FY2016/2017 Annual Report

Published May 2017

Strategic partners

Director's Foreword

We started the 2016/17 financial year with a strong focus on cultivating an entrepreneurial culture within eNtsa through the implementation of a structure that lends itself towards the establishment of business units. This approach would assist eNtsa staff develop a better understanding of their financial responsibility to deliver a financially sustainable professional service to all stakeholders. This ongoing process will be continued and refined as we go forward.

Evaluating the overall effectiveness of the unit, by considering human resource effectiveness data, project volumes, impact on clients and turnover, it can be concluded that 2016/17 was another successful year for eNtsa. An integral part of this success was the enormous effort put in by all staff to ensure the challenges posed by the Fees Must Fall (FMF) campaign and other unforeseen events that were successfully met and overcome. During the FMF campaign, eNtsa staff had special permission from NMMU management to continue operation as an essential service. It is acknowledged, however, that this continuation of services was done under very testing circumstances. At this point, I have to express a word of appreciation, in this foreword, for the commitment and tenacity of eNtsa staff, with the support of specific NMMU professional staff and management, without which the unit would most probably have had to resize or even close-down. The scale of disruption caused by the FMF campaign came as a total surprise and was not predicted in any of our planning scenarios or strategic models. This further emphasises the debt of gratitude owed to our staff, making the fact that we came out with a good performance, so much more praiseworthy.

Dealing with the complexity of engineering issues is something that eNtsa is geared up to deal with professionally and the additional complexity of social/political upheaval required something new. Jim Rogers and other economists refer to the complexity of life, and that has led me to think more about these things that we do not understand, compared to those that we as engineers and scientists can solve via complex calculations, models or control algorithms. In Jim Rogers words: "*Acknowledge the complexity of the world and resist the impression that you easily understand it. People are too quick to accept conventional wisdom, because it sounds basically true and it tends to be reinforced by both their peers and opinion leaders, many of whom have never looked at whether the facts support the received wisdom. It's a basic fact of life that many things "everybody knows" turn out to be wrong.*"

During the last financial year, we saw a rapid rise in the value of eNtsa funded R&D projects. This is in line with our drive to add in-house value to engineering services rather than simply responding to client needs. It has certainly contributed to ensuring that the NMMU, through eNtsa, can tackle the next technology and knowledge gaps for our industrial partners, better enabling us to capitalise on the opportunities and challenges presented by our industrial transition.

In closing, I would like to emphasise the value that an innovation unit like eNtsa brings to the university as part of its overall academic project. Our contribution towards appropriate and applicable high-level knowledge generation, to networking - national and international, to modernisation and maintenance of our laboratories for both under and postgraduate students, to training and mentor opportunities to graduates and the economic value provided to the Nelson Mandela Bay and other industry partners are invaluable in the current climate.

eNtsa places a very high value on our responsibility, at all levels, to embrace the eNtsa philosophy of "innovation through engineering" for the benefit of all. Considering eNtsa's 2016/17 financial year-end data, with the associated challenges and unforeseen complexities, one appreciates this was only possible through the hard work of the individuals who form the eNtsa team, together with associated academics and support services. We have a highly motivated and competent group of professional staff who are focused on achieving the high goals set, and in overcoming operational and political constraints.

Prof DG Hattingh
Director eNtsa

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About eNtsa

eNtsa is internationally recognized as a hub of innovation. We are based at Nelson Mandela Metropolitan University with strong strategic relations with the Technology Innovation Agency and the Department of Science and Technology. eNtsa continuously strives to enhance technology innovation to stimulate a climate of sustainable socio-economic growth in South Africa.

Furthermore, eNtsa's ambition is aligned with the NMMU's Vision & Mission, aiming towards providing an environment generating cutting-edge knowledge and providing a platform for diverse educational opportunities to constructively contribute to a sustainable future, globally.

In 2002, eNtsa started off as the Automotive Components Technology Station (ACTS), with three staff members and limited funding, from thiseNtsa evolved into a preferred centre of excellence with a staff compliment of fifty and a turnover in excess of R43m.

This report will provide a synopsis of the areas of focus and capabilities developed within eNtsa during the 2016/17 financial year:

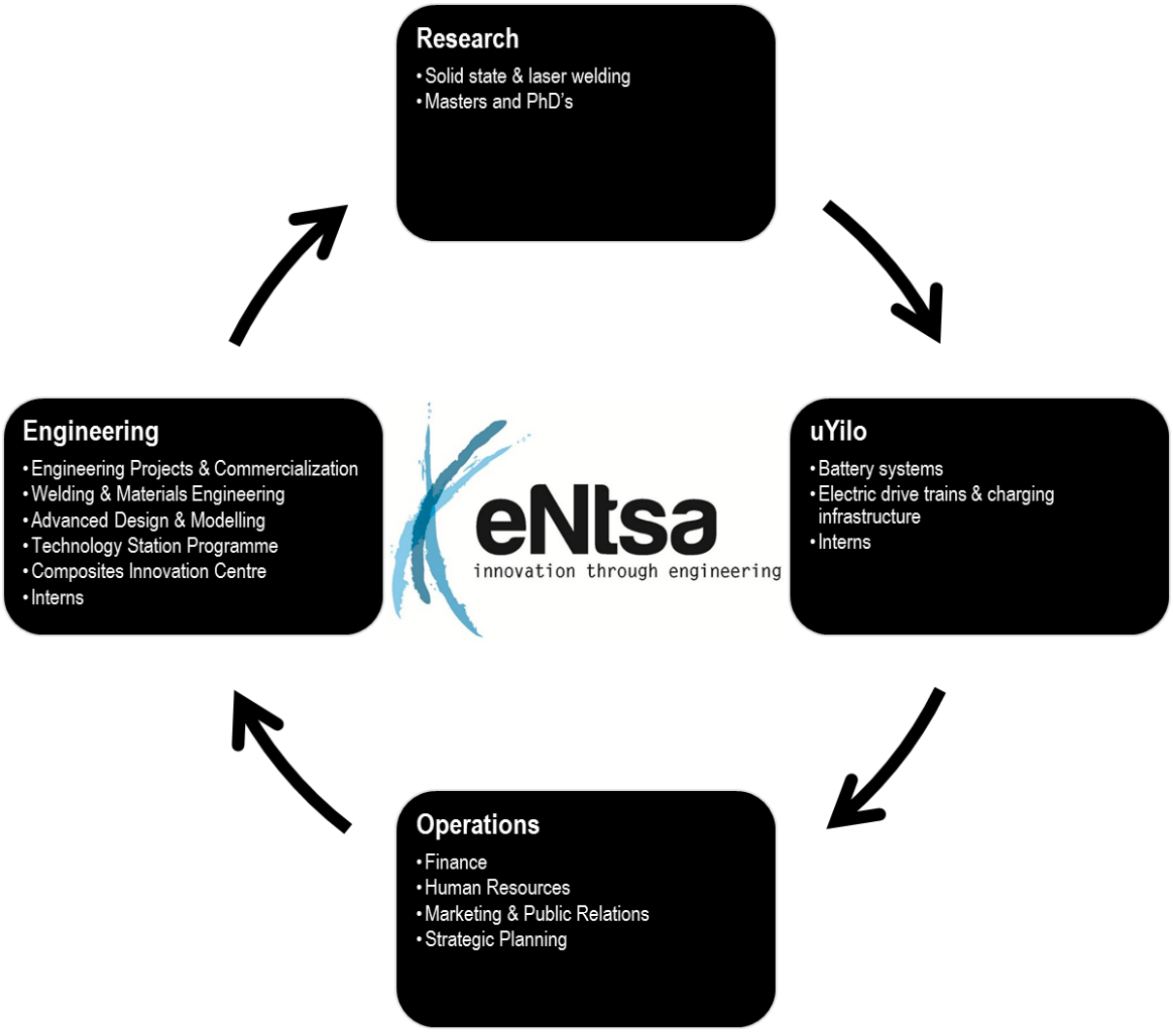


Illustration 1: eNtsa's areas of focus and capabilities

OUR VISION

Engineering innovative solutions for a sustainable future

OUR MISSION

To be a workplace of **choice.**

To deliver **innovative engineering solutions** and services.

To facilitate **knowledge and skills development.**

To create new business and **business opportunities.**

To develop a culture of **innovation and entrepreneurship.**

To leverage local and international partnerships for **socio economic growth**.

To develop an organisation that is **adaptable, sustainable and motivated**.

OUR SLOGAN

"Innovation through engineering"

OUR VALUES

Team work

We are committed to common goals.
We expect everyone to actively participate on the eNtsa team.
We openly communicate up, down and across the organization.
Communication builds trust and trust builds cohesion.
We value the diversity of our workforce.
We willingly share our resources.
Attitude for altitude.

Integrity

We never compromise our principles or values.
We act with integrity, communicate respectfully and accept responsibility.
We require ethical, professional behaviour by all persons associated.
We conduct our activities in an accountable and transparent manner.

Innovation

We nurture creativity and entrepreneurship.
We take calculated risks to advance innovation.
We learn from our mistakes and do not punish those who make them.
We promote and reward ideas that advance our institution and support sustainable development.

Excellence

We pride ourselves in delivering work that is of the highest quality.
We strive to exceed expectations.
We commit to quality management and continuous improvement.
We take the responsibility for driving tasks and actions.

Our portfolio

ENGINEERING

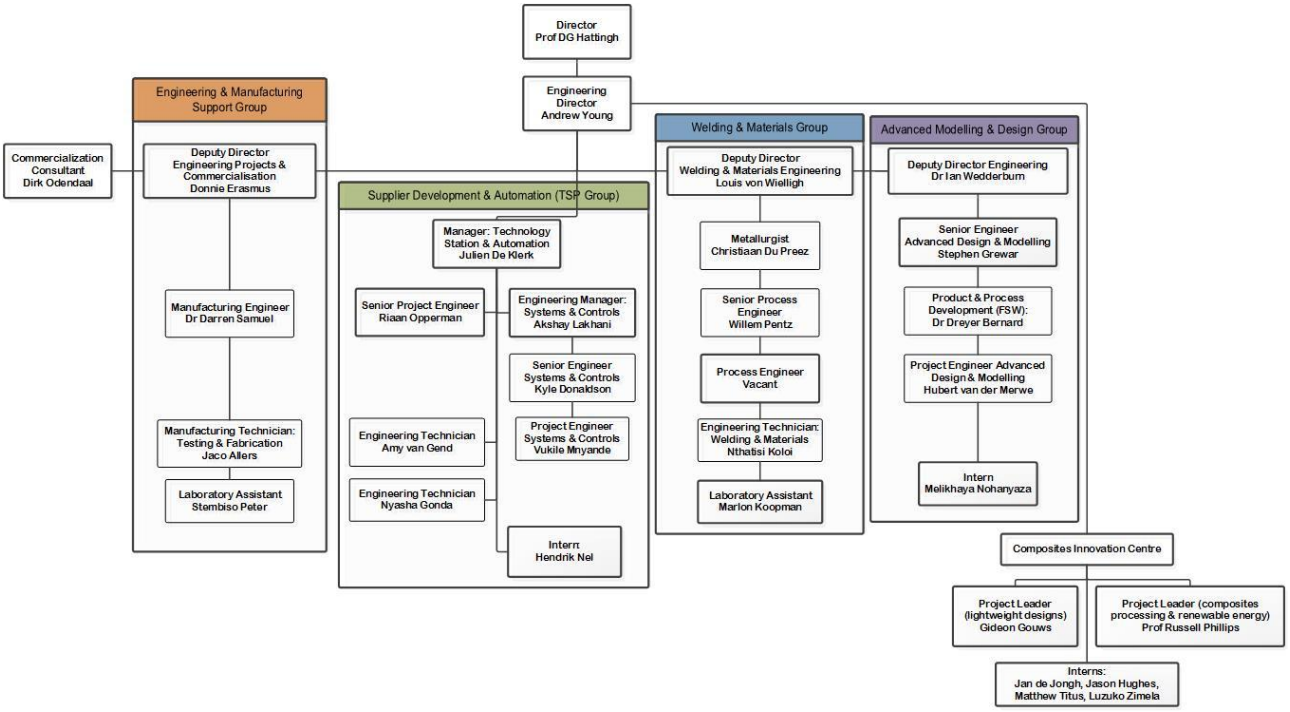


Illustration 2: eNtsa engineering HR compliment

eNtsa is recognized as a leading research, design and technology support hub for the broader manufacturing sector, with specific focus on automotive components, as well as the power generation, petrochemical and nuclear industries. eNtsa hosts a number of programmes and projects to enhance engineering related research and development (R&D) efforts within NMMU and the country.

