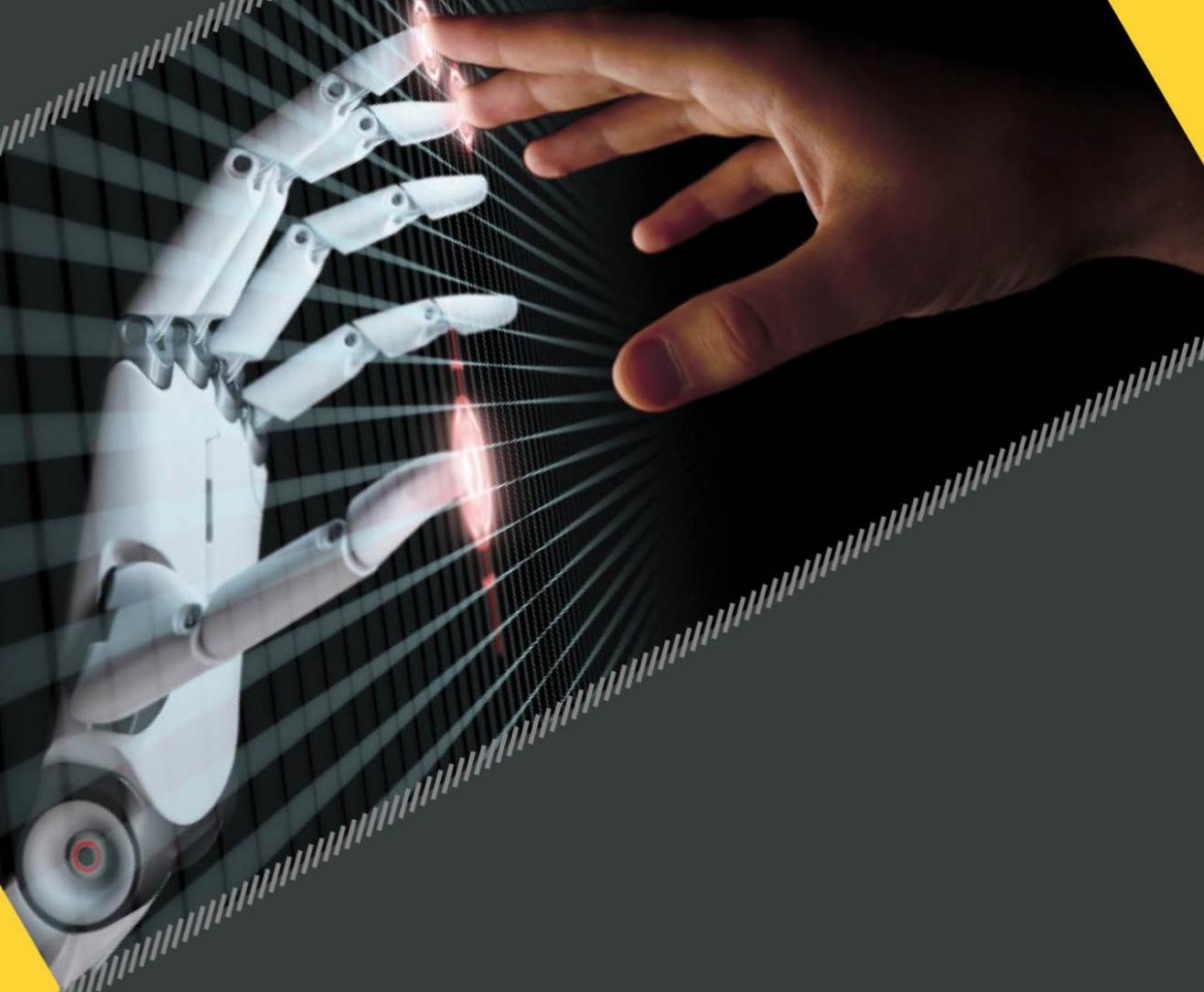




# SATN

SOUTH AFRICAN TECHNOLOGY NETWORK

TECHNOLOGY FOCUSED UNIVERSITIES



**ANNEXURES**

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# **ANNEXURE 1**

## ANNEXURE 1



### DR ADRIANA MARAIS

*Theoretical physicist, Head of Innovation at SAP Africa and aspiring extra-terrestrial*

Dr Adriana Marais, theoretical physicist, Head of Innovation at SAP Africa and aspiring extra-terrestrial, believes that we are living at a unique point in the history of life on Earth. Developments in science and technology are taking place at an unprecedented rate, and the expansion of our society beyond this planet is within reach. In her presentation she talks about her research in quantum biology and the origins of life, the technology required to sustain terrestrial life on Mars and the various projects aiming to send crewed missions there. She describes how the establishment, and potential discovery of evidence of, life on Mars, would be one of the most profound possible contributions of science to humanity.

Adriana holds an MSc (summa cum laude) in quantum cryptography and a PhD in quantum biology. Her postdoctoral research focused on quantum effects in photosynthesis as well as the origins of prebiotic molecules and life itself. As Head of Innovation at SAP Africa she is passionate about exploring innovative applications of emerging technologies to challenges facing the continent. Adriana has authored numerous academic & popular science articles on her research, and has received a range of research awards, including the global L’Oreal-UNESCO Women in Science Award in 2015, and Royal Society of South Africa Meiring Naude Medal in 2016. Adriana is also a faculty member at Duke Corporate Education, and volunteers as a board member of the Match4Action Foundation to accelerate social impact and director at the Foundation for Space Development South Africa, an exciting initiative of which is the Africa2Moon project. Since childhood, Adriana has dreamed of living on another planet, and is currently one of the 100 Mars One Project astronaut candidates in the running to move to the red planet in the next decade. She is grateful for the platform she has as a scientist, innovator and Mars One candidate to inspire school children, teenagers and adults around South Africa and globally to get excited about the future, believe in their dreams and remember Nelson Mandela’s words “It always seems impossible until it’s done”.

## CONFERENCE OPENING ADDRESS: THE ALLURE OF THE UNKNOWN – THE REASON I WANT TO GO TO MARS



We are living in an unprecedented era of information inundation. This could present a danger in that people may think that they have lost their agency and their capacity to play meaningful roles, that they are being swept away and being left behind. However, quite the opposite is true, as this presentation will hopefully highlight.

Where do we come from? For practical purposes, the elements and molecules needed for life on earth to exist were formed about 350 000 years ago. The building blocks of life - such as glycine – have been floating around in inter-stellar clouds. The SKA radio telescope is an innovation of which we should be very proud of as South Africans. This telescope will generate 160 terabytes of information per second once it starts operating optimally, which will stimulate a range of new knowledge and innovations. One of the aims of the SKA is to identify these building blocks for life and may find even more living building blocks or living organisms.

Much of the water on earth is older than the sun. Since liquid is the medium we need to facilitate the synthesis of life on earth, water is a critical element. All life on earth contains DNA, which is also a further critical step in linking life on earth and other life forms.

Humans have a proud history of exploring the surface of the earth. We have covered most of the habitable parts of the earth, and in the 1960's we left earth to explore the moon. We now also have a deep understanding of the surface of Mars, which has been expanded by sending technology such as the Curiosity rover to Mars in 2012. This rover has been sending information about Mars back to Earth which will inform the first mission to send humans to Mars in the 2020s. South African-born Elon Musk is working on developing the hardware and technology to launch a rocket to Mars, for which volunteers were invited to apply.

Musk's Falcon Heavy was successfully launched recently to start the journey and can carry the crew as well as the infrastructure that they will need to survive. The boosters that launched the rocket landed safely back on earth and will be repaired for further missions to outer space, which will also reduce the cost of future projects.

The first thing humans need is to generate sustainable power to heat the settlement, given that Mars is extremely cold at -60 degree Celsius. This will be done through solar power. Water is another critical resource, and which will be generated - along with oxygen – by harvesting ice-crystals which are tied up in the soil. On Mars the environment does not sustain plant life, which



will necessitate precision-farming in controlled environments and through focused agricultural processes.

A 3D printer will be taken along to manufacture equipment and whatever else is needed on Mars. Traditional mining is not a sustainable practice, and it is extremely dangerous and costly. We need to think of different ways to extract resources other than digging 2 kms into a planet made of rock; space resources are available in asteroid belts.

How was the universe formed? Nobody can answer that question – maybe God created the universe, or maybe it was created by the Big Bang. Perhaps we can decide for ourselves what we believe. As people working in universities, it will be important to think how one allows people to ask the big questions and think about their responses in answering the question whether we are alone in the universe.

The Mars One Project will take 100 astronaut candidates to Mars, which will include, among others, engineers, medics, and researchers who will hopefully contribute to our existing knowledge.

Who am I? What is the role that each of us are playing in the 4th industrial revolution? While not all of us will be shooting off to Mars, it is important for all of us to be thinking creatively how we will generate knowledge, ask questions, and think deeply about how we can maintain life on earth and be proudly human.

#### QUESTION AND ANSWER SESSION

**CUT:** Mars has two moons whereas Earth has only one – how will the rotation of these moons affect the measurement of a Martian year, and humans' ability to live on Mars. Also, how does the rotation of Mars around the Sun change the environment?

**Marais:** Mars has a day and night, following a cycle of 24 hours and 39 minutes. One Martian year is however equivalent to two Earth years, because it takes Mars longer to rotate around the Sun. Mars also tilts, so there will be seasons when it is warmer or cooler. Even though time on Earth and Mars seems similar, there is still plenty to think about because time is still an enigma on Earth. We are not yet sure how the two moons affect living conditions on Mars.

**NUST:** We always battle between cognition and emotions as human beings. Are you fearful to leave earth and never return?

**Marais:** No, I am more scared that I won't get to Mars and fulfil my destiny. I think humans need to continue exploring and asking questions – I am not fearful, because fear is simply a transitional process. It is important to use fear to become better, making it a useful emotion.

**CUT:** What happens if somebody should die on Mars?

**Marais:** Each person's religion would dictate how they view dying on Mars. I would insist on every single molecule of my body being reused, either for medical purposes or to grow food for future generations.

# **ANNEXURE 2**

## ANNEXURE 2



**Prof. Seeram Ramakrishna, Director of the Centre for Nanofibers & Nanotechnology, National University of Singapore**

Professor Seeram Ramakrishna, *FREng* is the Director of Center for Nanofibers and Nanotechnology at the National University of Singapore (NUS), which is ranked as number one university in Asia, and among the top 20 universities in the world. He pioneered nanotechnology and materials circular economy in Asia. He is a member of World Economic Forum (WEF) Committee on Future of Production-Sustainability. He chairs the Circular Economy taskforce. He is a Highly Cited Researcher in Materials Science (*Clarivate Analytics*). Thomson Reuters recognized among the World's Most Influential Scientific Minds. A European study placed him among the only 2,610 researchers with H index over 100 in the history of science and technology. (<http://www.webometrics.info/en/node/58>)

He authored over 1,000 international journal papers which received ~82,000 citations and 134 H-index. He received PhD from the University of Cambridge, UK; and The General Management Training from the Harvard University, USA. He received numerous recognitions which include CUT Honorary Engineering Doctorate; APA Distinguished Researcher Award, IFEEES President award- Global Visionary; GEDC Ambassador; ASEAN Outstanding Engineer Award; IES Prestigious Engineering Achievement Award; IITM Distinguished Alumni Award; NUS Outstanding Researcher Award; CPS Biomaterials Award; Cambridge Nehru Fellowship, and Singapore LKY Fellowship. He is an elected Fellow of UK Royal Academy of Engineering (*FREng*); Singapore Academy of Engineering; Indian National Academy of Engineering; and ASEAN Academy of Engineering & Technology. He is an elected Fellow of International Union of Societies of Biomaterials Science and Engineering (*FBSE*); Institution of Engineers Singapore; ISTE, India; Institution of Mechanical Engineers and Institute of Materials, Minerals & Mining, UK; and American Association of the Advancement of Science; ASM International; American Society for Mechanical Engineers; American Institute for Medical & Biological Engineering, USA. He is an editor of Elsevier Current Opinion in Biomedical Engineering.

He is an editorial board member of NATURE Scientific Reports. His leadership roles include University Vice-President (Research Strategy); Dean of Faculty of Engineering; Director of NUS Enterprise; Director of NUS Industry Liaison Office; Founding Director of N U S Bioengineering; Founding Co-Director of NUS Nanoscience & Nanotechnology Initiative, NUSNNI; and Founding Chairman of Solar Energy Research Institute of Singapore, SERIS. He founded a successful international organization- the Global Engineering Deans

Council, GEDC (<http://gedcouncil.org/ambassadors>). He advises universities, corporations and governments around the world.

## CONFERENCE KEYNOTE ADDRESS: THE CIRCULAR ECONOMY AND THE 4TH INDUSTRIAL REVOLUTION: THE ROLE OF UNIVERSITIES



The 4th industrial revolution and the circular economy are intertwined, which is an important concept for South Africa to consider.

The mega trends of today include rapid innovation, particularly in terms of technological advancements; nativism; trade wars; and the increasing influence of the 'me-generation'. Innovation and technological adoption will decide which countries will emerge in the league table of economic power in the long run. 20% of per capita GDP growth is driven by labour and capital, but 80% is driven by technological innovation.

The 4TH industrial revolution is a confluence of robots, automation, the Internet of Things, big data analysis, machine learning, artificial intelligence (AI), cloud computing, 3D printing and nanotechnology, with transformative effects for the production and marketing of products.

AI will not only mean intelligent automation and machine vision but will influence cognitive systems and deep learning. The idea behind 4th industrial revolution technologies is to make us more productive and effective. Currently we learn and use technology; in future, technology will learn about us, and help us to be more productive and responsive.

Some tech companies have market capitalisation of over \$1 trillion. The world's GDP is \$78 trillion, of which only 15 economies match this output. This gives a sense of how large technology is becoming as a world-wide influence. The success of China's industrialisation over the past 30 years followed a pattern comprising investigation of best-in-class models from other countries, experimentation in specific locations, and scaling up of those models. Considerable resources are being invested on research and development worldwide, and the US and China are leading the pack, and several sovereign wealth funds in China, Singapore, Norway, UAE and other countries are investing in the 4th industrial revolution.

Why do we need other planets like Mars? In the past 50 years, humans have consumed more resources, in materials, energy and water, than in the previous 30 000 years. Over the same period, humans have also generated more waste than in all previous history. Food consumption



has been growing steadily across the world. Earth Overshoot Day, which tracks the rate at which we must generate food for humanity, comes sooner every year.

It is problematic that people continually replace obsolete or broken technological appliances, rather than repairing their existing ones. This generates mountains of electronic waste. In 2016, humans produced close to 50 million tonnes of e-waste. The current linear economy model, which relies on the mining of natural resources to create items for use, which end up on landfills or are incinerated, is not sustainable. The world's primary supply of these resources is running out, and while there are initiatives to explore the earth under the sea for minerals and materials, this is also not a sustainable solution. International shipping is the 6th largest emitter of green-house gases in the world, which increases our carbon footprint. Air pollution has been found to cause a major reduction in intelligence. Although London's air often appears clear to the naked eye, the city has had illegal levels of air pollution since 2010. The practice of burning plastic waste also has unintended effects on people's health. Waste paper used to be shipped from all around the world to China, but this practice has been stopped after China imposed a ban on it. The same model was used for electronic waste, which has also been stopped. The game has been changed in this regard, and countries are now required to think about recycling their own waste.

Moving from a linear economy to a circular economy should see us repairing more and replacing less, so that we will generate less waste. The circular economy could also create around 65 million new jobs around the world by 2030, all focused on sustainable industries. The EU will also implement a policy limiting single-use plastics, and countries like Japan are exploring what is used as 'urban mining', generating metals from recycled electronic waste.

All these initiatives should be considered by South African higher education institutions, who should adopt principles from the 4th industrial revolution and the circular economy to respond to these societal questions and benefit our own people.

# **ANNEXURE 3**



### ANNEXURE 3:

#### **THEME 1: THE 4TH INDUSTRIAL REVOLUTION: INTERNATIONAL EXPERIENCE AND TRENDS- ROUNDTABLE DISCUSSION**



**Dr Joseph Ryan**

*CEO Technological Higher Education Association (THEA), Ireland*

Dr Joseph Ryan is the inaugural chief executive officer of the Technological Higher Education Association, being the advocacy and representative body for Ireland's 14 institutes of technology. He was previously vice president academic & registrar of Athlone Institute of Technology. He is a musician by formation and was the founding chairman of the Forum for Music in Ireland, an inclusive representative voice for music in the country. Dr Ryan also served as the chair of the Contemporary Music Centre, Ireland's national archive and resource centre for new music, supporting the work of composers throughout the Republic and Northern Ireland.

Joseph Ryan taught in St Paul's Secondary School in Greenhills, Dublin. He has also lectured in University College Dublin and the National University of Ireland at Maynooth. For some two decades he served as a commissioned officer in the Defence Forces Music Services where he held positions as executive office and senior conductor and director of the Army No.1 Band. He was also a member of the Westmeath Arts Forum and an architect of the inaugural county arts plan.

Dr Ryan is a former conductor of both the University College Dublin Chamber Choir and later the specialist ensemble, Gaudete Singers; he is also a sometime director of Cumann Náisiúnta na gCór, and has been conductor of the Donnybrook Parish Choir, and former director of the Palestrina Choir in Dublin's Pro Cathedral. His research publications reflect his principal interest in history and welfare of music in Ireland. He has adjudicated widely in choral, band, and general music competitions and has chaired the international adjudication panels for both the St Patrick's Festival in Dublin and the Limerick International Band Festival. He is currently Director of Music for the annual Dublin Festival that centres on the popular St Patrick's Day Parade.

He has worked with committed colleagues to champion learning and teaching sectorally. He has chaired various committees for Quality and Qualifications Ireland and for the legacy body, the HETAC. He has contributed to and chaired the Council of Registrars for the Institutes of Technology Ireland. Dr Ryan is chair of EduCampus which provides IT shared services to the Higher Education Sector and is deputy chair of the board of the National Forum for the Enhancement of Teaching and Learning.



**Prof. Ronald Quincy**

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

**Professor Ronald Quincy** earned his Ph.D. from the College of Social Sciences at Michigan State University. He served as a member of the Governor of Michigan's Cabinet, Director of the Michigan Department of Civil Rights, and Director of the Michigan State Office of Human Resources Policy and Special Projects. His other previous positions include the following: Associate Vice President, Assistant to the President, of Harvard University; Chief Operating Officer of the Martin Luther King, Jr. Center for Nonviolent Social Change; Executive Director/President of the Congressional Black Caucus Foundation, Inc.; President of the White House Fellows Association and Chairman, White House Fellows Foundation; Senior Management Consultant, Towers Perrin (the world's 11th largest management consulting firm); and Foreign Policy Advisor, U.S. State Department, Africa Bureau. Dr. Quincy is the Director of Centre for Non-profit Management and Governance, and his research interests include non-profit, nongovernmental, and civil society leadership development, diversity, mentorships, succession planning, and executive coaching, non-profit organizational accountability and performance.



**Mr Imraan Patel**

*Acting Director-General, Department of Science and Technology*

A public policy and strategy manager with a focus on innovation, inclusive development, sustainability, social and economic development, and public management and governance.

Employed since 2006 at the Department of Science and Technology, he is currently a Deputy Director-General and represents the department on the social and economic clusters of government. He is a current member of the board of the Water Research Commission, Trade and Industrial Policy Strategies (TIPS) and a past board member of MINTEK and SASSCAL.

Prior to joining the DST, he worked at the Centre for Public Service Innovation, an agency of government supporting innovation in the delivery of public services and the Department of Public Service and Administration. He began his working life with a five-year stint at the Workplace Information Group (WIG), a non-governmental organisation supporting trade union followed by three years during the formative years of the National Labour and Economic Development Institute (NALEDI), a think tank to COSATU.

At DST, he is responsible for strategically driving a portfolio of investments and policies that advance the social and economic development priorities of government through science and technology-based interventions. Particular areas of focus include science and technology for sustainable development, R&D-led industrial development, environmental technologies, and the Next Industrial Revolution.



**Prof. Henk de Jager**

*Vice-Chancellor, Central University of Technology (CUT), Free State*

Prof. Henk de Jager was inaugurated as Vice-Chancellor and Principal of CUT on 30 June 2017. He has almost 3 decades of experience in Higher Education, South Africa; of which 12 years as Executive Dean in the field of Engineering and Technology. He held the position as Deputy Vice-Chancellor: Academic and Research at the Central University of Technology effective from 1 July 2012 until 31 December 2015. The position was re-envisioned to become the Deputy Vice-Chancellor: Research, Innovation and Engagement his official portfolio. He holds an MDipTech in Electrical Engineering; BA (Industrial Psychology); PGDip (Tertiary Education); and a DTech (Education Management). Furthermore, he is a member of several professional bodies, and is registered as Professional Engineering Technologist with the Engineering Council of South Africa. Over the past 15 years, he was involved in various quality assurance audits for the Certification Council of Technikon, the Engineering Council of South Africa, the Higher Education Quality Committee (HEQC) of South Africa and the Quality Assurance Authority for Education and Training of the Kingdom of Bahrain. He has supervised at post-graduate level and holds several publications in proceedings and scientific journals. His research interest is focussed on quality assurance, engineering education and strategic management in Higher Education. He is married to Miemsie and they have two children, Melandie and Henko.



**Prof. Seeram Ramakrishna**

*Director of the Centre for Nanofibers & Nanotechnology, National University of Singapore*

Professor Seeram Ramakrishna, *FREng* is the Director of Center for Nanofibers and Nanotechnology at the National University of Singapore (NUS), which is ranked as number one university in Asia, and among the top 20 universities in the world. He pioneered nanotechnology and materials circular economy in Asia. He is a member of World Economic Forum (WEF) Committee on Future of Production-Sustainability. He chairs the Circular Economy taskforce. He is a Highly Cited Researcher in Materials Science (*Clarivate Analytics*). Thomson Reuters recognized among the World's Most Influential Scientific Minds. A European study placed him among the only 2,610 researchers with H index over 100 in the history of science and technology. (<http://www.webometrics.info/en/node/58>)

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## ROUND TABLE DISCUSSION: HOW DO WE PREPARE FOR THE 4TH INDUSTRIAL REVOLUTION



**Patel:** Humanity must adopt both a philosophical and a practical approach to technological change. The philosophical approach would require us to think about technologically-enabled, human-centric and sustainable solutions, which should be the watchwords for all change.

