place in Marketing and Recruitment, 1st place in Finances and Sponsors and 1st place in SRCS. Overall the Engineering Chapter of 21/22 placed 1st for the best chapter of the year between eight chapters.

The Engineering SAC is proud of its achievements as a student academic chapter. Our committee worked extremely hard to better the student experience of the engineering students and to keep improving the Faculty of Engineering.

We cannot wait to build on the Engineering SAC's legacy in 2023!



OUR FACEBOOK YEARBOOK HIGHLIGHTS

Starting the new academic year on the right foot



Our very own NWU - North-West University Engineering Student Chapter team, began the year earlier than all the other student, with a 2-day retreat for team building and planning sessions at the Elgro River Lodge.

The session did not only give them time to readily plan for the committed academic year ahead, but as well a time to have some good clean recreational fun while debriefing on the past year's plans and objectives.

Our 2022 orientation and registration programme

During our 2022 orientation and registration programme, the faculty hosted new students in a covid conscious fashion. This crucial and informative two-day programme comprised of an introduction and overview of our faculty and staff, computer and systems setup, as well as a campus general tour to acquaint the 1st year students with their new home away from home.



Farewell to Mr. Nico Lemmer



In February 2022 We bid farewell to Mr. Nico Lemmer, who served the NWU for an impeccable 10 years. He served in our faculty as Laboratory Manager at within the School of Chemical and Minerals #Engineering.

We were honoured to host him and his wife for a farewell braai with staff as he served his months' notice.

Inaugural lecture



On 24 February 2022 from 17h30 to 18:00 Prof Sanette Marx presented her inaugural lecture, broadcasted in a hybrid fashion. Her address entailed:

"Turning waste into products: a circular economy concept".

She was supported by her family and fellow faculty professors.



Prof Dawid Eduard Serfontein - Inaugural address



On 10 March 2022, Prof Dawid Eduard Serfontein of NWU Faculty of Engineering within the school of Industrial Engineering presented his inaugural address on:

"The future of electricity generation in South Africa, the place for nuclear power in it and what you can do about it". The auspicious celebration was supported by his wife, daughter, and fellow professors from the faculty.



Annual Femmengineering

The annual Femmegineering event this year was streamlined together with the annual Modiragatsi competition. The 2 events were held separately, but in parallel through a live media feed. Modiragatsi from Sandton JHB and Femmegineering at NWU Potchefstroom. Femmegineering is focused on the girl learner, to inspire and motivate them to pursue careers in engineering, which is so often seen as a manly field of choice.



Video link of entertainment: <u>https://fb.watch/i60ieujqH0/</u>

Modiragatsi

The Modiragatsi competition is a high-school focused competition that aims to expose learners to engineering and problem solving. The registered learners are tasked with solving various environmental, economic and social problems our society faces, and challenged to compete by creating innovative solutions to these problems. (Modiragatsi winner 2022 - Amy Vockerodt of Hoerskool Waterkloof)



Event video clip: <u>https://fb.watch/ePiw-Xjzom/</u>

Ambassador Maruyama visited the HYSA Infrastructure Centre

West University co-hosted by the University and CSIR, guided by its Director Professor Bessarabov. This centre is a site of the five-year joint research project "Development of New Ammonia Synthesis System using Renewable Energy and Hydrogen" between NWU in South Africa and KOSEN Numazu in Japan and other research institutes in both countries. The project will formally start from the coming October in the framework of SATREPS (Science and Technology Research Partnership for Sustainable Development).

It aims to expand the use of green ammonia as an energy carrier through technology development by the research partners of our two countries, thereby promoting the use of renewable energy in South Africa, which is currently highly dependent on coal. Sasol, as an industry leader for a national hydrogen economy, will also provide scientific and engineering support.

The Embassy of Japan in South Africa looks forward to the steady progress of this project, which is expected to contribute to decarbonization.



First ever ONLINE OPEN DAY



The winter of 2022 our faculty hosted the first ever ONLINE OPEN DAY, on 10 August.

The Focus of the remote open day was our very own proud flagship project, Naledi 2.0 (SOLAR CAR), which boasts collaborative advances from each of our faculty's fields of study, Namely:

- Chemical Engineering
- Electronic and Computer Engineering
- Mechanical Engineering
- Industrial Engineering
- Electromechanical Engineering
- Mechatronics Engineering, and
- Nuclear Engineering.

Video Link Online open day: https://www.youtube.com/watch?v=wzrtJWy_pao&t=5689s



The online open day hosted by Mr GP van Rheede van Oudtshoorn, comprised of a 3-hour, detailed and informative presentation from our various schools, offering registrants elaborate insight into what each entail, with introductionws to our industry partners, as well a unique chance to meet our Dean, Lecturers, Alumni and Student Academic chapter representatives

We Congratulated our PhD graduates







On June 22 2022 We Congratulated our PhD graduates, who took to the stage in a prestigious ceremony.

Their hard work, perseverance and commitment to upholding the values of the #faculty of #engineering was celebrated by us all.

- Mr Cornelius Ockert Koekemoer School Of Nuclear Engineering
- Ms Maria Susara Gouws School Of Chemical Engineering
- 3) Mr Johannes Gert Nel School Of Nuclear Engineering
 - Ms Mia Pillay-Mangaroo School Of Industrial Engineering
 - Mr Whisper Maisiri School Of Industrial Engineering
 - Mr Crynos Mutendera School Of Development & Management Engineering
 - Ms Evgenievna Alina Kozhukhova School Of Chemical Engineering
 - Mr Alexandrovich Abram Alexander -School Of Chemical Engineering
 - Mr Malakhov Albertus Meyer School Of Mechanical Engineering













Prof Henri Marais at Electra Mining Africa





On the 7th September 2022 Prof Henri Marais Senior Lecturer in School of Electrical Electronic and Computer Engineering represented us at Electra Mining Africa, where he was part of the ECSA panel involved in the scope of practice for engineering work pertaining to #ComputerEngineering, as well compliance with the gazetted regulations for Computer and Mechatronic Engineers. At the NWU Faculty of Engineering we change the world for the better. We do this, first, by educating and developing exceptional engineers who can and want to change the world and, secondly, by finding answers to current and future real-life challenges of our industries and communities, through our cutting-edge as well as applied research. We value our industry, academic and community partners, who enable us to develop relevant, sustainable, multi-disciplinary solutions, as well as engineers with the ability and attitude to do the same.

VISIT OUR WEBSITE TO FIND OUT MORE ABOUT OUR FACULTY AND OUR FIELDS OF STUDY!

https://engineering.nwu.ac.za





Industrial Engineering



Mechanical Engineering

Computer and Electronic Engineering

Chemical Engineering







Electrical and Electronic Engineering



Mechatronics

Chemical Engineering: Minerals Processing









The ideal engineer is a composite ... He is not a scientist, he is not a mathematician, he is not a sociologist or a writer; but he may use the knowledge and techniques of any or all of these disciplines in solving engineering problems.

~ Nathan W. Dougherty, American civil engineer



A year in the life of the NWU FACULTY OF ENGINEERING 2022