Furthermore, eNtsa strives to offer professional and innovative engineering solutions to our stakeholders (national & international) with the aim to increase the economic competitiveness, to contribute to socio-economic growth and support renewable energy technology initiatives in South Africa to attain global attractiveness.

With the support of the Technology Innovation Agency (TIA) and the Department of Science and Technology (DST), this group is equipped to stimulate and enhance innovation and technology within higher education institutions (HEIs) encouraging a multi-disciplinary solution-driven approach, addressing the need for engineering skills, services, providing training more readily to individuals, small to medium enterprises (SMEs) and large companies according to best international practices.

eNtsa's engineering capabilities have a strong focus on supporting and stimulating local engineering skills in order to support these sectors to exploit and develop new markets. Initiatives that support this drive include the Technology Station Programme (TSP), uYilo eMobility Technology Innovation Programme, various funding platforms and the in-house hosting of modern facilities available to the local companies.

Engineering projects & commercialization

Contract research remains one of the lifelines of eNtsa, Eskom and SASOL has been instrumental in this regard with a number of active projects closely aligned to the use and implementation of the WeldCore® and associated technologies. Site applications utilising the WeldCore® technology at Arnot Power Station, Rotek facility in Germiston on Hendrina turbine rotors, and sampling at Secunda were successfully completed during the past year. Regular working group meetings provide a platform for feedback on projects and the discussion/interaction on potential projects directly addressing current concerns within the power utility.

Sasol has positioned eNtsa as a strategic partner in the sampling, evaluation and life extension of pipework at the Secunda Synfuels facility. eNtsa has actively played a pivotal role in the removal of metallurgical samples at identified locations on pipework over the past year utilising the WeldCore® technology. Contract research and the use of Small Punch Creep testing (SPCT) to evaluate material state and assist with plant condition monitoring within Sasol has grown into one of the focus areas of eNtsa. Regular working group meetings provide the platform for feedback and interaction as to potential requirements within this field where eNtsa could assist.

Welding & Materials Engineering

eNtsa's Materials and Welding capabilities were restructured as one group for the 2016/17 financial year. The materials group focusses on providing professional metallurgical services and reports whilst conducting failure investigations, assessing process / production issues or performing chemical and mechanical testing. Our services assist local manufactures and OEM's to make strategic decisions regarding issues such as raw material conformance, process or production optimization, component quality as well as export readiness. Metallurgical skills and services are in short supply in our region due to the operational & equipment costs associated with these services and skills availability in-house.

The welding group focusses on developing innovative solid-state welding solutions primarily for use in the power generation and petrochemical industries. This groups' focus was extend to laser material processing in the 2016/17 financial year and this endeavours will continue going forward, building competencies in laser surface modification, hardening, welding and metal deposition. Laser material processing is seen as a key enabling technology in current and future manufacturing processes. It is vital to build local knowledge and expertise in these areas assisting the manufacturing industry in assessing the benefits of the technology / the implementation thereof in their production processes.

Advanced Design & Modelling

The Advanced Design & Modelling group within eNtsa provides a comprehensive range of services in terms of mechanical design consulting. Capabilities from basic mechanical and CAD design through to advanced finite element analysis (FEA) services allows for a multidisciplinary mechanical design services offering. The group makes use of a number of leading CAD platforms that allows for seamless interfacing with the varying client systems. Aligned with the CAD systems the team makes use of NX Siemens, advanced finite element software, which provides linear and non-linear analysis solving capability.

The design group is capable of conducting all phases of the mechanical design process of components, machines and related mechanical structures, from initial 2D conceptual design sketching through to detailed 3D CAD design and issuing of detailed manufactured specifications and 2D CAD drawings. Other services provided include CAD draughting, component/design assessment, product development, re-engineering, design optimisation and 2D to 3D CAD translations. The group works closely with the automation capabilities within eNtsa to design, automate, commission and deliver customised "turnkey" engineering solutions.

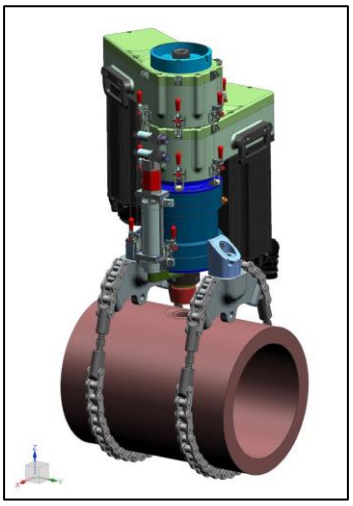


Image 1: Design of the in-house commissioned WC4 Boss Welding Machine mounted on a modelled specimen

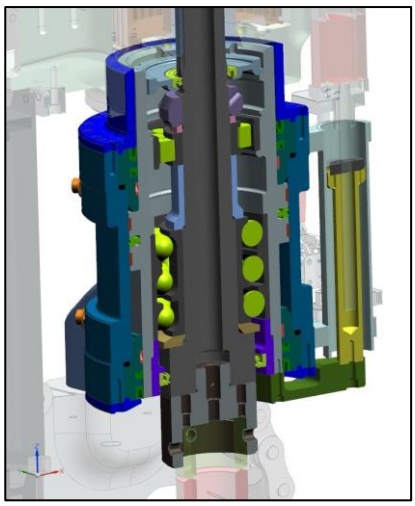


Image 2: Cross-section of the WC4 Boss Welding Machine spindle arrangement

A vital component to any mechanical design process is component verification. This is where the finite element analysis capability is critical to production of verified components and systems. The group has developed these services and the capability to confidently provide FEA services to industry.

These services primarily cover, Linear Static, Buckling and Non-linear (geometric, contact, and material non-linearity) analysis approaches. Also included in the groups capabilities is Modal, Thermal and coupled Thermal-Structural Analysis.

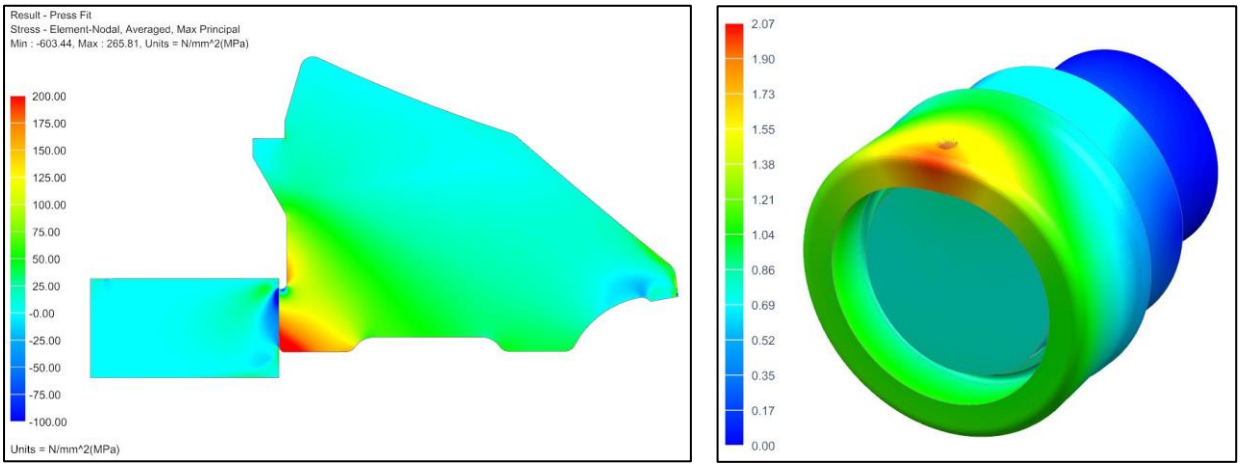


Image 3 & 4: Finite element models of a press fit component

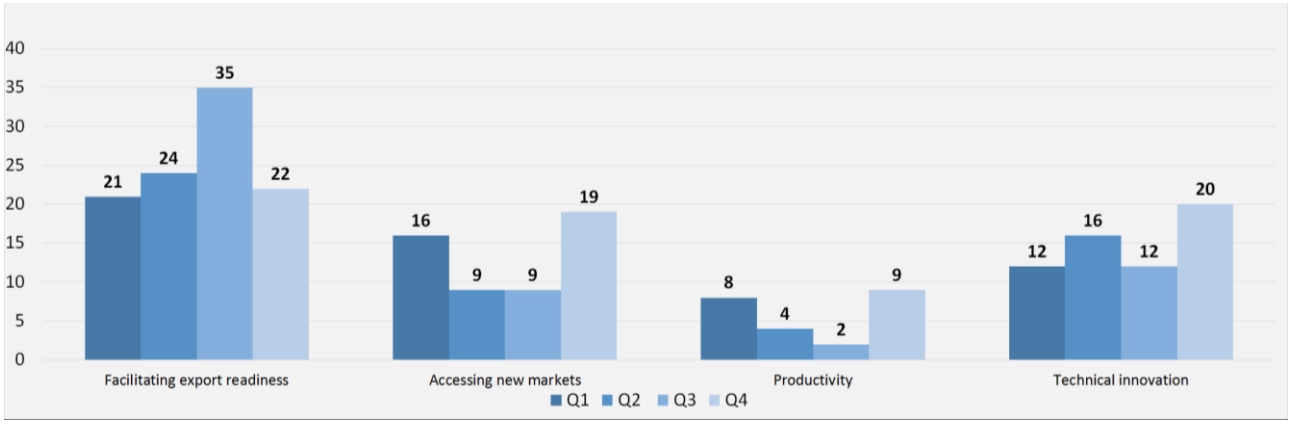
In conjunction with the design and analysis services, the group is also involved in component failure investigations where design assessments are coupled with material failure investigations to determine cause of failure in working components or systems.