Technologically-enabled change will also require us to think differently about business models. Many people mention Uber and other disruptive business models as solutions, but one should also consider how sustainable they are. These solutions must also be human-centric and must not perpetuate inequalities and unfair business practices. We must think of workers owning factories and doing less work, which links to welfare policy and how we distribute the fruits of what we produce. We must also think about environmental issues and optimising the use of our natural resources. Estimations have been done that cars are one of the most resource-inefficient technological solutions that we have ever developed.

**Ryan:** The themes that have been emerging thus far focused on the sustainability of our current models; how we ensure jobs in a fast-changing future scenario; and what the most reasonable response of academia to these issues should be. In Ireland we have been thinking about changing our strategies and responses. We must also think about how the UN Sustainable Development Goals (SDGs) can be built into our responses. Ireland is also grappling with the future of education, and how universities should respond to the need to develop flexible, responsive people for technological change, without losing sight of the human aspect.

**De Jager:** We should consider the role of the human being in our responses to the 4th industrial revolution and the circular economy, as well as how our responses address inequalities in our society. A revolution is defined as an overthrow or a regime change of an existing system, which relies on protest. Perhaps we should view the process as evolutionary rather than revolutionary. We must also ensure that the role of the human being in this process will ensure advancement, growth and progression. In the current technological era, we are so concerned with our individual issues, which is enabled by technology. We should rather consider how we could move away from 'me' to 'we'. In South Africa particularly, those would be important considerations to improve our own situation, and that of broader mankind.



**Quincy:** In our institution, we have problems with ethics, equity and inclusion, particularly of women and under-represented minorities. We view the 4th industrial revolution as an economic, national and political issue. In the US science has been politicised, and the contributions of women and people of colour have been negated. I asked Buzz Aldrin what he thought about when he walked on the moon for the first time, and he said that he thought of the 10 000 people who worked for years to put two men on the moon. We must think of the ethics and inclusivity of the 4th industrial revolution going forward.

**Manilal:** How will we guard against consumerism overtaking all these other points that have been raised?

**Ramakrishna:** When one talks to individuals in Asia, they will claim that they are entitled to better lifestyles, which translates to more conveniences and comforts and makes it unlikely that they will buy into the concepts of sustainability and ethical consumption. We must therefore think how people can be encouraged to embrace 4th industrial revolution technologies to equalise our society. The gap between the super-rich and other people is widening, and the key for universities would be to retool our education systems so that all these fundamentals underpinning 4th IR technologies are aligned to the UN Sustainable Development Goals to provide food, transport, energy, quality air and water for all.

**Manilal:** What is the role of developing countries in developing and embracing new technologies? Should they brace for impact?

**Quincy:** We need to be as inclusive as possible, educating the general population about the benefits of the 4th Industrial Revolution and the spin-offs and impacts from these technological advances that could benefit them. We must build safer cars, generate solar energy, think about how we process food, etc. and be sure that our general population understand these benefits.

On the issue of inequality, we have seen that productivity and profits rise because of technological innovation, but wages for those involved in production are declining while executive remuneration keeps rising. That is why I work in ethics and technological development.

**Manilal:** Is there policy convergence between different government departments in South Africa that will help us generate a harmonious response to the 4th Industrial Revolution?

**Patel:** South Africa is not unique in trying to make sense of 4th Industrial Revolution. There is an acknowledgement that we need a coherent national response, and the President is currently spearheading a process to draft such a process. It is important to think what our orientation to the 4th Industrial Revolution will be, and whether it is only an economic development or also a social development. We think that a more holistic response is required. Because the concept of production should also include the circular economy, we must clarify what this means for education, transport, health and other policies. While the thinking is emerging, it is not something that government alone should drive – we want business and other stakeholders to participate in the process.

**Manilal:** How is the higher education system calibrated to take full advantage of 4th Industrial Revolution in Ireland?



**Ryan:** As a small country we are agile, but conversely, we are also held back by this lack of scale. We need to have both a national conversation as well as an international conversation. It is important to remember that we share DNA as we heard earlier today. We live in an increasingly individualised and materialistic world, and the key to understanding that all things are inter-linked is dependent on good education. Dr Padayachee talked to me about our recycling regime in Ireland, which is very simple but has become part of our holistic culture. The Dublin University, for example, will comprise older and brand-new buildings, all of which are completely green – the only cars on the campus are service cars which do not use fossil fuels. We are grappling with these issues, thinking about policy coherence at all levels, including aspects such as social cohesion and a valuable student experience, among others.

**Manilal:** How is CUT responding to the time pressure, given that universities are not agile structures?

**De Jager:** We must collectively challenge the status quo. CUT has partnered with other parties such as SATN and DST to develop the CUT Innovation Eco-system, thinking how we take students coming from the school system through their study career. By emphasising the value of STEM subjects at school, we stimulate awareness of the opportunities that will arise from the 4th Industrial Revolution to incubate new ideas, which could be commercialised. The Dean of Teaching and Learning or the HoD cannot stick to old ways of teaching, and the same applies to research – we must address the challenge of remaining relevant and at the forefront. The higher education sector must partner with policy makers and other critical agencies to develop innovative solutions, but also to strengthen those aspects that work well.

**Manilal:** What would the dark side of the 4th Industrial Revolution be?

**Quincy:** I think that there is a rise in store. That confluence between the need to save our planet and ourselves against the economic client is important. At our university we restructured the research enterprise, calling it Research and Economic Development, focusing on commercialising our research from the outset. If I get a grant to develop some technological innovation, I must also generate some economic output through patents.

**Manilal:** How do I sell that to a person living in a rural area on \$1 a day?

**Quincy:** That is why we need to popularise science, and why we need to combine science and social science. We have programmes from cradle to PhD, and the first cohort of the children that went through the STEM programme started enrolling in PhD programmes a couple of years ago in top research universities in our country. We must make science available to learners in the most remote parts of the world, which technology can do, if we have funding available to do so.

**Manilal:** What percentage of the US population have no concept of 4th Industrial Revolution?

**Quincy:** I would say about 90% have no concept of 4th Industrial Revolution. But people are talking about the new iPhone, and we need to use that phone to get them to connect with this concept.

**Manilal:** Could you describe the teenager we will see 20 years from now?



**Ramakrishna:** How many of you experience loneliness? Please raise your hands? A good proportion. If one asked this question in high-income countries, one in three people would answer in the affirmative. Most people feel lonely. If you want me to describe the next generation, I have to say that the social structure has changed completely. Mother and father are very busy earning money because the cost of living has increased; students have phones and technology which gives them access to people on social platforms, but they are technically lonely. The previous Chief Medical Officer of the US declared loneliness an epidemic in the US. The concept of virtual friends is false. This brings us to the question what a human being in the 21st century will be like, and how their needs must be addressed. We must continue asking questions about what it means to be human in the 21st century, and how we must approach our relationships. The biological revolution on planet earth is not well understood. We still don't understand how well our minds work. That is why our virtual friends will not meet our emotional needs. If you look at words that describe how our minds work, you will see that we still do not understand properly how they function. There is a lot that needs to be done to use technology to understand these issues. In countries like China, as youngsters migrate to cities, there are increasingly lonely families. The important thing is how we can be truly human beings in the 21st century.

**Manilal:** How is Ireland's people coping with the angst that the 4th Industrial Revolution will present in terms of possible job losses?

**Ryan:** There must be a very delicate balance. The Irish are very gregarious and social. We accept that the technological sector must serve our economy, but we do not only see people as conscripts. We are looking at engagement in much different ways, considering lifelong learning as a critical response to our developmental needs. We are also looking at other pedagogical approaches in teaching students who study online, by trying to give them an affirming student experience. We are taking an optimistic outlook but also realise that there are problems and limitations.

## QUESTION AND ANSWER SESSION

**CPUT:** Are there elements of Society 5.0 that we could adapt in South Africa?

**Quincy:** Transformational change needs transformational leaders, who are willing to set aside their petty skirmishes and look at the big vision, and who can articulate that vision in a way that the common worker or school child can understand and participate in. We need to understand that we might not go to the Moon or Mars ourselves, but that we could contribute to putting people there. The first African American woman in space inspired a generation of girls and boys to study in science and technology. We need a more inclusive approach if we hope to counter a rising sense of disenchantment with the way that the economy develops.

**Manilal:** Do you have the ethical leadership to protect against the possible nefarious effects of the 4th Industrial Revolution?

**Quincy:** Yes, we have national leaders who have the presence and ethics to ensure that we remain focused, but the cyclical leadership structure mitigates against this.

**??:** *The history of humanity has shown that every time there is a revolution, jobs may be lost, but people also develop new skills. Humans are reactive. Is it possible to be proactive for once and figure out what skills will be required, so that we can prepare ourselves?*



**Manila:** Is the policy environment reacting, or being proactive?

**Patel:** I think it is difficult to be aware of all the changes that we must make. There are so many perspectives to be considered. Human beings are adaptable, but we need to think about the nature in which we adapt – we need to construct the debate about how we adapt, and must focus on the value. We should ask questions about whether Facebook should hold our data and generate profit from it. We must reconsider the value that we generate from the work that people do, so that they do not spend 80% of their time working to generate only 20% of value. We must think of how our policies optimise the labour of our people and the time that they spend working. We need to steer a local and global pathway that will optimise value for the whole of humanity.

**NRF:** There has been a strong emphasis on humanity versus the coldness of technology. We know that the world is at war with itself, and that we produce weapons of mass destruction. Looking at the future, how can we avert war among people?

**Quincy:** We have the world's largest supply of weapons of mass destruction and I regret that we are the only nation in the history of the world that has used those weapons. Thinking how new technology can be weaponised is a serious issue. Our President indicated that he wants to create a Department of Space Defence, which I think will take us back to where we were at the close of WWII. I think there is huge resentment in the US against this drive, and that there is a growing call to dismantle our nuclear weapons. We must lead the world in dismantling those weapons.

**CPUT:** I am interested in the fact that we name these revolutions in hindsight. We are discussing what we think will come, but we might already be over the goal.

**Ramakrishna:** Human beings are not good at predicting the future. It is also natural for us to ask 'what next' and understand that we can only predict 10 to 15 years ahead. The 4th Industrial Revolution has been adopted worldwide as the next big thing, but it must link to the principles of the circular economy to respond to other basic physical needs of a growing population such as food security, water, global warming, and other elements. We must embrace the UN SDGs linked to the circular economy concepts.

**Ryan:** In Ireland we developed an overarching plan to ensure that the role of universities is linked to a national strategy, which in turn links to the European strategy. We need a policy framework as far as possible.

**NUST:** Do we run the risk that IA will retard our cognitive ability over time?

**Ramakrishna:** The answer is not simply yes or no. We have seen devices being developed that could enhance memory retention for people who may suffer memory loss, but it could in time mean that we might lose the ability to memorise things for ourselves. There is the possibility that we could lose a range of uniquely human functionalities if we relied too much on technological interventions. There has been research which showed that by stimulating parts of the brain a naturally pessimistic person could be made more optimistic, or to stimulate more confidence in people who are not naturally confident. The 4th Industrial Revolution could influence how we as human beings think about ourselves. This would require ongoing and systematic research to identify the beneficial and harmful effects, so we could mitigate them. There is a role for the Social and Health Sciences in this regard.



**Manilal:** How should we prepare for 4th Industrial Revolution?

**Patel:** DST has just released a draft White Paper on the 4th Industrial Revolution, and I encourage all to read it and respond.



**Ryan:** Policy coherence and equipping our academics and educators to be as flexible as they can be.

**Ramakrishna:** Do not resist, but embrace, and make the most of it, but keep an eye on it so it will benefit human beings.



**De Jager:** Do not see the 4th Industrial Revolution as a threat but see it as an opportunity. We as human beings should embrace pockets of proactive excellence.

**Quincy:** Consider collaborations and inclusive partnerships and consider stimulating new funding partnerships as well.



# **ANNEXURE 4**



## ANNEXURE 4

### **THEME 2: THE 4TH INDUSTRIAL REVOLUTION: IMPLICATIONS FOR HIGHER EDUCATION**



**Prof. Thomas Thurner**

*Research Chair in Innovation and Society, Cape Peninsula University of Technology (CPUT) and Professor at the National Research University Higher School of Economics in Moscow, Russia*

Thomas Wolfgang Thurner studied Economics, History and Energy Engineering. Thomas is Research Chair for Innovation in Society at the Cape Peninsula University of Technology (CPUT) for the faculties of Informatics and Design and Health and Wellness Sciences and is Professor at the Higher School of Economics in Moscow, Russian Federation. From 2008 to 2011, Thomas worked as Associate Professor at the University of Cape Town.

His research work thematizes innovation processes and technological upgrading in emerging markets. He analyses weaknesses in the national innovation systems and studies private and public initiatives to help overcome these difficulties. Hence, he has a specific interest in user innovation. Especially for Africa, Thomas advocates a strong focus on the usage of technology and its diffusion. Thomas also engages in technological development and works with his team at CPUT on technological solutions to mobility and medical challenges. He also works on Artificial Intelligence solutions in Education.

Thomas published his work in leading international journals like Entrepreneurship and Regional Development, Technological Forecasting and Social Change or the International Journal of Innovation Management. He also serves on the editorial board of a number of international journals and is a member of various steering committees like the “Digital Dome” at the Planetarium of the IZIKO in Cape Town.

## SESSION THEME ADDRESS: FROM INNOVATION STUDIES TO INDUSTRY 4.0: UNIVERSITIES OF TECHNOLOGY AS CHANGE AGENTS



This presentation incorporates some data that was analysed in Russia in drafting policy that would stimulate Industry 4.0. Technological development as a serious force to be reckoned with, with the caveat that society should still determine how it will be used, and which technologies will be beneficial for the greater good of all.

There are two technologies that are very interesting. Carlsberg introduced a beer bottle made of cardboard yesterday. They promised that the quality of the beer would not be diminished, while the process is far more sustainable than selling the beer in glass or tin. Another fantastic development is Volvo's first autonomous car, which has been designed to compete against long-distance air traffic, providing an individual first-class travel pod on the road. The point is that both these developments, ground-breaking as they are, originated in a university. They both followed the principle of open innovation, based on the notion of collaboration between innovators and other partners along the innovation pipeline, based on what people need. Three of the most innovative societies, the US, China and Germany, passed policies that will stimulate innovation as a collaborative activity. The idea behind this is that all collaborators have areas of strength and contribute unique inputs that will benefit the end result. It is however necessary to be smart about how these partnerships and collaborations are approached – the process works best when energy and resources come together.

UoTs must act as knowledge providers, knowledge multipliers, and as drivers of the educational agenda. Such a complex system will need reliable, quantifiable information. Most information about knowledge providers and innovation activities refer to the triple helix mode of innovation, and the importance of state intervention to develop new industries and technologies. However, there is a dearth of innovation success stories in developing markets. This year, a study was done in Russia on more than 6 000 innovative companies, which identified that most of these involved advanced technological processes. Doing such studies helps to identify the direction that technological advances is taking, which is relevant for policy makers. This capability is under-developed at South African UoTs.

Using available knowledge and bringing right actors together, UoTs could use technology platforms to act as knowledge multipliers and exchange ideas. An analysis of ICT maturity and triple bottom line benefits has shown that South Africa has rather under-developed infrastructure, but that usage of this kind of information is quite high. This is an area of strength in which UoTs could play an important role.



A study into the way that technology was used to drive organisational change in a Russian company identified that people had an inherent sense of fear towards new technology. UoTs could play a role in improving the way that people view and understand new, innovative technology. A lot of companies may need support in this regard, where UoTs could be valuable partners.

As drivers of education, UoTs should guard against confusing skills-oriented training and holistic education. There is a need for a broad range of educational offerings; UoTs could for example identify those online educational offerings that will benefit people in the long run and increase their quality of life. The understanding of which technology really enriches our lives is vital. The main point is that there must be a careful balance between intrinsic versus extrinsic motivation, which students must understand to contribute to the greater good of society.

# **ANNEXURE 5**



## ANNEXURE 5

### **THEME 2: THE 4TH INDUSTRIAL REVOLUTION: IMPLICATIONS FOR HIGHER EDUCATION**



**Prof. Narend Baijnath**

*CEO, Council for Higher Education (CHE)*

Narend Baijnath is CEO of the Council on Higher Education since October 2015. Before joining the CHE, he was Pro Vice Chancellor of the University of South Africa. Prior to that he occupied the positions of VP: Strategy, Planning and Partnerships and VP: Research and Planning at the same institution. As PVC at UNISA he drove the digitisation and OER strategies of the university.

Prof Narend holds a Masters Degree from Durham University, and a Doctorate from the University of the Western Cape. He taught at the universities of Cape Town and Western Cape and was Director Academic Planning at UWC before joining Technikon SA in 1998 as Dean of Community Sciences. After serving his term in the latter capacity, he was promoted to Deputy Vice Chancellor: Planning and Development.

In July 2012 he was nominated the South African representative on the Commonwealth of Learning board by the Minister of Higher Education and Training. He has served on the CoL EXCO and is currently Audit Committee chairperson. He is a member of the Academy of Science of South Africa. In 2008 he was appointed a Fellow at St Edmunds College, Cambridge University and simultaneously a research professor at OUUK. He currently serves on the boards of SAQA, Umalusi and QCTO in an ex officio capacity. In 2014 he was elected Honorary Vice President of the National Council for Persons with Physical Disabilities of South Africa.

He is currently a member of the Advisory board of the EU-AU sponsored Harmonisation of African Quality Assurance and Accreditation initiative, and a member of the Hagen University sponsored Universities Futures Project, aside from the advisory board of the Unbundled University project.



**Dr Gansen Pillay**

*Deputy Chief Executive Officer, RISA, National Research Foundation (NRF)*

Dr Gansen Pillay is the DCEO responsible for leading the Research and Innovation Support and Advancement division of the NRF. His career includes academic, management and full professoriate positions in SA. He was a Visiting Research Professor at Cornell University, USA; the RMIT in Australia; Goethe Universitat, Germany; and the SCRI in Scotland. He obtained a post-M.Sc. qualification in Biophysics at the Weizmann Institute for Science in Rehovot, Israel, and a PhD degree in Microbiology from UD-W. He completed the International Executive Development Programme (WITS University; London School of Business; Indian Institute of Management); and the “Senior Executive Leadership Programme” through Harvard Business School, Harvard University, USA and is a Harvard alumnus. Dr Pillay served/serves on (i) the Selection Committee for the Future Earth Engagement Committee; (ii) the International Steering Committee of the Global Research Council (GRC); (iii) the Steering Committee of the Belmont Forum; and (iv) the Council of the International Institute for Applied Systems Analysis (IIASA) in Austria where he is the Vice Chair.



**Dr Diane Parker**

*Deputy Director-General, University Education, Department of Higher Education and Training (DHET)*

Dr Diane Parker is Deputy Director General: University Education in the Department of Higher Education and Training, South Africa. Before the joining the Department she spent 18 years as a teacher educator and academic in the fields of sociology of education and mathematics education. She served on the Board of the Health Professionals Council of South Africa, the Higher Education Quality Committee, and the Council on Higher Education. She is responsible for overseeing policy development and implementation to regulate and support the South African Higher Education System, including universities, private higher education institutions, the Council on Higher Education, National Institutes of Higher Education and the National Student Financial Aid Scheme (NSFAS).

## RESPONSE TO SESSION THEME ADDRESS: FROM INNOVATION STUDIES TO INDUSTRY 4.0: UNIVERSITIES OF TECHNOLOGY AS CHANGE AGENTS



Prof. Baijnath shared the following thoughts on the challenges and promises presented by the 4th Industrial Revolution.

In thinking about how the 4th Industrial Revolution can be harnessed for greater good, one must consider the 3rd Industrial Revolution, which harnessed electronics and information technology to automate production. Not too long ago, when somebody did a Master's degree, they relied on an industry of support people who typed up their thesis for them. Very rapidly, as technology developed, people acquired computers. In time, the capacity of these devices grew incrementally to what we have nowadays. We now take it for granted that technological advances have made unanticipated technological capacity available at our finger tips.

The problem is that this kind of technology is not freely available to all in South Africa. The affordability of devices with this kind of computing power is still a challenge for many students, and the cost of bandwidth remains prohibitive. The cost of a gigabyte of data has greatly reduced over the years, which has greatly assisted students. Of course, some students also resisted adopting technological change over the years. This will continue to be a challenge until government policy and our corporate citizens make technology available and accessible to all university students.

We must also think about how higher education models should change to support the 4th Industrial Revolution, and how the workplace is structured. Both these elements inform the aspirations of young people entering the world of work. The current antiquated model of work provision, which assumes that somebody else will create the jobs, must change. This is far from the truth and does not resonate with the principles of the 4th Industrial Revolution. To generate greater productivity and output in the workplace, we need to rethink how technology is used.

Considering that the 4th Industrial Revolution may see some job losses, the skills and attributes that our graduates will need must also change. UoTs must anticipate and respond to this imperative. As a developing nation, South Africa should clarify whether it should be at the leading edge of the 4th Industrial Revolution, given the challenges that the country must resolve. The contestations and needs in our society and in our universities, based on our inherited history, may not support the kind of responses that we need locally. We need to ask what prohibitive factors are preventing visionaries from implementing positive change locally.



UoTs should produce good quality graduates with high-level capabilities that they can use to the greater good locally, working in society and the business world. They need both computer and computational literacy; they must be able to use technology for greater effectiveness, efficiency and productivity. These should inform the public service and help create a better equipped citizenry, but also require people to have the acumen to identify developmental opportunities. Universities should understand how these issues must inform curriculum reform, and how they will influence the kind of graduates that UoTs produce.

**Pillay:** The role of higher education institutions in responding to the 4th Industrial Revolution must be contextualised. In mapping the research agenda for South Africa for the next 30 years, and keeping the imperatives of the 4th Industrial Revolution in mind, it will be important to consider global trends, the continental agenda, the NDP, and national priorities where we invest our resources.

