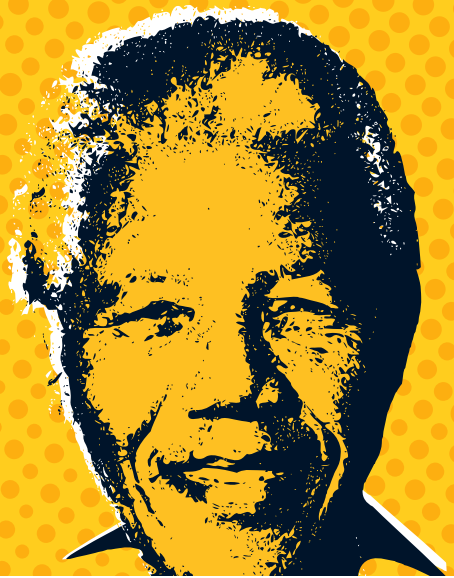
merSETA
MANUFACTURING, ENGINEERING AND RELATED SERVICES SETA

NELSON MANDELA UNIVERSITY



"Celebrating seven years of Success"

February 2018

Change the World

mandela.ac.za

INTRODUCTION

The merSETA Chair in Engineering Development (ED) was introduced in 2010 at Nelson Mandela University. Mr Karl du Preez, a principal lecturer in Mechanical Engineering and the Director of the Advanced Mechatronic Technology Centre (AMTC), was appointed as the Chair.

This milestone arrangement between merSETA and Nelson Mandela University was a pilot programme and a first for merSETA with a tertiary educational institution. The primary objectives of the programme are to:

- Provide technical assistance to technical high schools in the Eastern Cape region.
- Enhance the relationship of the tertiary educational institutions with TVET Colleges.
- Introduce a programme that would provide both academic and non-academic support to female students at Nelson Mandela University.
- Provide support to enhance the development of specialised skills in the fields of mechatronics and renewable energy systems.

Among the many highlights during the past seven years, is especially the introduction of an agreement to further Marine Engineering as part of Operation Phakisa. The collaboration between merSETA and Nelson Mandela University led to the introduction of a BEng Tech: Marine Engineering in Semester 1 of 2018.

"The introduction of the merSETA Chair in ED in 2010 has enabled the university to enhance its relationship with technical colleges, high schools and local industries. The programme provided much-needed assistance to effective infrastructure and skills development in the Eastern Cape. It has also assisted in creating an engineering environment in the School of Engineering where students can flourish and experiment with new ideas," – Karl du Preez, merSETA Chair in ED at Nelson Mandela University.

This publication summarises some of the highlights and successes of the first seven years of the merSETA Chair in ED at Nelson Mandela University.

Figure 1: Karl du Preez (Chair) and Meera Naidoo (Project Manager).

Figure 2: merSETA Chair in ED and Nelson Mandela University staff.

1. merSETA OPERATION PHAKISA MARINE ENGINEERING

A co-operation agreement between merSETA and Nelson Mandela University was signed in April 2015 with the purpose to:

- Co-operate in the services related to all aspects of expertise shared by the two parties to establish a strong partnership between the parties to this agreement, particularly services in support of Operation Phakisa, Marine Engineering and the "Blue Economy".
- Clarify the manner in which Manufacturing Engineering and the Related Services Sector Education and Training Authority (merSETA) and Nelson Mandela University must co-operate with each other and co-ordinate their functions to promote consistency in respect of quality assurance.
- Establish a funded programme in Marine Engineering at Nelson Mandela University that will be implemented within a three-year period from the date of the signing of the Agreement.
- Explore and develop allied programmes, which will be aligned with Operation Phakisa.
- Work with TVET colleagues to develop possible articulation routes into marine programmes offered at Nelson Mandela University.

Figure 3: Howard Theunissen, Manager of the Marine Engineering Programme in the merSETA Chair in ED

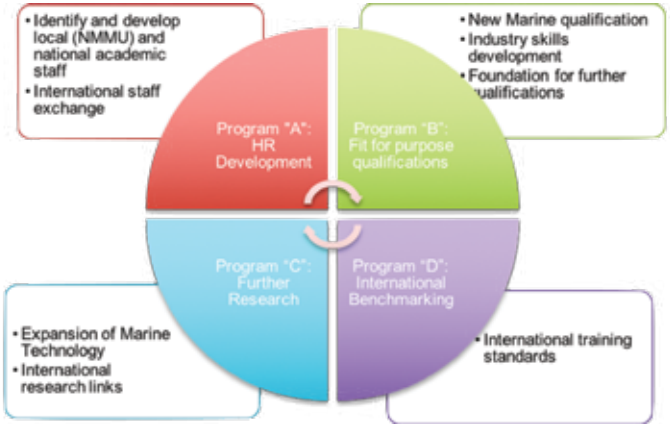


Figure 4: Overview of the merSETA Operation Phakisa Marine Engineering at Nelson Mandela University.