A recent addition to the group's work scope has been the inclusion of Small Sample Material Testing (Creep and Toughness testing) services. (see **Research** for more information on the Small Sample Material Testing).

The **supplier development** initiatives, closely linked to the TSP within eNtsa, is to support and stimulate local engineering innovation in order to improve the competitiveness of local manufacturers which will enable industry to exploit and develop new markets. With the support of the Technology Innovation Agency (TIA) and the Department of Science and Technology (DST) eNtsa is able to make much needed engineering skills, services and training more readily available to SMEs operating in the local manufacturing sector according to international best practices.

In the 2016/2017 period eNtsa provided custom knowledge transfer and training to 51 individuals in technical areas ranging from Safety in electrical design to operation of 3D scanning systems. In the period of 1 April 2016 to 23 March 2017 eNtsa assisted in **246** projects for **128** SMEs. During the same period, **183** projects were completed for large companies, with an average of **21** large companies assisted each quarter. Thus, **429** industry interventions were completed during this period. This industry assistance covers a wide spectrum of testing, design, product/process development, technology demonstrations and manufacturing assistance.

Many projects enable the production of local components and/or products destined, fully or in part, for export markets. Most of these clients require assistance in product design, process development, product quality verification or product testing in order to maintain or secure supply contracts for the export market. From the analysis done it can be observed that **102** of the projects completed had an element of export readiness identified. The areas of impact for the TSP projects completed in 2016/2017 can be seen in the graph below.



Graph 1: Impact by SME projects complete in FY2016-2017

In the 2016/2017 period funding was secured to purchase new high end equipment to expand eNtsa's abilities and maintain a high end portfolio of technology available at the unit. Funded equipment includes a portable hardness testing system as well as a Digital Image Correlation system for dynamic, full field strain measurement. These new systems pave the way to new research and development, product testing, analysis and improved technology based innovation in both academic and industrial projects within eNtsa/NMMU.

Image 5: Digital Image Correlation equipment used on a spare wheel strain gauged in order to validate the FE model under both an inflation test as well as a dynamic fatigue test.

The Controls and Automation group consisted of four engineers and one intern. The group's primary focus was development and support of in-house custom machines, such as the WeldCore® platforms and small punch testing platform. The group completed a record number of platform builds in the previous year, completing the assembly and commissioning of 11x SPCT platforms, 2x WC3 systems and 1x prototype Electrical Discharge Machining (EDM) system. Last year, the group expanded their capabilities to incorporate small scale industrial automation, and a number of projects were carried out with industrial partners such as programming services provided to Welfit Oddy for PLC based automation of previously manual systems.

The group played a significant support role in the area of maintenance and inspection services offered to the renewable energy sector. This is a fast growing industry based on increased demands as more IPP contracts are awarded in SA. The group also leveraged their existing electronics and microcontroller knowledge, together with software writing skills to increase small scale, fast implementation, cost effective, microprocessor based solutions for industry projects requiring responsive solutions and prototypes. Small low-cost prototypes with dedicated smartphone Apps for various solutions, such as the QPark reserved parking system, and a media player for the blind were developed. Together with the design and modelling group, an innovative multi-axis groove grinder is currently being designed using high-end precision controllers and motors. As Industry 4.0 becomes a worldwide trend in Controls and Automation, this group is gearing up for a connected environment by developing solutions and data sharing across different platforms.

Composites Innovation Centre

The objective of the Composites Innovation Centre initiative, funded by DST via the CSIR, is to establish a composites engineering footprint by initiating a programme with activities that will create knowledgeable, experienced engineers with a composites capability. Four individual 'sub-projects' have been identified to address the identified skills requirements within the scope of work.

The subprojects include:

1. The development of Finite Element Analysis (FEA) skills used in the development of a lightweight wing structure for a Light Sport Aircraft (LSA Category). The build and test phase of the wing structure has been completed with the documentation now required.

2. A project aimed at assisting the renewable energies sector by building a large 3D printer capable of printing the moulds for the manufacture of turbine blades is receiving interest from the manufacturing sector. The project will assist in tooling design and manufacturing techniques in composites.

3. To address the viablity of composites in the automotive sector it was decided to design and build a spare wheel using composites. Custom Works in Jeffries bay is assisting with the build and techology transfer. The project will require the use of Pre-Preg Carbon Fibre materials and autoclave post curing.

Image 6: Moulds for the construction of an automotive spare wheel to address the viability of composites

4. Reverse engineering is not the process of simply copying a design and reproducing the product but rather includes sophisticated equipment for profiling the shape, design of the superstructure and determiing the possible failure modes. During the development of these skills in the use of composites in the marine environment a sport and recreation boat was laser scanned, the CAD was then altered to the desired design, a plug was machined and the moulds built. The initial parts from the the moulds were built using vacuum infusion, the aim was to introduce vacuum infusion as a viable techniology for boat building and to ensure that a light constistent build was achieved.

Image 7: Vacuum infusion setup used to introduce infusion as viable technology for boat building within the CIC programme

Image 8: First prototype of the boat linked to the reverse engineering project within the CIC programme

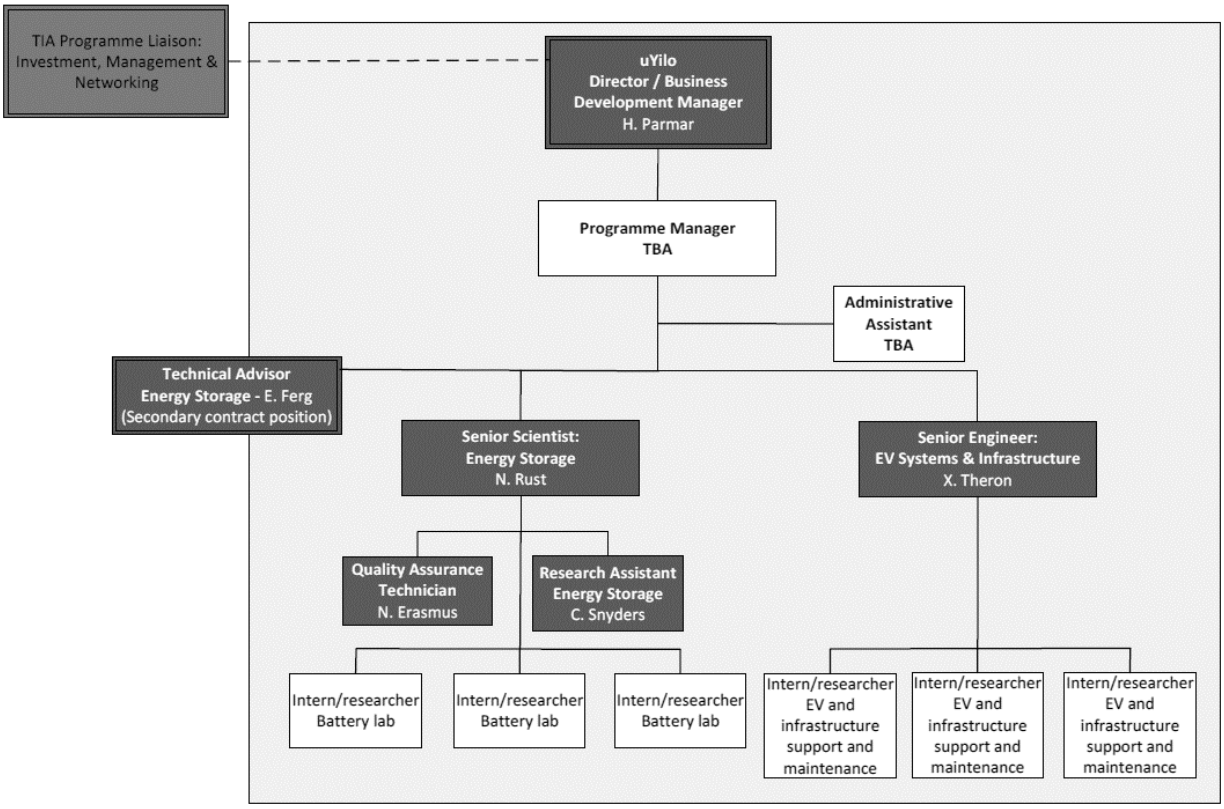


Illustration 3: uYilo HR Compliment (effective since 19 May 2017)

The uYilo E-Mobility Technology Innovation Programme (uYilo EMTIP), hosted by NMMU was launched on 13th March 2013. The Programme was initiated by the Technology Innovation Agency (TIA) with the aim to accelerate the development and commercialisation of key electric vehicle (EV) technologies to support the emerging local EV industry. While the Programme has been operating as a national multi-stakeholder innovation programme across three technology focus areas: energy storage technology, grid integration and power train components, the renewed focus areas over the next 2 years are towards enabling, facilitating and mobilising the eMobility industry for South Africa.

The Programme is open to the entire electro-mobility innovation value chain which includes higher education institutes (HEIs), science councils, small medium micro enterprises (SMMEs), automotive component suppliers, original equipment manufacturers (OEMs), innovators and entrepreneurs. Thus, uYilo connects, facilitates and enables e-mobility technology development across a broad spectrum of national stakeholders.

The Programme has demonstrated value in attracting and accelerating technology development in the E-mobility space, with at least two (2) supported projects showing some commercialisation potential. Further, the Programme acts as a neutral platform to facilitate public private partnerships between government and industry, most notably the establishment of the Electric Vehicle Industry Association (EVIA) bears evidence.

The Programme at the NMMU spans across a number of faculties (Engineering and Science) and departments such as engineering, information technology and chemistry, where in its first year of operation it focused on activities to establish and position the Programme to solicit input from the industry and government to define strategic direction. Consequently, with the necessary infrastructure provided at NMMU, facilities were upgraded, expanded and the inherited vehicle assets from the Optimal Energy programme are currently being integrated into the demonstration of the live testing environment.

The Programme received commercial support for the commencement of commercial battery testing services for lead acid batteries. With the existence of the Kick Start Fund across two funded cycles, the programme showed the working of a TIA funding mechanism to be effective within the highly specialised field in order to attract and fund new technologies that have the potential to move to full commercialisation.

An important forum that was established by the programme was the establishment of the national Electric Vehicle Industry Association (EVIA) which has allowed for a range of stakeholders to communicate through a forum. Furthermore, the Programme focused on increasing support to the National System of Innovation (NSI) and to build national expertise in the field of EV through possible strategic projects in order to enable innovation.

Battery & storage systems

The independent operating battery-testing laboratory, which forms part of the Programmes capabilities, supports local manufacturing companies by providing accurate and reproducible testing services during the evaluation of new storage solutions whilst providing validation of existing battery technologies. The existing testing services within uYilo extends towards supporting materials characterization and batteries testing across all applications. The battery testing laboratory has acquired SANAS accreditation under ISO 17025 compliance.