All these future plans must be informed by the resources available to us. The DST's Draft White Paper deals with South Africa's response to the 4th Industrial Revolution. We must also consider that research requires an investment in people, a number of research facilities and platforms, and how the knowledge generated by these projects can be used to garner further support from other parts of the world. Huge amounts of data could be coming into the country, but we will need the capacity to analyse and synthesise that data to generate wisdom for the future.

**Parker:** the DHET's role is to support and develop universities and the higher education sector to do their work. Although poverty has decreased in SA, inequality has increased, and this divide is something that universities must address by harnessing new technological innovations and using them to increase effectiveness and efficiency. If we do not use our knowledge to make fundamental changes in society and the way we live in the world, universities will have failed society.

Another thing to consider is the role women must play in driving change. We must consider how these divides, which are so engrained in our societies, can be changed. We must also think how we can encourage the youth to participate in changing our universities and businesses for the better. Universities are slow to adapt to change, and we must think about their roles in society. They must produce knowledge, and be innovative, but this is not their only role - they must educate the youth, reproduce knowledge and create access to real knowledge that will make a difference in the lives of people from divided societies. We emphasise that it is important to make rapid changes without fear, to generate a more entrepreneurial mindset and harness the opportunities created by the 4th Industrial Revolution. UoTs must rethink how they teach, and what they teach, to make the most of these rapid changes in technology.

Universities must also support young people from diverse backgrounds to use technology to help them succeed academically. Universities can use technology to improve their own operations, using data analytics for student support and to stimulate interest in new knowledge areas.

Universities must also structure themselves to be more responsive to society and the world, from an administrative and human perspective. The issue of curriculum renewal, and the development of academics with the necessary capabilities to respond to young people who may need new approaches to teaching, must also be considered.



## Question and answer session

**SATN:** How do universities ensure that staff members continuously update their knowledge and improve their teaching practice?

**Parker:** That is quite difficult. The DHET has several programmes to support staff development, through the University Capacity Development Programme (UCDP) and the New Generation Academics Programme (NGAP). The DHET also supports collaborative programmes for staff development and to develop capabilities in new technologies. The issues of curriculum change and responsiveness are also critical. For universities to continue dealing in new ideas and knowledge, we need to attract young, vibrant people to enter academia rather than going into the corporate world.

**Pillay:** Research is the only job in the world where you get to play to your heart's content and get paid for it. If that is not enough of an impetus, one must also remember that good teaching requires continued research and community engagement. The triple helix has now moved to the quadruple helix, which requires a range of partners, including government, business and civil society, to invest in research. We must also lobby for at least 1.5% of GDP to fund research. Researchers are highly motivated, and they should be supported to do their work.

**Baijnath:** Every university should think how it will approach systematic change, which should start with the objectives to be pursued and how the university can create an enabling environment. This should be followed by curriculum change and staff development. If one of these elements should be lacking, the efforts would be diluted, and chances of success would be diminished.

**Turner:** It is true that South Africa is investing too little in R&D, which is a shortcoming on the part of both government and business. Well-trained researchers have few opportunities to work outside of universities, which also limits their scope to some extent. If they should be keen to pursue a career in research, they must leave the country. This could change if UoTs were to increase their career prospects – people should be encouraged to work in industry and then return to universities, to do shared research projects, to share new skills across universities and the business world. I think it is possible to be a good teacher without research, depending on your area of study. Teachers should be stimulated to consider knowledge production from an intrinsic and extrinsic point of view.

**VUT:** Could South Africa and developing countries contribute to the 4th Industrial Revolution, and should government support these initiatives?

**Baijnath:** The problem is that our resources for higher education are finite, while the demands continue to increase. The biggest challenge in our society is inequality – addressing inequality should be a priority, which is a political choice. Whether we will then be able to compete with the greatest universities in the world is questionable, given their scale and the funding that they have available. South Africa has greater priorities, so we should perhaps focus on extending quality services to our people, rather than devoting attention to responding to the 4th Industrial Revolution at this stage. In the area around the VUT, there is a problem with effluent flowing into the Vaal River, which should probably be addressed first. You also have a lack of basic amenities



in the Vaal Triangle, which VUT should probably first respond to before spending money on projects linked to the 4th Industrial Revolution.

**Pillay:** The confusion that arose between the mandates of UoTs and universities is probably one of the saddest things we have witnessed in the past few decades. The NRF views fundamental and applied research as a continuum. When we talk about being an effective teacher and a competent researcher, it is based on the belief that one must engage in scholarly activities to be an effective teacher. Developing countries and emerging economies are huge laboratories for the rest of the world to do research in. We have a youthful population, which is an advantage, but only if that group is well educated, otherwise they will become a drain to society. We must focus on education in the fundamental disciplines, which could translate into policy change.

**Parker:** We might not agree on all these things. It is my view that all teachers must be scholars and must explore different ideas, although they do not have to be engaged in fulltime research. Any academic in our universities should however also be involved in teaching – if they want to be researchers only, they should probably go to work in research councils or business. The core business of a university should also be informed by innovation. We do not have to think about these things in a narrow way – we invest in our youth by providing them with a quality education that will graduate them to enter the world of work. We must use technology to improve the way we do things, to benefit society and to address environmental issues. We probably have to think of other ways to use resources like water, for example. We must use our challenges and opportunities better.

**Tshwane North College:** If one looks at the automotive engineering industry, could we not develop the skills in South Africa to produce our own car?

**VUT:** Industrialisation in Europe was stimulated by particular movements, such as the Bauhaus, where industry and universities collaborated closely. Is that something that we could duplicate here.

**TUT:** The problem is that we use archaic curriculum development and approval processes in South Africa, which means that universities are unable to respond quickly to societal needs. We are making a big fuss of the 4th Industrial Revolution, but our policy environment does not reduce bureaucracy. We should also focus on the graduate attributes of our students.

**Turner:** This question is asked quite often. South Africa could probably build its own car, but it will not make economic sense to re-invent the wheel. Building a system like that from scratch would not make business sense. South Africa should rather focus on other areas where they can optimise their own competitive advantages. The way that cars will operate in future will probably change – it will be less about hardware but software in future, and ownership will also change.

In terms of the role of design in UoTs, we have strong industrial design schools and creative students, which should be put to good use. 3D printers are becoming cheaper, and if the earlier industrial revolutions are anything to go by, it is the creativity and ideas of people that make technology much more powerful. South Africa can really grow in this area.



**Baijnath:** The answer is that we can probably produce items such as our own uniquely South African car, but we might not have the enabling environments to do so. Nokia is a case in point, where a once dominant technology started to wane. Korea decided that they will enter and dominate the market, from a context that was probably quite like ours. When they started producing Samsung telephones, they literally started from scratch. People talk about the virtuous cycle, in which government created an enabling policy environment which allowed them to do business internationally. The private sector was also capacitated to participate, and the universities were encouraged to invest in new knowledge. Of course, Korea also had people willing to make the investment in their own personal development. In South Africa we might not produce enough people with the relevant skills.

We have a highly bureaucratized system, which probably has too much regulation, but this is also necessary to protect the public from unscrupulous providers. It is time to reflect on how we can change the system to be less repressive. If the regime is slowing us down and preventing institutions from being agile, we must change it.

**Parker:** Relating to how bureaucracy prevents the approval of new curricula, we need to harness technology to streamline our processes and shorten the cycle without sacrificing quality. Universities must be more responsive and must be supported by the system to do so. We cannot have curricula that do not respond to our critical needs. South Africa could probably develop our own car, but the question is whether this would be an appropriate focus. We know that even if with little investment in research, we still manage to punch above our weight. We do produce cars in South African factories, using South African labour, although they might have been developed in other countries.

**Pillay:** The CSIR did produce a prototype car, but it was never commercialised. We should reduce complexity throughout the system – if the rule is stupid, we must kill it to enable people. It is also true that as a country we punch above our weight given the little investment that we make in research. The DST's entire budget is the same as that of Wits University, indicating that we need stronger political will to support research.

What are the things that we should stop doing? We must understand that as a developing country, our funding should support projects that will be for the greater good - our work must be relevant. If you look at the average age of people who have made great discoveries throughout history, they were all around the age of 25. We must trust the younger generation and invest in them. The NRF is developing an intervention that will fast track 50 to 100 bright youngsters to become leading international scholars, with the aim to transform our workforce. This project is still under discussion.

**CUT:** The skills that we need to impart must be relevant for the 4th Industrial Revolution, but we must also ensure that our students are given adequate time to be socialised in the university to gain knowledge.

**Pillay:** It is important to remember that are two candidates for the Mars 100 from South Africa. We must also remember some of the innovations that South Africans have produced over the years, including oil from coal, CAT scans, Pratley Putty, open heart surgery, the Kreepy Krawly, etc.



**Parker:** It is important to think how we should change pedagogies to teach differently. Teaching basic mathematical principles could probably be done through technology. In the US they have improved student success by using technology to teach large groups online. Academics were not happy at first, but it also freed them up to do more scholarly work. We must use technology interactively to change our pedagogies.

**Baijnath:** We must think about what is realistic at individual, institutional and systemic level to respond to the 4th Industrial Revolution. We need to guard against the hype and consider what we can harness to be responsive and relevant. Universities must equip our graduates with the skills and competencies to help them realise their full potential.

**Thurner:** University teachers must identify how they can change their teaching practice to meet students' needs, but they must also consider the needs of the labour market. The drive towards the 4th Industrial Revolution will also require us to consider the humanitarian needs.

# **ANNEXURE 6**



## ANNEXURE 6

### PARALLEL PAPER SESSIONS: PRESENTERS BIO AND PAPER ABSTRACT

VENUE: SUITE 1



**Prof R Pellissier**

*Director Strategic Initiatives and Partnerships, Cape Peninsula University of Technology*

René describes herself as an informationologist and a futurist/strategist. She holds a PhD (Systems Engineering), MBA, and MSc (Mathematical Statistics). Her experience includes being Director, Strategic Initiatives and Partnerships in the office of the DVC, RTI, Cape Peninsula University of Technology, Visiting Professor in Mechanical and Industrial Engineering, University of Massachusetts Amherst; Prof Emeritus and Prof Extraordinaire, University of South Africa; and Faculty Associate, Albert Luthuli Center of Corporate Governance, University of Pretoria. She enjoys reading and writing and learning about the way the world operates. She says of her engineering degree that it allows for an interdisciplinary approach dealing with the design and deployment of management systems. The world of work has re-engineered itself around new technologies and it is up to higher education to catch up and lead the conversation.

Her research work focuses on innovation and technology, complexity, business and competitive intelligence, international trade. Her consulting work involves complexity management, research design and strategy development and execution. René has held several executive and research positions across the globe, and have taught across Europe, the U.K, Africa and the U.S. She is the recipient several research awards and accolades from scientific journals and is on the on the review boards of several scientific committees. In 2004 she founded an International Research Institute in Leadership and Innovation and also co-founded The Informational Accounting Institute of Southern Africa. She currently lives in Cape Town.

### **DEALING WITH THE ELEPHANTS IN THE ROOM: A SYSTEMS ENGINEERING APPROACH TO STRATEGY DEVELOPMENT AND IMPLEMENTATION IN A UOT SETTING**

#### **ABSTRACT:**

Problem: There is no doubt that technological changes increasingly impact on the ability of the University of Technology (UoT) Sector to develop and maintain their strategies. This sector is unique in that it is not only the understanding and application of technology that classifies it as a technological university, it is the interrelationships between industry, technology and the institution, which sets apart a UoT. Indeed, in this, the South Africa Technology Network,



suggests that 'A University of Technology offers technological career-directed educational programmes, focusing on innovative problem-solving research and engages with government/business/industry with communities as end users. The focus is on the study and implication of technology from the points of view of innovation and engagement.'

The above is specifically true in relation to complex factors, such as the Fourth Industrial Relations (4IR), the Smart Society as expressed by the Fifth Industrial Revolution (5IR) and the cyclical economy. Although much is said about the impact of the 4IR on higher education (HE), perhaps, the most notable outcome will be the application of these drivers into strategy development and implementation. The South African HE landscape is therefore not different from the international one in its increasing complexity. Strategy, therefore, cannot be a fixed destination but needs to incorporate elements of resilience in order to acknowledge a growing number of drivers and constraints towards a journey of excellence and relevance in the selected strategic thrusts.

Method: A systems engineering approach is followed to develop a strategic framework for a selected UoT in the adoption of the components and outcomes of 4IR and other technological and non-technological drivers. The development of a strategy is easier said than done as such a framework will need to consider financial constraints, transformation and national and international requirements, in the development of a university strategy that will provide students in the UoT environment the opportunity to develop skills that are as yet unknown in preparation for a changing world of work that is largely technologically driven – in other words, the environment is increasingly complex. Systems engineering is ideally suited for this purpose. For one, it allows for the modelling of ecosystems such as a university and, secondly, it allows for the development of a strategy that acknowledges interdependencies and embeds feedback and learning at every stage of the strategy design and implementation.

Purpose and outcomes: This paper therefore presents the development of the conceptual design of the strategy for a UoT that is resilient in terms of extraneous environmental factors.



**Prof AB Ngowi**

*Central University of Technology and National University of Singapore*

Professor Alfred Ngowi is the Deputy Vice Chancellor – Research, Innovation and Engagement at the Central University of Technology (CUT), Free State. He was previously the Dean of the Faculty of Engineering and Information Technology at CUT. He holds a Bachelor of Science (Civil Engineering) from the University of Dar es Salaam, Tanzania; a Master of Civil Engineering (Construction Engineering and Management) from Chalmers University of Technology, Sweden; and a PhD in Construction Engineering from the University of the Witwatersrand, South Africa.

Professor Ngowi's research interests are multi-disciplinary and they include engineering, the built environment, (particularly construction procurement and project Management), human capital, strategic management, performance management and the future of the workplace. He has published over 100 papers in journals, proceedings and book chapters. He is the co-Chief Editor of the Journal of Construction in Developing Countries (JCDC); an Associate Editor of the Journal of Built Environment and Asset Management (BEPAM); and a Reviews Editor of the Botswana Journal of Technology (BJT). He is a registered professional construction project manager (Pr.CPM), member of Botswana Institute of Engineer (BIE); Member of the Institution of Engineers, Tanzania (MIET); Member of the Chartered Institute of Building (MCIQB); and member of the International Association of Housing Sciences (IAHS).

## **EMERGING INDUSTRIAL REVOLUTION: SYMBIOSIS OF INDUSTRY 4.0 AND CIRCULAR ECONOMY: THE ROLE OF UNIVERSITIES**

### **ABSTRACT:**

The past three hundred years experienced the linear economy i.e. mine, produce, use and throw. Undesirable effects of linear economy on the living environment and biodiversity is evident around the world. Growing consumerism and population worldwide raises concerns about the sustainability for future generations. These led to calls for concerted efforts to shift from the linear economy to circular economy which is gaining momentum globally. Circular economy emphasises that we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and resources (materials, energy, water, etc.) at the end of each service life. In other words, nothing is lost, and everything is regenerated. Circular economy approaches lead to zero waste scenario of economic growth and sustainable development. These approaches are based on semi-scientific and empirical concepts with technologies enabling 3Rs (reduce, reuse, recycle) and 6Rs (reuse, recycle,



redesign, remanufacture, reduce, recover). Global consultancy firms estimate that transition to the circular economy would save the world trillion dollars annually while creating new jobs, business opportunities and economic growth. Emerging industrial revolution will be a result of symbiotic pursuit of new technologies and circular economy, to transform the production systems, business models, economic growth, employment, and sustainability.

This paper examines the trends, availability and readiness of industry 4.0 technologies (for example, Internet of Things (IoT), machine learning, cloud computing, big data analytics, artificial intelligence (AI), sensors, robotics, 3D printing, wearables, to mind-technologies, biotechnology and nanotechnology), to support and promote the circular economy. Other questions that will be addressed include which sectors of the economy will have the most impact? Which industries and businesses will be benefited and who will be affected? What are the opportunities for innovation? What are the best practices around the world, and examples to emulate? What are the changes needed in engineering education to nurture future engineers? What is the role of universities in the emerging industrial revolution? The paper concludes with several higher education initiatives focusing on supporting a transition towards a Circular Economy, and lessons that could be adopted, as Universities should play a pivotal role in transforming from the linear economy to the circular economy.



**Ms D Selepe**

*Vaal University of Technology*

Dikeledi Selepe is lecturer at the Vaal University of Technology. She is the Nursing Programme Coordinator and teaches Ethics and Professional Practice as well as Health Service Management to Undergraduate and Post Graduate Nursing Students. She is an Albertina Sisulu Executive leadership programme fellow at Fort Hare University and serves on the Executive Committee of the Gauteng Nurses Leaders forum. She obtained a Diploma in (General Nursing, Community Nursing, Psychiatry) and Midwifery from Bonalesedi Nursing College, and B cur (NWU) majoring in Nursing Education and Administration. She is currently pursuing a Masters' Degree in Public health with Fort Hare University (Albertina Sisulu Executive Leadership Programme) in collaboration with Harvard University School of Public Health and Pretoria University School of Public Health. She is an active Mentor to colleagues, staff, postgraduate and undergraduate students. Her current academic interest includes Curriculum Relevance and reform curriculum design and nursing education for the future of South Africa

## **NURSING EDUCATION AND TRAINING FOR THE 4<sup>TH</sup> INDUSTRIAL REVOLUTION**

### **ABSTRACT:**

Our study is based on our focus on clinic practices and patient perceptions of service integration, clinic accessibility, hours of clinic operations, assessment and treatment of chronic ailments and diseases, availability of medication, staff attitude and approaches to patients in public health institutions. Our findings suggested a need for service integration, increased geriatric care, quality care for patients particularly women, mental health support and addressing psycho-social and health education within the South African context. We explored avenues to improve nursing care, communication and service delivery with a view to meeting the demands of the 4th Industrial revolution. The need for Information Technology and the use of high technology dolls/manikins together with their maintenance and repair in simulation laboratories was found to be important to be included in the nursing curriculum for undergraduate and postgraduate students. The use of robotics for medical supply management of hospital stock and the interlinking of all public health institutions/ or private institutions with each other would also become a routine process for optimal service delivery, as suggested in the NHI (Private Public Partnership). Health promoters and policy makers may use such data in developing an effective health service that would cater for all patients.

ICT, Technology training, robotics, services, nurse technician, PPP, NHI Faculty of Applied and Computer

## VENUE: SUITE 2



**Prof Muthoni Masinde**

*Central University of Technology*

Professor Muthoni Masinde is a distinguished computer scientist with BSc, MSc and PhD computer science degrees from the University of Nairobi, the Free University of Brussels and University of Cape Town respectively. One of her achievements in the realm of computer science is a novel, drought prediction tool dubbed ITIKI, which taps into the rich African indigenous knowledge on droughts and augments it with ICTs; Wireless Sensor Networks, artificial intelligence and Mobile phones in this case. The novelty of this contribution was recognised by the IITU's Focus Group - Bridging the gap: From Innovation to Standards. Her contribution was also featured on the BBC World Service, New York Times, Reuters TEDx Talks and Global Aidpreneur. ITIKI also saw Masinde emerge the winner of the 2016 Distinguished Young Woman Scientist – Research and Innovation Awards of the Department of Science and Technology.

Masinde is among the 2017 awardees for 2017 Securing Water for Food (SWFF) by USAID. Through SWFF, she received funding worth US\$500,000 for the 2016-2019 period. This funding has enabled her to develop entrepreneurship skills that have seen her become the founder and director of two private companies.

Masinde is currently an associate professor at the Department of IT, Central University of Technology, Free State (CUT) where she also doubles up as the Dead of the Department. She is the head and founder of the Unit for Research on Informatics for Drought. Through this Unit, she has spawned postgraduate projects and published over 50 publications. Her interests in mentoring women in STEM saw her initiate the Women in Engineering and IT (WEIT) organisation and for which she is the patron.

**SUSTAINABLE SMART CITIES AS VEHICLE FOR MULTI-DISCIPLINARY RESEARCH  
WITHIN A UNIVERSITY OF TECHNOLOGY IN SOUTH AFRICA**

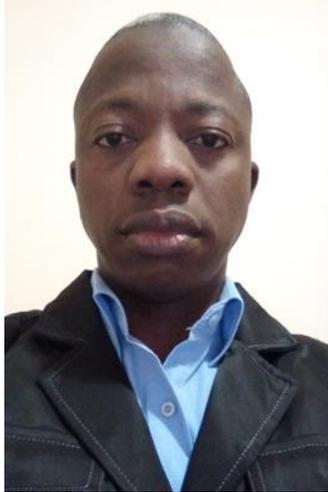
### ABSTRACT:

Sustainability requires our generation to manage the natural resource base such that the average quality of life that we enjoy today can be shared by all future generations. It is about a development that meets present needs without compromising the ability of future generations to meet their own needs. Sustainable development implies economic growth that protects the environment, each reinforcing the other. In the same analogy, sustainable technology is a technology that provides for our current needs without sacrificing the ability of future populations



to sustain themselves. Approaching the synthesis of sustainably engineered solutions requires weighing the qualities of different proposals from a variety of different perspectives. Of necessity, these problems need to be solved from multidisciplinary perspectives. The concept of sustainable development and technology is intended to cut across all engineering disciplines, within a multidisciplinary environment, incorporating the latest advances in cognitive science and computer-supported development.

Cities are faced with the challenge of keeping people on the move, providing a reliable, cost-effective supply of power and ensuring safe, secure and smart buildings. Thanks to the sustainability theories of infrastructures, cities can boost performance, lower costs and improve resource efficiency. This project has the intention to utilise SMART technology for the implementation and adoption of Industry 4.0 into Sustainable SMART Cities. This will also contribute towards the United Nations Agenda 2030 and in particular to the Sustainable Development Goals (SDGs). The paper focuses on how to integrate different research foci within an institution into multi-disciplinary research projects. This is important to ensuring that staff and thus students are gaining knowledge on Industry 4.0 revolution but also manage the limited resources within an Institution of Higher Learning.