1.1 Human Resource Development

Three academic staff members and one administrative staff member have been appointed in the programme. The academics are Mr Sergio Giannotti, Mr John Fernandes and Mr Boswell Douse. The appointment of Mr Douse is funded by an NGap appointment. An administrative assistant, Ms Phateka Hobongwana, was appointed to facilitate all the various projects. Mr Fernandes, currently busy with his PhD in Mechatronics, specialises in automation and Chief Engineer Giannotti has a wealth of practical experience having worked on cargo ships, cruise liners and eventually on ferries (standard and high speed) as Chief Engineer. Mr Douse has completed his MSc Maritime Engineering Science / Naval Architecture at South Hampton University and is now a qualified naval architect.

Figure 5: Marine Engineering staff members

Figure 6: Mr Douse showing Dr Franks his Master's certificate

I would like to take this opportunity and thank merSETA for affording me the funding for my Master's degree for the 2016-2017 academic year at the University of Southampton.

While at this University, I had the chance to explore various Naval Architectural principles on a number of ships/vessels namely, HMHS Britannic, Titanic, Olympic, HMS Queen Mary 1 and various yacht models.

1.2 BEng Tech Degree in Marine Engineering

The CHE (Committee of Higher Education) gave approval for the Bachelor of Engineering Technology (Marine Engineering) on 26 June 2017 and Nelson Mandela University registered their first students in February 2018. The qualification is a three-year Bachelor's degree, which leads to an Honours, Masters and Doctoral Degree.

Year 1	Year 2	Year 3
Mathematics 1 &2	Mathematics 3	Marine Engineering Knowledge 3
Physics 1 & 2	Strengths of Material 1 & 2	Naval Architechture 3
Eng Drawing 1	Statics and Dynamics 2	Thermodynamics 3
Prof Communications (Gen)	Marine Engineering Knowledge 2	Mechanical Design 2
Prof Communications (Comp)	Fluid Mechanics 2	Marine Elect Systems 3
Naval Architechture 1	Naval Architechture 2	Project Management
Marine Engineering Knowledge 1	Thermodynamics 2	Marine Automation and Programming
Marine Law 1	Mechanical Design 2	Marine Advanced Automation 3
	Marine Elect Systems 2	Marine Engineering Project

Table 1: BEng Tech academic programme.

1.3 Commissioning of marine facilities

The collaboration between merSETA and Nelson Mandela University has enabled the university to collaborate with various international academic institutions and the maritime industry. One of these collaborations with Wartsilla lead to the donation of an 8L20 engine in 2015 and will be followed by further equipment donations.

The donated equipment will be installed in the phase two Engineering building on Nelson Mandela University's North Campus and will be utilised for student and industry specialised training.

Figure 7: Prof Swartz receives the 8L30 Engine from Wartsilla

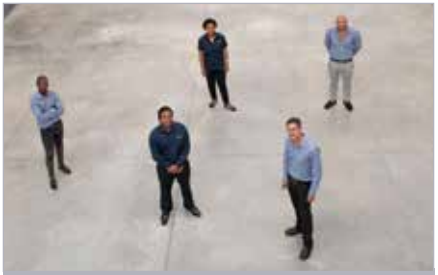


Figure 8: Marine Engineering staff in the new Engineering building where the Wartsilla Engine will be commissioned

"From the bottom of my heart, I thank you and appreciate all you have done in affording me the opportunity of studying for a Master's degree," – Boswell Douse, Marine Engineering Lecturer.

1.4 Further research

As the academic programme in Marine Engineering continues to grow, the staff continuously improve their qualifications and become involved with further research and development. Mr Fernandes is enrolled for his PhD in Mechatronics, Chief Engineer Giannotti for his PhD and Mr Douse is investigating his research theme for his PhD at South Hampton. Mr Theunissen is currently registered for his PhD at the University of Johannesburg. Emanating from the involvement of staff, various research projects have been completed. These include the development of a virtual process control and simulation system, an active heave compensation simulation system and a Web-Based Real-Time Hybrid System for Remote Engineering Laboratories.