Image 9: Part of the work the battery testing facility does is to subject batteries to simulated accelerated life cycle testing with post mortem failure analysis. As example, the cell failure due to material shedding and short circuiting of a lead acid starter battery after testing is shown in the picture

Image 10: Elemental analysis using XRF

Image 11: Acid density measurement of batteries

Electric drive trains & charging infrastructure

The EV Systems Laboratory provides a platform to facilitate EV compatibility with products from a variety of global suppliers to accelerate the development and deployment of electric vehicle technologies into SA. In order to establish a benchmark and help set future research goals, new technologies need to be evaluated from component level to the vehicle system level for energy consumption and performance.

Through the provision of unbiased research results to all stakeholders, we are able to provide support in evaluating current and future technologies for EV components to aid in the development and optimization of advanced technologies to expand commercial applications in South Africa.

The Live Testing Environment (LTE) serves as a simulator for the EV ecosystem to facilitate universal connectivity between EVs and the electric charging infrastructure. The facility supports analysis, development, and testing of EVs and smart grid technologies to aid in the development and optimization of advanced technologies to expand commercial applications.

The facility provides important insight into the vehicle's energy requirements and user acceptance, as well as providing valuable information for OEMs, Utility and Energy companies. This will allow the programme to establish key research projects to further the development and testing of procedures for controlled charging and to establish IT protocol for the feedback of electrical energy usage and its impact on the power grid.

The platform consists of testing and development of various EV ecosystem elements such as electric vehicles, charge points and data & information communication systems. The ecosystem currently consists of a network of charge stations powered via renewable energy and incorporates storage in the form of a repurposed electric vehicle battery pack serving as demonstration of 'second life' of EV batteries, and an overall energy management system to optimise charge events.

The network will be integrated into a Smart Grid ecosystem in order to support future developments such as investigation of vehicle grid technologies and energy trading. The facility allows testing activities that will provide data critical to the development and commercialization of next-generation vehicles.

All uYilo EMTIP initiative seeks to ready South Africa for the introduction of e-mobility by creating new business opportunities and generating the know-how to support electric vehicles.

Image 12: Smart grid ecosystem for electric vehicles

Image 13: uYilo Energy Management System

RESEARCH

Joining technologies, such as solid state welding and laser processing, are the primary areas of research within eNtsa. Research initiatives support NMMU's mission, by identifying and serving the needs of the national and international engineering community by contributing to sustainable development of innovation, knowledge generation and technology transfer.

Friction Processing is a field pioneered within the group, advancing research boundaries. Expertise has been obtained in Friction Stir Welding, Friction Hydro Pillar Processing, Friction Taper Hydro Pillar Welding and Friction Welding (including Boss Welding, Friction Stud Welding and Hexagonal Bar Welding). eNtsa with the assistance of its strategic partners, hosts a variety of state-of-the-art equipment and platforms. In 2016/2017 research activities within eNtsa predominantly focussed on the laser processing of Titanium and Light Metals using the Trumph TruLaser5020 platform that we procured in 2015. The available research platforms are instrumental in various collaborative projects with a number of local and international institutions.

The result of 15 years of research, NMMU, through the efforts of the eNtsa team received international accreditation from the American Society of Mechanical Engineers (ASME) for WeldCore®, a South African developed friction taper hydro-pillar welding and repair process, which has saved the local power generation and petro-chemical industries billions of rands in 2015. The collaboration with ASME has led to a strong strategic partnership, which has allowed eNtsa to host the ASME VIII workshop for strategic industry research partners during 2017.

Small sample testing is closely aligned with the WeldCore® technology developed by eNtsa where the small sized samples retrieved by the WeldCore® procedure can be further analysed for creep and toughness properties. This field requires development, however it is gaining increasing and on-going acceptance by the petrochemical and power generation industries where high temperature component condition monitoring is becoming increasingly critical for safe and economical plant operation. eNtsa has 11 Small Punch Creep Testing platforms, which are currently occupied with on-going and scheduled testing. Testing procedures and data evaluation are continuously developing and require standardisation, therefore, the team is collaborating with international leaders in this field to ensure our knowledge and service is at the forefront of development.

Image 14: Small Punch Creep Testing Facility based on NMMU South campus

Funding for research stems from a variety of funders (NRF, RISP, THRIP, LMI-TiCoC, ESKOM, SASOL and TESP) and are expedited according to the respective grant agreements/ contracts in accordance to NMMU financial policies.

Postgraduate projects		
No.	**Doctoral project titles**	**Status**
1	Influence of microstructure homogeneity on fatigue and creep properties of Ti6Al4V, and applied to Rotary Friction Welding of small rods [PhD Mechanical Engineering]	Active
2	Provisional: Characterisation of laser welds for thin-walled complex shape structural components [PhD Mechanical Engineering]	Active
3	Laser Beam Welding Process Development of Ti6Al4V Additive Manufactured Tubular Sections [PhD Mechanical Engineering]	Active
4	Influence of Process Energy on Stress Corrosion Susceptibility of a Friction Hydro Pillar Repaired Steam Turbine Rotor Disc Blade Locating Hole [PhD Mechanical Engineering]	Active
5	Determining the fracture toughness of friction stir welded Ti-6Al-4V [PhD Mechanical Engineering]	Completed
No.	**Masters project titles**	**Status**
6	Tribo-corrosion analysis of Aluminium and Titanium alloys used in Friction Stir Welds (FSW) and Laser Welds [MSc Chemistry]	Completed
7	Investigating the effect graphitization has on the static mechanical properties of service exposed ASTM A516 Grade 65 steam pipe material [MSc Chemistry]	Completed
8	Characterization of the influence of build height on thin wall laser metal deposition Ti6Al4V components [MEng Mechanical Engineering]	Active
9	Computational Analysis and Cavity Optimisation to Achieve Directional Solidification in a Cast Aluminium Alloy [Al7Si0.4Mg] Component [MEng Mechanical Engineering]	Active
10	Friction Welding of Thin Walled Zircaloy-4 Tubes for the Nuclear Industry [MTech Mechanical Engineering]	Completed
11	Modelling the effect of graphitization on the fracture toughness of ASTM A516 G65/70 using the small punch [MEng Mechanical Engineering]	Completed
12	Using additive Manufacturing Technologies for the Production of Modular Wind Turbine Blade Moulds [MEng Mechatronics]	Completed

Table 1: Postgraduate projects 2016

Research outputs		
No.	**Conference paper title**	**Status**
1	Review of recent advances in local approaches applied to pre-stressed components under fatigue loading	Presented
2	Mechanical Properties and Microstructure of Friction Stir and Laser Beam Welded 3mm Ti6Al4V Alloy	Presented
3	Applications of Residual Stress in Combatting Fatigue and Fracture	Presented
No.	**Journal article title**	**Status**
1	Multiaxial fatigue assessment of friction stir welded tubular joints of Al 6082-T6	Published
2	Assessment of crack tip plastic zone size and shape and its influence on crack tip shielding	Published
3	Crack initiation and propogation paths in FSW tubes under fatigue loading	Published
4	Crack path and fracture analysis in FSW of small diameter 6082-T6 aluminium tubes under tension-torsion loading	Published
5	Review of recent advances in local approaches applied to pre-stressed components under fatigue loading	Published
6	Applications of Residual Stress in Combatting Fatigue and Fracture	Published
7	Semiautomatic friction stir welding of 388mm OD 6082-T6 aluminium tubes	Published
8	Implementation Aspects of an Industrial programmable Controller Using PID Control on a FSW Process	Published
9	Asympototic stresses in butt-welded joints under fatigue loading	Published
10	Damage assessment and refurbishment of steam turbine blade/rotor	Published

Table 2: Research outputs

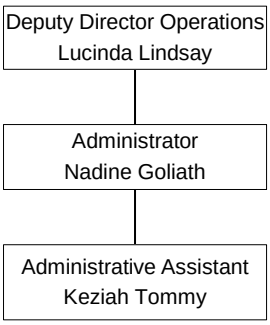


Illustration 4: eNtsa Operations HR Compliment

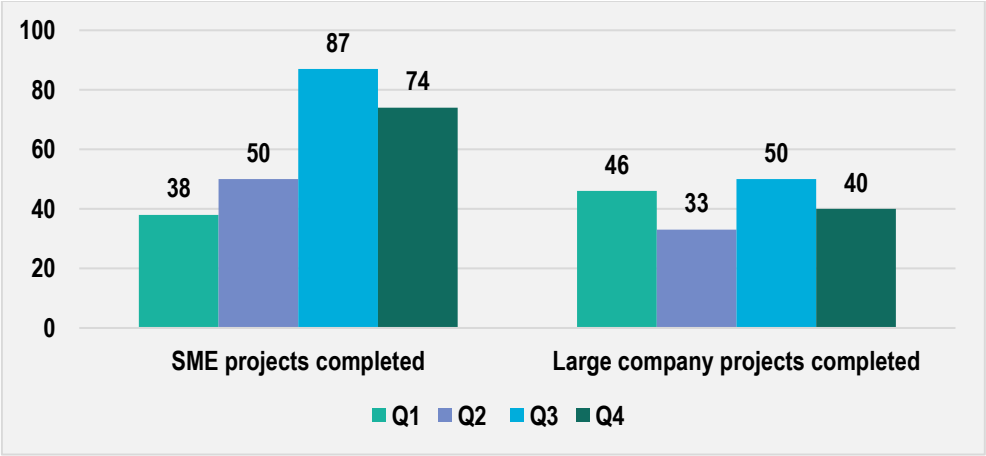
eNtsa's Operations team is a well-integrated group consisting of office professionals, engineering professionals and technical support staff. This group is responsible for the operational function within eNtsa, cohering with official NMMU policies and procedures, which includes human resource management, resource & finance management, marketing, branding, facilities maintenance and general administrative support to the eNtsa team (which includes engineers, researchers and interns).

Staff within this group have a unique scope of skills which provides a distinctive approach in assisting with the service delivery and addressing the demand for interventions within the engineering and innovation sphere. Through strategic planning and industrial feedback, it has become apparent that it is feasible for eNtsa to continue support to these sectors it serves and provide training and short course opportunities addressing the shortfall of skills development initiatives within the local sector.

eNtsa believes that growing the engineering and manufacturing economy in South Africa holds the key to sustainable job creation, to improve quality of life and invigorate the socio-economic climate within the country.