**Dr Kayode J Samuel**

*Mangosuthu University of Technology*

Dr Kayode Julius Samuel obtained a PhD in Urban Geography from the University of Ibadan, Ibadan, Nigeria and Professional Certificates in ArcGIS and Geodatabase Development from Environmental Systems Research Institute, Redlands, United States. His research interests span social dimensions of human settlements, urban environmental change, urban informatics, urban governance and public service delivery. He has published in reputable local and international scientific outlets. He has a decade of teaching and research experience at the Department of Geography, Osun State University, Osogbo, Nigeria. Currently, he is a research fellow at the Human Settlements Unit, Research Directorate, Mangosuthu University of Technology, Durban South Africa.

## **AFRICAN CITIES IN THE 4IR: THE ROLE OF AFRICAN UNIVERSITIES**

### **ABSTRACT:**

The convergence of technologies in the physical, biological and digital domains characterize the Fourth Industrial Revolution (4IR), which has been predicted to cause monumental disruptions not only in the socio-economic and power relations but also in the way we engage with our environments. One of the domains that will be most affected by this wave of revolution is the urban ecosystems which are mostly the producers and consumers of these innovations on one hand and the bearer of the bulk of externalities that result from such fundamental change on the other. It has been postulated that the 4IR holds a lot of promise for cities in the developing countries to leapfrog most of the developmental obstacles that had hindered their smooth ascension on the developmental ladder. However, many African cities are ill-prepared, ill-positioned to benefit from the opportunities provided by this wave of change. This paper, relying on evidence from diverse archival sources, traces the trajectory of technological change and urban development in Africa, identifies opportunities and likely problems that will characterize African cities' engagement with this innovation-driven change. The paper concludes by advocating a more practical, home-grown, context-specific knowledge and innovation production in the human settlement sector from the ivory towers and an increased town-gown collaboration in Africa in order to strategically position African urban centres to profit from the 4IR. In doing this, the study recommends a blend of traditional ecological knowledge (TEK) and modern scientific knowledge in the planning and management of cities to achieve the desired sustainable objective.



**Professor Sechaba Mahlomaholo**

*Walter Sisulu University*

Prof. Sechaba Mahlomaholo joined Walter Sisulu University at the beginning of 2017 as the Deputy Vice-Chancellor for Academic Affairs and Research. He is a graduate of the Universities of the North, Harvard and Western Cape. He is an NRF-Rated Professor of Education and has ended his two-year term as the President of the South Africa Education Research Association (SAERA) on October 25, 2017. He is UMALUSI's Council member and that of the Ministerial task Team Analysing textbooks around issues of social cohesion and transformation.

He has successfully supervised over 31 PhD and 30 MEd students and published over 50 peer reviewed journal articles, book chapters and conference papers both nationally and internationally. He was also Dean of the Faculty of Education at the University of the Free State (2015 to 2016), Research Professor at North-West University (from 2008 to 2010), Professor and Director of Research and Postgraduate Studies at the Medical University of Southern Africa (2001 to 2004), was Head of the Education Department at Vista University (1999 to 2001), Head of Educational Psychology and Deputy Dean (at the QwaQwa Campus of the University of the North from 1996 to 1999).

He continues to lead an NRF sponsored research team of 15 academics across the following universities: WSU, SPU, UFS, Unizulu and UKZN.



**Dr Makeresemese Qhosola**

*University of Free State*

She is currently teaching in the undergraduate and PGDip programmes at the University of the Free State. She supervises both the Master's and PhD students. She has published internationally and locally in the peer reviewed journals. She is contributing a chapter in the book titled: Decolonising Higher Education in the Era of Globalisation and Internalisation accepted for publication by the Sun Media Press. She has two papers that are under review of the internationally accredited high impact journals. She was a special invited presenter to the Speaker Session of the international symposia representing South Africa at the American Education Research Association (AERA) in April 2018.

She recently presented a paper in the World Education Research Association (WERA) conference in August 2018. She is guest editing the special issue of the accredited Educational Research for Social Change Journal. She has the privilege of being chosen as the Task Team member in the implementation of the Integrated Transformation Plan (ITP) at UFS. She also has been invited by the Vice Chancellor of the UFS to be one of the 8 Task Team Member to lead the whole University's Fourth Industrial Revolution project. At the same time, she is continuously invited by National Research Fund (NRF) as a panel member to review and serve as the assessor for their various funding meetings.

### **CREATING SUSTAINABLE LEARNING ENVIRONMENTS FOR THE FOURTH INDUSTRIAL REVOLUTION: A STUDY OF MANAGEMENT STRATEGIES**

#### **ABSTRACT:**

This study explores management strategies which are suitable for the creation of Sustainable Learning Environments within the context of the Fourth Industrial Revolution. This paper will also focus on the 2 kinds of challenges experienced in this revolution. The first challenge being that of a demand for high levels of technological acumen operating at the interface of the human-to-human, human-to-machine and the machine-to-machine interaction and the second highlights the challenges posed by the Fourth Industrial Revolution on humanity to acquire skills and expertise far beyond what current higher education offers.

On the other hand, those who fall within the middle and lower ends of the education and skills ladder, stand to be rendered superfluous; especially in the labour market. These challenges increase the levels of inequality, unemployment and poverty amongst those in this category of society. These diverse challenges require a form of leadership that can create a sustainable learning environment, where all – regardless of their differences – can flourish and complement each other.

This paper reports on how such leadership is created and sustained at an urban higher education context and also in the rural higher education environment.



## VENUE: SUITE 3



**Mr Peter A Lansdell**

*UNISA and University of Johannesburg*

Peter Lansdell is a Chartered Accountant and Technology Enhanced Learning coordinator for the College of Accounting Sciences at the University of South Africa (UNISA). His role amongst others, entails the design and implementation of best practice Technology Enhanced Learning strategies to transform the current accountancy curriculum to a blended and/or fully online environment. His approach to design online modules (subjects) incorporates inter alia, relevance to students, student centeredness, responsiveness to the needs of students and the community at large, Africanisation, Decolonisation, using cutting edge technology in learning, improved student graduateness and advancing critical thinking and ethical creative problem solving skills of students.

He recently completed his Master Degree (with distinction) at the University of Johannesburg (UJ). The title of his dissertation is “The development of pervasive qualities and skills of prospective chartered accountants”. In 2016 he received the Excellence in Tuition and Learning Award from the Principal and Vice Chancellor of UNISA for the development of the universities first fully online and e-learning module – “Perspective on Accountancy”. In addition, he also received the award from the Dean of the UNISA College of Accounting Sciences for Excellence in Teaching and Learning for his contribution toward best practice learning strategies to enhance student’s learning experiences within an Open Distance Online Learning environment (ODEL).

Peter has a research interest in accounting education and training, specifically to challenge the content and how we currently educate and train the future generation CA. Accordingly, his research focus is on the development of prospective CAs soft skills to remain relevant by means of meeting the expectations and requirements for the future generation CAs. This includes the demands instilled and/or expected from industry 4.0, artificial intelligence and BigData. He has various papers submitted to international journals for publication, however at the time of this conference is still in the process of review.



**These include:**

- The impact of industry 4.0 on the development of soft skills by SAICA-accredited academic programme providers
- An analysis of the development of South African prospective chartered accountants' soft skills
- An analysis of the development of pervasive qualities and skills of prospective chartered accountants from a different perspective
- Taking stock on how South African academic programme providers develop prospective chartered accountants' soft skills

As part of his commitment to community engagement, Peter is part of the Research on Audit Committees South Africa (RACSA), a research group conducting research into various governance issues. His role is focused on the effectiveness of national and provincial department's audit committees. The first phase of the research is completed which entail the mobilisation of a focus group by making use of Interactive Qualitative Analysis (IQA). Each focus group was conducted with audit committee members of national and provincial departments as well as stakeholders of possible audit committee oversight. The second phase is planned to be completed by the end of 2018, where after the results will be release to National Treasury and the Institute of Directors South African during 2019.

**THE IMPACT OF INDUSTRY 4.0 ON THE DEVELOPMENT OF SOFT SKILLS BY SAICA-ACCREDITED ACADEMIC PROGRAMME PROVIDERS**

*ABSTRACT:*

The fourth industrial revolution (industry 4.0) is anticipated to significantly impact on the role and function of the future generation Chartered Accountants (CAs). Accordingly, current and prospective CAs are expected to acquire and develop soft skills, which would enable them to add value as responsible business leaders and thrive within industry 4.0. The South African Institute of Chartered Accountants (SAICA) identifies specific soft skills which all competent prospective CAs are expected to master and apply in the work environment. These skills are articulated in SAICA's 2014 Competency Framework. One of the constituents responsible for developing these skills are the academic programmes of universities (Academic Programme). These programmes are investigated in the empirical work of this paper.

The research problem is informed by the limited research available on soft skills development, specifically within the context of industry 4.0 and from the perspective of the prospective CAs themselves (as the recipients of the soft skills imparted by the Academic Programme). The quantitative results indicate that the Academic Programme is perceived to have developed most of the soft skills required by industry 4.0 and SAICA's Competency Framework. However, that specific skills are not developed. Additionally, the extent to which industry 4.0 skills are perceived to have been developed, suggests room for improvement.



**Dr Anneke Harmse**

*Vaal University of Technology and North West University*

Anneke Harmse commenced her career as lecturer at the Vaal University of Technology in 1998. She is a senior lecturer in the ICT department in the Faculty of Applied and Computer Sciences and serves as a mentor to undergraduate and post graduate students. She is currently the acting Head of the ICT Department within the Faculty. Her academic interests include the role of the Higher Education Sector in the ICT Industry, the skills required in an ICT environment and the development of such skills from basic education through to the working lives of ICT graduates. In addition, she is passionate about academic support and mentoring.

#### **HIGHER EDUCATION INSTITUTIONS, ICT GRADUATES AND SKILLS REQUIRED FOR THE 4<sup>TH</sup> INDUSTRIAL REVOLUTION**

##### **ABSTRACT:**

A key objective of Higher Education Institutions (HEIs) is to meet the needs of the ICT industry, to promote educational and industrial relationships within the ICT industry. Of importance is the promotion of skills and abilities for the enhancement of graduate contributions to the 4<sup>th</sup> industrial revolution. To this end a possible solution is the development of an ICT skills framework in relation to the needs of the ICT industry which would guide the development of ICT curricula at HEIs in South Africa. The purpose of this study was therefore to develop such a framework based on an understanding of requirements as set out by the South African ICT industry. The study used a descriptive phenomenological grounded theory design, applying the Constant Comparison Method (CCM). The study explored and described the lived realities of ICT practitioners using instructed interviews.

Data obtained from these interviews were benchmarked against the Skills Framework for the information Age (SFIA) to assist with the identification of technical skills required. However additional skills were identified as a requirement for effective ICT graduates. Qualitative data obtained resulted in the creation of large number of codes that required 'quantitising' qualitative data. The data therefore was analyzed by cluster analysis and revealed the requirement of two broad categories of skillsets namely technical and additional non-technical skills. These are incorporated in six categories identified using Ward's method. The resulting skills framework comprising of six categories was developed and presented herein as a South African ICT skills framework for use in the 4<sup>th</sup> industrial revolution.



**Prof Logan D Naidoo**

*Mangosuthu University of Technology*

Prof Logan D. Naidoo has been in the tertiary sector for over 40 years. He served for 22 years at the former University of Durban Westville (UDW) and now University of Kwa-Zulu Natal (UKZN) as a Senior Administrator. For the last decade he has been at the Mangosuthu University of Technology where he is a Senior Lecturer in Human Resource Management. His area of specialisation is Leadership Ethics and Governance.

#### **THE 4<sup>TH</sup> INDUSTRIAL REVOLUTION: ARE UNIVERSITIES OF TECHNOLOGY CATALYSTS FOR CHANGE?**

##### **ABSTRACT:**

A trip down the industrial revolution memory lane provides an insight into how communities and institutions have developed and where they are. In the late 1700's the world experienced the first industrial revolution of steam and water followed in the late 1800's with the second industrial revolution which saw the age of electricity and new forms of communications. The mid to late 1900's, the 3<sup>rd</sup> industrial revolution, gave to the world technological advances; the age of the computers and the internet. And while the world is still adjusting to technology, it is suddenly at the doorstep of the 4<sup>th</sup> industrial revolution. Artificial intelligence and talk of humans and robots occupying the same space and in time robots performing the functions of humans with the threat of even replacing them. With exponentially improved use of cloud technology, cybersecurity and virtual reality this revolution is set not only to transform almost every activity that is currently undertaken by humans, but also of transforming minds and bodies as well. The big statement is that the 4<sup>th</sup> industrial revolution is upon us, but the bigger question is ... Are we ready for this revolution? Not only us but our institutions as well. More importantly the concern is whether the universities of technology (UoT) are able to embrace the 4<sup>th</sup> Industrial Revolution.

The universities of technology in South Africa in most cases have suffered from serious and long term under resourcing and continue to cater for students with a disadvantaged past. These disadvantages lead to a student intake from a schooling system that still struggles to deliver an adequate standard of primary and secondary education. The students themselves come from communities that are bedevilled with poverty and unemployment. On registration at a university of technology they encounter institutions that are lacking in infrastructure and resources. These institutions have been unable to completely adopt the benefits of the 3<sup>rd</sup> industrial revolution with regard to the technology transformation and blended teaching. What hope is there that they will soon embrace the 4<sup>th</sup>?

# **ANNEXURE 7**



## ANNEXURE 7

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



**Mr Sampan Silapanad**

*Vice-President and General Manager, HDD Operations, Western Digital Corporation, Thailand*

Sampan Silapanad is Vice President and General Manager of Western Digital, the worldwide leader in Digital Data Storage Device manufacturing. Western Digital had revenues of US\$ 20.6 billion for the fiscal year ending June 2018 and employs more than 71,600 employees worldwide.

Sampan graduated with a Bachelor Degree in Mechanical Engineering from Kasetsart University, Thailand, a Master degree in Management from Sasin Graduate Institute of Business Administration of Chulalongkorn University, Thailand, and was bestowed an Honorary Doctorate degree in Industrial Engineering by Suranaree University of Technology, Thailand.

Sampan has had more than 35 years of experience in executive positions of large firms, mainly in Electronics and Digital Storage industry, including National Semiconductor, Seagate Technology, Hitachi Global Storage Technology, and Western Digital Corporation. Besides, he has a special and keen interest in improvement of Thailand's education and has been working with many governments and international organizations and educational institutions both in Thailand and all over the world on many impactful programs, such as Cooperative Education and Talent Mobility, for the manpower development for Thailand and other countries.

#### **SESSION THEME ADDRESS: FROM INNOVATION STUDIES TO INDUSTRY 4.0: UNIVERSITIES OF TECHNOLOGY AS CHANGE AGENTS**

Cooperative Education at Western Digital





Western Digital has 44% of the market share in Thailand and employs 65 000 people all over the world. It has manufacturing capacity in various countries, including Brazil, China, Japan, Malaysia, and Thailand.

In considering the effects of the 4th Industrial Revolution, there are claims that the risk of unemployment through automation could be as high as 72% in Thailand, while in South Africa the risk could be as high as 67%.

Industry 4.0 comprises nine pillars of technological advancement. These include autonomous robots, simulations, horizontal and vertical system integration, the Internet of Things, cybersecurity, cloud computing, additive manufacturing, augmented reality and big data. Western Digital has made good strides in implementing automation and will move on to artificial intelligence (AI), which will rely on machines interacting with other machines, eliminating manual processes such as testing and inspections.

84% of enterprises believe that investment in AI will lead to greater competitive advantage. Global revenues from AI for enterprise applications is projected to grow from \$1.62 billion in 2018 to \$31.2 billion in 2025. To drive this investment, universities must produce the graduates needed to support this increase. These changes will mean that manpower demand shifts will occur, some skills will become obsolete, and people will have to acquire new skills. The soft skills that would be needed include critical thinking, a growth mindset, agility and resiliency. In terms of hard skills, the skills required 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 will have to move from an 'old smart' to a 'new smart' mindset. They will have to adopt an outlook that acknowledges 'I am good at not knowing', continuously asking questions to improve their views, to seek the truth, keeping an open mind to learn, and understanding that mistakes are learning opportunities.

A new culture will also foreground teams that win rather than individual wins, strengthened by collaboration and transparency. The future of education is about collaboration. Since 2008, Western Digital has collaborated with 121 universities, both locally and internationally, on 918 projects, involving 1 036 participants. Mentors are appointed to guide students, on projects spanning a minimum of 4 months. The most important part of these projects is that students must achieve specific learning outcomes during the four-month period. During the past five years, 16 South African students participated in co-operative education opportunities. A similar programme has been instituted at PhD level, involving 9 government institutes, 18 universities and 295 researchers over the past 8 years, greatly increasing talent mobility.

Once a month, students are required to spend some time working in the community, teaching children in neighbouring schools. Students who passed the boot camp generally find employment much faster, and they also tend to stay in the company for longer because they are more invested in the culture.

# **ANNEXURE 8**

## ANNEXURE 8

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



**Keith Anderson**

*Chief Executive Officer, SAWEEDA*

Keith was born on 19th September 1952 of South African Parents. He is married to Schane and has three sons. He and his family are resident in KwaZulu-Natal. Keith matriculated at Damelin College in 1969 and has been educated at Damelin College, Stellenbosch Graduate School of Business, UCT Graduate School of Business, Heriot-Watt University, La Salle University and Century University in the USA.

Keith has held senior executive positions in various industries including Banking, Petro-chemical, Information Technology, Services and Consulting. Keith Anderson's fields of specialisation include: Environmental issues, waste management, information technology, restructuring and regulation in support of sustainable development. Keith, at the behest of governments and multi-nationals, has for years and still continues to, deliver papers globally on environmental issues and waste management. He has served as an adviser to numerous cross-border government departments, multilateral organisations and major international and South African corporations.

For the past three years, he has been involved extensively within the private equity arena primarily focusing on unlisted companies, performing company analysis and valuation, turnaround propositions, mergers and acquisitions involved with some of the country's largest blue-chip organisations.

Having chaired and served on numerous boards of companies in various stages of their life cycles over the years, Keith is widely recognised as having provided outstanding natural acumen and sound leadership to those corporates, partners and stakeholders, sharing his extensive international management and enterprise project development experience. Keith was also the founding member of the e-Waste Association of South Africa.

Currently, Keith sits on the Board of numerous Companies. He is past President of the Information Technology Association of South Africa (ITA) and is currently Chairman of the E-Waste Association of South Africa (EWASA), which he founded in 2006. He has also chaired



various REMCO Committees and Finance and Investment Committees. Keith has also served on the Board of the ISETT SETA for four years. In addition, Keith was also one of the Founder Members and Directors of Qhubeka, [www.qhubeka.org](http://www.qhubeka.org), to create a means of providing much needed socio-economic development (SED) support to SA's disadvantaged communities.

Keith was one the ICT Personalities of the year finalists in 2012 and was awarded the ICT Social Responsibility Award in 2016. Keith drafted the first Industry Waste Management Plan (IWMP) for e-waste in 2010 and submitted it to the DEA. Keith is a sought-after public speaker and presents papers frequently, both locally as well as internationally on E-waste Management and the Circular economy. He is recently formed and launched the Africa WEEE Forum, [www.weee-africa.com](http://www.weee-africa.com) with the objective of establishing a uniform E-waste standard throughout Africa. Keith enjoys cycling, swimming and Motorsport and is a qualified Diving Instructor.



**Ms Tracey October**

*Regional Manager, Southern Africa Web of Science, Head of RIMS Solutions for Africa, Converis, Clarivate Analytics*

Tracey has been in her role as Regional Manager for Southern Africa, Head of RIMS Solutions for Africa, Clarivate Analytics, operating in the Government and Academic space, since May 2015, and is passionate about the role that science, technology and innovation can play in Africa’s development. From 2016 she was asked to perform a dual role as the Head of Research Information Management Solutions for Africa.

Tracey obtained a Bachelors Degree in International Relations and a Masters Degree in Political Science from Vrij University Brussels and Universite Libre de Bruxelles, respectively.

Tracey works with research centred institutions, to assist them in increasing their research output and impact, and drive innovation. One of the key areas of focus in her work is to develop strategies to showcase the quality of African research on a global scale.



**Mr Sandeep Vakharia**

*Managing Director, Aashumi Chemicals India*

In 1997, environmental concerns precluded the Government of India from issuing clearances to manufacturing companies. It was in an atmosphere of stringent scrutiny that the Indian Ministry of Environment and Forests designated Aashumi Chemicals Private Limited as the first company to have an environmentally sound manufacturing process for non-ferrous metals. The company that overcame governmental hurdles to commence operation twenty-one years ago, continues to break barriers in the Indian landscape of recycling due to the vision and dedication of its Founder and Managing Director, Mr. Sandeep Vakharia.

The son of a stainless steel industrialist, Mr. Vakharia nurtured his aspiration of running his own factory from his college days at the Manipal Institute of Technology, Manipal, India. He established Aashumi Chemicals Private Limited with the humble production of copper sulphate. Today, the company specializes in the recycling and separation of various non-ferrous metals, scrap and residues, in addition to its prowess in e-waste/cable recycling of varied materials like marine cables household wires underground cables telephone wires. Mr. Vakharia, in turn, has been acclaimed by the Indian recycling industry on several occasions for his expertise in situations of technical perplexity. He has conceived a process to separate quaternary constituents in complex scrap having copper, tin, lead, and iron which has found practical application in the manufacturing process. He was consulted by the Ministry of Environment and Forests in drafting the Hazardous Waste Management and Handling Rules 1989 through 1995-97.

The hurdles that Mr. Vakharia faced in establishing a factory were not simply governmental, economic or technical. Aashumi Chemicals Private Limited is mainly run by a ground staff of unskilled workers. Over the years, the company has trained its workers, most of whom hail from the interiors of rural Maharashtra to gain the technical experience and education necessary for a production process of its merit. Far beyond increasing employment, Aashumi Chemicals Private Limited plays its part in boosting scientific and technological education in Wada, Maharashtra where it is situated. In this light, the company was awarded the Platinum Technology Award for Quality and Best Trade Name in Rome, Italy to recognise its innovation and quality.



