SATN

SOUTH AFRICAN TECHNOLOGY NETWORK

TECHNOLOGY FOCUSSED UNIVERSITIES

CONFERENCE REPORT

4th INDUSTRIAL REVOLUTION: ROLE OF UNIVERSITIES

11 - 13 SEPTEMBER

Conference Centre, Great Ilanga, Elangeni Hotel
Durban, Kwazulu Natal, South Africa







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1. INTRODUCTION

This report provides a summary of the conference keynote addresses with annexures and details on the papers presented at the conference. The conference endeavoured to:

- Explore how institutions in other countries are addressing the challenges presented by the 4th Industrial Revolution;
- Understand the demands of business and industry;
- Hear the voices of students;
- Showcase university innovations, and
- Network with all stakeholders.

Discussions at this conference explored the question of the Role of Universities in the 4th Industrial Revolution and provided the platform to explore different approaches to achieve equity and to overcome the limiting features caused by inequality, disadvantage, poor health and poor educational opportunities to produce healthy, smart, confident and young people who will be ready for the challenges and opportunities of the 4th Industrial Revolution. The overall aim of the conference was to serve as a platform for sharing new developments and initiatives as well as provide opportunities for policy makers, academics, practitioners, industries and businesses to strengthen partnerships, gain a broader perspective on addressing issues and contextualising the 4th Industrial Revolution against our own country situations within a more global agenda.

The SATN member institutions declared their commitment to ensuring that those who teach and learn at their respective institutions will be prepared for the challenges and opportunities that the 4th Industrial Revolution brings. The experts, scientists, industry and business have shared a great deal of information and we have all learned much from each other even though three days is a very short time for such a huge and complex topic. There is no doubt that the conference achieved its expected outcomes of informing and sharing knowledge and experiences with policy makers, practitioners, scientists, students and lecturers on the latest research, innovations, developments and the needs of industry as well as created opportunities for new networks.

The conference acknowledged that universities have always emphasised their role in shaping future technologies by being the testbeds for innovation and educating future generations. The conference also accepted that traditional education has contributed greatly to current levels of industrial evolution and technological advancement. More importantly the conference argued strongly, that for higher education to deliver future generations with the right set of skills and knowledge, an imperative question must be asked regarding how higher education would be affected by the 4th Industrial Revolution and how the delivery of education will be transformed.

Reviewing what we in higher education teach, how we teach and how we engage with business and industry, has become more necessary than ever before. It is no longer an option to keep doing things the old way and universities, businesses and industries recognises their interdependence in ensuring that we are ready for the 4th Industrial Revolution. More importantly, all the delegates recognised that innovation and accepting change are now a prerequisite for survival. The conference proceeded as follows:







2. WELCOME AND CONFERENCE IN CONTEXT

(Chairperson for the session: Mr Alan Khan, Senior Director: Division of Corporate Affairs, Durban University of Technology)

2.1 Prof Lourens van Staden, Chairperson of the South African Technology Network and Vice-Chancellor of Tshwane University of Technology

Prof. van Staden extended a word of welcome to all international visitors, guest speakers and sponsors of the 2018 SATN Conference. The conference was arranged to discuss the role of universities of technology in the 4th Industrial Revolution, responding to the stern warning to governments, companies and institutions of higher learning to speedily address the challenges that the 4th Industrial Revolution will present to the world of business. The programme presented opportunities for an impressive line-up of knowledgeable speakers to consider the priorities and developments at local, regional and international levels.

2.2 Dr Anshu Padayachee, CEO of the South African Technology Network (SATN)

The last three industrial revolutions were characterised by a change in the way that people taught and learnt.

The World Economic Forum identified that the 4th Industrial Revolution will not only change the way we work, but also what it means to be human. The disruption that the 4th Industrial Revolution will bring could lead to the loss of thousands of jobs and economic and social inequality – these are the most critical considerations that must be addressed by business leaders, governments, and most critically, by higher education institutions who have the responsibility to capacitate graduates timeously. We cannot wait until there are massive dislocations in our society to prepare for the 4th Industrial Revolution.

The challenge is that if these dislocations are not addressed now, it will be too late to do so in a few years' time. This conference invited thought leaders to share their perspectives, but also to stimulate further debate, raise questions and identify viable solutions around the role of universities in the 4th Industrial Revolution.

2.3 Ms Nomusa Dube-Ncube, MEC for Co-operative Governance and Traditional Affairs, KwaZulu Natal

Madam MEC, Ms Dube-Ncube welcomed all delegates to the SATN International Conference and expressed a message of support from the KwaZulu-Natal Province.

The way that we live and work has been marked by transitions towards a knowledge-based society, where innovation and knowledge production will be critical contributors for the continued competitiveness of businesses and governments. Service delivery







through improved technological advances and innovative practices will assist to achieve our national development goals. The conference theme of the 4th Industrial Revolution will help universities of technology to identify revolutionary ways of integrating skills and knowledge to respond to these social and economic challenges.

Peter Drucker said that 'The best way to predict the future is to create it'. It was hoped that the conference will identify innovative solutions to help government and business to implement smart, stimulating interventions that will help to serve our people better.

3. CONFERENCE OPENING ADDRESS: THE ALLURE OF THE UNKNOWN – THE REASON I WANT TO GO TO MARS (Annexure 1)

Dr Adriana Marais, Theoretical physicist, Head of Innovation at SAP Africa and Aspiring Extra-Terrestrial

Dr Marais' address centred on three questions: Where do we come from? How was the universe formed? Who am I? Dr Marais briefly unpacked the formation of the universe and indicated that the building blocks of life link all things in the universe. Noting the history of exploration in human history, starting on Earth and expanding to the Moon. Through the use of the Curiosity Rover, humanity now knows more about the surface of Mars, coupled with the successful launch of the Heavy rocket, which is a one-way voyage to Mars for 24 volunteers is currently being planned.

Volunteers selected for the voyage will make use of several technologies including solar power, 3D printing machines and will harvest water and oxygen from ice-crystals found in the soil. Dr Marais explained that it is not possible to define how exactly the universe was formed. She also impressed upon the audience that it is necessary for everyone to create their own conclusions. Noting that it is not possible for everyone to reach Mars, we all play a role in the 4th Industrial Revolution. The role of all people is to be creative in the generation of knowledge, ask questions and think deeply on how life may be maintained and bettered for all on Earth.

4. CONFERENCE KEYNOTE ADDRESS: THE CIRCULAR ECONOMY AND THE 4th INDUSTRIAL REVOLUTION: THE ROLE OF UNIVERSITIES (Annexure 2)

Prof Seeram Ramakrishna, Director of the Centre for Nanofibers & Nanotechnology, National University of Singapore
(Chairperson for the session: Prof Rob Midgley, Vice-Chancellor, Walter Sisulu University)

The 4th Industrial Revolution and the circular economy are intrinsically linked. The 4th Industrial Revolution is the confluence of automation, robots, internet of things and artificial intelligence to name but a few, which have transformative effects for the production and marketing of products. Technology is becoming a world-wide influence and considerable resources are invested in research and development worldwide.