Figure 9: Active Heave Compensation Simulation System.

1.5 National and international partnerships

The following six institutions have agreed to work together in the area of maritime studies of Marine Engineering and Nautical Science. The programme will focus on four primary areas in the sector of Maritime Education and Training for Deck and Engine seafarers.

- Satakunta University of Applied Sciences, Finland
- WISMAR Maritime University - Germany
- SOLENT University – Southampton
- Durban University of Technology
- Cape Peninsula University of technology
- Nelson Mandela University

Figure 10: Facilities at Solent University

2. HIGH SCHOOL COLLABORATION

2.1 Educator support

High on the agenda for high schools are the up-skilling of technical educators through various forms of certified training modules in mechanical and electrical engineering. Altogether 249 educators received training over the seven-year period at Nelson Mandela University. An additional 28 learners received certified automation training for the Junior Cyber Junkyard competition.

Figure 11: Educators at a one-week AutoCAD training session for the subject Graphic Design

2.2 eLearning projects

The eLearning programme initiated by merSETA has an online technical schools course, which has evolved over two years. An initial singular schools-based project has grown into seven parallel streams (including 36 individual modules), some currently live, with others in various stages of development, serving technical schools, Nelson Mandela University students, industry and special projects.

The merSETA technical schools' server was set up and launched to house all the modules developed under this project. The server was also upgraded to the latest version of the Moodle LMS, version 3.3, pre-formatted in a neat, uncluttered format to reflect ease of access and merSETA corporate colours, and all courses are developed to the same uniform functionality, visual layout and format. Currently, two schools, Khwezi Lomso CS and Alphendale SS, are actively utilising the platform and 93 educators are currently enrolled in the various modules. http://merseta.mandela.ac.za

Figure 12: merSETA Schools' eLearning website launch page

Online module development includes the completion of the technical subjects Welding and Metalwork (Grade 10 and 11) as well as Grade 10 Electrical Technology.

Figure 13: Interactive resistor selection activity on the E-Learning platform

An online communications platform for technical schools educators (merSETA EduChat) as well as an online repository for Grade 12 EGD exemplars and memoranda were also completed. A one-day Moodle LMS Training Course for technical schools educators was conducted on the settings and set-up on individual schools' sites to ensure that educators had reasonable autonomy on their school sites. Altogether 18 educators including District, Head Office and National Office representatives from 15 different schools across the region attended the course.

Figure 13: Interactive resistor selection activity on the E-Learning platform

"The MERSETA and Nelson Mandela University through Karl du Preez and his team introduced the Department of Education (PE district) to the new MOODLE programme. This programme really is an asset to any educator willing to use it. We are trying to introduce it to more schools in the province and we have introduced it to other provinces. The only drawback currently is that the platform uses data to access. We as a department are extremely grateful to Nelson Mandela University and MERSETA for introducing this platform and making it available to us as a department," - Mr AS Paulsen, DCES: Technical Subjects, DOE.

Additional projects that were developed on the eLearning platforms included online courses in Finite Element Analysis, Motor Selection (Industrie 4.0), Basic Electronics (Industrie 4.0) and an Eco-Car app.

Figure 15: Screenshot of the launch page of the Eco-Car app

2.3 Technical Science Kit Development

The merSETA Chair in Engineering Development collaborated with STEM in ACTION to develop and distribute technical science kits for Grade 11 and 12. The kits were developed to enable learners to perform all the experiments referred to in the CAPS document. The contents of the kit include worksheets for the learners, educator guides as well as the memo for each experiment. Ten kits were manufactured, educators received training and the following schools each received two complete kits:

- Khwezi Lomso Comprehensive School
- Gelvandale Senior Secondary School
- Itembilihle Comprehensive School
- Newton Technical High School
- Otto du Plessis High School

"STEM in ACTION believes that by learners performing each experiment themselves, the concepts taught and illustrated in the textbooks become "real" and learners interact with the content on a concrete level. More senses are involved and learning takes place more effectively. It also adds a sense of fun and we believe in the saying, "hands-on, brains-on,"- Isabel van Gend, Manager STEM in ACTION.