While his operations rest on the production process itself, it is the challenge of recycling new materials that Mr. Vakharia truly enjoys. He maintains that the key to success in the recycling industry lies in locating simple solutions via indigenous processes and inexpensive methods to complement the manufacturing process. The enabler is avoiding the use of capital-intensive foreign machinery and instead, devoting efforts to perfect the most organic and indigenous way of manufacturing. In all his endeavours, academic and industrial, he follows the four R principle - reduce, reuse, recycle and recover.



### **Mr Hugh Mtshali**

*Chief Executive Officer, SATRUCO*

Mr Hugh S. Mtshali is a recognized and successful business leader, entrepreneur, analytical chemist, and community builder. Born and raised in Soweto, Hugh has a long-proven record of accomplishments as a visionary, strategist, and a passionate investor in people. His career spans over three decades of business dealings in South Africa, America, and Asia. He founded several businesses from the ground up as well as negotiated major partnerships and deals including with Fortune 500 companies. Hugh holds a diverse portfolio of business interests and is involved both as director and shareholder in more than thirty companies spanning a broad spectrum of sectors that range from healthcare, manufacturing, electrical, communications, mining, energy, textiles, and Fast-Moving Consumer Goods (FMCG). His approach to business focuses on driving positive social impact within the community.

Currently, Hugh serves as chairman and director of RTT MedCon, a major player in the preventive healthcare industry. Under his leadership RTT MedCon became one of the first manufacturers in South Africa to be approved for the DTI's black industrialist programme. The company is recognized as a leader in the continent and has developed strategic alliances with some of the world's largest healthcare manufacturers. Recently, it was selected to participate in a healthcare documentary which highlights the work and the contribution that the company has made over the years. This documentary was shown in 12 countries around the world. Hugh is a qualified analytical chemist and his early career began as a laboratory analyst at Metal Box R&D; and a microbiologist at SGS Qualitest; and a training manager at Kemklean Limited – just to name a few. He later became sales manager at New Age Beverages (Pepsi SA). Along the way he worked as marketing director for MSH Distributors and was instrumental in the establishment of Procter Gamble's sales and marketing operations in the South African communities.

Hugh is a humanitarian and his community building engagement dates back to the early 80s as the socio-political climate of the country was shifting and South Africa's doors were opening to the world. He remains engaged to this day now serving as the chairman of the South African National Civic Organization (SANCO) Investment Group (SIG). During the 90's Hugh was involved with connecting and bringing diverse groups of international leaders – mainly from the U.S. business, political and professional fraternities. These initiatives began an adopt-a-school movement that saw several township schools receive the much-needed school supplies, computer laboratories, libraries, as well as science laboratories.

Hugh is the graduate of Wits Business School (Management Advancement Programme) and Setlogelo Technicon (Analytical Chemistry).



**Mr Sampan Silapanad**

*Vice-President and General Manager, HDD Operations, Western Digital Corporation, Thailand*

Sampan Silapanad is Vice President and General Manager of Western Digital, the worldwide leader in Digital Data Storage Device manufacturing. Western Digital had revenues of US\$ 20.6 billion for the fiscal year ending June 2018 and employs more than 71,600 employees worldwide.

Sampan graduated with a Bachelor degree in Mechanical Engineering from Kasetsart University, Thailand, a Master degree in Management from Sasin Graduate Institute of Business Administration of Chulalongkorn University, Thailand, and was bestowed an Honorary Doctorate degree in Industrial Engineering by Suranaree University of Technology, Thailand.

Sampan has had more than 35 years of experience in executive positions of large firms, mainly in Electronics and Digital Storage industry, including National Semiconductor, Seagate Technology, Hitachi Global Storage Technology, and Western Digital Corporation. Besides, he has a special and keen interest in improvement of Thailand's education and has been working with many governments and international organizations and educational institutions both in Thailand and all over the world on many impactful programs, such as Cooperative Education and Talent Mobility, for the manpower development for Thailand and other countries.

**SESSION THEME ADDRESS: FROM INNOVATION STUDIES TO INDUSTRY 4.0: UNIVERSITIES OF TECHNOLOGY AS CHANGE AGENTS**



## Panel response



Mr Vakharia shared the following thoughts.

As a business person, the inputs on the 4th Industrial Revolution have been enlightening. The important principles around the 4th Industrial Revolution that we should not lose sight of are reuse, reduce, recycle, and recover. It is critical to remember the problems that we must find solutions for. The recycling industry is the goal keeper for these issues. Students from other countries benefit from initiatives such as those driven by Western Digital, but it might be important to understand a different viewpoint, that of industry, which is focused on production, recycling and creating a product.

For UoT's to work towards meeting the challenges of the 4th Industrial Revolution, they must establish strong partnerships with industry to collectively resolve problems and find solutions as part of a mutually beneficial and supportive relationship. UoTs should invite industry participants to share their perceptions with students, regardless of the courses being taught. Students should be exposed to regular industry interactions, through apprenticeship programmes that involve them in the world of work and motivates them to adopt an entrepreneurial mindset.

Mr Mtshali of SATRUCO responded as follows.

UoTs are meant to provide innovative solutions to SATRUCO'S brief, which is to recycle waste tyres, and produce a range of other products that would stimulate new product development and economic growth. SATRUCO has set aside a budget to instil a culture of innovation in UoTs, to stimulate growth and address challenges such as unemployment and new product development. There is a need to collaborate with small businesses and government departments such as the Department of Trade and Industry (DTI) and the Department of Public Enterprise, to create a demand for new products and export them to other countries.



### Question and answer session

**TUT:** In the South African context there is collaboration between universities and industry. However, these collaborations have not yet reached the stage where they stimulate research projects – we must educate both industry and universities about the desired outcomes and nature of these collaborations.

**NUST:** We heard that we need to create demand and markets for products generated from recycled goods. How do we get people to be excited about such products – Namibia has a smaller economy, making it more difficult to create a buzz for our products internationally.

**VUT:** What is the relationship between AI and the 4th International Revolution and nuclear power?

**Silapanad:** In terms of creating demand for products, it is necessary to actively explore opportunities for new markets. Customers must be educated to accept new products and to create a demand. Industry and universities should collaborate closely on these aspects. Research projects also contribute to this drive, which may involve undergraduate students, to create employment opportunities and build stronger relationships between employees and companies. It is important to understand that all parties will benefit from the engagement. Students should learn from the exposure.

On AI and nuclear, my response is going to be limited.

**Mtshali:** We innovate to stimulate economic growth, which means that we must sell products. This will need feasibility studies to be conducted and offtake to be stimulated. We have the Proudly South African campaign to market our products locally and internationally, and we also have preferential procurement programmes supporting SMEs.

**October:** I'm from Clarivate Analytics, and we support universities and research institutions to advance the research agenda. It will be critical for universities to clarify who should be responsible for driving industry collaboration. If researchers are responsible for these collaborations, the current incentives which favour research publications might need to change. If institutional Research Offices are responsible for driving this issue, do they understand their research data thoroughly? Data analytics could support this kind of project.

**Silapanad:** In our company, we take full ownership of projects, involving both researchers in the company but also those within universities we collaborate with.

?: We heard about the differences between soft and hard skills, such as creativity. Could you comment on the critical nature of this aspect?

**TUT:** In the South African context there is collaboration between universities and industry. However, these collaborations have not yet reached the stage where they stimulate research projects – we must educate both industry and universities about the desired outcomes and nature of these collaborations.



**Anderson:** Mr Silapanad's presentation highlighted that although we have technology and other support mechanisms, but we tend to operate in silos. We must move from the linear to the circular economy. All the innovation and excellent design can only take us so far if we do not have supporting legislation and policy, and we need a mind shift from doing business in traditional ways which could stifle innovation and collaboration. Companies that have adopted new approaches have been more successful in making the change. Industry has had to be clear about what it wants from the people they employ. The 4th Industrial Revolution could influence a range of jobs, even something as supposedly unlikely as life guarding, where a drone could greatly enhance the efficiency and effectiveness of the life guard.

**TUT:** In my view the challenge in South Africa is that the triple helix framework is not clearly understood. Very little attention has been paid to who should take the lead in driving these linkages. These could be universities, industry or government, depending on their areas of strength. We need a regulatory environment that retains our skills in universities. We also have too few spin-off companies in our UoTs; we patent cutting edge findings but without commercialising our own ideas. We should run these companies and create employment in our own regions and cities. We must find ways to optimise these linkages, relying on those that have the most valuable skills. The nature of these partnerships must be revisited.

**MUT:** As academics we think we know the answer to every question, but when our students graduate, our graduates are often unemployed. In the classroom we are dictated to by national frameworks and authorities, which may be misdirected. The space for industry to contribute seems limited. How do we blend industry contributions into the teaching to create meaningful results, given that we are dictated to and funded by national bodies?

**Tshwane North College:** What criteria do students have to meet to be employed in companies?

**Silapanad:** Five years ago, I was in Durban to talk to students, and the lecturers were very helpful in creating linkages. We have many mentors in the company to oversee projects and strengthen relationships. We interview students over Skype, putting mentors and students in contact with each other. Thereafter the practical arrangements are made, and the responsibilities of the company and the university are clarified.

**Vakharia:** It is important to bring industry representatives into the classroom, to motivate students to be entrepreneurial, and also to help them to solve problems for which industry may need solutions. This motivates students greatly to think in a different way and helps to stimulate leadership skills. It is a mutually beneficial partnership that must be encouraged at a national level, and not only in individual universities.

**Silapanad:** Students must be encouraged to learn in industry – they should not be kept only in the classroom. This has been my experience. Industry has a lot of pain points which universities could help resolve. We made a mistake in Thailand that we involved universities, who then assigned those projects to PhD students, which meant that it took too long to develop solutions. We need a quick turnaround in business, which is why it is better for us to ensure that we retain ownership and responsibility for projects.



**Mtshali:** There was a comment about commercialising patents. Talking on behalf of SATRUCO, we are keen to come up with products derived from tyres – if anybody has a patent that fits this brief, talk to us. By collaborating we could define how we work together and who owns the IP.

**Anderson:** Those institutions that have merged vocational and practical training by collaborating with industry tend to be more successful, based on a better understanding between the two parties of the problem and the solution. Lithium ion batteries is an area where we could have great collaboration between industry and universities, to collectively plan, train and develop technologies.

**Silapanad:** In Thailand, there have been several successful cases where SMEs and universities shared the IP. However, in cases where universities collaborate with large companies, the IP is never up for negotiation. Such collaborations may however generate new IP, which large companies would always be willing to buy from the university.

**DUT:** Could the panel share some thoughts on how we as universities should address the challenges of inadequately prepared students coming from the schooling system? Teaching students who are better equipped for university study would be much easier if we had a way to address this gap.

**TUT:** My question is to Mr Mtshali. Do you have knowledge of THRIP which has been run by DST in the past, and has been taken over by DTI? We used to have many projects through THRIP in the past, but this has greatly reduced.

**DUT:** One of the speakers highlighted that 60% of graduates are unemployed. We learnt that even robots must be trained to perform better. Companies tend to favour graduates who have experience – how can we ensure that students will have the experience they need to be employed?

**Silapanad:** In Thailand we try to look at the evolution of the curriculum. We start by looking at the demand and linking this to the skills sets that we aim to develop through the curriculum. We make sure that the curriculum will achieve the learning outcomes that our industry demands.

**October:** In considering IP, it is important to consider what has been patented, which could highlight gaps in the markets and possible partners for commercially viable partnerships.

**Mtshali:** I cannot answer the question on THRIP. The model that we work with is based on tyre levies, which is used to stimulate development and growth in various development and educational programmes, following an integrated strategy involving DTI, DST and small businesses.

**Rajah:** One cannot stress the importance of IP enough – successful economies are constantly producing new patents. We lag behind in the production of new patents that are geared to solve complex problems through developing new technologies or IP. Our difficulty is the processes of registering patents, which could be greatly streamlined. We tend to be very risk averse, which means that there is very little collaboration between universities and the private sector, prohibiting the IP that we can generate. People tend to be quite territorial and want to protect their innovations.



**Chair:** We live in the era of open source data and other open resources – how would this affect the future of the university?

**October:** I think that universities should debate whether they should patent innovations, given that they are funded by public money. It is also important to clarify whether something that has been published, which is a driving consideration for universities, could be patented.

**Anderson:** That is something that we should also clarify – IP laws are being challenged across the world on a regular basis. The movement towards free data is gaining increasing momentum, and it must be embraced by all stakeholders in a responsible manner. We probably need more debate on this issue.

**NUST:** One of the interesting questions is not how quickly we are able to register IP, but how quickly we are able to commercialise that IP into products. Other countries that have seen economic growth were very successful in taking those products to market.

**TUT:** One of the things that our universities should consider is the criteria that we use to appoint our staff. We need to consider new employment models to replace outdated models that are no longer relevant.

**Anderson:** We have universities and colleges, but also SETAs. SETAs must be part of the solutions, and we should stimulate collaboration across the board to deliver the kind of training needed in all sectors.

**Silapanad:** In future, technology will make our lives easier and better. Inequalities will be reduced. Machines will be doing jobs which will generate income for the government, which will in turn benefit the citizens.

**October:** There seems to be a push to involve academics and industry to understand better what the industry needs are, and to generate future thinking.

**Anderson:** Speaking for South Africa, we have some unique challenges. Job creation, enterprise development and SME development are key drivers, and we must understand how the 4th Industrial Revolution could be used to generate the technology that we need in a phased approach.

**Silapanad:** Industry and university collaboration is the answer for the future.

**Mtshali:** The President recently encouraged industry to come up with measures to stimulate growth. We realise that innovation will be critical to stimulate the economy. Through waste tyres, we believe that SATRUCO could develop tyre derived products which could open up avenues for further waste products.

**Vakharia:** Students will be better prepared for the 4th Industrial Revolution through closer collaboration with industry, and by focusing on a range of skills.

# ANNEXURE 9



## ANNEXURE 9

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



#### Prof. Ronald Quincy

*Academic Director, Rutgers Civic Leadership Institute, Mandela Washington Fellowship for Young African Leaders, Rutgers University*

Ronald L. Quincy, Ph.D., is a Professor of Professional Practice, Edward J. Bloustein School of Planning and Public Policy, and Senior Fellow, Diversity Studies at the John J. Heldrich Centre for Workforce Development, Rutgers, The State University of New Jersey. Dr Quincy serves as the Co-Academic Director of the Collaborative Centre for Community-Based Research and Service and is the Academic Director and the Principal Investigator for the Rutgers Mandela Washington Fellowship Civic Leadership Institute. Ron is also a member of the faculty for the Honours College and School of Arts & Sciences Honours Program, and Faculty Director for the Honours College South Africa Study Abroad program. He is additionally the Co-Editor-in-Chief, *Collaborations: A Journal of Community Based Research & Practice*.

Ron served as a cabinet member for two Michigan Governors, as Director of the Michigan Department of Civil Rights, and Director of the Michigan Office of Human Resources Policy and Special Projects. His other previous positions include the following: Associate Vice President, and Assistant to the President, of Harvard University; Executive Director, of the Martin Luther King, Jr. Centre for Nonviolent Social Change; Executive Director of the Congressional Black Caucus Foundation, President of the White House Fellows Association and Chairman, White House Fellows Foundation; and Foreign Policy Advisor, U.S. State Department, Africa Bureau. Earlier in his career, Dr Quincy served as a White House Fellow for the Secretary of the United States Department of Housing and Urban Development.

Ronald Quincy earned his Ph.D. from Michigan State University

**SESSION THEME ADDRESS: INDUSTRY AND UNIVERSITY TECHNOLOGY PARTNERSHIPS: THE GRAND CHALLENGE – A CASE STUDY**



We need to talk about the challenge of creating successful and sustainable partnerships between universities and industry. Rutgers University is the 8th oldest university in all of America. We have multiple campuses and over 70 000 students, and an annual budget of \$ 4.5 billion. We have a responsibility to create a viable study experience for our students and must give them qualifications that will guarantee them jobs.

Economic growth in the 60s and 70s in the US was stagnant, while Japan was emerging as the leading force of economic growth and innovation. The US government sought ways to boost growth, because a vast percentage of innovations and IP were not commercialised, and because universities and industry were not allowed to collaborate. This was changed by implementing a facilitative policy based on the Bayh-Dole Act on patents and trademarks. From 1996 to 2012, the innovation economy took hold, which saw over 4 million new jobs supported through academic spin-offs. 12 000 new start-ups were formed from academic research, and \$ 1.3 trillion was generated for the fiscus.

There is however a clash of cultures between universities and corporates, given that universities having high autonomy and distributed governance. Corporate social responsibility is another issue that universities are increasingly being pressured to check before entering into partnerships with industry. This has caused many businesses to review their social responsibility activities, because we want them to be socially responsible and fund programmes and services that the government may not be able to fund. Companies are kept accountable and ethical. To create sustainable and strategic partnerships, the goals of these partners should be consistent with those of the university. There should be a line of sight between educational resources and the students' pathways to jobs and advancing their careers.

In the US, community colleges also matter. They allow alternate pathways for non-traditional college students, who often have low literacy levels, may be dislocated workers, or are just starting to learn the English language. Only 22% of full-time and 15% of part-time community colleges students are able to get a post-secondary degree, because students are often forced to work and learn simultaneously. A community college and business partnership can transform the lives of these students, allowing them to obtain a degree while working and earning. We find that increasingly high performing students elect to go to community colleges first, and then to enrol in university, because of the economic benefit. That is a very positive thing. In STEM subjects, the two-year college system provides better care in developing STEM skills sets, because they have access to more academic support systems and more faculty contact because teaching staff are not as engaged in research. As a result, we have signed partnership agreements with several colleges guaranteeing their students access to our programmes.



The historically black colleges and universities in the US – of which there are 110 and most struggle financially – may not survive in the long run. The output of these institutions in the STEM subject are being encouraged to transfer to our universities, also through partnerships to realise the potential of these students.

Rutgers University has also entered into partnerships with industry role players such as Johnson & Johnson and RWJ Barnabas Hospital. Since 1960, when the percentage of US GDP for healthcare was 5%, this allocation has grown to about 18%. It is important for institutions to enter into partnerships with major hospitals to access this funding. We have a massive healthcare enterprise at Rutgers. However, our structure requires staff to be both clinicians and members of faculty. We have received \$ 1 billion over the next ten years from Barnabas Hospital for medical research. There are various important jobs and positions that are not strictly medical, so we are working to prepare our students for these additional jobs. This partnership will serve 5 million patients per year and is one of the largest in America. We will also take advantage of our relationship with the hospital to provide in-service training to these students.

Rutgers University and Johnson & Johnson (J&J) has had a close historic collaboration for over 125 years, although in this time we also missed out on opportunities because our vision was not broad enough. J&J and Rutgers established the Rutgers Honours College to increase the number of female graduates in STEM disciplines. We also offer Byrne seminars taught by J&J corporate leaders on positive leadership and new product planning, among others. The benefits for students are extraordinary, because the industry teachers bring vast real-world experience into the classroom. Another project with the Office for Diversity and Academic Success in the Sciences exposes high school students to Saturday classes to introduce them to experiments in laboratories.

Rutgers has a large research enterprise, which is growing because of these industry partnerships. Patents are generated and generate more than \$ 30 million per year. Other universities generate more than \$ 100 million per year, and Rutgers hopes that these projects will generate considerably more income.

Rutgers' research revenues are much higher than that of Princeton and other state universities in the area. Rutgers implemented a programme to engage schools that we did not traditionally engage with in the past, bringing scholars onto campus in summer, followed up by ongoing engagements throughout the year. By the time they graduate high school, these scholars have an entry into the university, with a guaranteed scholarship, which is important for first-generation students from economically challenged families. This helps to strengthen the pipeline in STEM subjects, which will also aid economic development in the US. President Obama set the goal of 1 million STEM-educated graduates to join the job market, which in the past had to be outsourced to other regions of the world. Therefore, a firm pipeline in Rutgers is critical. Rutgers is proud to graduate students who will go on to study at some of the top research universities in the US. It is our goal to scale this up to a national initiative which all 4 000 higher education institutions in America can do.

J&J partnerships in Africa are growing, and Rutgers hopes to participate in these partnerships. These include a partnership with UCT Business School to develop hospital leaders, and another project with SOS Children's Villages.

# **ANNEXURE 10**



## ANNEXURE 10

### THEME 3: UNIVERSITY INDUSTRY PARTNERSHIPS IN THE CHANGING WORLD OF WORK (CONTINUED)



**Mr Barlow Manilal**

*Chief Executive Officer, Technology Innovation Agency*

Barlow holds a BSc Hons. Degree in Industrial Technology & Management and several other management and technical qualifications including having completed a Masters Programme at the University of Pretoria. He is also currently busy with a PhD Programme focussing on optimised models of Programme Management. Barlow has gained excellent knowledge of advanced project management, project engineering, global competitiveness, advanced manufacturing and technology development in the automotive environment at Toyota SA, Mercedes Benz SA and the Automotive Industry Development Centre (AIDC).

Under his leadership, the AIDC underwent significant transformation to becoming a formidable and leading mechanism for project delivery in the country. Throughout his career Barlow has served in several strategic roles whilst also having taken numerous awards for excellence both nationally and internationally, these include recognition as a “Public Sector Visionary” and ‘Lifetime Achievement’. In striving to achieve his personal philosophy and motto to “Make excellence an attitude”, he encourages a learning culture whilst entrenching a winning team spirit comprising the elements of,

***People - Process – Products - Purpose - Pride – Passion***

Barlow continues to participate in numerous strategic thought leaderships platforms which focus on manufacturing, technology, innovation and leadership. He assumed his role as CEO of the Technology Innovation Agency in April 2015.



**Mr Gavin Rajah**

*Creative Director/Rainmaker/UNICEF Goodwill Ambassador*

Gavin Rajah is an international, award winning brand in fashion, interiors and events. Having strayed from a legal career he has built a business that is based on creativity. His work these days involves mentoring young creatives, businesses and the development of creative intellectual property. A regular on the guest speaker circuit he focuses on rapid prototyping solutions, creative management and the importance of design in creating social transformation. The United Nations has appointed him a Goodwill Ambassador for Children (UNICEF) for his efforts in assisting children in vulnerable communities around the world. He is also an Advisory Board member for Africa to Harvard University. He is passionate about life, children, music and his mum.