Waste generation has been steadily growing as broken or obsolete technological appliances are continually replaced, resulting in inefficient and unsustainable waste disposal practices. Moving from a linear to a circular economy is expected to lessen the amount of waste generated. Current waste management strategies include but are not limited to incineration, landfilling and the exporting of waste to other countries for further processing. Policy makers are currently developing policies to limit the production and utilisation of single-use plastics, whilst global powerhouses such as China have banned the importation of waste, which has resulted in countries reconsidering their current waste management strategies. It is recommended that the higher education institutions of South Africa consider adopting the principles of 4th Industrial Revolution and the circular economy to respond to societal questions and benefit their people.

5. THEME 1: THE 4th INDUSTRIAL REVOLUTION: INTERNATIONAL EXPERIENCE AND TRENDS

Round Table Discussion: How Do We Prepare for the 4th Industrial Revolution (Annexure 3)

(Chairperson for the session: Mr Barlow Manilal, Chief Executive Officer, Technology Innovation Agency)

Participants:

- Dr Joseph Ryan, CEO Technological Higher Education Association, Ireland
- Prof Ronald Quincy, Academic Director, Rutgers Civic Leadership Institute, Mandela Washington Fellowship for Young African Leaders, Rutgers University, New Jersey, USA
- Mr Imraan Patel, Acting Director-General, Department of Science and Technology
- Prof Henk de Jager, Vice-Chancellor, Central University of Technology, Free State
- Prof Seeram Ramakrishna, Director of the Centre for Nanofibers & Nanotechnology, National University of Singapore

At the onset of the discussion it had been noted that humanity must consider adopting a philosophical and practical approach to technological change. It was also mentioned that business solutions must be human-centric and not perpetuate inequalities and other unfair business practices. A recurrent theme throughout the discussion was the sustainability of current models, addressing inequalities and utilising the 4th Industrial Revolution to achieve the United Nations Sustainable Development Goals (UN SDG). This was reiterated by the panel agreeing that Universities should retool education systems so that all the fundamental principles underpinning 4th Industrial Revolution technologies are aligned to the UN SDG.







6. THEME 2: THE 4th INDUSTRIAL REVOLUTION: IMPLICATIONS FOR HIGHER EDUCATION

Session theme address: from innovation studies to industry 4.0: universities of technology as change agents (annexure 4)

Prof Thomas Thurner, Research Chair in Innovation and Society, Cape Peninsula University of Technology and Professor at the National Research University Higher School of Economics in Moscow, Russia
(Chairperson for the session: Dr Chris Nhlapo, Vice-Chancellor, Cape Peninsula University of Technology)

In his address, Prof Thurner indicated that the 4th Industrial Revolution has allowed for innovations to be born through collaborations, whilst considering the needs of the people. Collaborations allow for the collaborators to contribute their strength and unique inputs to benefit the end result. Universities are not just knowledge multipliers but can also assist in identifying the direction that technological advances are taking as this is relevant information for policy makers. Lastly, a careful balance between intrinsic and extrinsic motivation must be understood so as to contribute to the greater good of society.

Respondents (Annexure 5)

- Prof Narend Baijnath, CEO, Council for Higher Education
- Dr Gansen Pillay, Deputy Chief Executive Officer, RISA, National Research Foundation
- Dr Diane Parker, Deputy Director-General, University Education, Department of Higher Education and Training

It was emphasised that when discussing the 4th Industrial Revolution it is necessary to take cognisance of the implications of the 3rd Industrial Revolution which harnessed electronics and information technology, allowing for theses and studies to be completed by the researcher as opposed to an industry of support people. It is necessary for Universities of Technology to respond to the changing skills and attributes that graduates will need. Research requires an investment in people, research facilities and platforms as we require capacity to analyse and synthesise data in order to generate wisdom. The need to use the 4th Industrial Revolution as an instrument to achieve the UN SDG was reiterated, noting that it is necessary to make fundamental changes in society and the way we live in the world.

7. PRESENTATION OF PAPERS IN PARALLEL SESSIONS (Annexure 6)

SESSION 1 - Chairperson: Prof Sheldon Marshall, Acting DVC: Research, Technology, Innovation and Partnerships, Cape Peninsula University of Technology

Paper 1 - Prof Rene Pellissier, Cape Peninsula University of Technology
"Crafting a strategy in a Higher Education (HE) institution while dealing with the elephant in the room"

The presentation addressed how we look at industry 4.0 in developing a strategy for universities, in particular CPUT. The strategy looks at where we are and how the world changes. In this regard, UoTs have a competitive advantage because of their understanding of how the world works, as UoTs are inherently connected to the world of industry. As a system engineer, Prof Pellissier stated that the most appropriate way to understand the development of a strategy for HE in the 4th Industrial Revolution is to begin by understanding the changes to the world of work. In this regard, the graduate attributes are core as a student will leave the university to enter the labour market and it is crucial to consider how do universities prepare these students. More challenging, is the realisation that universities do not really know what the world of work will look like in the future and can only gain clarity by looking at how other countries have prepared for the changing world of work as South Africa is lagging behind global trends.

Touching on technological developments, Prof. Pellissier highlighted that in the 4th Industrial Revolution, it is all about automation. However, in progressing to the 5th Industrial Revolution, it's about integrating the human into the technology and the revolution and CPUT is developing their strategy to be resilient and focus on future trends as it is not certain how far the next IRs shall progress, thus requiring constant adaptive capabilities. She further added that there is a need to reflect on the Sustainable Development Goals and students need to know of these goals as they are to inherit the Earth in the future. Another component is on Cyclicality in which our solutions for problems create new opportunities for others. Moreover, Prof Pellissier stressed the importance of promoting entrepreneurship and world competitiveness, and in a scenario where South African students in universities are not kept abreast with world trends, in a world of haves and have nots, the have nots will be our South African students if we don't adapt to 4th Industrial Revolution.

In the changing landscape of higher education institutions, there are international challenges that are faced, such as mobility, sustainability and finance. In South Africa, universities face further National challenges such as opening space for the less fortunate as well as youth unemployment. Additionally, there are internal challenges which include aging academic staff, throughput rates and finances. The strategy also reflects on transformation, the future student and how they will respond if they are exposed to the technologies. More importantly, we need to address how is higher education relevant to the society and take cognisance of the content released in the draft White Paper on Science and Technology that has tried to incorporate the 4th Industrial Revolution and what higher education needs to do. Lastly, there are discussions on the matter of recognition and how universities compete in ranking systems which focus on aspects such as research output.







In adopting a Systems Engineering approach as a methodology for developing a strategy for universities, the focus is on input (students, faculty and staff, infrastructure) and transform these components into outputs (graduates, research achievements and IP). Moreover, the characteristics of the system is that the university is a complex system which is man-made, physical and open system which responds to the changing needs and developments in society. As such, this warrants and permits us to use the systems engineering approach on developing strategies.

In developing a strategy for CPUT, key principles have included resilience and flexibility, and creating a balance between academic and research excellence, and academic and research relevance. This has resulted in the culmination of CPUT 3.0: ONE SMART CPUT, which is based on four strategic thrusts of ONE SMART CPUT, namely Smart Teaching and Learning, Smart Research in Technology and Innovation, Smart Engagement, and Smart Operations.

During the question and answer session, key discussions revolved around what universities should be doing to work together? It was emphasised that innovation comes in different forms, and it's up to universities to make sure that students know the future will be different and they need to be prepared for this.

