CONFERENCE REPORT

NINTH ANNUAL INTERNATIONAL SATN CONFERENCE

12 – 14 OCTOBER 2016

CONFERENCE CENTRE, ATLANTIC SUITE, LAGOON BEACH HOTEL, MILNERTON, CAPE TOWN, SOUTH AFRICA

CO-HOST: CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

PARTNERSHIPS FOR INNOVATION AND DEVELOPMENT: MAKING IT HAPPEN. MAKING IT MATTER

SATN Secretariat · Private Bag X680 | Pretoria, 0001 · (012) 382 4896 · 086 623 7678 · admin@satn.co.za · www.satn.co.za

Vat no: 4620259822

EXECUTIVE SUMMARY

1. Background to the Conference

The 9th Annual International SATN Conference 2016 was held at a time when universities in South Africa are grappling with a number of critical issues. Despite the upheaval in the system, The SATN Secretariat worked tirelessly to make the conference a reality in difficult circumstances and to ensure that the conference proceeded as was planned.

The conference received sponsorship support from CPUT (co-host), TIA, EWSETA, ETDP SETA and Coca Cola. Over 125 attended the conference over the three days. The participants were from member universities, universities in South Africa and internationally, government institutions, private businesses and students.

The conference also provided the platform for a three day pre-conference student workshop which was funded by TIA in partnership with the SATN. The focus of the workshop was "Innovation Skills Development, Future 500 Programme: From Idea to Product". The students were also able to attend and be exposed to the first half day of the SATN conference.

The conference programme was structured around the theme of the conference **"Partnerships for innovation and development: Making it Happen. Making it Matter** and included keynote and session theme addresses, selected research paper and project presentations, panel and roundtable academia discussions.

The summary below provides a brief overview of the proceedings of the three day conference

2. Welcome
Prof Lourens van Staden, Chairperson of the SATN welcomed all delegates to the conference. He re-iterated the importance of such a conference for the UoT sector. In order for UoTs to drive innovation and create a strong entrepreneurial system, it is necessary to strengthen leadership, coordinate initiatives across all sectors and build strategic and vibrant partnerships with government, other agencies and international partners. Also integrate successful entrepreneurs in the teaching arena and to actively encourage entrepreneurship, providing opportunities to take ideas from concept to action.

3. Conference Keynote Address
The Conference Keynote Address was delivered by the DDG of Environmental Affairs, Mr Mokoeana, who represented the Ministry and the Department of Environmental Affairs, to share their support to science research, technology development, specifically on waste recycling and innovation. In a 2011 report, 97 million tons of waste was deposited in land-fills, which challenged the thinking in waste recycling. As a throw-away society we need to make a paradigm shift, create awareness and provide focused academic programmes that will change the way we interact with the environment. The UoT sector is applauded for its efforts in this regard and the DEA is keen to partner with the SATN. Government is committed to creating a conducive environment for recycling. We need to harness the opportunities that lie in waste recycling to establish businesses. Academic partners have critical roles to play by educating our communities, removing monopolies and making recycling a worthwhile venture. This conference will provide the opportunities to come up with tangible plans and solutions.

4. SATN/TIA Commercialisation Project
This joint project allows students from all UoTs to collaborate on a project that exposes them to different thought leaders, issues on IP, product development and inventions, commercialisation of patents and designs and reaching the right target market. The students were divided into groups, and were asked to develop a new product and the winning group presented their product at the conference. The winning group will also be given the opportunity present at a conference in Canada in 2017.

5. Theme 1: Portraits of Success – Partnership Models

5.1 Session Theme Address
Prof Ahmed Bawa, CEO, Universities South Africa, shared his thoughts about universities as centres for innovation and a development of a culture, movement/national approach with financial support for innovation to be strengthened. The lessons listed for UoTs are:

- Universities have to be innovative in their own right if innovation is to be a key element of how they teach their students – students have to see innovation in action in the context where they are being taught;
- Universities have to give students opportunities to engage in innovative problem solving activity across the board; the biggest challenges in South Africa are at the social level, which opens up a range of possibilities for innovative development.
- Universities have to make the right appointments, and bring the right people on board who will see innovation as a key enterprise of the university. How do universities choose individuals who will bring the required level of passion to their academic work?
- Universities are encouraged to think of projects that span the student's entire study career, which can be woven throughout the curriculum in a multi-disciplinary, integrated fashion and can be adequately supported.
- Universities to adopt a more focused engagement on context, identifying opportunities to work in an integrated fashion across a broad spectrum, and by engaging in-depth with various partners.

5.2 Panel Discussions and Paper Presentations: Inputs of Local and International Speakers
Insight into UoT networks with national and international universities reaffirmed the importance of collaboration and partnership models. The success of partnerships is founded on strong leadership, infrastructure and sound financial management thereby creating an enabling environment for innovation and development. DHET's view on internationalization is that universities should think how internationalization can be of benefit to the institution and the broader system and that partnerships should go beyond collaboration on education to society in general.