**Mr Ademir Bassanesi**

*Professional Coach and Mechatronics Consultant, Brazil*

Ademir Bassanesi is a Professional Coach and Mechatronics Consultant. Expert of Brazil in Mechatronics with Worldskills since 2003, Ademir Bassanesi has prepared several teams from Brazil and, in the last 6 world championships, his teams have won 6 medals, 3 of Gold and 3 of Silver. At the “Olympics of Knowledge”, which is the national competition in Brazil in six editions, his teams won five consecutive Golds and one Silver.

Ademir Bassanesi holds an academic degree in Industrial Automation, specializing in Professional Education and Sports Psychology. Also has Training in Coaching and Behavioral Training.

Ademir served in the classroom for 12 years with professional education in the areas of Automation and Mechatronics. He also worked in the development of electronic equipment for the areas of aesthetics, physiotherapy and genetics.

Currently Ademir Bassanesi is a partner of the TRINUM Training and Development company that acts in the behavioral preparation of professional education competition teams. TRINUM was responsible for the preparation of teams from Brazil that reached the TOP ONE of WorldSkills in São Paulo 2015 and fourth place in Abu Dhabi 2017. TRINUM also performed the behavioral preparation in 7 modalities of the Russian team for Abu Dhabi 2017.



**Ms Nombulelo Nxesi**

*Chief Executive Officer, ETDP SETA*

Ms Nxesi is the Chief Executive Officer of ETDP SETA since 2004. She previously occupied the following positions:

Director Teacher Development- Department of Education (national) – 1999 – 2004; Chief Education Specialist: Curriculum and Teacher Development – Gauteng Department of Education 1998 – 1999; Deputy Chief Education Specialist: Teacher Supply, Utilisation and Development- Gauteng Department of Education - 1997 - 1998 ; Lecturer: mathematics and Physical Science - Daveyton College of Education - 1995 – 1997; Teacher & Head of Department Mathematics and Sciences -1989 – 1995

Ms Nxesi holds the following qualifications: Masters in Business Leadership (MBL) (UNISA); Honours in Public Administration (Stellenbosch University), Bachelor of Education Post Graduate Degree (University of FortHare), Higher Education Diploma and Bachelor of Science, majored in Mathematics and Chemistry. (University of Witwatersrand). In addition to the academic qualifications, Nombulelo also holds the following occupational qualifications, Management Development Programme (MDP), Total Quality management (TQM) and Practical Project Management (PPM).

Ms Nxesi serves in the following governance structures: Council of Higher Education as a Council Member, Central University of Technology as a Senate, HRC Member and a Council Member and the Human Resource Development Council in various provinces. She serves as the chairperson of the Advisory Committee for Community Colleges. Ms Nxesi has strengths in management and leadership, strategy planning, execution and implementation as well as corporate governance among other fields. She is currently enrolled with the University of Johannesburg pursuing doctoral studies, PhD in Personal and Professional Leadership.



**Mr Sagie Pillay**

*Profile Head, Clinical Operations, Wits Health Consortium*

Mr Pillay, currently COO Wits Health Consortium, the support operation through which the Wits University Faculty of Health Sciences - conducts research, manages donor-funded activities, pursues entrepreneurial innovation in health and supports clinical trials. A respected public health executive with extensive national and Pan African experience in health and Laboratory systems strengthening. Close affiliation with academic medicine and Research. MBA (Liverpool University and Masters in Health economics (Leeds University)

## RESPONDENTS SESSION



**Manila:** Establishing strong relationships between universities and the private sector is critical and should be mandatory, because we all participate in the same ecosystem and should function equally well in terms of the quadruple helix model. Problems arise when one of these participants want to continue operating in a silo. The current university model is becoming obsolete – universities lack agility and appear reticent to become more fluid. Businesses need fluidity and will always gravitate towards value. If businesses are not knocking on the doors of universities, it may be because they clearly do not see value. Therefore, we need to change the way we operate as universities. We need to decode the concept of partnerships as well; often we use the term, without understanding the nuances. Partnerships must be symbiotic rather than parasitical.

Partnerships based on personal relationships are also not sustainable; partnerships should be institutional. We have too many sterile partnerships, that have no yield and are not productive. Merely having a signed MoU does not lead anywhere. Partnerships require open sharing of information and an interface of strategic discussion.

**Ryan:** We heard yesterday that universities are not adequately responsive, and Prof. Quincy has highlighted the ability of community colleges to be responsive.

**Nxesi:** There are 21 SETAs in South Africa. They are meant to focus on skilling and re-skilling people, capabilities that universities and industry are not really using. SETAs must also ensure a balance between demand and supply of skills for the future workforce. We must also develop sector skills plans, for which huge sums of money from the Skills Levy has been set aside, but the return on investment remains limited. We must make the most of these opportunities, since SETAs are supposed to bring universities and industry together and stimulate cooperation. Large numbers of graduates in South Africa are unemployed because of a mismatch between demand and provision of skills. Employers also require graduates with employable skills, which we must address through dedicated projects.

We tend to forget that many challenges come from the basic education system, where there is limited collaboration. Universities have no interest generating the kind of students that they need from the schooling system.

Workplace plans submitted by industry also do not consider current and future students, and universities are also not aware of the work being done in industry. Until there are workable partnerships bringing these elements together in a common agenda, we will not have an employable workforce.



**Pillay:** I will take a different angle from everyone else. I work as the COO for the Wits Health Consortium, a wholly-owned company of Wits University which serves as the Faculty of Health Sciences' innovation arm.

Part of our work is to develop models for future healthcare delivery, which links closely to the discussion on the 4th Industrial Revolution. I am excited by the opportunity to discuss delivery in the health services area, where we have a need to break down barriers, minimise silos and ensure collaboration across various parts of the system. Several improvements have been implemented in healthcare, and the future NHI may also address some of the inequalities in the system.

Since most of our doctors currently serve the urban areas, we could use tele-medicine to patients in rural areas. We could provide cheaper and more effective treatment to people using technology, which will become increasingly available. The third part is that we should empower patients, which could be done through giving them access to information. Currently patients are required to wait for their doctor to contact them to share test results, which could in future be provided immediately on their mobile phone – this puts patients at the centre of what is happening, which is not happening now. There is a serious shortage of healthcare professionals in South Africa. If we increase the technology available to us, we could train doctors and nurses using robotics, which could provide more responsive, appropriate and more affordable interventions. Lastly, we should work to strengthen partnerships between government and other role players to improve training for the next generation of healthcare professionals.

**Bassanesi:** My background is in education, in mechatronics and people development. The first presentation highlighted the gap between industry and universities. It might be useful to issue competitions to invent solutions for industry partners, making use of the brain power available in universities. This could improve the educational process, benefit communities, and could motivate students. It is important to ensure alignment between the values of the university and its partners.

**Rajah:** We must remember that we are situated in Africa, and as such have many challenges – such as poverty alleviation and eradicating inequality – which we must resolve. We must focus on the UN's Sustainable Development Goals, which we could achieve by creating a more enabling environment for stronger partnerships between government, universities and industry.

Our responses to the 4th Industrial Revolution should probably focus on developing individuals with strong problem-solving skills, which will require higher levels of education. To produce individuals suited for the world of work would be critical – numerous people apply for jobs everyday who are hardly equipped to enter the world of work.

Although we are always looking for funding, universities must also understand that businesses are looking to generate value and profit; they are not in the business of charity. Universities will also have to embrace a corporate culture to survive in future. We must generate more endowments for universities to be financially viable – the reason why South Africa lags behind is because we are not generating IP and patents. If we want to be competitive on the worldwide stage, we must increase our revenue generating capacity through IP projects.



University curricula must be reviewed, and we must also revisit the way we teach – the use of corporate partners in academia should be strengthened. The work that universities produce generates considerable brand value and instills confidence from corporate partners, so data analytics would be important to illustrate that value. We must be more aware of what we need to change in Africa and South Africa and use the technology and information available to us to bring about those changes.

**Ryan:** It is important to understand that in all our projects as universities the UN SDGs should inform what we do, and that although we should foster partnerships with relevant partners to optimise our outputs, we must not lose our agency

### Question and answer session

**VUT:** Although we heard that relationships between universities and industry require careful management, we also heard of the successful collaboration between Rutgers University and J&J. What key strategies did Rutgers adopt to stimulate cooperation with its industry partner?

**CPUT:** We seem struggle to get our partnerships right in South Africa, even though we could solve so many problems if we worked in teams. We see a trend towards consortiums to address societal problems, but our current model does not follow this dictate despite very clear, effective examples.

**UP:** Could you give some pointers on how the timelines between industry, which requires immediate results to keep the competitive edge, and universities, whose slow response rates are frustrating for industry partners, could be resolved. How do you ensure regional growth in partnerships, and how do you ensure that other universities in your region are brought into the fold?

**Quincy:** In terms of easing the clash of cultures, it helps that Rutgers and J&J have been partners for 150 years. There are literally thousands of Rutgers alumni working for J&J. When you have a partnership in which the partners do not know each other so well, the clash becomes more real.

Risk analysis and due diligence are important elements of entering into partnerships, but one should also not rely only on lawyers to drive the process – the impetus, accountability and responsibility cannot reside with lawyers. Every time a new partnership is being discussed, the lawyers will give you several reasons why such a partnership cannot work. At Rutgers we generally rely on our more entrepreneurial professors to drive these relationships, and while we protect ourselves legally, we do not allow these issues to scupper a viable deal.

We have appointed a Senior Vice President for Research and Economic Development to focus on research from an economic point of view. One must be equally careful not to focus only on money; partnerships should also be about other values and benefits for the university, its students, and for the industry partner.

Finally, even if there was no money on the table, the value of mentorships and exposure to the world of work is very important. These relationships between students and their mentors can be lifelong.



**Manilal:** It is not only university and industry partnerships that are important. One of the flaws in the South African system is that we fixate on benchmarks from Europe and America, but that we seldom look at top universities in Africa or the SADC region.

Universities in our country are serious drivers for change and catalysts for growth, but they are largely lying latent because we focus on Europe and the US. We must mobilise our resources to resolve our local problems. We have numerous social problems and service delivery issues, and we must develop skills that would stimulate our own economy and address these problems. Universities must produce job creators, and not job seekers. Universities must be accessible to communities; they are currently mostly inaccessible to the communities around them. We must be making the most of the limited resources available to us. We must also think about the projects that we fund. Instead of doing research to change the colour of roses – for which there is no doubt a market, but how critical is it really - we should focus on resolving our current societal problems, such as getting books to schools in Limpopo and feeding people.

**Rajah:** It is true that the curriculum needs to be reviewed. There are programmes that teach students, but they are not acquiring any skills of value, and one should ask how the SETAs allocate funds to those projects. In Africa we have priorities, one of which is to create jobs. We have the highest unemployment figures, and we must put thought into how our outcomes are achieved, which must be properly audited. A couple of years ago our country had no black fashion designers, which we have developed to create designers with brand value. The problem is that we need to replicate these initiatives and programmes, to stimulate a more entrepreneurial system. We need to collaborate and share more, for which we need collaborative exchanges with businesses and other partners. Rapid prototyping is what we need to respond to our needs, but that needs the quadruple helix to be working properly.

**CUT:** The speakers all spoke about skills development. In our country, there is no awareness of the other types of institutions that could develop skills across various levels, instead of starting off at university. Students view anything other than universities as of lesser quality. We must also address the problems of the basic education system, which is not aligned with the needs of the university system. In schools, students are discouraged from doing mathematics because their marks may be too low to pass.

?: Technology-driven transformation is critical. We should consider how we could develop standards and regulations to help facilitate responses to the 4th industrial revolution.

**TIA:** Mr Rajah raised an important issue about Africa not yet responding adequately to the 4th industrial revolution. School leavers are not appropriately trained to respond to the needs of the 4th Industrial Revolution – are we ready to tackle our own social problems, particularly in health and other areas?

**Manilal:** I concur that we need an urgent response. For me, it is important to teach people to think. We need to develop higher order learning and critical thinking, rather than merely knowing things in theory. #Feesmustfall was probably the best opportunity to restructure higher education in South Africa, and we missed it.



**Nxesi:** If we do not collaborate, we will perish as a society. We have got funding available, but we must resolve the silo mentality – we have thousands of schools, many colleges, private institutions and 26 universities, all of which must work together on skills development. SETAs have a role in this regard, but our challenge is that we view universities as the only vehicle to develop skills, overlooking TVET colleges. Our country needs diverse skills of high quality. We are not bankrupt as country, but we do waste a lot of our resources, which is a pity. Government must play a critical coordinating role.

**Pillay:** The 4th Industrial Revolution cannot be a driver for change, but it is a tool that we must use optimally to harness technological advances that will serve our needs. Key to that issue is how we democratise delivery of these objectives to the country and the continent.

**Bassanesi:** It is good to see the focus on soft skills development. The focus of the 4th Industrial Revolution is not on robots, but on people.

**Rajah:** We need to train young people to be entrepreneurial. If we do not, we will only be training people to enter higher paid jobs. We must equip people with the skills to solve complex problems, to be better than AI, but also to be accountable and responsible and to take ownership for processes that will help vulnerable communities to improve their situations. In South Africa we must be cognisant of the fact that we are still coming to terms with overlapping challenges from the 2nd and 3rd International Revolutions while having to adapt to the 4th Industrial Revolution.

**Quincy:** Understand who you are as universities and businesses, and what value you bring to your country. Do not be too concerned about what is happening in Europe or the US. I have learnt so much from you on every visit; you have extraordinary students here who are intellectually strong and have a sense of global citizenship. When you sign MoUs, be sure that they are mutually beneficial, and that you benefit from them. Do not sign them if they are not mutually respectful.

# **ANNEXURE 11**



## ANNEXURE 11

### THEME 3: UNIVERSITY INDUSTRY PARTNERSHIPS IN THE CHANGING WORLD OF WORK (CONTINUED)



**Mr Trevor Raman**

*President, Saab Grintek Defence (SGD)*

Trevor Christopher Raman was born in Durban, South Africa on 22 December 1969. After graduating from the University of Durban Westville in 1994, (BSc Hons in Mechanical Engineering) he was employed by the Aero-Systems Division of Armscor. He was seconded to Aerosud Aviation where he completed his engineer-in-training programme. He was appointed technology manager for Advanced Materials and was the founding member of the Ledger Human Capital Development programme with Tertiary Institutes. He held various programme manager positions on transport-, trainer- and fighter-aircraft as well as weapons systems, which included ILS manager for the Rooivalk Attack Helicopter and Cheetah Dual Mid Life Upgrade.

In the year 2000, Raman received an MBA scholarship in Aerospace in Toulouse, France. Part of his studies included work exposure at Airbus and Turbomeca. On completion of his MBA at the end of 2001, Raman was seconded to Sweden as the ILS programme manager for Gripen. In 2005, he was promoted to senior manager technical and the Gripen programme manager. He was responsible for the entire Gripen Weapon System development, production and implementation. On completion of the Gripen programme in 2011, he was appointed senior manager technology management and analysis, responsible for the execution of Defence Research and Development Fund. He spearheaded the committees responsible for Armscor Intellectual Property Policy, Armscor Technology Development Policy, Defence Technology Collaboration requirements and Defence Intellectual Property. He is also an Armscor representative in the India/Brazil/South Africa (IBSA) Defence Related Industry and Institutes collaboration initiative. He serves on various Defence Committee Working Groups. In August 2013, he was entrusted with the restructuring of the Armscor R&D Department and the integration of Armscor Defence Institutes into Armscor Corporate.

#### **SESSION THEME ADDRESS: INDUSTRY REFLECTIONS 4IR: A RENEWED RELATIONSHIPS BETWEEN INDUSTRY AND ACADEMIA**



Before 1994, SA spent close to 10% of its GDP on defence. After 1994, this spending decreased to below 1% of GDP, which meant that our relationship between universities and the defence industry declined. While one may ask why South Africa has a defence industry at all, it is important to note that it employs passionate and innovative people who have entered into international markets, collaborated and developed some interesting solutions.

The SAAB Group faced similar challenges as they were growing as a defence company. It currently offers more than 500 products to more than 100 countries across the world. The South African business is the biggest outside of Sweden. This has been achieved through good government policies that supported the development of IP and commercialisation, and strong partnerships.

SGD develops products in areas such as microwave, EW and radio frequency, and employs more than 800 South Africans. The applications of these products are used in integrated defensive aid systems, land and naval electronic defence systems, lead systems integration, command and control training systems, and health and usage monitoring systems. SGD has forged strong relationships with traditional universities such as University of Stellenbosch and Wits and would be keen to discuss possible relationships with the UoT sector.

The defence sector in South Africa is about more than its most well-known constituent, Denel. An organisation known as Aerospace Maritime and Defence comprises 80 individual companies working in this sphere and which contribute R 20 billion in revenue to the GDP, 70% of which is from export customers. This means that private industry is self-sustainable and has considerable growth potential. All these defence companies are intent on growing for which it will need to employ knowledgeable people to do research and development in keeping with the 4th Industrial Revolution. UoTs could benefit greatly from relationships with these companies.

Considering that innovation is a key pillar of SGD's business, the company spends approximately 25% of average sales per annum on research and development. The focus is on engineering processes and re-engineering to compete with large companies internationally, which drives price to market and innovation which in turn need improvements in product lifecycle processes, business processes, and the innovation cycle. People are key to the business, and by partnering with universities it will be possible to secure graduates that will help the company to remain globally competitive.



It would also be necessary to engage government about regulatory frameworks that impede export business and prevent the generation and commercialisation of IP.

In the product lifecycle, basic and applied research are critical components of the triple-helix model. Companies tend to understand the customer's needs, while universities best understand the technology. These different strengths must be optimised to develop workable solutions. SGD focuses on both spin-on and spin-off ventures, which include digitisation of elements from the internet of things.

To put the triple helix in action, SGD's innovation strategy focuses on strategic research areas within the strategic national research agenda. Activities are based on forums, research networks, technical clusters, demonstrators and arenas, closely co-ordinated with the National Programme for Aerospace Research. Various stakeholders join forces in both domestic and international triple helix contexts where cooperation is mutually beneficial.

SGD would be keen to collaborate with universities to open access to markets, and to facilitate access for industry partners to the knowledge sharing programmes offered by universities. Another element is digitisation – it requires people, it creates a knowledge base, increases mobility and opportunities for collaboration. AI is already part of the SGD business model. Employees are also encouraged to consider innovations in non-core areas.

Because of uncertainties around IP, SGD prefers to self-fund its projects, amounting to R 130 million per year. Universities could participate in these projects. In Sweden, government invests in Saab, which develops the IP but shares the royalties through an agreed formula. Industry can take IP to market to generate income for universities, in addition to various other beneficial models that should be explored.

#### **Question and answer session**

**TUT:** Would you consider a different model for sharing royalties from IP than the one that you mentioned?

**Raman:** There are various other IP models to explore. SGD would consider co-ownership, but it is important to consider the optimal management and control of IP, because industry partners are in the business to make money. Often university partners do not understand exactly what is required in terms of product development and industrialisation to take IP to market. Companies are willing to invest in those phases, and if one could enter into an agreement, sharing might be possible. If universities would want free right of use and possible sharing of IP with our competitors, universities would not be amenable to entering an agreement. We recently concluded an IP agreement with the CSIR, after resolving governance issues associated with that agreement. There must be some controls in place.

**TIA:** Our greatest need is to build a strong entrepreneurial capability and support innovators and entrepreneurs to develop useful solutions. Do you have mechanisms to strengthen the supply chain for those companies?



**Raman:** The greatest emphasis should be on supply chain optimisation to reach the market as quickly as possible and develop products that will be functional and easy to industrialise and manufacture. University interventions could benefit industry greatly by optimising non-core functions such as supply chain.

**Chair:** What should UoTs be able to deliver to industry, and what is expected from them?

**Raman:** It would be useful for UoTs to come and see what SGD does. We are focused on production and getting product to market, so we do not fully understand what universities can offer. Come and see what technologies and factories we have. We will also happily invest in universities.

**Padayachee:** Thank you for the invitation. A delegation of technology-focused universities will most definitely use the opportunity to discuss possible interactions and sign an MoU with SGD before the end of the year.

# **ANNEXURE 12**

## ANNEXURE 12

### THEME 3: UNIVERSITY INDUSTRY PARTNERSHIPS IN THE CHANGING WORLD OF WORK (CONTINUED)



**Dr Raymond Patel**

*Chief Executive Officer, merSETA*

Raymond holds a Phd in Education Management, focusing on Performance Management. He has over 30 years of experience in Education and Training. He was a teacher, lecturer, education planner, teacher development, director of Education, MD of a company he founded. Previously the CEO of Chemical SETA (CHIETA) and since 2006 the CEO of merSETA.

He is a Board member of the Human Resources Development Committee of RSA (HRDC)

#### **INDUSTRY PARTNERSHIPS WITH UNIVERSITIES OF TECHNOLOGY (UoTs) AND TECHNICAL VOCATIONAL AND TRAINING (TVET) COLLEGES – PLACEMENT OF STUDENTS: WORK INTEGRATED LEARNING (WIL)**



Charles Darwin said that it is not the most intellectual or the strongest species that will survive, but those that are able to adapt and adjust to changing environments.

The merSETA is focused on corporate citizenship, integrated thinking, and viewing the organisation as part of society. It also considers it important to include stakeholders in tackling the imperatives of the 4th Industrial Revolution. Our culture is about the philosophical underpinnings of caring, serving, and belonging, all of which are about people.



The buzzwords around the 4th Industrial Revolution are computation, networking and physical and cyber-physical algorithms. We must understand what it means to talk about 3D printing and additive manufacturing, Artificial Intelligence, automation, Big Data and Big Data analytics, the Internet of Things, robotics and digital manufacturing. It is critical to find ways to adopt a holistic approach to education and training, which must include the schooling system and TVET Colleges. All these approaches require partnerships with institutions and industry both locally and internationally. merSETA is also engaged in a project with JET to make all the learning materials available in the cloud.