2.4 Laboratory development at technical high schools

A number of laboratories have been upgraded, refurbished or maintained at various technical high schools. Laboratories that were commissioned during the past seven years include:

- Electrical Engineering laboratory at VM Kwinana Technical High School
- Welding laboratories at Khwezi Lomso Comprehensive School (Port Elizabeth), Gelvandale Technical High School (Port Elizabeth), McCarthy Street Technical High School (Uitenhage), and Westview High School (Port Elizabeth)
- New Graphic Design laboratory at Gelvandale Technical High School
- New Graphic Design laboratory at Kwezi Lomso Comprehensive School
- Maintenance on the roof of the Electrical Engineering laboratory of Bethelsdorp Technical High School
- Logo automation hardware for Port Rex Technical High School in East London

Figure 16: STEM in ACTION hands over the Grade 10 Science Kit to Itembilihle Secondary School

Figure 17: Content of the Science Kit

Figure 18: Educators from various schools building an atom as part of the training for the Technical Science Kit

The merSETA Chair in ED is currently developing an electronic training box that will be implemented in a rural technical high school in the Eastern Cape in April 2018.

Figure 19: VM Kwinana Electrical Laboratory

Figure 20: Kwezi Lomso dignitaries at Graphic Design Laboratory

Figure 21: Electronic training box (to be commissioned in 2018)

2.5 Engineering Winter School – Somerset East

An engineering winter school was offered to learners from the rural areas of Somerset East. The learners were exposed to various aspects of engineering and IT at a five-day winter school, initially at Gill High School in Somerset East and later at the North Campus of Nelson Mandela University. Visits to engineering laboratories and the local automotive industry were accompanied by various practical lectures dealing with engineering and IT related topics. Altogether 87 learners attended the winter school during the period 2011 to 2013.

Figure 22: Learners on a laboratory tour at Nelson Mandela University

Figure 23: A learner enjoys a virtual race at the VWSA Pavilion

2.6 Engineering awareness workshops

Engineering career presentations were performed at 29 different high schools within the Eastern Cape during the past seven years. Altogether 3 639 learners attended these workshops. The merSETA chair in ED invited East Cape Midlands College (EMC) staff to accompany the extended roadshow at the schools. The merSETA Chair in Engineering Development was invited to address the Grade 9 students of Adelaide Gymnasium on subject selection. An hour-long presentation was conducted and as a result, the school requested that Nelson Mandela University School of Engineering's vehicle projects be exhibited for their learners.

Figure 24: merSETA Chair handing over the Career Pathway poster to JA Calata SSS in Cradock

Figure 25: JA Calata matric learners that attended the engineering awareness workshop

2.7 Maths and Science Incubator Schools Programme (ISP) in Somerset East

Maths and Science Touch TutorTM resource packages were installed on 30 desktops in various schools and one was placed at the Resource Centre of the Department of Basic Education in Graaff-Reinet. Every school was provided with an MOU illustrating how the laptops should be used. The packages included workbooks and logbooks to keep track of the usage. merSETA Sponsorship signboards were placed at each ISP school in their resource centre.

2.8 Youth Quake Tour (Matatiele)

The merSETA chair in ED at the University was approached by an ex-winter school student to assist in getting the merSETA bus to an event in the surrounding areas of Matatiele. The Youth Quake Tour is an annual tour where students and young working professionals, from different disciplines, visit the disadvantaged school in the rural areas of the Eastern Cape. The primary aim is to assist learners in applying for institutions of higher learning and encouraging learners to make better daily decisions.

Figure 26: Learners in the merSETA bus

3. TVET COLLEGE SUPPORT

One of the major interests of merSETA was to build a strong relationship between the TVET Colleges in the Eastern Cape and Nelson Mandela University. The major objectives identified included the up-skilling of educators, laboratory development as well as the provision of academic articulation opportunities for TVET College students.

3.1 Up-skilling of TVET College Staff

Various technical training workshops and short learner programmes were offered to the technical educators from the TVET Colleges. TVET Colleges that benefited from the merSETA collaboration were South Cape (Mossel Bay), Ikhala (Queenstown), Eastcape Midlands (Uitenhage), PE (Port Elizabeth) and Buffalo (East London). The various courses offered to TVET College staff include:

- Pneumatic and electro-Pneumatics
- Siemens Logo
- Siemens SERVE 1
- Siemens SERVE 2
- Siemens Pro 1
- Siemens Pro 2
- Wind Energy
- Renewable Energy
- Siemens 1200

Altogether 72 TVET College academics received training during the seven-year period.