Paper 2 - Profs AB Ngowi, HJ de Jager and S Ramakrishna, Central University of Technology and National University of Singapore

"Emerging Industrial Revolution: Symbiosis of Industry 4.0 and Circular Economy: The Role of Universities"

The paper unpacked the competing discussions between a linear and circular economy in which the linear economy model is based on extract, make, use and dispose. This model is based on the consumerism lifestyle which is unsustainable and damaging to the ecosystem. The reasons for the sustained adoption of the linear economy is the availability of plentiful and inexpensive natural resources. In contrast, the more sustainable future which is based on the circular economy model, focuses on the recovery of resources and regeneration of products and resources at the end of their lifespan. Such a model is expected to save trillions in dollars, by amongst other things, lowering energy demand, and using renewable energy.

What is the role of Universities? Firstly, universities must get involved in the circular economy by looking at resources, the environment and the economy. Additionally, universities must consider global competencies whereby students exiting universities are prepared for and fit into the global market while respecting global culture and responding to the changing world environment. This will require universities to mix traditional education and MOOCs (i.e. online learning). Current HE initiatives focusing on supporting a transition towards a circular economy include the CE 100 which is an international platform that has brought together leading companies, emerging innovators, and regions, to facilitate sharing of expertise and collaboration. Other initiatives under the CE 100 include Pioneer Universities which aim to further the collective understanding of the circular economy and enable a transition to it through skills development. For example, Bradford is the first university to offer a Master's qualification in Circular Economy. Lessons that could be adopted from these Pioneer Universities includes the establishment of hubs and centres, offering specific courses and programmes, collaboration, and developing practical toolkits for universities and industry.

Crucial questions during the session raised the question of how do HE institutions build graduate attributes and curricula for the circular economy. It was indicated that some attributes are measurable, and others are not. For example, critical thinking can be measured based on assessment. What needs to be done is combine face to face teaching and online learning. Instead of teaching a classroom, we need to create a system which is fixed to a social environment. In addition, discussions suggested that universities need to transition from their current linear economy model, towards a circular economy. Universities are engaged in innovative research, however, applications of the research output remain limited. Moreover, it was mentioned that the curriculum needs to teach innovation. Lastly, academics need to join the 4th Industrial Revolution and apply their research, before their relevance is questioned in the 4th Industrial Revolution.

Paper 3 - Ms D Selepe, Vaal University of Technology

"Nursing Education and Training for the 4th Industrial Revolution"

The study focused on the perceptions of HIV+ patients that are 50 years and older regarding services that are provided at Sebokeng hospital in Gauteng. The Sebokeng hospital has a different clinic that is outside the mainstream hospital that provides HIV treatment. Therefore, the finding of the study indicated that there is a requirement to introduce service integration, specialised geriatric care, quality care for patients with HIV/AIDS, psycho-social health support, and address economic issues with pertinent health education. The study further found that there is limited empirical research that has been conducted in South Africa that investigates people who are older and have HIV. In terms of the needs for the 4th Industrial Revolution, the use of an information system (IS) is currently not applied as efficiently as it is meant to. If used effectively the IS has the potential to increase the quality and accessibility of HIV patient's data and improve patient safety and clinical processes through clinical decision support and create efficiencies in HIV health care.

The study was undertaken at the ART clinic in Sebokeng hospital, Gauteng, SA. The study investigated the medical needs of Older People Living With HIV (OPLWHIV) attending the clinic, the HIV/AIDS services provided to these patients and their perceptions of the services they received, experiences of HIV positive (>/=50 years) patients receiving services at an HIV/AIDS clinic, and medical needs of OPLWHIVs (other non-communicable diseases). In terms of the research method the sample population were HIV positive patients aged 50 years and older, attending treatment at Sebokeng Hospital HIV/AIDS Clinic, present on the particular day and time for treatment. Additionally, the sample population included nurses practicing in HIV/AIDS unit and other departments. The sampling technique which was employed was that of non-probability sampling with particular use of convenience sampling. In total, the sample population consisted of 20 patients and 7 nurses.

Some of the study findings include the need of an operational patient monitoring system which must be incorporated into care, treatment and prevention as well as rehabilitation at a health facility. The study further found the need to use information technology in the teaching and learning in nursing for undergraduate and postgraduate students. The study also found that in the near future, the application of the 4th Industrial Revolution could include the use of robotics for medical supply management of hospital stock, preparing patients medical files/data,







interlinking of all public health institutions/ or private institutions, use of technology for routine process such as urines testing and blood pressure tests for optimal service delivery.

In terms of the curriculum proposal, in the current entry requirements for nursing education and training, basic computer skills are part of the criteria. However, there is a need to include and increase the skills requirements of basic computer skills to Level 4, post matriculation. The result will be ICT being included at all levels of undergraduate and postgraduate training and provide new opportunities for nurses to become nursing technicians. A nursing technician will be tasked with maintaining the devices, as well as monitor the performance of devices and equipment. This will require the development of well-informed nurses who a capable and skilled in the utilisation of the equipment and be familiar with the specifications of the equipment. The resultant effect could be the alleviation of current difficulties in providing appropriate health care.

Its therefore of the outmost importance that nurses obtain formalised in-depth ICT training. In conclusion, the 4th Industrial Revolution compels the health care system to rethink nursing education and training and improve the health care system in South Africa. This study recommends the integration of ICT into the current curriculum of nursing, and for policy review of nursing education and training. Key discussions emanating from the presentation was on the impact of rapid prototyping/3D printing for nursing programmes and devices. It was revealed that rapid prototyping/3D printing can have a great impact as it can be used as part of training of students and reveal to them what is required in their field of practice.

SESSION 2 - Chairperson: Ms Senisha Moonsamy, Head of Innovation Skills Development, Technology Innovation Agency

Paper 4 - Profs M Masinde; H Vermaak; F Emuze; K Kusakana; A Ngowi and Dr B Awuzie, Central University of Technology

"Sustainable SMART Cities as vehicle for Multi- Disciplinary Research within a University of Technology in South Africa"

The emergence of the 4th Industrial Revolution and the related IoT's (Internet of Things) has brought about both positive and negative influences on our societies and community members. Unfortunately, some government policies are still not ready for the rapid emergence of the 4th Industrial Revolution in concept stages, especially those of developing countries where suitable infrastructure is severely lacking. With this in mind, Prof Masinde stated that this paper has brought together an amalgamation of ideas from various members of the CUT faculties including Engineering, Information Technology (IT) and the Built Environment.

The concept of a SMART city is derived from the city's ability to encompass all its inhabitants within the complex systems of urban life and provide the public with technological connections that will improve life. In addition, these SMART cities have based its formation, development and expansion on being completely sustainable. When creating the necessary and sustainable SMART devices and tools for these cities, the key factor is to ensure an improvement in performance, a reduction in costs and an increase in social efficiency. This idea is able to work together with the emergence of a circular economy and to promote social and economic upliftment.







In relation to these SMART devices and tools, CUT is currently housing the functional testing of 4th Industrial Revolution devices and tools. One such testing that CUT is currently focusing on is the introduction of SMART systems into University lecture theatres to establish utilisation of these facilities. Additionally, the team at CUT are currently investigating the use of a fingerprint registry device for each venue. Moreover, CUT have also launched a project focusing on the emergence of SMART buildings by installing sensors to monitor the building's electricity usage and foot-traffic. In closing, Prof Masinde expressed that we need to create a 'roadmap' or plan as to how we are going to actively participate in the 4th Industrial Revolution, promote multidisciplinary collaborative research, design and development within the sphere of the 4th Industrial Revolution to contextualise and solve the problems being faced by our societies and its people.