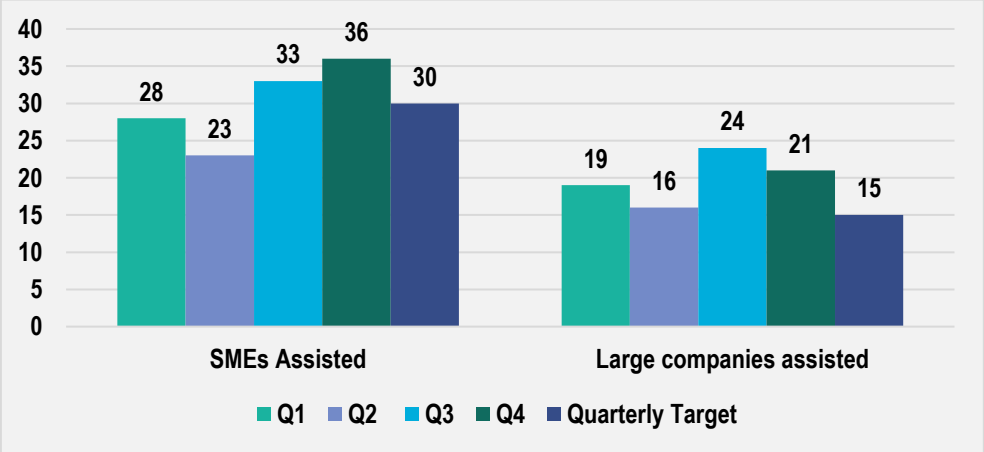
Outputs

Number of projects completed for 2016/7 were 418. (SME = 249 and large companies = 169)



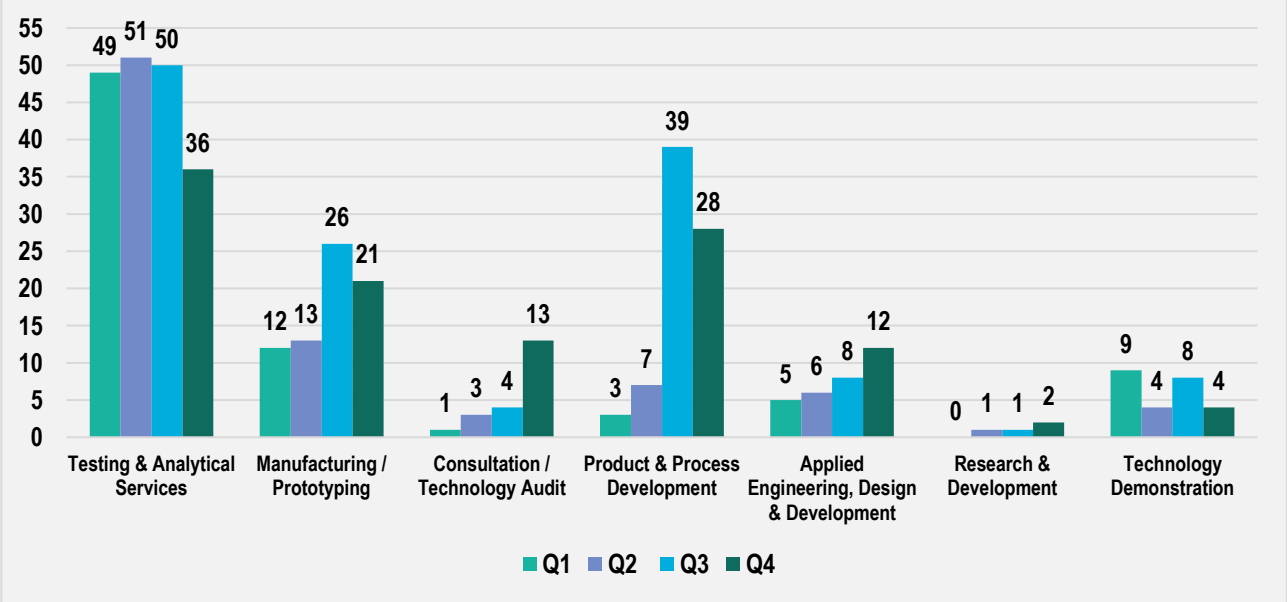
Graph 2: Number of projects completed FY2016/2017

Number of companies assisted



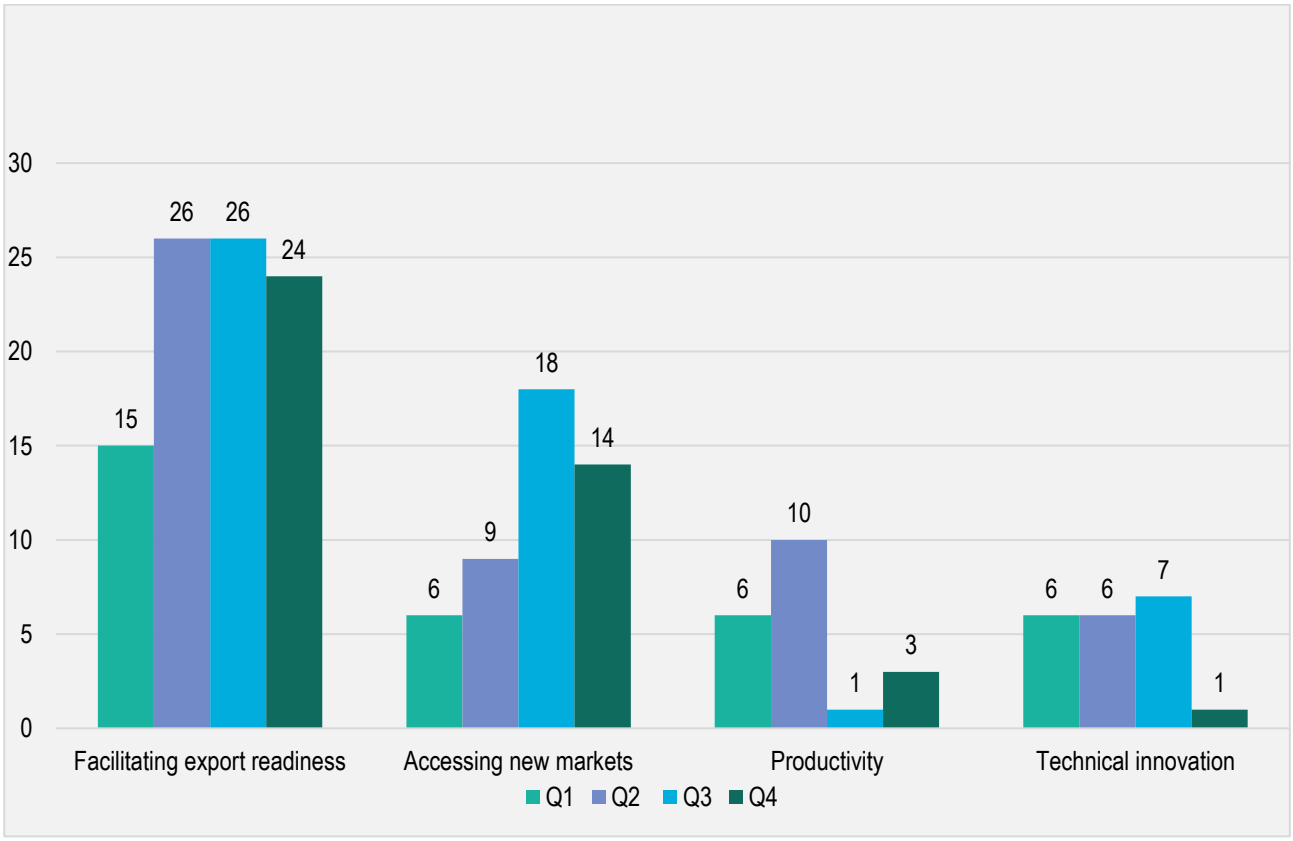
Graph 3: Number of companies assisted in FY2016/2017

Type of services performed



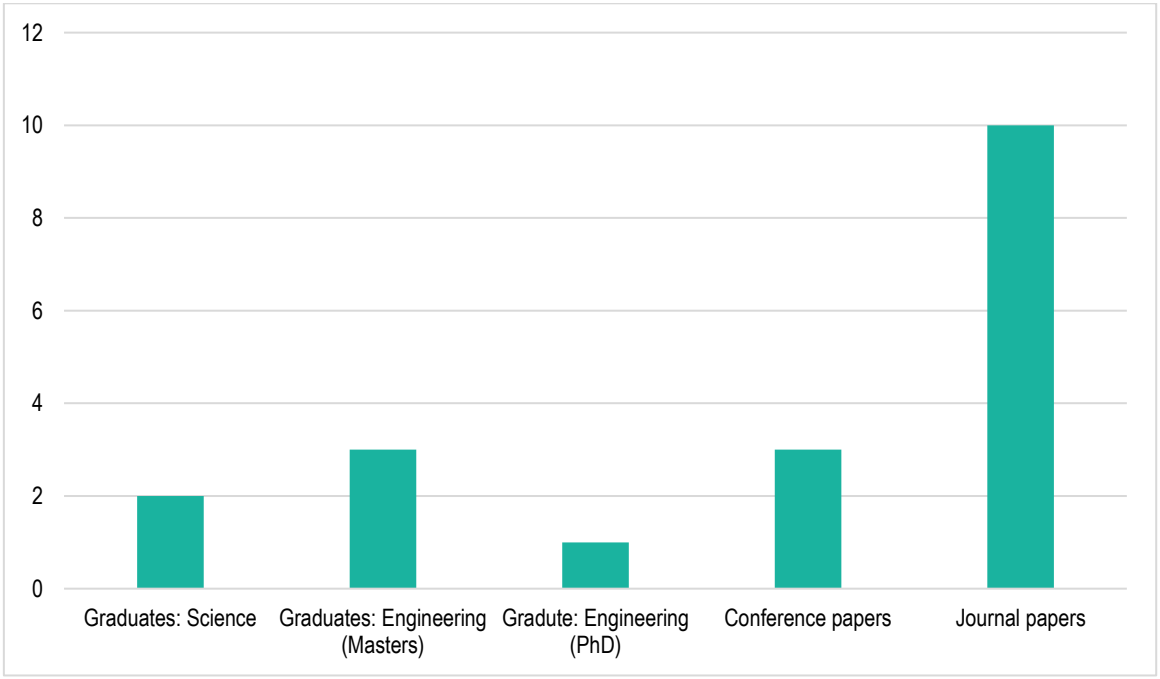
Graph 4: Type of services performed in FY2016/2017

Impact in industry in FY2016/2017



Graph 5: Impact in industry in FY2016/2017

Research Conference and Journal Publications



Graph 6: Research Conference and Journal Publications

Intellectual Property

Patent title	Description and summary	Inventors	Country	Application type	Application date	Application number	Current status
Friction Welding Apparatus	Novel apparatus for conducting friction hydro pillar processing on plant equipment subject to high temperature and pressure (materials stress fatigue).	DG Hattingh, IN Wedderburn, P Doubell	South Africa	Provisional	28-May-08	2008/04630	-
			Europe	Regional Phase	29-May-09	No. 09793721.3	Abandoned
			USA	National Phase	29-May-09	No. 12/995,014	Abandoned
			PCT	Application	29-May-09	PCT / AZ2009 / 00004	-
			South Africa	National Phase	09-Nov-10	ZA2010/08015	Granted
Method of repairing radially cracked hole	Relates to a method of repairing a radially cracked blade locating hole in a turbine rotor using a friction welding process	L von Wielligh, W Pentz, DG Hattingh, P Doubell	South Africa	Provisional	07-May-12	2012/03293	-
			PCT	Application	06-May-13	PCT / IB2013 / 053608	-
			South Africa	National Phase	19-Feb-14	ZA2014/01252	Granted
Undercutting Tool Arrangement	Apparatus for under cutting tool arrangement utilised in displacing core sample from parent material.	DG Hattingh, IN Wedderburn	South Africa	Provisional	18-Jun-08	2008/05279	-
			PCT	Application	17-Jun-09	PCT / IB2009 / 052571	-
			South Africa	National Phase	18-Jun-08	ZA2008/05279	Granted