Figure 27: South Cape College lecturers that received SERV 1 training

3.2 Laboratory development at TVET Colleges

Parallel to the up-skilling of technical knowledge of the TVET College staff, four laboratories were developed, maintained or upgraded. A Fanuc industrial robot was maintained and commissioned at PE College for utilisation in the NQF Level 4 Mechatronics qualification whereas the Logo PLC automation system was developed for the assessment of the NQF Level 4 Electrical Engineering module at East Cape Midlands TVET College. Fifteen Siemens Logo PLC training stations were designed, manufactured and commissioned for Ikhala TVET College in Queenstown whereas 10 Siemens LOGO PLC programming stations were manufactured for South Cape TVET College. The merSETA Chair in ED has standardised all automation training hardware for the mentioned colleges, which allows them to prepare for their respective trade tests.

"The collaboration between Nelson Mandela University and the East Cape Midlands TVET College has been instrumental in the advancement of the technical skills of my staff. The commissioning of training equipment assists the college to stay abreast of the ever-changing technology in automation and control. The collaboration with merSETA is an important and strategic initiative that provides critical assistance to colleges,"

– Klasie Claassen, Registrar: Institutional Development, Eastcape Midlands TVET College.

Figure 28: Ikhala TVET College staff with the Siemens hardware

Figure 29: Standardised Siemens LOGO PLC training station; Industrial wiring station and Siemens course notes

4. PROMOTING WOMEN IN ENGINEERING

In 2011, the merSETA Chair in ED at Nelson Mandela University established the Women in Engineering Leadership Academy (WELA). This academy focuses primarily on the support of female students in the school of engineering to enhance their academic experience and more importantly, their probability of successful completion of their academic studies. This programme includes various developmental workshops, outreach, guest lectures, academic support, meeting and gatherings as well as a portfolio development project for students.

In 2013, WELA registered the "Women Leadership Development Programme" as a formal university short learning programme (SLP). The content of the SLP is structured in such a way as to develop women in the field and prepare them to take on roles such as managers, leaders and participants in their field. The participants in the SLP are encouraged to interact with other female engineering students and to encourage young girls to enter the engineering field.

Every year, all women engineering students, (new students and those who have not yet joined WELA) are invited to attend the WELA launch. WELA started with eight members and is now growing on a yearly basis from strength to strength. The 2017 WELA launch was successful as 58 first years and 37 senior WELA students attended. The 2018 WELA launch was on 23 February.

Many different events and workshops are presented to the WELA members, throughout the two-year period, in an effort to enhance their feeling of self-efficacy and thus improve the retention rates of female engineering students.

- Team building (first-year WELA)
- Mentorship orientation and training (senior WELA)
- True colours (first-year WELA)
- Wellness/Strengths assessment (first-year WELA)
- Portfolio development (first-year WELA)
- Assertiveness/Conflict management (first-year WELA)
- Job interviews (senior WELA)
- Presentation skills (senior WELA)
- Professionalism – branding yourself (all WELA members)
- Project management (senior WELA)
- Leadership practice (senior WELA)
- Etiquette and netiquette (first-year & senior WELA)
- Project management (seniors)
- Introduction to Lean (seniors)
- Self-leadership (senior)
- Leadership practice (seniors)
- 7 Choices for successful Women (junior)

Senior WELA members are trained as mentors to junior WELA members. Factory visits are arranged for all WELA members and a yearly panel discussion is hosted where relevant topics are selected and discussed by invited women working in the industry. WELA also takes part in the International Women Engineering celebrations to create awareness of engineering as a career option and promote women in the field.

Portfolio leaders are selected annually to provide leadership opportunities for WELA members. The portfolio leaders organise various activities such as visits to care homes as well as mentoring and tutoring school learners.

Figure 30: WELA members visited a child haven, Itmeba Lam.