Paper 5 - Dr KJ Samuel; Prof SB Agbola and Dr O Olojede, Mangosuthu University of Technology

"African Cities in the 4th Industrial Revolution: The Role of African Universities"

The 4th Industrial Revolution has brought about many positive changes to society and the functionality of our economy, including the improvement of efficiencies, capital utilisation and overall global expansion of marketing and sales. On the other hand, the 4th Industrial Revolution has exposed our economy and societies to risks such as cyber-attacks/hacking, exploitation and an increasing inequality on both a local and global scale. Dr Samuel explained that Africa is severely lagging in this wave of the 4th Industrial Revolution and by not contributing or adapting to the technological advancements that are taking place, our level of disparities with international societies will continue. With regards to the 4th Industrial Revolution and cities, Dr Samuel describes cities as the central hub of innovation and demand in the 4th Industrial Revolution and as a result, they are considered to be both a beneficiary and recipient of prospects and problems for the 4th Industrial Revolution. The 4th Industrial Revolution is a direct outcome in attempting to achieve the 11th Sustainable Goal set by the United Nations, as it hopes to improve cities' metabolism, mobility, service delivery, safety and security, environmental friendliness.

The study focused on examining the role of African universities in helping African cities respond to the opportunities and challenges posed by the 4th Industrial Revolution. The research methodology adopted by the study was a transdisciplinary approach which connects the state of the African cities, as well as the research and innovation performance of the African universities.

The study highlighted the role of universities for the 4th Industrial Revolution African city, namely production and co-production of knowledge, skills development, and active community engagement. More importantly, Africa must be a co-producer in the current wave of innovations and not the consumers as it had been in the previous revolutions. To do this, the responsibility rests on the universities and in its ability to support its students with the required knowledge and motivate them to create.







Paper 6 - Prof S Mahlomaholo and Dr M Qhosola, Walter Sisulu University and University of Free State

"Creating Sustainable Learning Environments for the Fourth Industrial Revolution: A Study of Management Strategies"

This paper focused on the technical aspect of the 4th Industrial Revolution, by asking 'who takes responsibility in terms of ensuring that the 4th Industrial Revolution is implemented at an institutional level. Prof Mahlomaholo stated that, as managers we need a different kind of managerial style to ensure that there is inclusivity in the 4th Industrial Revolution. If we want universities to move forward and progress toward the 4th Industrial Revolution, management styles need to adapt and must take everyone into consideration. The conventional management strategies which are used in many institutions include aspects such as rewards, specified job design, management by objectives (MBO), participative decision-making and delegation. However, Prof Mahlomaholo stated that the 4th Industrial Revolution calls for management strategies to focus on complex problem solving, critical thinking, creativity, people management, coordination with others, emotional intelligence, judgement and decision making, service orientation, negotiation and cognitive flexibility.

The concept of Sustainable Learning Environments is derived from the United Nations 17 Sustainable Development Goals (SDGs) of 2015 and describes the idea that an individual's environment or context is important in determining the level of one's learning. Therefore, once contexts are established, they allow those who are learning within, the opportunity to function with ease in the destined environment. With the emergence of the 4th Industrial Revolution, creating such environments would require management strategies that are in place to prevent challenges such as greater inequality and earning disparities from occurring. Therefore, collaborations between different stakeholders including the HE institutions is a necessity in ensuring that quality education is realised.

This study presents a strategy for effective management of the person which emphasises inclusivity and allows management to recognise her/his individuality. The study was able to create four broad elements that management must take into consideration when creating new strategies in line with the 4th Industrial Revolution, namely the physical, the physiology, the psychological/emotional state, and the social-cultural background. According to Prof Mahlomaholo the main reason why this suggested management strategy seems effective in creating Sustainable Learning Environments in the 4th Industrial Revolution, is its ability to empower its institutional community and provide quality education that is inclusive for all.

SESSION 3 - Chairperson: Dr Thandi Mgwebi, Deputy Vice-Chancellor: Postgraduate Studies, Research, Innovation and Engagement, Tshwane University of Technology

Paper 7 - Mr PA Lansdell, Profs B Marx and A Mohammadali-Haji, UNISA and University of Johannesburg

"The Impact of Industry 4.0 on the Development of Soft Skills by SAICA-Accredited Academic Programme Providers"

The study focused on how UNISA and UJ responded to the training of accountants, while simultaneously responding to 4th Industrial Revolution principles. The research identified that technical skills alone were not enough, but that there was a need for critical thinking, working in a team, communication skills and how they could add value to business as responsible leaders. The market requires these skills to be developed as part of the accounting programmes. It is also important to think how these skills should be developed for accountants in response to the 4th Industrial Revolution, and how academics could adopt innovative methods to develop these skills. The Accounting profession must therefore reinvent itself to remain relevant, and for this reason SAICA raised questions such as; which competencies should prospective Chartered Accountant be equipped with to ensure that they remain relevant once they enter the profession and workplace? and which additional skills they would need?

The Conceptual Framework identified skills such as complex problem solving, critical thinking, creativity, people management, coordinating others, emotional intelligence, sound judgement in decision making, service orientation, negotiation, and cognitive flexibility as critical skills. In the past, knowledge was viewed as more important than the soft skills component. The current model is competency-based, focusing on knowledge and soft skills that would allow them to impart their knowledge and add value. SAICA's competency framework included some of the soft skills, which align with those of the WEF, including the ability to solve complex problems, manage people, listen and write, think strategically, negotiate effectively, and ethical awareness. The methodology included a literature review, comparing the skills required by SAICA and those dictated by the WEF. These were tested by asking new entrant Chartered Accountants to respond to a questionnaire, and more than 40% responded. The Statistical Package for the Social Sciences (SPSS) was used for analyses, which were again linked to SAICA's proficiency levels as a benchmark.

Key findings emanating from the study include creativity and emotional intelligence being low in the scope of results, while complex problem solving, and critical thinking were at the mid-levels. Combining the latter two skills levels with technical knowledge will probably be insufficient in practice. In terms of people management, coordinating others, judgement and decisions, the new Chartered Accountants were insufficiently qualified to apply these skills. Most of the 4th Industrial Revolution skills predicted by the WEF are to some extent included in SAICA's competency framework. Since it is questionable whether these will meet the demands of the 4th Industrial Revolution, it is recommended that the skills of creativity and emotional intelligence be included in the curriculum, and that Chartered Accountants should receive attention in developing their soft skills as demanded by industry 4.0.







Paper 8 - Dr A Harmse, Profs DB Jordaan, AS Blignaut and A Wadee, Vaal University of Technology and North West University

"Higher Education Institutions, ICT Graduates and Skills required for the 4th Industrial Revolution"

When VUT reconsidered what it should teach to respond to the 4th Industrial Revolution, it considered the objectives of HE institutions, which include producing graduates for industry and to promote educational and industrial relationships within the ICT industry. It is important to consider the promotion of skills and abilities for the enhancement of graduate contributions to the 4th Industrial Revolution. The research problem was then to identify an ICT skills framework for South Africa, which did not exist, and to identify the skills that should be included in such a framework. Literature showed that there has been a decrease in IT graduates in South Africa. The problem was identified as a skills gap between what universities produced, and what organisations looking for talent wanted. Higher Education Institutions (HEI) need to restructure themselves and their curricula frequently to meet these changing industry needs. A framework will create a common language for stakeholders, as well as a platform for industry to communicate their performance expectations and guide collaboration with HEIs.