Table 3: "Background" Intellectual Property (IP)

Trademarks

Trade Mark	Description and summary	Inventors	Country	Application type	Application date	Application number	Current status
WeldCore®	Trademark granted in classes 9 and 42 the Trademarks act. Trademark is associated with the WeldCore® apparatus and process.	n/a	South Africa	Trade Mark	10-Mar-10	2010/05041-2	Granted

Table 4: Trademarks

Human Resources

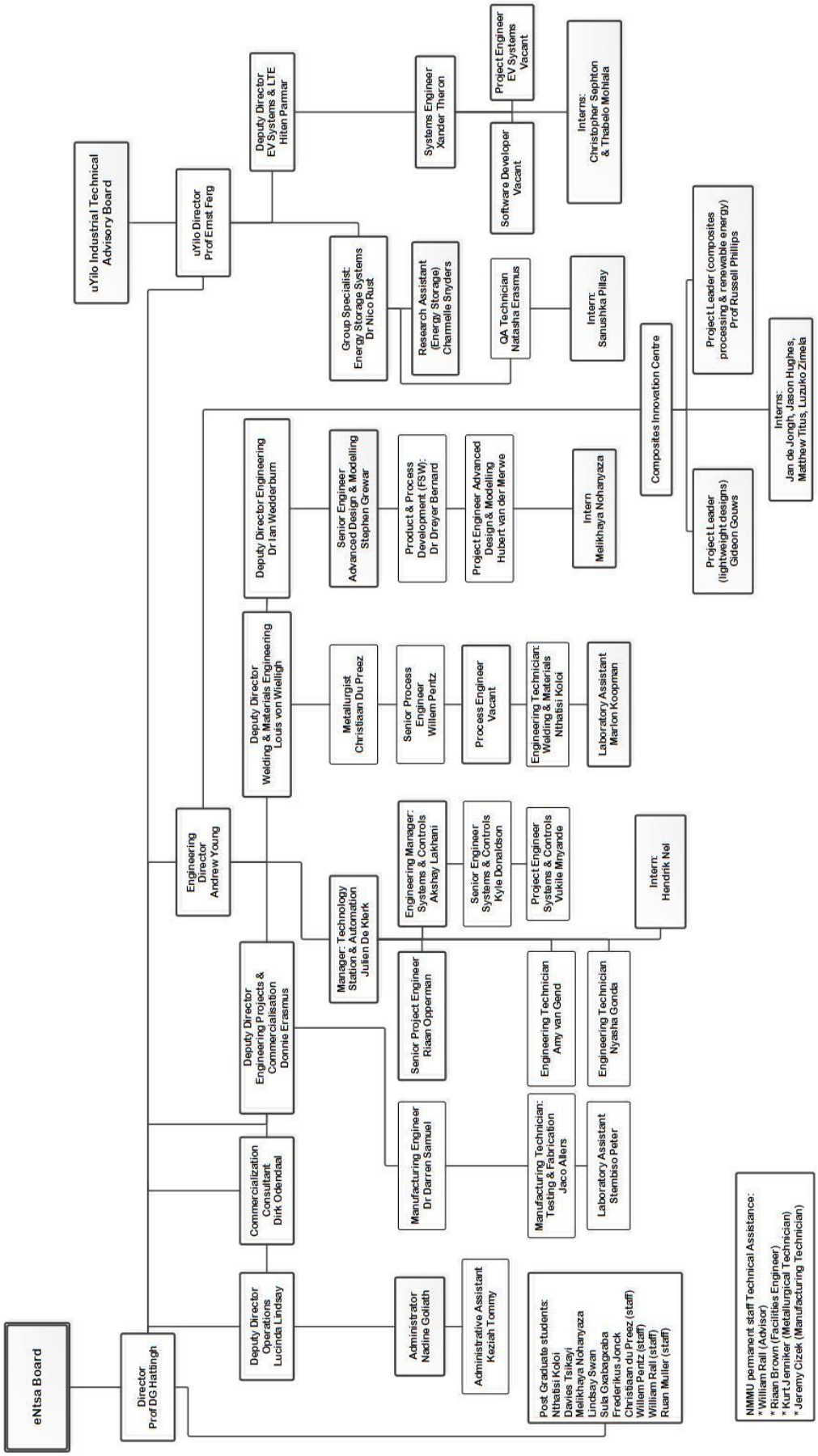
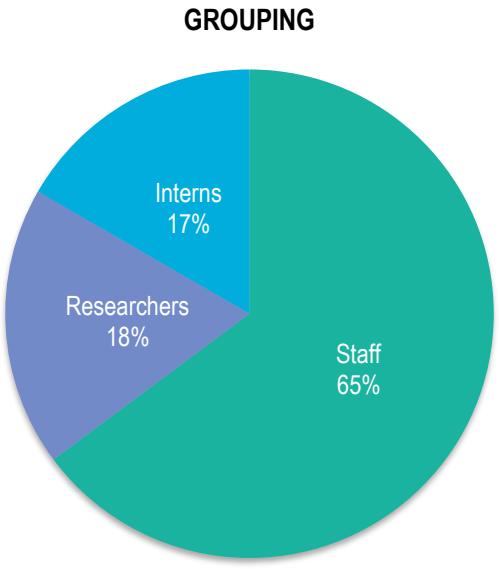
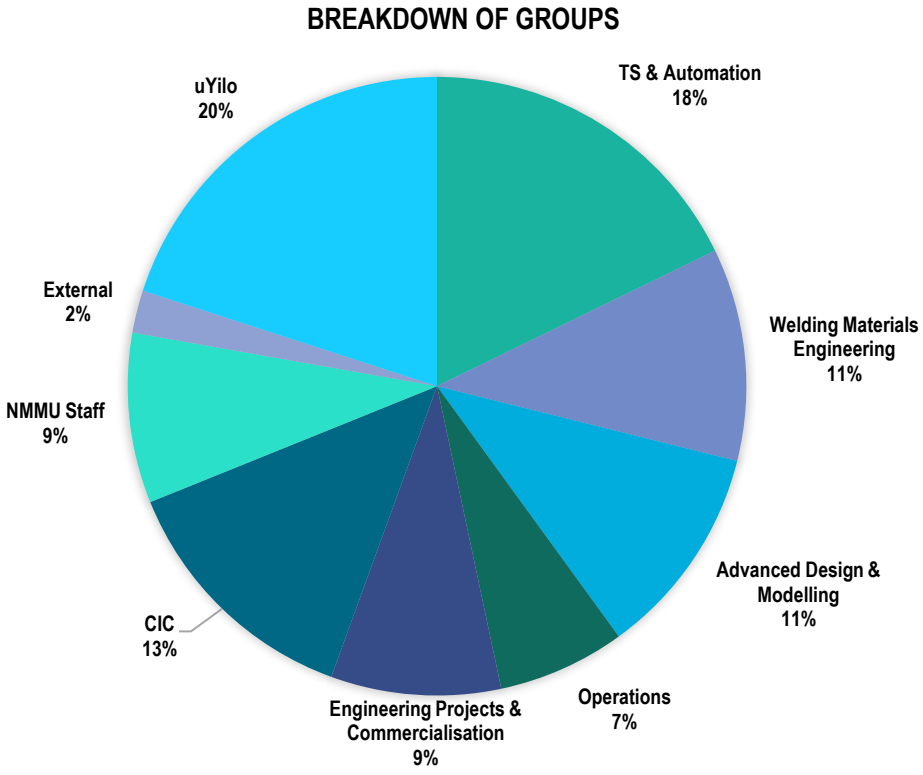