Figure 31: WELA Launch 2017

4.1 Wela research and publications

Dr Ann Lourens has attended various national and international conferences and has established links with similar programmes at local and universities abroad. Dr Lourens has produced various research articles as well as brochures that promote Women in Engineering. Academic publications include:

- *The design of a leadership development programme for women engineering students at a South African university, American Society for engineering education (ASEE), Annual Conference (Atlanta, USA). 23-26 June 2013*
- *Exploring the differences in male and female engineering students' motivation to successfully complete engineering studies: Findings from a longitudinal study measuring the self-efficacy of engineering students. Ireland International Conference on Education (IICE-2015). April 20-22, 2015, Dublin, Ireland*
- *Exploring the self-efficacy of engineering students: findings of a longitudinal study relating to student recruitment, development, retention and success, Journal for new generation sciences: volume 13 Number 1*
- *Engineering Co-Curricular Role Model Interventions To Develop Women Engineering Students' Self-Efficacy At A South African Comprehensive University. The International Academic Forum: European Conference on Education (ECE) 2014 (Brighton, UK) 9-13 July 2014*
- *The development of co-curricular interventions to strengthen female engineering students' sense of self-efficacy and to improve the retention of women in traditionally male-dominated disciplines and careers*
- *Lourens, AS & du Plooy B. A South African perspective on self-leadership development for women engineering students- a pilot study. ICWSET: International Conference on Women in Science, Engineering and Technology (Dubai, UAE). 12-13 March 2014.*

At the end of their first year as WELA members, students are asked to write a reflection on the past year, which is published in the "inspirational students" booklet; in addition, an "inspirational women" booklet is published to showcase women working in engineering-related fields in the Eastern Cape. Research has shown that it is important for young women and students to have role models and these two publications serve an important purpose.

Figure 32: Wela publication for inspiring students

"WELA continues to grow from strength to strength and it is through a partnership with other women and supporters, such as merSETA, that we are able to continue growing and strive to make a difference, not only to our WELA members but also to the Eastern Cape Industry. The WELA team is humbled and honoured to work with so many bright, enthusiastic and ambitious female engineering students and women already in the field who are willing to be role models and share their experiences with the new generation of women,"
– Dr Ann Lourens, Wela Project Manager

Figure 35_1: Nomqhele Baloyi

"My name is Nomqhele Baloyi and I am currently studying Electrical Engineering. I am a very ambitious girl that believes that reaching your goals have the ability to transform you into someone you had never imagined. As a South African, I love interacting with other people and this is such a huge opportunity as we are a diverse university.

The benefits I have been afforded by Wela, include the fact that I can interact with girls that have the same goals and mindset as I do. Through the workshops I have been attending, I have learnt that even though I am currently pursuing a career that is male-dominated, it is not impossible for a woman to attain high standards. I am now more confident about reaching my goals than I was before joining Wela. It has motivated me to push harder – to prove that women can do it as well."

5. SPECIALISED SKILLS DEVELOPMENT

This project was initiated to enhance opportunities in new training programmes for the industry as well as the development of specialised skills in the mechatronic and renewable energy fields. During the past seven years, a number of projects were completed wherein students could participate to improve their skills, which assisted and enhanced their employability in local and national industry. These include student projects, such as the design and manufacture of a solar car, a Formula student racing vehicle, an Eco-Car and the manufacturing of a solar parabolic trough collector. All these projects have been developed into a platform that is continuously utilised at Nelson Mandela University for student training in academic modules.

The various projects supported by merSETA plays an important role in the development of students at Nelson Mandela University.

5.1 Solar Process Heat Unit

The solar processing unit has been commissioned and assembled at the Outdoor Research Facility on South Campus of Nelson Mandela University. This heating unit uses renewable solar power to evaporate water from the effluent. This system could serve as a heat source for an Organic Rankine Cycle. This is an innovative way to combine renewable energy with recycling.

Figure 33: Self-tracking solar concentrator on South Campus

5.2 Shell Eco-Car Marathon

The Shell Eco-Marathon is based on student/school teams producing an ultra-lightweight vehicle, built specifically to travel as far as possible on a litre of fuel, thereby exposing students/scholars to the concepts of efficiency, lightweight design and more economical solutions to the challenges presented to society in respect of carbon-footprints. The Eco-Car team has been very successful the past two years, being crowned African Champions in 2016 as well as 2017. The car travelled 128km in 2016 and 160km in 2017 on one litre of fuel!

Figure 34: 2017 Nelson Mandela University Eco Car Team

Figure 35: 2016 and 2017 African Champions

"Driving the eco-car required constant concentration to make improvements on each lap, as well as, staying hydrated due to the intense heat in the car. The experience I have gained on this project is invaluable in my preparation to enter the working world,"
– Nureen Hoosein, Eco-Car team member.