The skills that would be required in South Africa considered the phenomenology to arrive at a qualitative strategy, while considering the needs of various industries. It was deemed necessary to also interview practitioners to get an idea of the total skill set required. Data collection followed a model of unstructured individual interviews. The results suggested that in addition to technical skills, most ICT professionals identified additional critical cross-field outcomes that were not listed in Skills Framework for the Information Age (SFIA). The development of the ICT skills framework then tried to incorporate these additional skills, resulting in 130 skills required by the ICT industry.

In conclusion, universities must develop graduates who possess not only technical, but also critical non-technical or soft skills. Universities should therefore develop ICT curricula that respond to these needs, which must include comprehensive communication skills. Those who already use SFIA (pegged at Level 3) should consider whether the skills at this level are appropriate and how these skills would respond to the needs of South African businesses.

Paper 9 - Prof LD Naidoo, Mangosuthu University of Technology

"The 4th Industrial Revolution: Are Universities of Technology Catalysts for Change?"

Universities of Technology in South Africa have been under-resourced for a long time, despite having to cater for disadvantaged students who come from a poor schooling system. The students themselves come from poor communities where their parents are unemployed, and they enrol in institutions that are beset by infrastructure limitations. What hope is there that they will be able to flourish in universities, some of which still struggle to adopt the innovations brought about by the 3rd Industrial Revolution. The current environment in which we operate must rapidly adapt to disruptive technologies and trends such as the internet of things, robotics, virtual reality and AI, which will change the way we live and work. What does this mean for education? How do we educate students for the 4th Industrial Revolution, and are our programmes and systems still relevant? If not, how do we reconstruct our system to be responsive to these needs? How will universities respond meaningfully to these issues and develop students who will be relevant to the market place? These were just some to the questions that centred around the presentation by Prof Naidoo.







In addressing these critical questions, Prof Naidoo stated that to meet the changes in our society, our universities should implement curriculum change focused on developing other core skills. They must focus on staff involvement and training to change the way that people teach and must ensure that industry is involved in the curriculum changes. Large percentages of graduates find it difficult to enter the world of work. What do academics and industry players think must be done? Three UoTs were asked to comment on this aspect, involving both academic and administrative staff as well as industry role players. It was revealed that academics were unaware of formal endeavours to address their preparedness for the 4th Industrial Revolution. The curriculum only incorporated one additional IT course, but little else that could be linked to the 4th Industrial Revolution. Staff were not involved in programme development that would respond to the 4th Industrial Revolution. Of great concern, the study found that no university-wide policies addressing the 4th Industrial Revolution were found and no resources were made available to support these initiatives.

The industry representatives indicated that students, particularly engineering students, encountered tools and equipment critical to their jobs for the first time in the workplace, meaning that their employers had to teach them to use these pieces of equipment. No industry representation on advisory boards, creates the perception that universities do not think it important to consult with them. Considering that 60% of graduates from one university remained unemployed, it is important to ask what the situation is at other universities. In one instance, a text book that was three decades old and severely outdated, still formed part of the prescribed curriculum. UoTs will have to consider how they teach and ensure that their curricula are relevant to the world of work. The study identified areas that need to be addressed which include curriculum change, staff development, investment in infrastructure, and industry involvement.

DAY 2: 12 SEPTEMBER 2018

8. THEME 3: UNIVERSITY INDUSTRY PARTNERSHIPS IN THE CHANGING WORLD OF WORK

8.1 Session theme address: From innovation studies to industry 4.0: universities of technology as change agents (Annexure 7)

Cooperative Education at Western Digital:
Mr Sampan Silapanad, Vice-President and General Manager, HDD Operations, Western Digital Corporation, Thailand
(Chairperson for the session: Dr Thandi Mgwebi, DVC: Postgraduate Studies, Research, Innovation and Engagement, Tshwane University of Technology)

Industry 4.0 comprises nine pillars of technological advancement. These include, but are not limited to autonomous robots, simulations, horizontal and vertical system integration, the Internet of Things, and cloud computing, to name a few. Western Digital has made great strides in implementing automation and intends to move on to artificial intelligence (AI). Artificial Intelligence will rely on machines interacting with other machines, eliminating manual processes such as testing and inspections. As a result, a significant majority of enterprises believe investment in AI will lead to greater competitive advantage.







In association with the rise in use of AI, manpower demand will shift. Therefore, it will be necessary for people to acquire new soft and hard skills. The soft skills that would be needed include critical thinking, a growth mindset, agility and resiliency and hard skills include, data scientists, analysts, equipment data automation skills, skills to develop industrial intelligence systems, and system integration skills. People will have to adapt to a culture of constantly adapting and upgrading their skills.

People must continuously ask questions to improve views, seek truth and keep an open mind to learn. The future of education is about collaboration. Western Digital of Thailand has created linkages with educational institutions locally and internationally, including South Africa. This has allowed the company to collaborate on projects, providing students with guidance from mentors, community engagement and Work Integrated Learning (WIL) opportunities.

Respondents (Annexure 8)

- Mr Keith Anderson, Chief Executive Officer, SAWEEDA
- Ms Tracey October, Regional Manager, Southern Africa Web of Science, Head of RIMS Solutions for Africa, Converis, Clarivate Analytics
- Mr Sandeep Vakharia, Managing Director, Aashumi Chemicals India
- Mr Hugh Mtshali, Chief Executive Officer, SATRUCO

It is critical for universities to remember the challenges for which we must develop innovative solutions. Universities and industries must work together to educate customers on accepting new products and creating a demand for these products. It is essential for universities to achieve clarity with regards to who should be responsible for driving industry collaboration. If researchers are to be responsible for the relationship, it is necessary to address the current system whereby research publications are preferred.

Industry representatives entering the classroom is believed to be beneficial to students as it will increase student motivation as well as allow for university curricula to evolve, based on the needs of the industry. Active learning in the workplace will also facilitate greater understanding with regards to what skills are required by industry. Further discussions to refine the roles of industry and university in the collaboration is imperative, ensuring both parties benefit greatly from the relationship.

8.2 Session theme address: industry and university technology partnerships: The grand challenge – a case study (Annexure 9)

Prof Ronald Quincy, Academic Director, Rutgers Civic Leadership Institute, Mandela Washington Fellowship for Young African Leaders, Rutgers University, New Jersey, USA

(*Chairperson for the session: Dr Joseph Ryan, Chief Executive Officer, Technological Higher Education Institution, Ireland)*







There is a challenge regarding the creation of successful and sustainable partnerships between universities and industries. In order to create a sustainable and strategic partnership, the goals of the industry partner should be consistent with those of the university. Corporate social responsibility programmes facilitate the formation of these partnerships as it allows for companies to fund socially responsible programmes and services (which may be initiated by universities).

It is also evident that industry and governmental departments are allocated larger budgets than those of universities. As such, collaboration with universities will provide companies with access to innovative research and in turn allow for universities to access additional funds and provide students with opportunities for work experience and WIL. In the United States of America, start-ups formed from academic research has generated significant revenue.