Illustration 5: eNtsa structure

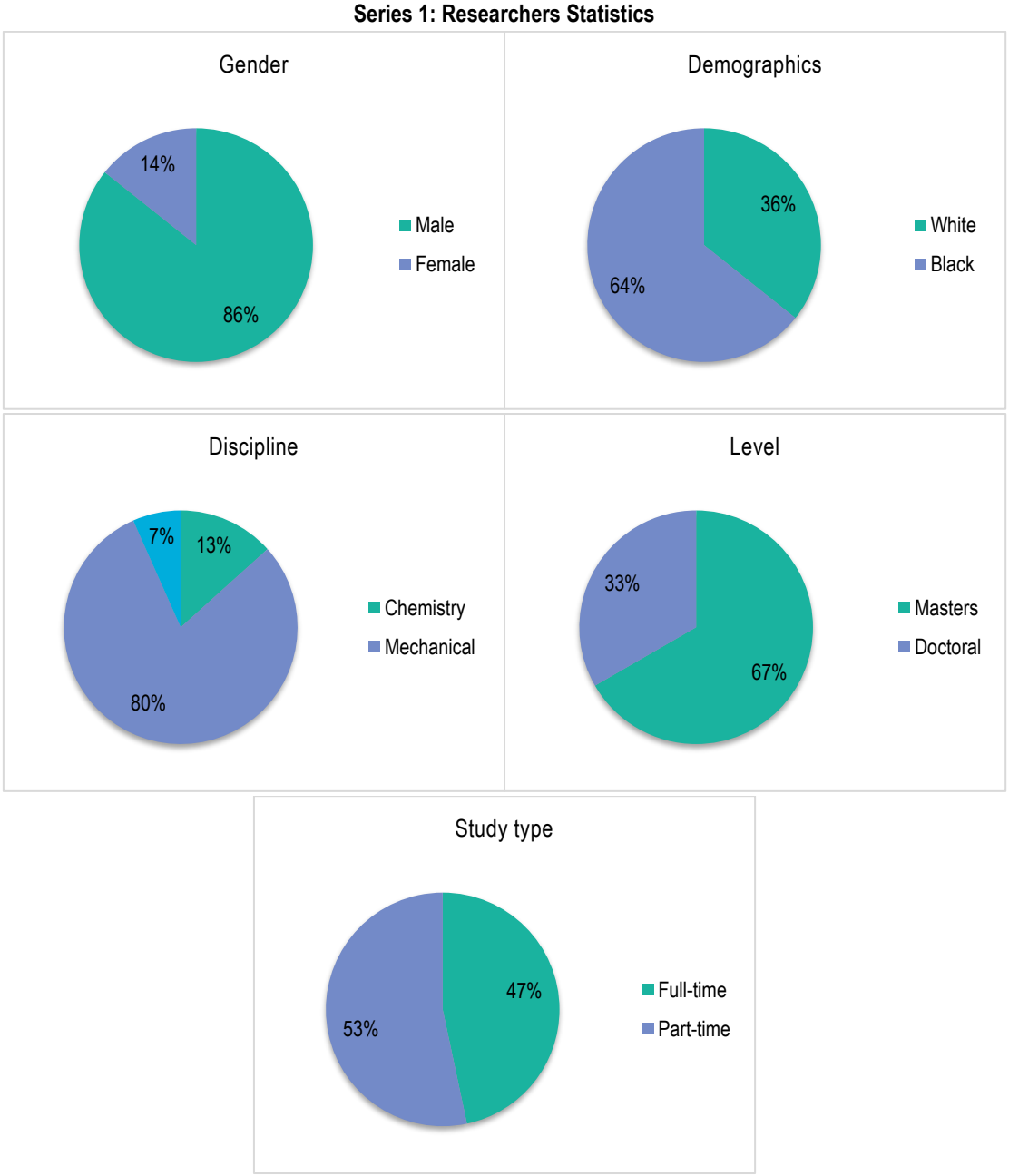


Graph 7: eNtsa Employment Grouping Stats



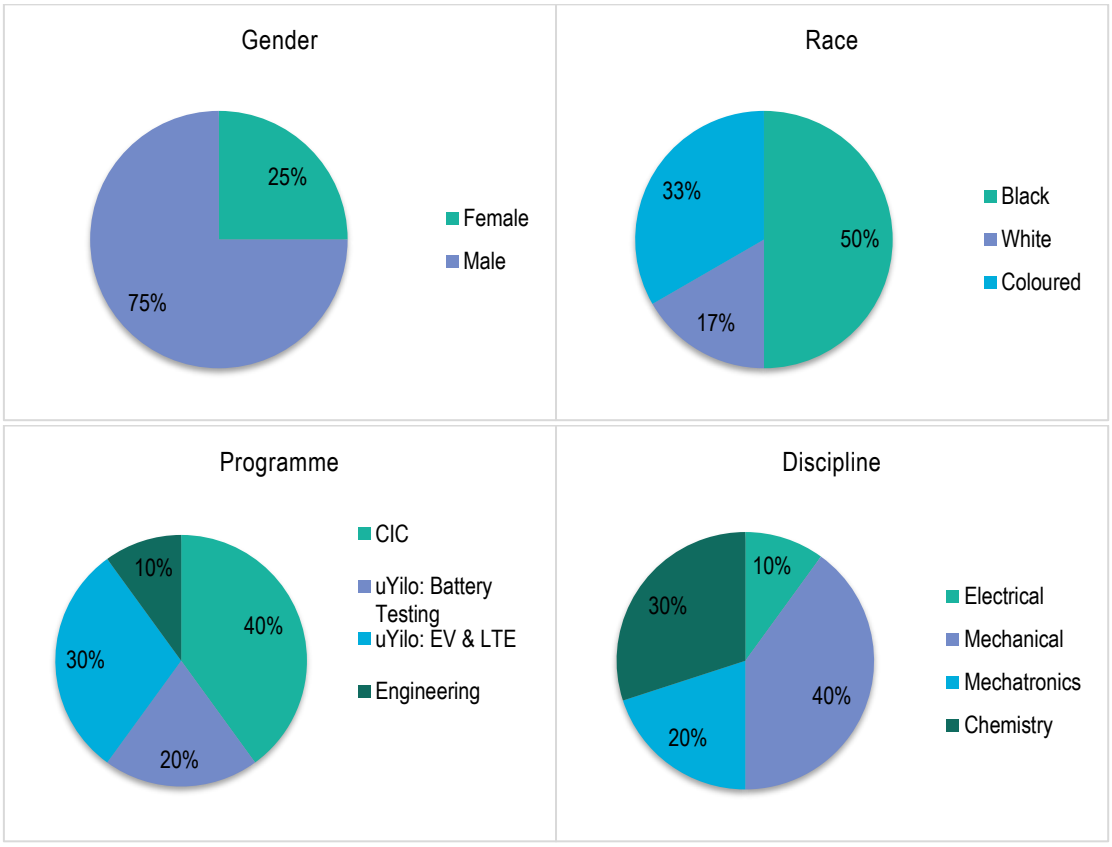
Graph 8: eNtsa Grouping Stats

Researchers



Interns

Series 2: Interns Stats



Governance

eNtsa has been operating as a separate NMMU group since inception under the directive of the eNtsa Board, chaired by the Executive Dean of Engineering, Built Environment and Information Technology (EBEIT). Separate cost centres are set up to ensure that all funds (income and expenditures) are properly recorded and managed according to NMMU policy and procedures. A close organizational relationship exists with the Senior Director Finance and Director Innovation Office. Operational matters are directed by the eNtsa Director within policies and coordination with academic leaders and administrative line functions within NMMU. The Director is however assisted by a number of committees, where collective decisions are made, that support all endeavours to successfully manage eNtsa.

NMMU has empowered faculty structures to ensure that maximum benefits (internal as well as external) could be derived from the human, physical- and intellectual property within the institution. The Deputy Vice Chancellor: Research and Engagement, a member of the Executive Management Committee of the institution, in association with the Executive Dean are responsible for ensuring that operational structures are set up within faculties to allow maximum benefit from units like eNtsa. An integral component of these structures is ensuring a seamless integration between the core business of the institution i.e. teaching and research and the transfer of technology to industry and the community served by the institution. The School of Engineering's position regarding the aforementioned has been strengthened by this strategy. The graphical representation shown below reflects the current position of eNtsa within the structure of the NMMU.

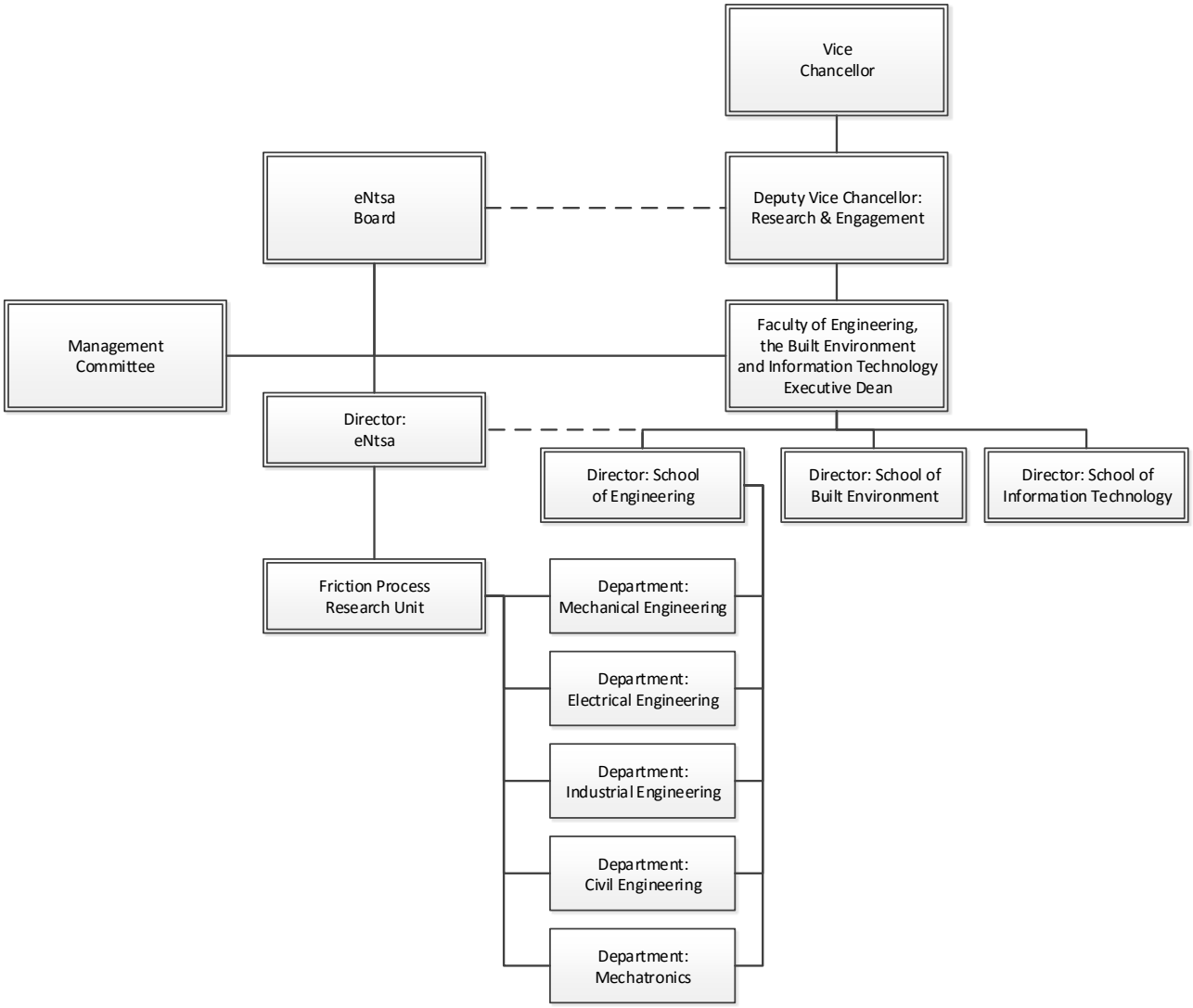


Illustration 6: eNtsa Governance Structure

eNtsa Board Members

Designation	Name	Portfolio
Executive Dean: Faculty of Engineering, the Built Environment and Information Technology	Dr O Franks (Chair)	Faculty Management Committee Chairperson. Ensure proper management and integration into the Faculty EBEIT. Staff contracts and agreements. As Chairperson, liaise with TIA.
Executive Director: Human Resource	Mr S Hlohlolo	Staff contracts and agreements.
Director: Engagement and Collaboration	Prof G de Lange	External Liaison: Industry: Experiential learning, student involvement & networking with industry.
Senior Director: Finance	Mr J Wasserman	Financial Management: Ensure sound financial management and provide financial statements/reports.
Director: Innovation Office	Ms J Barnett	Innovation Support and Technology Transfer
Director: School of Engineering	Prof K Abou-El-Hossein	Oversee interaction with laboratories and academic staff across departments. Staff contracts and agreements.
Head of Department: Mechanical Engineering	Mr G Kleyn	Oversee interaction with laboratories and academic staff within Department of Mechanical Engineering.
Director: eNtsa	Prof D Hattingh	Day-to-day management of eNtsa. Prepare all agreements and policies as needed.
Director: uYilo Programme	Prof EE Ferg	Day-today management of uYilo Programme. Prepare all agreements as needed.
External Member	Mr T Hayter	Commercialization Specialist
External Member	Mr J Astbury	Industry
External Member	Mr T Mtati	SMEs
TIA Representative	Ms C Twala / Mr V Skosana	Representing TIA
Chairperson of the Staff Trust	Mr A Barton	Representing the Staff Trust