5.3 Solar-Driven Vehicles (Gonzo 1-4 and Wonzo 1)

In 2014, the students at the renewable energy lab at Nelson Mandela University were challenged to build a solar-powered vehicle, which had to be cheap, reliable, without any other energy source except for the sun, and they had to make use of parts that were easily available. Gonzo 1 was born. Gonzo 1 was designed and manufactured by adapting two bicycles with four 200W solar panels and a direct DC motor. In November 2014, the engineering students tested the first prototype on Verneukpan in the Northern Cape and managed a speed of 37,1 km/h. In 2017, the latest version of Gonzo was tested and it achieved a top speed of 52km/h and a total distance travelled in six hrs of 127km. The students were inspired to extend the experience gained with Gonzo and in November 2017, introduced Wonzo (Water Gonzo). Six solar powered boats were designed and manufactured by students and staff and competed in a Solar Power Boat Race in the St Francis channels. The planning for a national race between academia from other universities, the industry as well private citizens are planned for December 2018. Details of the race can be viewed on http://solarboatrace.co.za.

Figure 37: Engineering students preparing Gonzo 4 on Verneukpan in 2017

Figure 38: Wonzo Team in 2016 with Wonzo 3

Figure 39: merSETA staff member, Christo Basson, monitoring the progress of the solar vehicle at Verneukpan.

Figure 40: Wonzo being raced in St Francis Bay by Prof Phillips.

Figure 44: Post Doc student, Sean Poole testing his solar boat.

Figure 45: Wonzo as pictured from a drone.

6. ACTION BASED RESEARCH

In 2017, the merSETA project introduced an Action-Based Research programme. This industry-based research was initiated to solve an immediate challenge for the manufacturing industry.

The merSETA Chair in Engineering Development embarked on a programme through which it identified specific needs at companies in the manufacturing sector in the Eastern Cape. The intervention identified specific challenges that the manufacturing companies face, assign senior students to the issue and endeavour to solve these issues for the companies.

6.1 PROJECT 1: Voltage Limiter (Wellfit Oddy)

Objectives:

- Investigate the possibility of installing a voltage stabilising system, to lower peak demand.
- Identify areas in the process where supplementing with EG solar panels could significantly lower peak demand.

Results:

Results show minimal savings and hence a voltage limiter was not financially viable to install (on energy savings alone). The poor savings were due to the large portion of welding equipment used at the plant, which does not benefit from the lower voltages.

6.2 PROJECT 2: Solar Heating of Air (Safetech)

Safetech provides consulting services to clients all over South Africa for the past 25 years and has several clients that need to save on energy costs where your expertise could assist. Safetech has two clients at present that are interested in obtaining a solution to reduce their current nonrenewable energy industrial heating requirements. A BTech student, Ruben van Tonder, has taken on this research project. He is currently looking at various possibilities using conventional solar geyser tubes for a hot air application. The final goal of the project is to deliver a robust and cost-effective solution for industry use.

Progress to date

Background research completed. Design and building of test rigs completed. Testing and data analysis currently underway.

Figure 41: Student, Ruben van Tonder working on the Solar Heating of Air project. Figure

42_1: Simulation of heat transfer through the evacuated tube at a flow rate of 5.3 kg/hr.

6.3 PROJECT 3: Acoustic Shock Tester (Tenneco)

Project details:
The task was to develop a more robust solution for a defect detection system. The system is to pick up noise from a vehicle shock during a compression stroke. This noise is analysed to determine if the shock has any manufacturing defects.

Results:
From phase 1 was shown that "The superior clarity of the frequency spectra generated from the accelerometer and reduced background noise present in the signal coupled with the strong signal and durability of the sensor suggest that the accelerometer with integrated ICP / IEPE amplification is the optimal sensor for the squeak detector system."

Figure 47: New Squeak detector IO enclosure backplane showing supporting hardware and PLC components.

6.4 PROJECT 4: Housing 3D Printer

Project details:
The request for this research came from the School of Built Environment at Nelson Mandela University. The request was to develop a 3D printer for the printing of houses.

Progress to date
Initial concepts and CAD design have been completed, and structure for the printer commissioned. A student is currently working on the design and manufacture of a printer head to print the requested building medium.

Figure 438: Student, Lloyd Mann working on a 3D head to print houses.

Figure 449: Completed structure of a 4x4m printer.

"merSETA, solving pressing industry needs by getting academia and industry around the same table for clean sheet yet practical solutions," - Prof Russel Phillips, Research Professor at Nelson Mandela University.