Participants in Panel Discussions (Annexure 10)

- Mr Barlow Manilal, Chief Executive Officer, Technology Innovation Agency
- Mr Gavin Rajah, Creative Director/Rainmaker/UNICEF Goodwill Ambassador
- Mr Ademir Bassanesi, Professional Coach and Mechatronics Consultant, Brazil
- Ms Nombulelo Nxesi, Chief Executive Officer, ETDP SETA
- Mr Sagie Pillay, Profile Head, Clinical Operations, Wits Health Consortium

Establishing strong relationships between university and private sector is critical and should be mandatory and symbiotic. The collaboration also means the open sharing of information and an interface of strategic discussion. The focus of Sector Education and Training Authority's (SETAs) is on skilling and re-skilling people and ensuring a balance between demand and supply of skills for the future workforce.

Of concern, is that unemployed graduates are a result of a mismatch between the demand and provision of skills. Universities are not aware of the work being done in industry, whilst the industry's workplace plans often do not consider current and future students. Teaching methods and curricula need to be reviewed to incorporate the requirements of industry. Also, businesses tend to seek value and profit and as a result it is necessary to enhance a corporate culture in order to survive in the future.

8.3 Session theme address: Industry reflections 4th Industrial Revolution: A renewed relationships between industry and academia (Annexure 11)

Mr Trevor Raman, President, Saab Grintek Defence (SGD)
"Chairperson for the Session: Prof René Pellissier, Director, Strategic Initiatives and Partnerships, Cape Peninsula University of Technology"

Prior to the attainment of democracy, South Africa used 10% of the GDP on defence, thereafter it used below 1% of the GDP on defence. SAAB Grintek Defence (SGD) employs more than 800 people and offers more than 500 products to more than 100







countries. This has been achieved through the employment of passionate and innovative people, and government policies that supported the development of IP and commercialisation.

The growing defence companies in South Africa will need to employ knowledgeable people to conduct research and development as well as keep up with the 4th Industrial Revolution. In this regard, SAAB Grintek Defence has already forged strong relationships with traditional universities (Stellenbosch and Witwatersrand). Universities of Technology can also benefit greatly from such a relationship.

At SGD, approximately 25% of sales go to research and development. The focus is usually on engineering and re-engineering, driving price to market and innovation which in turn requires improvements in product life cycle, business and innovation cycle processes. It is necessary for industry to engage government regarding regulatory frameworks that impede export business and prevents the generation and commercialisation of IP. This would allow for industry to take IP to market to generate additional income for universities.

8.4 Industry partnerships with Universities of Technology (UoTs) and Technical Vocational and Training (TVET) colleges – placement of students: Work Integrated Learning (WIL) (Annexure 12)

Dr Raymond Patel, Chief Executive Officer, merSETA

The Manufacturing Engineering and Related Services SETA (merSETA) is the largest SETA in South Africa and focuses on benefiting and growing the economy by adding value through IP, research and development. MerSETA has identified several potential solutions linked to the 4th Industrial Revolution such as mobile device-based machines, autonomous vehicles, logistics automation etc. There is a fear that individuals will lose their jobs, however, it must be comprehended that individuals need to develop new skills for the future, in areas such as robotics, AI, coding and cloud computing.

There are several challenges inhibiting tertiary institutions in participating in the 4th Industrial Revolution, which includes; disinterest in innovation, outdated curricula, lack of qualified teachers and lecturers, and the negative image of Technical Universities and TVET Colleges. In order to resolve these challenges, it is necessary for partnerships to collectively find a solution. Moreover, to move into the 4th Industrial Revolution, it is necessary to change the process for deciding curricula. The current process is a protracted endeavour and as a result, curriculum changes are often approved after technology has been transformed.







8.5 Showcase (Annexure 13)

Mr Richard Hardiman, Entrepreneur and Environmentalist, Ranmarine Technology, Waste Shark Drone

Mr Hardiman highlighted how Ranmarine Technology develops aquatic drones for the environment and used to service and survey the environment with particular focus on smart-cities and maritime needs. The aquatic drone had been inspired after observing how individuals in a boat use a drag net to manually remove litter from the water. This method has been considered as outdated and inefficient. Considering the current challenge with single-use plastics, it was necessary to research innovative solutions.

Thus, the WasteShark was designed to performs two functions which are to remove litter from the water and assess the quality of the water. The drone has several models, which range from fully automated to models which require an individual to remotely control the device. The WasteShark is currently manufactured in Holland, as funding partners were not available in South Africa. It was also less challenging to access individuals with the necessary knowledge and skills that were willing to assist with the project.

The remotely controlled drone is recommended for use in South Africa as it requires people to manage the drones. This allows for the upskilling and empowerment of individuals to perform their work in a more efficient and dignified manner. The current objective of Ranmarine is to have as many drones in the water to collect as much data and litter as possible.

DAY 3: 13 SEPTEMBER 2018

9. THEME 4: THE 4th INDUSTRIAL REVOLUTION AND SUSTAINABLE FUTURES

9.1 Session theme address: Trends for the future (Annexure 14)

Prof. Chris Adendorff, Professor in Future Studies, Nelson Mandela University
(Chairperson for this session: Prof Urmilla Bob, Dean of Research, University of KwaZulu Natal)

In his address, Prof Adendorff stated that the future is arriving faster than ever before. In this regard, mankind will experience changes that had never been anticipated and it is how we prepare for that future that will help us survive. Moreover, there is no room for negativity and we must instead see the opportunity in every difficulty, preparing our students for the future. The 4th Industrial Revolution may be out of our comfort zone, but we should consider that all our knowledge is about the past, while all our decisions are about the future. As such, most of what we need to know to make good decisions today is outside our comprehension – we don't even know what we don't know.







In the future, some current job positions will decline while others will see a rise. In this regard, the top ten skills that will be critical from 2020 onwards include, among others, complex problem solving, critical thinking, and emotional intelligence. Furthermore, 60% of jobs that will exist 10 years from now have not yet been invented, which means that the role of the university will change. By 2030, over 2 billion jobs will have disappeared, freeing up talent for many new fledgling industries. By 2030, basic computer programming will be considered a core skill required in over 40% of jobs and we will see a surge of micro training colleges to switch professions.

In the 4th Industrial Revolution, eight key drivers of change will be critical for the future, namely rethinking workspace, continuous organisational redesign, blended and swarm workforces and gig workers, HR by Algorithm, talent wars, continuous feedback and performance review, workplace practices and flexible benefits. The most critical role of the workforce will see the focus shifting to the C-suite and the IT function to deliver the necessary technological infrastructure and business transformation. Therefore, we must consider the role of people in this process and ensure that change is managed properly. Prof Adendorff emphasised that technology can do more of our work, but we must remember that people will remain important.

Respondents (Annexure 15):

- Dr Azar Jammine, Director and Chief Economist, Econometrix
- Prof. Seeram Ramakrishna, Director of the Centre for Nanofibers and Nanotechnology, National University of Singapore

Dr. Jammine responded that it is difficult to adapt sufficiently and rapidly enough to the imminent changes brought on by technological advances. In South Africa, it will be vital in the new age to assimilate and dissect information, get the right perspectives, and communicate this with others, for which proper education will be critical. In South Africa our universities are holding up quite well, producing knowledge and research at a good rate. The problem is that it is still not wide-spread enough. Too much of the research output comes from only a small number of universities, which will require the other universities to be capacitated. He further mentioned that there also needs to be a strong focus on education in the schooling system.