Our economy must be strengthened to transition into a knowledge economy, and we must transform our declining manufacturing sector, heavy reliance on imports, and uncompetitive resources through innovation and labour productivity.

merSETA is the largest SETA in South Africa and it focuses on beneficiating and growing our economy by adding value through IP and research and development. The 4th Industrial Revolution must enhance and change traditional manufacturing processes, but we need people to be part of the process. If labour were present at this conference, they would object to every point that had been made here. We must be conscious of the need to create new opportunities.

merSETA has identified several potential solutions linked to the 4th Industrial Revolution, such as mobile device-based machines, autonomous vehicles, logistics automation, self-diagnosing machines, etc. It is interesting that not one single human hand is involved in manufacturing an iPhone, until the phone is packaged and sold. People are scared that they will be without a job, but do not realise that they must develop a new set of skills for the future in areas such as robotics, AI, coding, cloud computing and networking.

It is necessary to challenge the archaic ways that we construct our curriculum to move from Industry 2.0 to Industry 4.0. By the time committees in our institutions have met and discussed curriculum change, the technology has already transformed.

Manufacturing processes become agile and automated, products must be increasingly personalised and customised, small factories must be set up at decentralised locations, we need dynamic and predictive supply chains, and high-level and direct relationships with customers.

Industry 4.0 has had a lukewarm reception in most areas, apart from the automotive industry which has fully-operational, extensively automated smart factories as seen in innovation-driven environments.

There is a need for alignment between government, industry, and training institutions. Singapore has done it successfully, and we must learn valuable lessons from them. We must correct our education system to improve the input, otherwise our output will remain bad. Another concern is the limited interest in innovation in general – we tend to see it as a cost, and not as an enabler.

Skills for the future must be aligned to the tasks that we want employees to undertake. We must think what kind of new machines and tools will be deployed in future manufacturing plants, and how the operator will use these new tools and machines. It will also be important to think what skills people will need to successfully execute tasks. It will be necessary to think how qualification



requirements will change. How much manual work will be done? What will the new mode of communication be? The problem is that we also discount the value of institutions like TVET Colleges.

The challenges include the mismatch between demand and supply, access, lack of industry training, outdated curricula and lack of qualified teachers/lecturers which impact on the quality of programmes, whether the NQF is still relevant, lack of resources, the negative image of Technical University training and TVET Colleges, and the SETA landscape beyond 2020.

The SETAs cannot afford to address all these issues on their own. It is therefore critical to enter into partnerships, to collectively find a solution to the problem. Some international partnerships identified jobs of the future and helped to establish partnerships and collaborations to develop the technical and vocational skills that will be needed in future. merSETA is therefore developing an atlas of future jobs, using virtual reality, augmented reality and indigenous career and life design. In Germany, students were supported to complete PhD programmes at Bremen University, and are expected to re-invest their time in developing TVET College lecturers.

Return on Training Investment was addressed through a tool that was developed to support learners. The premise is that this investment will deliver far more return than was invested. Industry must invest more money in training.

It will also be important to engage rural universities, to expand this kind of developmental thinking beyond the urban universities. A Chinese motor manufacturing company identified the need to train graduates to work in local motoring factories. Lecturers were also exposed to mechatronics, automation, and other innovative practices. China hosted the BRICS Skills Competition in 2017 and South Africa will host the next one. This event will create opportunities to expose lecturers and students to future skills by advancing skills development and encouraging students to understand the skills areas open to them.

In 2017/18 a project to provide students with WIL opportunities was initiated. Various Chinese companies that could provide structured work placement for students were identified, and students were placed with them. Of 199 students who took part in the internship 158 graduated. 15 learners will return to China to complete their degrees of which 5 will complete Master's degrees. This year, another 200 students will visit China.

#### **Question and answer session**

**CUT:** In the morning we spoke about skills and learnt that our institutions impart knowledge which is not always relevant. We must ensure articulation between universities and TVET Colleges.

**NWU:** Since yesterday we have heard of the misalignment between TVET College and university curricula. The question is how we will rectify this misalignment. In assessing a computer skills module for a public TVET College, it was shocking to learn that the course still mentioned a floppy disk, and that the software used to teach students was obsolete. The skills we provide to learners must be current and relevant.



**Patel:** There is a college called Taletso in Mafikeng where the average age of lecturers was 26. This could be viewed as either impressive, because the staff are all youthful and energetic, but on the other hand they might all be too junior to make a valuable contribution to their students' education. I served on the Umalusi Standardisation Committee for 8 years, and the pass mark in the TVET Colleges is way below 26%. It indicates that lecturers were inexperienced and did not have the required skills.

We view education too lightly in this country – when we change the curriculum in the school system, we think that a three-day workshop will change a mindset in our teachers that had been adopted 30 years ago. There is something wrong with our teaching methodology and our research into teaching practice. We need mechanisms to update our education system. We cannot teach learners about outdated concepts and think that they are going to be prepared for the future. Skills development was the quickest get-rich scheme in the past 20 years, with people who have not passed matric opening institutions because there was no control. We must focus on the quality of the training provided to our learners. We must address the quality of the training we provide to people. Poverty and social injustice are to blame for people not entering the system; therefore, articulation between TVET Colleges and university must be done properly.

**Tshwane TVET College:** There are various problems in the system, such as bridging the considerable gap between poorly functional workshops in TVET Colleges and those in industry. Is there a policy mechanism to ensure that TVETs deliver on their mandate, and whether the funding they receive is well spent?

**Patel:** Together with the CSIR, we are drafting a blueprint to determine what TVET Colleges should look like.

**Chair:** We need to understand what the jobs of the future will look like. We also need to understand that if we teach today's student as we taught yesterday's students, we will rob them of tomorrow. SATN should celebrate the unique identities of UoTs.

# **ANNEXURE 13**

## ANNEXURE 13

### THEME 3: UNIVERSITY INDUSTRY PARTNERSHIPS IN THE CHANGING WORLD OF WORK (CONTINUED)



**Mr Richard Hardiman**

*Entrepreneur and Environmentalist, Ranmarine Technology, Waste Shark Drone*

Richard Hardiman is the founder and CEO of RanMarine Technology, a Netherlands based USV (Unmanned Surface Vessels) company. RanMarine's focus over the last 18 months has been on the release of their WasteShark Drone; a surface vessel that collects plastic and biomass waste from water. Richard's presence at the WasteExpo is primarily based on sharing the idea and product innovation of the WasteShark as a new, more efficient tool to collect plastic waste from ports, Marinas and in-land waterways.

Richard Hardiman divides his time between Cape Town, South Africa and Rotterdam, The Netherlands. Richard's background is predominantly in startups and scale up businesses, which RanMarine is the current focus of his activities.

The WasteShark, which now sees action in India, Europe and in the next few weeks the USA, is a simple but technological game changer in the fight against plastic waste in our Oceans and Biomass pollutants.

## SHOWCASE



RanMarine Technology develops drones for our environment, which are used to service and survey the environment around us, with a particular focus on smart-cities and maritime needs.

I came up with the product on a windy day in Cape Town when I saw two guys trying to clean rubbish out of the water using a dragnet and a small boat, which was inefficient and outdated. I did a little bit of research to find something more efficient and identified that the rest of the world also used two men in a boat with a net. Considering the plastic problem that we currently have, there had to be a better way to do it. I wanted to find a solution at source.

The Waste Shark not only removes garbage from the water, but also collects information which could assist people to assess water quality and for sonar imaging. It is also possible for cities to do immediate tests on their water quality, which they can keep for future comparisons. The more information is collected, the more valuable the data is becoming. The reason why we ended up manufacturing the Waste Shark in Holland was because there was no partner willing to fund the business in South Africa, and because it was easier to access people with the necessary knowledge and skills that were willing to help. No university, investors or government departments were interested in the project, yet now most of the interest comes from South Africa. It is irritating that our policy environment often does not support projects such as this locally.

The problem with an autonomous closed-loop system is that it could cause people to lose jobs. The beauty of the system is that people are still needed to manage the drones, but that they are upskilled and empowered to do their work in a much more efficient way. The objective is to have as many drones in the water to collect as much data as possible. Any opportunity for collaboration would be welcome.

### Question and answer session

**SMU:** In terms of data collection, do you analyse the data, or do you sell it raw to other parties? Do you have a warehouse where you store the data, or do you store it in the cloud?

**Hardiman:** Currently the data is probably only valuable to our client. We are however keeping all the raw data in the background, so we have data on Cape Town, Mumbai, London, Amsterdam, and we might release reports or sell it on at a later stage. We hope that once we



have thousands of drones we would be able to generate some data on the environmental impact. The data is stored in our servers in Rotterdam.

**CPUT:** CPUT would be interested in your project, because we are working on a similar project. We will engage with you.

?: Part of the 4th Industrial Revolution is about the skills. Did you have engineering skills that equipped you for developing the drone?

**Hardiman:** As an entrepreneur I would go for a gap, even though I may know anything about the subject. My previous business was in beauty products. I built the first prototype for the Waste Shark in my garage, using plumbing pipes and ideas from the internet. I watched a lot of YouTube videos. My premise was to make it work because if I could make it work, I knew that I could find far more knowledgeable people to make it work. We currently work with engineers in Europe who are methodical but also quite expensive. If we had done it here, we might have been able to produce it much quicker and cheaper.

**Patel:** NMU students are developing drones to study sea life and to deliver medical supplies to ships. You should speak to them.

**Chair:** Product innovation is obviously critical to generate data that could be used to inform further innovation. Thank you for your presentations.

# **ANNEXURE 14**



## ANNEXURE 14

### THEME 4: THE 4<sup>th</sup> INDUSTRIAL REVOLUTION AND SUSTAINABLE FUTURES



**Prof. Chris Adendorff**

*Professor in Future Studies, Nelson Mandela University (NMU)*

Chris Adendorff is a Professor at the NMU Business School and MD of various entrepreneurial ventures in South Africa, Greece and England. He has been a business entrepreneur since 1985 and, along with his Professional Futurist Architect wife, Gillian, built up their family business to such a degree that they are currently active both nationally and internationally. Prof. Adendorff holds 3 Doctoral degrees, a PhD he obtained from Rhodes University, a Doctoral in Business Administration in Future Studies from NMU and a PhD in Development Studies from Trinity University in the USA. Prof Adendorff also holds 2 Masters Degrees namely Masters in Commerce obtained from Rhodes and a MPhil (cum laude) in Futures Studies obtained from Stellenbosch. He specializes in Futures Studies, Scenario and Strategic Planning, Governance and Turnaround Strategies and lectures and promotes Futures Studies, Foresight for Development and Entrepreneurship at various Universities and organizations around the globe. Prof Adendorff has successfully promoted 36 Doctoral studies and more than 150 Masters Research efforts to date. Prof Adendorff currently also consults with various Governments and municipalities in South Africa and abroad on their Strategic Foresight Initiatives and turnaround strategies and is also the author of the South African Futuristic book: *The Future of South Africa towards 2050*.

To date, Prof. Adendorff has written a further 9 books and published over 100 articles in national and international journals on Future Studies, Technological Entrepreneurship, Leadership, Culture, Governance, Foresight and Innovation, Strategic Management, Demographics, Systems Management as well as Turnaround Strategies. Prof Adendorff has also delivered around 500 strategic presentations and television talk shows. He further serves on the Boards of the World Future Studies Federation (USA), the International Association of Futurists (Finland), the International Association of Social Entrepreneurship and Innovation (UK), the International Association of Social Enterprise and Entrepreneurship (USA), as well as the Board of the Interscience Publishers Ltd (UK).



Amongst other affiliations, Prof. Adendorff is a member of Development Consultants for Africa, Future Trends Network (USA), Future in Review (UN), Global Foresight (USA), International Association of Advisors in Philanthropy (USA), International Network of Socio-Eco Entrepreneurs (INSE), International Scenario, Future and Strategy Group (USA), Systems Thinking and Systems Dynamics Practitioners Global Network (USA), The Philosophy Network (UK), the world acclaimed Lifeboat Association (USA) as well as the World Future Society of South Africa. He also serves as a committee member of various other non-profit organizations in South Africa, England, and Greece. Prof Adendorff is driven by the conviction that negative outcomes are not inevitable and that it is possible to shape our future as future makers, based on the choices we make at critical branching points in the present.

### SESSION THEME ADDRESS: TRENDS FOR THE FUTURE



The future is arriving vaster than ever before. Mankind will experience changes that had never been anticipated and it is how we prepare for that future that will help us survive. There is no room for negativity. We must 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. 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. Emotional, spiritual and cultural intelligence fall within this scope.

The 1st Industrial Revolution was based on mechanical production equipment driven by water and steam power. The second was based on mass production enabled by the division of labour and the use of electricity. The third industrial revolution used electric and IT systems to further automate production.

In the 4th Industrial Revolution, Li-Fi may replace Wi-Fi, using light to transmit data wirelessly at even greater speed than ever before. It might also be able to transmit data more securely. It will also be possible to move from rural tools to wearable technology. People will in future not accept old limitations. It will be necessary to improve access for all our people to the internet.

AI is intelligence exhibited by machines, AI systems seeking to process or respond to data in a human-like way. The Internet of Things is a platform for devices to communicate with the world around them and to integrate human, natural and the built worlds to be connected anywhere and everywhere. The growth of the internet of things has been exponential. It is anticipated that over 50 billion devices will be connected by the end of 2020. We must look positively at more connection to increase opportunities. The world has more people every day and people will grow increasingly older. By 2050, Africa's population will reach 2 billion, most of them young.



Blockchain has potential applications in digital currency, smart contracts, securities and record keeping. Blockchain is radically changing the future of transaction-based industries, covering issues like digital rights, wagers, escrow, equity, private markets, etc.

In Japan, robots are already able to work unsupervised around the clock for up to 30 days without interruption. In 2018, 570 000 'robo-surgery' operations were performed. In future some current job positions will fade away while others will see a rise. The top ten skills that will be critical from 2020 onwards include, among others, complex problem solving, critical thinking, and emotional intelligence.

60% of jobs that will exist 10 years from now have not yet been invented yet. 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.

By 2030 we will see highways devoted to autonomous cars, and we will see over 40% of all new construction from printed buildings. In Dubai, a building of 32 storeys were printed in just over a month. It will be able to construct future cities and districts in short time.

Mega trends include augmented reality, urbanisation solutions for public, convergence and connectivity, smart is the new green, and smart districts. In the future, we will have to think of sustainable energy solutions such as using the sun's energy in cars, buildings and everywhere else. The cost of solar power will become increasingly more affordable.

Design will also change to incorporate elements such as smart energy, smart mobility, and smart technology. Future cities will be fully-automated 24-hours a day. It will be critical to have vision, skills, incentives, resources and action plans to manage this change. If not, there will be confusion, anxiety, resentment.

HR is currently preparing for a wave of transformation, brought on by changes in technology and generational differences. The 4th Industrial Revolution is already starting to change the world around and the way we work with the advent of AI, robotics and other innovations. Over the coming years we will have to address skills gaps, and HR will not be immune to the way that technology will reshape every aspect of society in terms of hiring, training and record-keeping. Emerging technology will transform business and help the workforce to adapt, and there will be new ways of organising people, working and learning.

8 key drivers of change will be critical for the future. We must rethink the workplace, continuously adapting with blended and swarm workforces and 'gig' workers. There will be talent wars and tours of duty and outsourcing of HR. Teams will work faster and smarter, which will require continuous performance reviews. This will mean flexible benefits in terms of salary, healthcare, discounts, location, hours and opportunities. 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. We must consider the role of people in this process and ensure that change is managed properly. Technology can do more of our work, but we must remember that people will remain important.

# **ANNEXURE 15**

## ANNEXURE 15

### THEME 4: THE 4<sup>th</sup> INDUSTRIAL REVOLUTION AND SUSTAINABLE FUTURES



**Dr Azar Jammie**

*Director and Chief Economist, Econometrix*

Dr Azar Jammie is Director and Chief Economist of Econometrix (Pty) Ltd, South Africa's leading independent economic research consultancy and forecasting company, established in 1982. He has been in his current position since December 1985 and has established a significant profile in South Africa as an analyst and commentator on domestic and international economic affairs. Dr Jammie has conducted over 4000 presentations to leading client corporations and other institutions as well as at conferences dealing with the local and international economic environment. In this capacity he has also been invited over the years by several corporations to serve as independent non-executive director. Dr Jammie is also a member of the National Advisory Council on Innovation, a body of experts appointed by the Department of Science and Technology. He is project leader of the annual production of a booklet of data detailing the state of science, technology and innovation in South Africa. Dr Jammie was recently honoured with a Lifetime Achievement Award at The South African Professional Services Awards Association (sponsored by Sanlam).

Academically, Dr Jammie obtained a BSc (Hons) in Mathematical Statistics and a BA (Hons) in Economics at Wits, followed by an M.Sc in Economics from the LSE and a PhD at the London Business School.



**Prof. Seeram Ramakrishna**

*Director of the Centre for Nanofibers and Nanotechnology, National University of Singapore*

Professor Seeram Ramakrishna, FREng is the Director of Center for Nanofibers and Nanotechnology at the National University of Singapore (NUS), which is ranked as number one university in Asia, and among the top 20 universities in the world. He pioneered nanotechnology and materials circular economy in Asia. He is a member of World Economic Forum (WEF) Committee on Future of Production-Sustainability. He chairs the Circular Economy taskforce. He is a Highly Cited Researcher in Materials Science (Clarivate Analytics). Thomson Reuters recognized among the World's Most Influential Scientific Minds. A European study placed him among the only 2,610 researchers with H index over 100 in the history of science and technology. (<http://www.webometrics.info/en/node/58>)

He authored over 1,000 international journal papers which received ~82,000 citations and 134 H-index. He received PhD from the University of Cambridge, UK; and The General Management Training from the Harvard University, USA. He received numerous recognitions which include CUT Honorary Engineering Doctorate; APA Distinguished Researcher Award, IFEEES President award- Global Visionary; GEDC Ambassador; ASEAN Outstanding Engineer Award; IES Prestigious Engineering Achievement Award; IITM Distinguished Alumni Award; NUS Outstanding Researcher Award; CPS Biomaterials Award; Cambridge Nehru Fellowship, and Singapore LKY Fellowship. He is an elected Fellow of UK Royal Academy of Engineering (FREng); Singapore Academy of Engineering; Indian National Academy of Engineering; and ASEAN Academy of Engineering & Technology. He is an elected Fellow of International Union of Societies of Biomaterials Science and Engineering (FBSE); Institution of Engineers Singapore; ISTE, India; Institution of Mechanical Engineers and Institute of Materials, Minerals & Mining, UK; and American Association of the Advancement of Science; ASM International; American Society for Mechanical Engineers; American Institute for Medical & Biological Engineering, USA. He is an editor of Elsevier Current Opinion in Biomedical Engineering.

He is an editorial board member of NATURE Scientific Reports. His leadership roles includes University Vice-President (Research Strategy); Dean of Faculty of Engineering; Director of NUS Enterprise; Director of NUS Industry Liaison Office; Founding Director of NUSBioengineering; Founding Co-Director of NUS Nanoscience & Nanotechnology Initiative, NUSNNI; and Founding Chairman of Solar Energy Research Institute of Singapore, SERIS. He founded a successful international organization- the Global Engineering Deans Council, GEDC (<http://gedcouncil.org/ambassadors>). He advises universities, corporations and governments around the world.



## RESPONDENTS SESSION



Dr Jammie 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 comes from only a small number of universities, which will require the other universities to be capacitated.

However, the solution does not lie only with universities. There also needs to be a strong focus on education in the schooling system. Only half of the students that enter school eventually finish matric, and do not end up in artisanal or vocational careers. Only one out of every 35 scholars entering the school system will go on to study at university, which is a major challenge.

Prof. Ramakrishna responded 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. 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 cheaper. If we think about a sustainable future, we must also consider our traditional strengths and optimise them.

### Question and answer session

**Chair:** How do we reconcile a lack of trust in our municipalities given the poor governance track record that they have demonstrated to date?

**Adendorff:** the job of a futurist is not to scare, but to identify opportunities that will arise in the future. Younger people are generally not scared of change. South Africa is not the only country with problems and issues, and it will only get better. The issue in South Africa is not poor governance at municipal level, but the problems that we have in terms of education. We closed our teacher training colleges a couple of years ago, which was a questionable move. We don't have capable teachers and headmasters – we need 800 000 of these people. We also need



feeding schemes for our children at schools. There is a select number of people who are working to bring about change and we are seeing it happening in our municipalities.

**CUT:** How do we ensure that our older trainers and teachers adapt to the changes that our future demands?

**WSU:** How will our literacy rate in South Africa affect our responses to the 4th Industrial Revolution?

**CUT:** Teachers are our hope for the future – we should also consider the future classroom and lecture hall, and we must ensure that our curriculum also keeps pace with future changes.

**Adendorff:** It will be about supply and demand. Universities will have to improve their ability to provide e-learning – many students learn more through YouTube than from their lecturers in the classrooms. It is argued that if we can train every child in South Africa to the age of 15, we will have the second highest economic growth in the world. The figures are staggering, but sadly, the WEF rates South Africa low in terms of our STEM performance. If national government cannot see that even South Sudan currently beats us, we must find solutions. Our basic education system must equip everyone up to the age of 15 with a sound education, and feed them adequately, which will eventually pay off.

**Jammie:** What has been overlooked in South Africa is pre-primary education and ECD – the role of parents and grandparents in preparing kids for schooling and eventually for further study. I think it was a mistake to first approve free higher education, while spending on the basic education system has been left behind – it does not work that way. It is not entirely negative – there are some schools, perhaps 10% of schools – where e-learning has been implemented. Unfortunately, many of them are private or former Model C schools, so we once again have a society that is skewed and with heightened inequality, which will in turn create all sorts of social upheaval.

**Ramakrishna:** The people working in the private sector will probably be the first to upskill themselves, given the fact that their futures are not guaranteed. It will be important for any system to ensure that they focus on STEM, future-proofing people to ensure that their skills remain relevant. The economy must be safe-guarded to provide the resources and means for the future, making it a circular process.

**CUT:** How can small businesses and existing capacity be preserved, both in terms of HR and other business processes?

**CPUT:** The ratio of youth in South Africa will be increasing, which means that we must focus on capacitating them for the future. We must ask them what their perspective on the future is.