"One of the major challenges of universities is providing appropriate technical, industry-related skills to their students, skills that make them employable and marketable. The collaboration with merSETA has exceeded all expectations of both academics and students at our university. In 2017, the merSETA awarded 174 bursaries to deserving engineering students at Nelson Mandela University. merSETA has changed the lives of hundreds of learners and students during the past seven years," – Karl du Preez, Director of AMTC and merSETA Chair in Engineering Development at Nelson Mandela University.

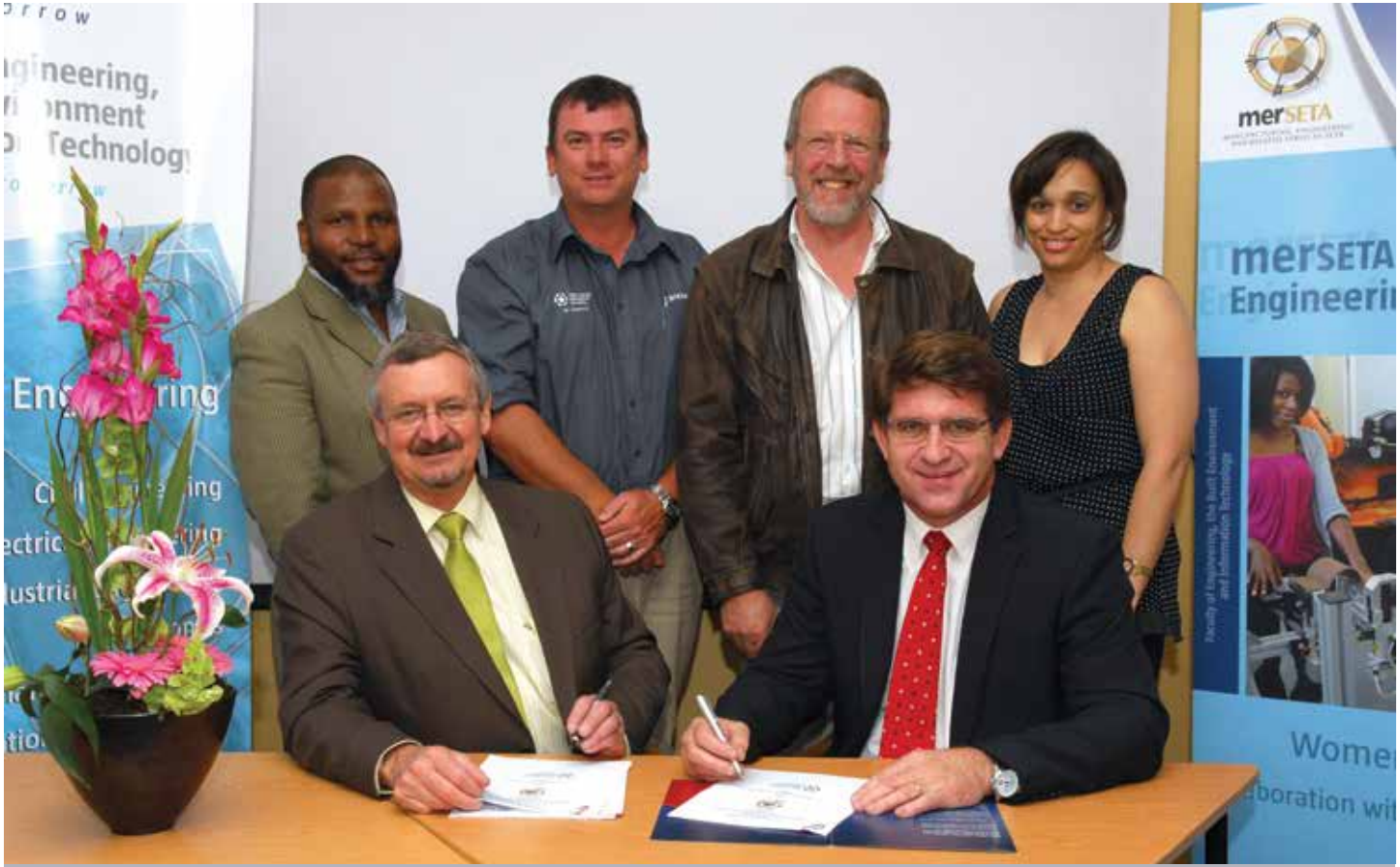


Figure 51: Signing of the first merSETA MOU in 2010