Prof. Ramakrishna added that changes from the 4th Industrial Revolution will not be taking place that fast in all sectors. However, this does not mean that we should be complacent. Rather, we must all be aware that we should improve our abilities and skills to keep up with the changes to ensure our sustainability into the future. In thinking about a sustainable future, we must think about how we could adopt a circular economy, improving economic activity that will drive the economy and make services more affordable. If we think about a sustainable future, we must also consider our traditional strengths and optimise them.







9.2 Showcasing institutional innovations and technologies (Annexure 16)

A robot took my job and other headlines in the year 2030: Future-proofing universities and learners for a rapidly changing world

Mr Myles Thies, Director of Digital Learning Services, Eiffel Corp
Chairperson for this session: Prof Alfred Ngowi, DVC Research, Innovation and Engagement, Central University of Technology, Free State

There have been many positive predictions about how the future will change, and the opportunities that this presents. For example, AI capabilities are increasingly being reported in daily headlines, and could change the way that we do business, provide healthcare, and educate people. Furthermore, autonomous vehicles are becoming increasingly ubiquitous, which will require us to think how people currently making a living from driving should be re-skilled. Additionally, positions that will most likely be replaced in the near future include data capturers, library technicians, tax preparers, cargo and freight agents, call centre marketers, and many others. In the South African context, 35%, or 5.7 million, of all jobs are at risk of digital automation within seven years. Considering that the half-life of a job skill is about 5 years, skilled workers need to get ahead of the curve.

In response, universities will have to deal with the commercialisation of education, as education increasingly turns into a buyer's market. There is an increasing number of globally capable organisations that are ready to move into the education market, which will use blended learning to cater for students who no longer want face-to-face learning. In this regard, technology is now enabling tangible levels of personalisation, allowing students to comprehend and reflect knowledge at their own pace and when they are ready. The solutions to some of the challenges must be underscored by adaptability, responsiveness, and high quality. Universities should also consider alternatives such as supplemental models, replacement models and emporium models rather than replicating existing functionalities. Crucially, educator skills and capabilities to facilitate and impart skills in a technology-dominated space must be prioritised at every level and the government and industry must also support these initiatives to ensure linkages back to industry and vice versa.

9.3 Food products derived from bambara groundnut

Mrs Halimah Rabiu, Technology Transfer Coordinator, Bambara Technology, Cape Peninsula University of Technology

The showcase revealed how CPUT has been conducting a study on the Bambara groundnut, which is an African indigenous legume that currently has little economic importance. It is relatively easy to grow, within 4 to 5 months, and can be farmed as a cash crop requiring minimal irrigation. The Bambara groundnut will meet an increasing demand from consumers who are health conscious and require products free from lactose and cholesterol, with high anti-oxidants. As an institution, CPUT has registered patents for a Bambara groundnut milk beverage and a probiotic beverage, as well as a solid dietary fibre that could replace starch in other food products.







It has been noted that there is a large market with significant growth potential and profit margin, with the Bambara groundnut tasting better than other lactose-free products currently available in the marketplace. The product could also be packaged and sold in dried powder form and is high in dietary fibre and nutritional value. As such, CPUT wants to establish a manufacturing facility in South Africa and India to supply the local and international markets.

9.4 3D printed implants and devices: how technology improves the quality of life for SA patients

Mr Gerrie Booysen, Director, Centre for Rapid Prototyping and Manufacturing, Central University of Technology

3D printed implants and devices are increasingly being used to improve the quality of life for South African patients. The Centre for Rapid Prototyping and Manufacturing (CRPM) at CUT was established in 1997 and has received ISO certification for 3D printing of medical devices, ensuring that their products conform to the highest international standards. Currently, 95% of medical devices in South Africa are imported from other countries, which presents great opportunities to enter this market. An estimated $8.7 trillion will be spent on global healthcare in 2020, and there is a major opportunity to improve the lives of people who are born with disfigurements, are injured in accidents, or whose bodies are disfigured by cancer. These customised laser-sintered implants help to restore the function and appearance of these body parts, and CUT has collaborated with De Montfort University to produce a complete prosthetic leg for a female patient.

In addition to focusing on advanced tooling, medical implants and devices, CRPM also produces aerospace structures and direct end-use products for SMEs. Progress has been made in research and development, but commercialisation must still be strengthened. The CRPM will launch a Chair in Innovation and Commercialisation of Additive Manufacturing to share best practices among all universities with capabilities in this field in the near future.

9.5 Composite materials and re-enforced moulded plastics product design, development and prototyping

Mr Ryan Hamilton, Durban University of Technology

Technology Stations are centres that provide access to world-class infrastructure and expertise that would otherwise not be available to SMMEs. The typical client generally needs a specific solution to a problem, which requires a long, steady process through conceptualisation, prototyping and eventual commercialisation. Often clients have ideas, which vary in their stage of development, and do not have funding to develop their ideas, which is where Technology Innovation Agency comes in. The process involves material testing, prototype manufacturing, small scale production and process development.







One of DUT's Technology Station's clients, a jeweller, wanted new manufacturing methods involving materials such as Bakelite and silver. The client relied on manual processes that were labour intensive and time consuming. The jeweller needed something that could be produced at scale, requiring CAD drawing and designs, composite manufacture, and CNC machining. The second client, Imvusa Training, wanted to supply carpets, door linings and boot linings for cars. They required comprehensive material testing, as well as a test jig design according to automotive test specifications. The third client, Vortex, required a fish hatch water circulator for recreational kayak fishermen, who need to keep their bait fish alive to catch larger fish. They needed a solution that would allow them to paddle out to where they would be able to fish, so it had to fit into a kayak, be easy to use, and be cost effective. The final product uses momentum to supply fresh water to where the live bait is kept, circulating fresh water through an overflow system. Once complete, the water can be drained out.

9.6 HIT-TO-LEAD identification and pre-clinical development of new therapies for prostate and breast cancer

Dr Njabulo Gumede, Senior Lecturer, Organic Chemistry, Mangosuthu University of Technology

The drug discovery and development process of a new chemical entity (NCE) is lengthy and costly, taking on average from 12 to 15 years to complete. The use of chemistry has been introduced to the process in the lead discovery phase. Most of the approved drugs have been withdrawn from the market due to serious side-effects, or because patients have become resistant to them. Additionally, prostate cancer has emerged as a serious threat in elderly males. The existing drug that has been used to treat prostate cancer is no longer effective, requiring a new drug to be developed.

The biochemistry of prostate cancer was studied to identify inhibitors that could be incorporated into new drugs, from existing compounds using a quantum-mechanical process. In this regard, two patents have been registered for this particular compound. Due to the manufacturing process being simplified, it is possible to test the product quicker and it would be able to simplify production.

9.7 What qualities should institutions of higher learning deliver?

Prof Pio Lumaga, Director, Innovation Design Lab (IDL), Namibia University of Science and Technology

Africa is facing enormous challenges in terms of water, energy and unemployment which require university leaders to find solutions. Two years ago, Innovation Design Lad (IDL) revealed the first prototype of the first solar electric taxi that they have developed. To date, IDL have refined the design, which now has an aluminium frame. Currently, IDL has 17 students involved in the project, which incorporates AI, mechatronics, safety, and energy preservation among others. The software allows real-time monitoring of what the team is doing and what challenges they must resolve.







The IDL team also have a solar still desalinator to produce drinkable water with solar energy for off-grid communities. In 18 months, they have designed and tested 6 prototypes and efficiency has increased from 3% to 47%, and the cost for a cubic meter has decreased from 23 Euros to 5.2 Euros. The IDL team is currently looking for funding to take the project further and have registered two patents, with a third under way.