**DUT:** How do we translate our research into practical solutions in the South African context, given that we have no access to cheap internet connectivity? What can we do to improve that provision, just as we focus on better performance in STEM subjects? What are the top five future careers that we should be preparing people for?



**UKZN:** How could the public healthcare system respond to 4th Industrial Revolution in taking healthcare to people in rural contexts?

?: If one considers the classification of subjects used by the DHET to fund our programmes in universities, why are some areas such as Agriculture receiving more funding than STEM subjects? How do we increase the impact of what we do, and how we do it?

**Ramakrishna:** In terms of public health, the 4th Industrial Revolution could give us access to data that will help doctors and public health officers to make better decisions. Models for good practice in these areas exist that could be emulated here. Another question related to learning in universities – one example might be to adopt the concept of ‘model factories’ using IR technology to train the next generation using completely digital technologies.

In terms of agriculture, in my limited understanding of South Africa, it will be critical to ensure that last-mile connectivity is prioritised. Considering that South Africa’s scientific output improves exponentially, it will be critical to ensure that its impact and relevance continues to be prioritised. Evaluation systems in universities and across the country must also be used to ensure that these aspects are addressed.

**Jammine:** In terms of employment, there are massive opportunities for new jobs to be created, but we must strengthen basic education for people to develop their own jobs. Regarding public health, there have been major advances in terms of AI and other technologies, which currently are unfortunately located in the private sector, but would have major positive spin-offs in the public sector. There is a need for the public and private sectors to build trust and collaborate better, making the most of the pockets of excellence that exist. The major constraint is a lack of trust and cooperation between public and private sectors.

**Adendorff:** We must remember that the future belongs to those who can see the opportunities in the challenges presented to them. It is important to remember that every change in technology has improved life for people over the generations – we just have to anticipate and prepare for the future. In terms of healthcare and agriculture, we must remember that it is about technology and energy – those aspects will determine the future jobs. The developing nations in the world are ageing, while in Africa we must prepare the youth. The future university must be prepared to teach young people and prepare them for the jobs of the future, quick in and quick out, using e-learning and adapting to change as they go along. Our business models as educators must change. We simply must maintain a positive outlook and prepare for the future.

**Jammine:** According to the data, the proportion of the population who have cell phones in SA is among the highest in the world. This means that the proportion of people who could access the internet is also among the highest in the world, which means that in theory we should be able to improve education in the country. One of the huge impediments is the cost of band width, which should be resolved simply.

# **ANNEXURE 16**

## ANNEXURE 16

### SHOWCASING INSTITUTIONAL INNOVATIONS AND TECHNOLOGIES



**Mr Myles Thies**

*Director of Digital Learning Services, Eiffel Corp*

Besides for heading up our Digital Learning Services, Myles has been involved in digital education for over ten years in various capacities. He is an experienced developer and facilitator of training programmes across multiple formats including blended delivery and fully online. With his strong technical and training administration experience, Myles has responsibility for the successful delivery of the Eiffel Corp Services portfolio of projects in Africa. Myles has a wealth of knowledge as an eLearning practitioner and administrator and to add to this, he has recently been accepted in the prestigious Edinburgh University 'Master's Degree in Digital Education'. He is involved in the development and delivery of strategic and consulting services in and around product adoption, learning design, eLearning effectiveness and custom strategy development for Eiffel Corp clientele and partners. Work history includes experience in project management, business analysis, quality assurance well as IT and eLearning management. Qualifications include B. Com Business Management, PMD, Diploma in Computer Science and various executive development programmes.

## A ROBOT TOOK MY JOB AND OTHER HEADLINES IN THE YEAR 2030: FUTURE-PROOFING UNIVERSITIES AND LEARNERS FOR A RAPIDLY CHANGING WORLD



There have been many positive predictions about how the future will change, and the opportunities that this presents. There are also many predictions that fortunately never come true. Over 90 years ago Thomas Edison predicted that text books would be obsolete within 5 years, which still has not materialised. Karl Marx predicted that the concentration of power in the hands of those who controlled production would be challenged in the future, which will most likely become a reality.

AI capabilities are increasingly being reported in daily headlines, and could change the way that we do business, provide healthcare, and educate people. The think tank funded by Elon Musk recently built a robot that was able to defeat all the pro-gamers who have trained for years to play the game Dota.

Autonomous vehicles are becoming increasingly ubiquitous, which will require us to think how people currently making a living from driving should be re-skilled. 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. Over 260 job types are likely to be replaced. International economies will struggle with jobs being automated, and it is estimated that robot automation will take over 900 million jobs by 2030. 35% or 5.7 million of all jobs in SA are at risk of digital automation within seven years.

Do we need to really worry about this, or is it just hype? Different types of AI exist – weak and strong. Weak AI does only one thing really well, while strong AI has the ability to potentially think and solve problems, which could approach how people function in the workplace. This might mean that we could be unable to distinguish between a human and a machine in future. Considering that the half-life of a job skill is about 5 years, skilled workers need to get ahead of the curve. As automation increases, situations could arise the pace of innovation will be faster than we could reskill ourselves.

At this stage, it is still uncertain what the future of work will be, and how it will affect the worker of tomorrow. We do not yet understand what automation will do. 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 ready to move into the education market, which will use blended learning to cater for students who no longer want face-to-face learning.



Personalisation of the education system is not a new concept, but technology is now enabling tangible levels of personalisation. We allow learners to finish at their own pace within a maximum period, allowing them 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. We need to embrace flipped classrooms; while there are pockets of excellence in this area, most institutions only pay lip-service to this concept. Universities should also consider alternatives such as supplemental models, replacement models and emporium models rather than replicating existing functionalities.

Educator skills and capability to facilitate and impart skills in a technology-dominated space must be prioritised at every level. Teachers will have to take responsibility for their own individual development in this arena. Faculties will also have to establish active communities of practice to share with each other what has worked well and allowing for experimentation. Institutions must embed these policies, and the government and industry must also support these initiatives to ensure linkages back to industry and vice versa.

General challenges such as the availability and costs of bandwidth and mobile data should be resolved. It will be necessary to focus on lecturer and learner support through integrated orientation programmes, and by doing quality reviews and assessment. We also need baseline standards that can be applied across the system. AI and automation will be a fact of life, and we must adapt to make the world better.

#### **Question and answer session**

**??:** Do we need these innovations? Why do we not put the brakes on these innovations if they are going to have a negative effect?

**Thies:** It is part of human nature to progress, and I think we must deal with the challenges as they arise. Do we want to live in a society where we hold back progress? We should rather find solutions to the problems that we might foresee.

**MUT:** How can concept learning reinforce higher order cognitive skills in the classroom?

**Thies:** I cannot hear and understand the question – perhaps I will speak to you afterwards.

**VUT:** What is your opinion about the possibility that innovations flowing from the 4th Industrial Revolution can have negative effects, perhaps increasing crime?

**Thies:** I don't think that we can argue this upfront – there are some self-drive cars that have been in accidents, and these cases are being addressed in the legal system. It will take time to resolve all these issues and understand their impact. How the 4th Industrial Revolution's innovations would affect crime we will have to make up as we go along, as part of the design and ethical considerations.



**Mrs Halimah Rabiou**

*Technology Transfer Coordinator, Bambara Technology, Cape Peninsular University of Technology*

Halimah Rabiou is the Technology Transfer coordinator at CPUT. She oversees the intellectual properties management and commercialization for the University. Halimah hold a Master's of Science from University of Cape Town.

#### **FOOD PRODUCTS DERIVED FROM BAMBARA GROUNDNUT**



CPUT has been doing a study on the Bambara groundnut, which is an African indigenous legume that currently has little economic importance other than just to be boiled and eaten.

It is relatively easy to grow, within 4 to 5 months, and can be farmed as a cash crop requiring little water. The Bambara Groundnut will meet an increasing demand from consumers who are health conscious and want products free from lactose and cholesterol, with high anti-oxidants. CPUT 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.

There is a large market with significant growth potential and profit margin, and it tastes better than other lactose-free products currently available in the marketplace. The product could also be packaged and sold dried in powder form. Products made from the Bambara groundnut are high in dietary fibre and nutritional value.

CPUT wants to establish a manufacturing facility in SA and India to supply the local and international markets.



### Question and answer session

**CUT:** There is an opportunity for people to grow this plant – how will people make money from it?

**UP:** Why are we always looking for investors in South Africa, when we have ground breaking products such as this. What about approaching the DTI?

**NUST:** In Namibia we import fruit and vegetables from South Africa. Would it be possible to grow these ground nuts in other parts of Africa, and has soil testing been done?

**Rabiu:** People are currently growing the plants to consume. That is why we want to beneficiate it, so that there will be more of it available. There is a cooperative in Limpopo growing Bambara groundnuts in mass. We do not only want to export the raw product but want to start a factory that will add value and export the final product. Groundnuts grow well throughout Africa, so it might be possible to grow it in Namibia as well, if there are farmers that could be encouraged to do so.

We have had TIA seed funding for the first part of the study, and we approached the DTI but we have still not received any feedback from them to take the project to scale.



**Mr Gerrie Booyesen,**

*Director, Centre for Rapid Prototyping and Manufacturing, Central University of Technology*

Mr Gerrie Booyesen is the director of the Centre for Rapid Prototyping and Manufacturing (CRPM) at Central University of Technology, Free State (CUT) in Bloemfontein, South Africa for the past 9 years. The CRPM was established in 1997 as a research centre offering a service to industry, academia and post graduate students and has approximately 750 clients on its database.

Over the past ten years, the primary focus has been on AM of patient-specific implants and devices, which led to the first SA 3D-printed hemi-mandible implant in 2014. This was followed by a further seven successful AM cases, including full- and hemi-maxilla implants. The CRPM received ISO 13485 certification for design and manufacturing of patient-specific titanium implants and nylon cutting/drill guides linked to 3D printing and making it the first company or university to obtain this in SA.

Booyesen obtained his master's degree from CUT in 2007. He is currently enrolled for his PHD study at Stellenbosch University (Industrial Engineering) and his project focusses on developing a certification framework for 3d printed titanium implants. He is the author/co-author of several articles on AM and product development in accredited academic journals and has read more than 40 papers on AM at local and international conferences.

### **3D PRINTED IMPLANTS AND DEVICES: HOW TECHNOLOGY IMPROVES THE QUALITY OF LIFE FOR SA PATIENTS**

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 at CUT was established in 1997. The CRPM received ISO certification for 3D printing of medical devices, ensuring that our products conform to the highest international standards. Currently 95% of medical devices in SA are imported from other countries, which presents great opportunities to enter this market. \$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. Customised laser-sintered implants help to restore the function and appearance of these body



parts, for example 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. Very good progress is being 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 when it celebrates its first birthday later in September.

#### **Question and answer session**

**Nhlapo:** CUT must be commended for establishing this centre – it is a ground-breaking establishment, and other institutions must be encouraged to collaborate with them to compete internationally.



**Mr Ryan Hamilton**

*Durban University of Technology*

Mr Hamilton joined the DUT, Reinforced and Moulded Plastics Technology Station in 2005 after completing his Master's Degree in Mechanical Engineering. His field of expertise is the robust optimization of composite structures and has co-authored 5 journal papers on the topic. He started his career at the Technology Station as a design engineer and has since then become the Technology Station Operations manager whilst still actively involved in design and simulations. He firmly believes that there are many untapped ideas just waiting to be made a reality if only they were given a chance.

### **COMPOSITE MATERIALS AND RE-ENFORCED MOULDED PLASTICS PRODUCT DESIGN, DEVELOPMENT AND PROTOTYPING**



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 may be quite developed or not. Very often the clients do not have money to develop their ideas, which is where TIA comes in. The process involves material testing, prototype manufacturing, small scale production and process development. New markets include new products that have not yet been developed, or clients that entered a new industry.



One of the DUT technology station's clients, a jeweller, wanted new manufacturing methods involving materials such as Bakelite and silver. He 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.

Vortex wanted 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.

#### **Question and answer session**

**DUT:** How do you secure new clients and make them aware of the services that you offer? How accessible are your services?

**Hamilton:** We rely on word of mouth, because we don't have a marketing department. We are also on the TIA website and they refer people to us quite often. We do use social media and a website, but we also need to be out there and showcase our products.

**DUT:** What criteria must a business meet to be helped by you?

**Hamilton:** Because we are funded by TIA, there are some criteria about viability and marketability, whether it will create employment, etc. If these criteria are met, they will be able to access our services. Big corporates might be able to pay more than small businesses. We help anyone.



**Dr Njabulo J. Gumede**

*Senior Lecturer, Organic Chemistry, Mangosuthu University of Technology*

Dr. Njabulo Gumede is currently a Senior Lecturer in Organic Chemistry in the Department of Chemistry at Mangosuthu University of Technology (MUT). He obtained his PhD in Chemistry in 2016 at Durban University of Technology entitled: "Computational and micro-analytical techniques to study the in vitro and in silico models of novel therapeutics drugs". He specialises in Molecular Modelling, Organic Chemistry, Analytical Chemistry, Cheminformatics and Medicinal Chemistry.

#### **HIT-TO-LEAD IDENTIFICATION AND PRE-CLINICAL DEVELOPMENT OF NEW THERAPIES FOR PROSTATE AND BREAST CANCER**



The drug discovery and development process of a new chemical entity (NCE) is very long and costly, taking on average from 12 to 15 years to do.

Chemistry enters 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 grown resistant to them. 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 in new drugs, from existing compounds using a quantum-mechanical process. Two patents have been registered for this particular compound. Because the manufacturing process could be simplified, it is possible to test the product quicker and it would be able to simplify production.

#### **Question and answer session**

**UP:** How far has the process of producing the drug progressed, and are there spin-offs and commercialisation opportunities to be harnessed?

**Gumede:** The patent has been registered in 2016, followed by the Patent Cooperative Treaty in 2017. In April 2018, the project has been filed in the US and Canada. We also want to patent in the EU and China, where large pharmaceutical companies are registered. We will do this after Phase 3 clinical phase trials. The product has not been tested in humans yet, we first have to do other tests.



**Prof. Pio Lumaga**

*Director, Innovation Design Lab (IDL), Namibia University of Science and Technology*

Pio Barone Lumaga is a technologist focused on the sustainability of social enterprise. In a four decades-long practice in Africa, Europe & North America he has brought to the market hundreds of innovative products and services.

Since 2015, as professor at Namibia University of Science and Technology, he is the founder & director of the Innovation Design Lab, a center of cross-disciplinary research applied to Namibian wicked problems. At the Lab he is developing the second prototype of a Solar Electric Taxi, a solar still desalinators, a micro-irrigation technology and a water purification system with 'green' chemistry, whilst fostering a new generation of African researchers and entrepreneurs.

As innovator has shaped new generations of services & products— from banks to computers, from children's creative games to lighting, from shoes to ultra-light catamarans, from concept cars to museums, from acoustic textiles to eco-efficient architectures. As chief designer, creative director, project leader, or consultant has collaborated with Artemide, BMW, Deutsche Bank, Deutsche Bahn, Electrolux, Fiat, Hermés, Husqvarna, IKEA, Mandarin Duck, Nobia, Philips, Olivetti, Raichle, Snickers Workwear, and others.

He has studied, researched or collaborated with institutions such as University of Naples, University of Milan, Bocconi University in Italy, Massachusetts Institute of Technology, MIT Media Lab Boston, Stanford School of Engineering Berkeley, & UCLA Los Angeles in USA.

With MSc in Civil engineering, post-graduate degree in Environmental engineering, and a Gemini Entrepreneur Fellowship is fluent in English, Spanish, French, Swedish; Italian is his mother tongue. He lives & works in Windhoek, Namibia & in Stockholm, Sweden. In 2015, he has been appointed Commander of the Order of the Italian Star for his contribution to design and innovation.

## **WHAT QUALITIES SHOULD INSTITUTIONS OF HIGHER LEARNING DELIVER?**



Africa is facing enormous challenges in terms of water, energy and unemployment, which require university leaders to find solutions. Today I will show you what we are doing on the ground at the IDL.

Two years ago, we showed the first prototype of the first solar electric taxi that we developed. We have refined the design, which now has an aluminium frame. We have 17 students involved in the project, which incorporates AI, mechatronics, safety, and energy preservation among others. The software allows us in real-time to follow what the team is doing and what challenges they must resolve.

We also have a solar still desalinator to produce drinkable water with solar energy for off-grid communities. In 18 months, we designed and tested 6 prototypes. Efficiency has increased from 3% to 47%, and the cost for a cubic meter has decreased from 23 Euros to 5.2 Euros. We are looking for funding to take the project further. We have registered two patents, with a third under way. The idea behind the project is that it would be sustainable and being able to be produced in situ.

We also have another project to field test water saving measures in the growing of vegetables using micro-irrigation while increasing produce yield. We used off-the-shelf products to build the device.

Another project is a water filter made of moringa seeds, sand and charcoal as a sustainable portable water depurator. The challenge is to make it portable, like 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.

Lastly, we focus on modular short courses for managers and entrepreneurs through a user-centric development, improvement loops, and wealth creation techniques. We want our courses and projects to be contextually relevant, they must be rapidly developed and proto-typed, tested and improved. Our approach is to reframe problems into challenges, and challenges into opportunities.

### **Question and answer session**

?: In your desalination project, what membrane did you use?

**Lumaga:** We use a process to increase evaporation and condensation, using hydrogel.



**Mr Nico Steyn**

*Senior Lecturer, Electrical Engineering Robotic Rollator, Tshwane University of Technology*

Nico Steyn was born in Witbank, South Africa, on 13 April 1976. He matriculated from High School in 1994 before commencing his studies at the Technikon Pretoria in the specialist field of Process Instrumentation. In the year 1999 he completed his BTech degree in Automation and was awarded his master's degree, entitled "Digital Control System for Active Magnetic Bearings" in 2006.

In September 2009 he commenced with his dual Doctoral Degree at the Tshwane University of Technology and University of Versailles, France. He received a très honorable Doctoral Degree from the University of Versailles in December 2013 and the Doctor Technologiae from the Tshwane University of Technology in 2014. During his studies he was a full-time lecturer presenting courses in the field of Process Instrumentation at the Department of Electrical Engineering, registered as a Professional Engineering Technologist at the Engineering Council of South Africa. During this period he further received a lecturer of the year award from the Faculty of Engineering and the Built Environment and is pursuing further Vocational Teaching studies at the Haaga-Helia University of Applied Sciences, Finland. He currently works closely with visiting professors from French Universities at the French South African Institute of Technology on Enabling Technologies with various collaborative research and patented outputs.

## **ROBOTIC**



TUT developed a robot to assist with the rehabilitation process of amputees. There are many such stories, indicating that there is huge scope for Human Activity Assistance Technology (HAAT) to help people integrate into society.



The project started 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 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.

### Question and answer session

**DUT:** Which of the products are ready for commercialisation?

**Steyn:** The augmented wheelchair is probably closer to commercialisation than the walker.



**Mr David Mauchline**

*Additive Manufacturing Specialist, Vaal University of Technology*

David Mauchline is an additive manufacturing specialist responsible for the VUT's advanced manufacturing division. He has been involved with design for additive manufacturing since 2005, when he worked alongside Professor Deon de Beer at the Central University of Technology, from where he received his mechanical engineering degree. His main focus is powder-bed manufacturing technologies, particularly laser sintering, and was instrumental in the setup of VUT's 11 industrial additive manufacturing systems.

### **FIRST STEPS USING THE SINTRATEC ADDITIVE MANUFACTURING TECHNOLOGY TO BRING DIGITAL OBJECTS TO FUNCTIONAL PARTS**



Much has been said about additive manufacturing in the past few days. Additive manufacturing 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 not only one product at a time, but several simultaneously. It is a great tool for prototyping. The problem is that the equipment and materials are still quite expensive, making it prohibitive for companies to acquire. Similarly, for research purposes, a machine like this 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 can manufacture complicated shapes with undercuts and occlusions, which could be pre-assembled. The problem 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, it was necessary to identify something that is inert and dark in colour. 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. Sintratec allowed these concepts to be tested and proven.

VUT would be keen to engage in collaborative projects.



**Prof. Adebola Oyedeji**

*Professor in Chemistry, Walter Sisulu University*

Adebola Omowunmi Oyedeji holds a PhD in Organic Chemistry from University of Ibadan, Nigeria. She is currently a Professor at Walter Sisulu University, Department of Chemical and Physical Sciences, NMD Campus, Eastern Cape, South Africa, where she teaches organic chemistry at both undergraduate and postgraduate level and, led a vibrant natural product research group with 10 (H, M and D) students. Her work hinges on natural products chemistry with special interest in finding the medicinal values of terpenoids class of compounds in medicinal plants. Most of her work has been on inaugurating the link between chemistry and the ethnomedicinal claim of the plant being used in traditional medicine and cosmetic. She has been able to establish the connexion between types of terpenoids in plants to their uses in traditional medicine. She has isolated several compounds, some of which were further derivatized and evaluated for their potency as anticancer (breast cancer), anti-inflammatory, anti-gonorrhoea, antibacterial to mention a few. She continues to study the South African essential oil bearing plants in order to establish the various chemotypes for commercialization. She is a C3 NRF rated scientist and has over 80 SAPSE published articles and has successfully supervised 5PhDs, 10MSc and over 15Hons students in the last 4 years.

Prof Oyedeji is a recipient of some awards such as DAAD (1997), TWAS (2003), NRF South Africa (2003-2004), University of Zululand Research Roll of Honour (2008), National Research Foundation Rated Scientist (2010-2015 and 2016-2021), WSU Established Female Researcher (2017) and WSU Vice Chancellor Excellence in Research (2017). She has successfully mentored several colleagues towards NRF rating applications, Thuthuka, IKS and Postdoctoral & Student Freestanding grant proposal applications. She currently chairs the Walter Sisulu University Manuscript Writing Committee and Scientific Committee for University Conferences under the Directorate of Research and Development. She is a member of Chemical Society of Nigeria (CNS), Third World Organization for Women in Science (TWOWS), Indigenous Plant Use Forum, South Africa, South African Chemical Institution (SACI) and Royal Society of Chemistry (RSC). She is also an affiliated member of the International Union of Pure and Applied Chemistry (IUPAC).

## CREATION NERVINE AND CREATION ARTHRITIS TEAS

WSU 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. 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.