Table 5: eNtsa Board members

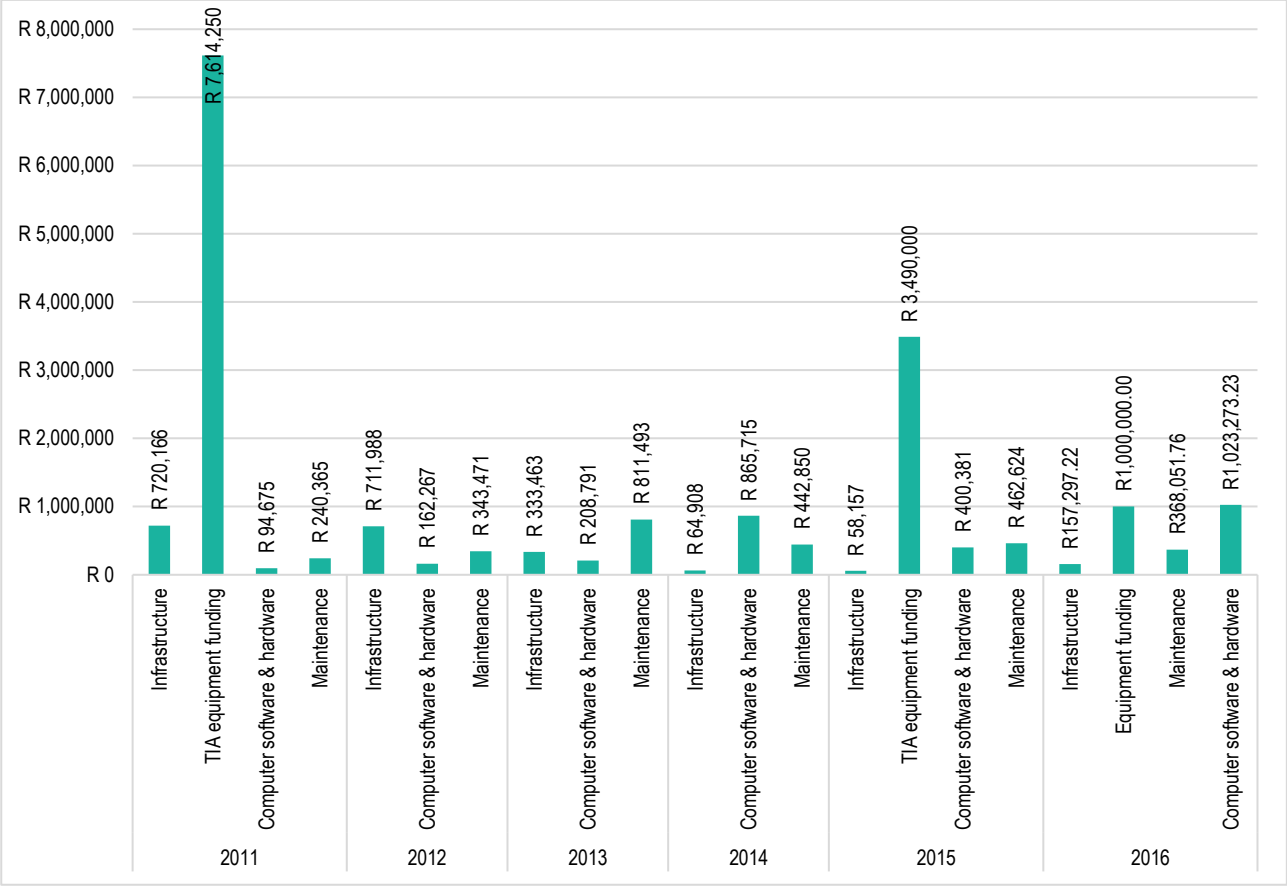
eNtsa Management Committee members

Designation	Name
Director: eNtsa	Prof Danie Hattingh (secondary appointment)
Director: uYilo Programme	Prof Ernst Ferg (secondary appointment)
Engineering Director	Andrew Young
Deputy Director: Engineering	Dr Ian Wedderburn
Deputy Director: Operations	Lucinda Lindsay
Deputy Director: uYilo LTE & EV	Hiten Parmar
Deputy Director: Engineering Projects & Commercialisation	Donnie Erasmus
External Strategic Consultant	Dirk Odendaal

Table 6: eNtsa Management Committee members

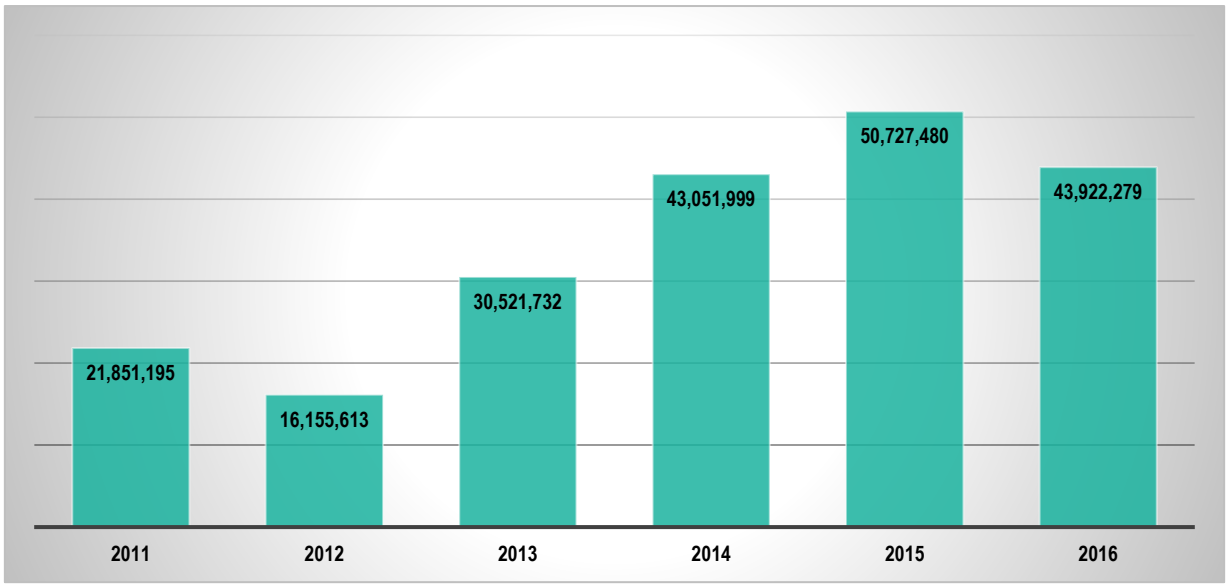
Financials

The graph below depicts the monetary value spent on infrastructure, computer hardware & software and maintenance on equipment since 2011.



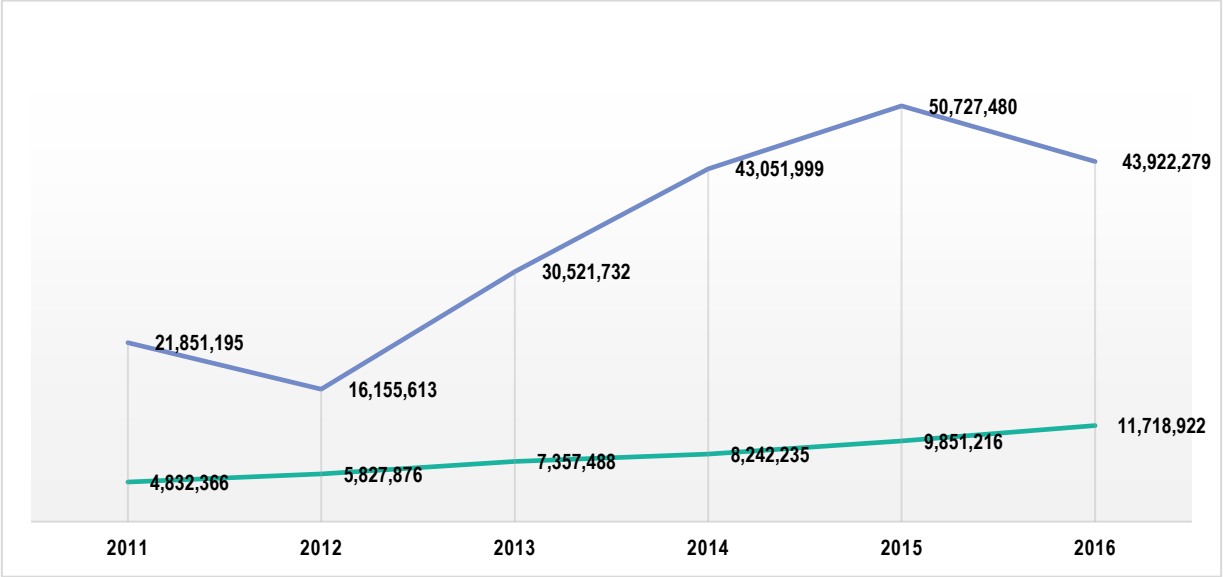
Graph 9: Infrastructure, computer hardware & software and maintenance expenditure 2016/2017

The graph below depicts eNtsa turnover since 2011:



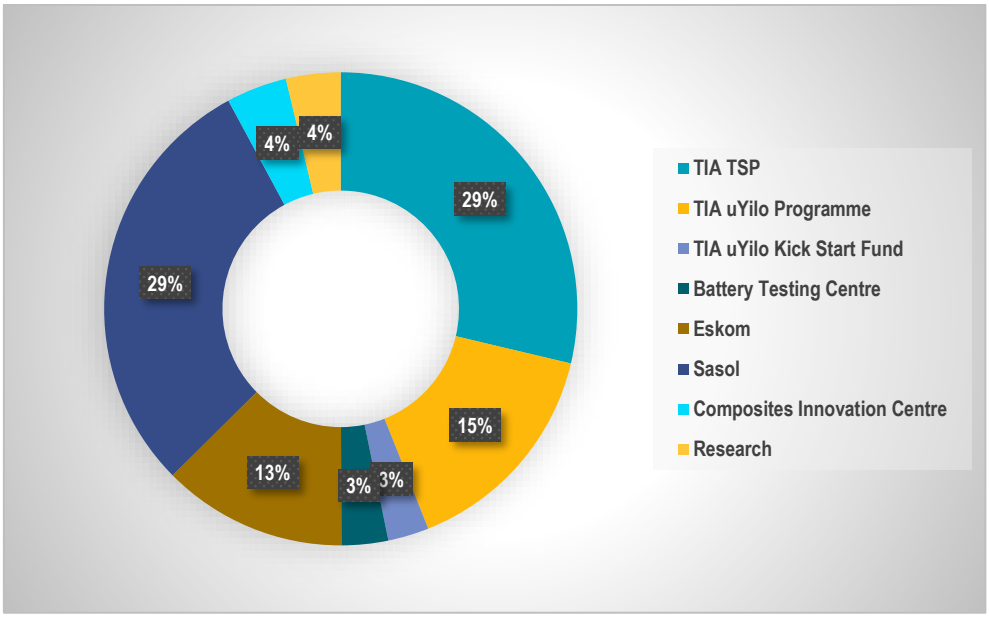
Graph 10: eNtsa Turnover (2011 – current)

The graph below depicts eNtsa Human Resource Expense vs Turnover since 2011:



Graph 11: eNtsa HR expense vs Turnover (2011 – current)

The graph below depicts eNtsa Income sources for the FY2016/2017:



Graph 12: eNtsa Income sources 2016/2017

Image 15: The eNtsa team at the annual photoshoot March 2017

Quick Reference List: Graphs, Illustrations, Images, Series and Tables