Other projects presently at IDL are in the field of testing water saving measures in the growing of vegetables using micro-irrigation while increasing produce yield. Another project is a water filter made of moringa seeds, sand and charcoal as a sustainable portable water depurator. The challenge is making it portable, in similar fashion to a backpack, and easy to use. Another project is an affordable hydrogen home production system, also using local materials at a fraction of the cost.

The IDL is also focusing on modular short courses for managers and entrepreneurs through a user-centric development, improvement loops, and wealth creation techniques. The goals for IDL is to offer courses and projects that are contextually relevant, rapidly developed and proto-typed, tested and improved. Their approach is to reframe problems into challenges, and challenges into opportunities.

9.8 Robotic

Mr Nico Steyn, Senior Lecturer, Electrical Engineering Robotic Rollator, Tshwane University of Technology

Mr Steyn showcased how TUT has developed a robot to assist with the rehabilitation process of amputees. In this regard, there are many cases which indicate that there is huge scope for Human Activity Assistance Technology (HAAT) to help people integrate into society. The project began by creating the equivalent of a 'flight simulator' for people confined to wheelchairs, using augmented reality, providing inclines and declines on which the user can incorporate a range of other architectural structures to do rehabilitation practices. This was followed by building a robot that could be managed remotely.

The platform could be expanded to develop other prototypes to cater for specific needs. The final prototype for a robotic walker was developed, which makes it much easier for disabled individuals to gain mobility. It can also be used for a range of disabilities and degenerative neuromuscular disorders, after strokes, or for prostheses rehabilitation, giving the patient much more stability. Clinicians can also gain information on the gait of the patient which allows them to make adjustments. A business plan is being developed, and further refinements would be made to the product before Commercialisation.

9.9 First steps using the Sintratec additive manufacturing technology to bring digital objects to functional parts

Mr David Mauchline, Additive Manufacturing Specialist, Vaal University of Technology

There has been increased interest in additive manufacturing, which includes various processes for making a three-dimensional object of almost any shape from a 3D model or other electronic data source, primarily through additive processes in which successive layers of material are laid down under computer control. Laser sintering is one such process, where a laser is used to adhere powder material to form a shape, fusing layer upon layer to build up a component. This allows one to produce several products simultaneously, and is a great tool for prototyping. The challenge is that the equipment and materials are still quite expensive, making it prohibitive for companies to acquire. Similarly, for research purposes, a machine of this nature requires a lot of material and there is a risk of something going wrong and damaging the machine.

The Sintratec Kit, which costs R 75 000, is much smaller and is very robust and durable. The Sintratec Kit can manufacture complicated shapes with undercuts and occlusions, which could be pre-assembled. The challenge is that the material is quite expensive. It is therefore necessary to consider what other materials can be used to sinter in this machine, which used a specific blue laser and a grey pigment – imported at huge expense - which absorbs the energy from the blue light.

Since there was a huge amount of white plastic powder available, activated charcoal, a dietary supplement, was added to the white plastic powder. These particles absorbed the energy and melted the nylon, which worked well. The new material retained its properties and is safe for medical use.

It will be possible to use this information in future research into bioplastics such as chitosan, which is made from shellfish shells, the re-use of used white PA12 nylon, and other plastics to which other components may be added. Of great importance is that Sintratec allowed these concepts to be tested and proven. In further expanding on research and testing, VUT would be keen to engage in collaborative projects.

9.10 Creation Nervine and Creation Arthritis Teas

Prof Adebola Oyedeji, Professor in Chemistry, Walter Sisulu University

The Walter Sisulu University (WSU) has developed Nervine and Arthritis teas, investigating 18 plant samples to identify their medicinal properties and toxicity. The process involved testing rats for inflammatory and analgesic effects. The teas were found to be significantly anti-inflammatory and analgesic. The teas were also tested for their sedative effects and their effects on the central nervous system. In this regard, the tea was found to have a calming effect, supporting its use in managing anxiety, agitation, insomnia, restlessness and other ailments. Another tea was developed for the treatment of arthritis. To commercialise the teas, it was necessary to ensure that the medicinal plants could be cultivated locally.

10. CONFERENCE CLOSURE

Dr Padayachee thanked all participants for attending the conference and for their presentations, comments, contributions and suggestions for the next conference. Dr Padayachee emphasised the need for upskilling and reskilling to prepare for the 4th Industrial Revolution as part of creating a sustainable future. The SATN's partner institutions will continue to consider these inputs when charting the course for the future.

Dr Padayachee further added that the conference has provided a wonderful opportunity to share ideas, forge new collaborations and partnerships. She thanked the sponsors, partners and participants who helped to make the conference a reality. She also thanked the organisers and the programme director for ensuring that the event ran smoothly, as well as the sound and camera crew who worked behind the scenes to make the conference a success.

In providing clarity to delegates on the SATN, Dr Padayachee elaborated that the SATN consists of universities that are technology focused and includes partner institutions in Namibia and Kenya as well as Technology Innovation Agency. The conference identified the need for greater collaboration between institutions, and between institutions and industry. Some specialised workshops will be held in the future and any updates on possible collaborations would be welcome. Although the student voice has been incorporated in the conference, they will continue to be strengthened. The SATN Board will consider all inputs at its next meeting.

11. CONCLUSION AND RECOMMENDATION

The conclusions drawn from this conference are:

- The world is at the dawn of the 4th Industrial Revolution. Shaped by globalization, the unfolding technological transformation has been triggered by the confluence of emerging technological breakthroughs, covering wide-ranging fields such as AI, IoT, 3D printing, robotics, nanotechnology, material science, quantum computing, autonomous vehicles and energy storage.
- This is no more science fiction, but already reality. The new revolution will have an impact on how we train the new generation today for future job markets.
- Universities have to take seriously what they teach, how they teach and how their students learn.
- Universities need to plan efficiently for the challenges and opportunities that will arise as a result of these new technologies, innovations and skills.
- Universities need to ensure that the curriculum, programmes offered and the research and innovation that they are engaged in, are relevant to meet the needs of business and industry.
- Xing and Marwala (2017) drew attention to the fact that higher education in the 4th Industrial Revolution is a complex, dialectical and exciting opportunity which can potentially transform society for the better.
- This period requires certain skills that are not exactly the same as the skills that were required in the 3rd Industrial Revolution where information technology was the key driver. These skills are critical thinking, people management, emotional intelligence, judgement, negotiation, cognitive flexibility, as well as knowledge production and management.

RECOMMENDATIONS:

Some of the broader recommendations that were distilled from the discussions are as follows:

- Formalise partnerships between universities and industry to ensure teaching, research, skills and learning is relevant for the 4tyh Industrial Revolution
- Ensure industry involvement in teaching, research and curriculum development (through adjunct professorships)
- Ensure teaching staff at universities are provided with opportunities to engage in professional development programmes in industry so as to ensure that they are kept abreast of the needs of Industry
- Review the Work Integrated Learning (WIL) programmes within disciplines and programmes
- Support capacity building and professional development of staff to ensure staff readiness to meet the demands of the 4th Industrial Revolution
- Formalise international partnerships in research and innovation to ensure global competitiveness.
- Formalise Engagement with TVET colleges for articulation purposes
- Curriculation of new programmes for new jobs that will be created by the 4IR , eg programmes pertaining to the circular economy.