Some of the questions posed to the panelists were:

a. **What are the key fundamentals that have to be in place to create a strong relationship between UoTs and industry? How will this partnership mature into a sustainable relationship?** A culture of support for vibrant partnership has to be enabled by a focused, designed strategy for partnerships; relationships are often strained by multiple stakeholders' inputs, preventing the ability to capitalise on strategic partnerships. Universities need to be clear on the partnerships needed and the benefits for both parties.
b. **Many partnerships are established with grandiose objectives. How does one ensure that these relationships will be sustainable over the long-term?** It is important to focus on the actual implementation and impact of the project, rather than the broad outcomes. Implementation is critical.
c. **Once you have a relationship, what must you do to sustain the relationship?** Regularly ensure that projects are still contextually relevant and responsive to the needs for trade and investment. Monitor partnerships to ensure that activities are being implemented and delivered.
d. **If one looks at the annual reports of a few South African universities, there is a huge disparity between income generated from third-stream income and support from industry. Although this is only a proxy indicator, what more can we do as a young university sector to unlock our partnerships with industry? What are the things that we should strengthen to unlock value from our partnerships?** Universities should focus on what they do best. It is important to focus on niche areas and interact with business to consider ways to generate additional resources.

6. Theme 2: Entrepreneurial innovation driving global, regional and local change: advancing the implementation debate

6.1 Session Theme Address

Ms Jaana Puukka, Innovation Engage (FR), Expert of the European Commission and World Bank. In the European context, a revitalised policy agenda was adopted to modernise higher education, focusing specifically on aspects like the quality, relevance, impact and responsiveness of higher education institutions. These institutions are required to play a role in the regional knowledge triangle, facilitating linkages between innovation, research, and teaching and learning. Universities are also required to act as centres for regional innovation and economic development. A Smart Specialisation Strategy was implemented to make funding from the government available for regional development, and to encourage local partnerships between industry role-players and universities. Examples of entrepreneurial and innovative universities of different sizes and in different contexts – Germany, Mexico and Spain – identified that cooperating closely with industry and keeping the context of the university's location in mind, enabled universities to respond to various imperatives in a positive manner. The realities of universities also differ greatly, depending on their context and placement. Some challenges faced by universities may be due to:

- A lack of strategic anchors within the universities' own policies, but also in the broader higher education policy at national level;
- A lack of system coherence and coordination within universities;
- A disconnect between knowledge transfer and regional growth;
- Focus on supply-driven education instead of responding to the actual needs of the context or the industry that they serve;

Key lessons and some steps for universities to move forward:

- Foster long-term partnerships and aim to understand partners' needs;
- Foreground innovation, entrepreneurship and regional development in the core functions of the university;
- Engage with the community and people;
- Work towards long-term and continuous university transformation.

At the university level the following steps should be taken:

- The institution should make a commitment to develop and support the region where it is located;
- It should understand the needs and opportunities of the region and its own capacity to address them;
- Map the university's linkages, and do a gap analysis;
- Set targets and develop an organisational structure to support the new agenda; and
  Develop a continuous feedback system – evaluate, benchmark and improve.

6.2 Panel Discussions and Paper Presentations: Inputs of Local and International Speakers

The overarching challenge to high impact and relevant entrepreneurial teaching is the development and successful implementation of an innovation and entrepreneurship ecosystem, buy-in from all internal and external stakeholders, dedicated resources and a structure that continues to monitor effectiveness to ensure success. Such a system will create jobs and enhance the socio-economic growth of the region, and eventually, the country.

Whether we address the universal sustainable development goals or our own concerns of the moment such as drought and food security, we need focused research, innovation and partnership to address these issues. We have to be careful about the partnerships that we engage in, and have to be clear what our partners will bring to the relationship.

Prof. King, IAUP There is a new paradigm developing in the demographics, wealth and power throughout the world, which will affect the way that higher education is delivered. Technological advances have created digital natives, which mean that the way in which people learn, consume and create knowledge is changing. These people think differently, socialise differently, and are almost completely out of sync with the professoriate. There is an increasing generational divide between the people that come into universities to be taught, and the people running those institutions. This is a crisis

for the system, which we must address. When technology is available to the entire world, education will be turbo-charged. We have to stay current and constantly learn new things in order to teach new concepts. Digital literacy has become a fundamental skill, and we have to create an environment in which global citizens will be comfortable.

Prof. Raza, India If you create a situation in a country where people lack scientific understanding, there will be no buy-in and support. Ensure that plans are humanised and form part of the inclusive programme of the country.

Mr Gradwell, EWSETA I want to encourage the organisers of this conference to consider providing an opportunity for young innovators and entrepreneurs to showcase their ideas at the next conference. We could assist them to network and find money to take their products to the market. The ability to produce new ideas, find solutions and pilot new products is what innovation is about. Leaders recognise the critical role of education to form and inform people's lives. The potential of higher education as a transformative force must never be overlooked, because it can open up access to the world as a broader construct. Universities have the capacity to help the world navigate the political, social and economic waters and emerge better on the other side. Strengthening relationships between SETAs and UoTs have to be a particular focus area for SATN.

7. Theme 3: Innovation: Powering the global economy

7.1 Session Theme Address
Dr Casper Durandt, Franchise Technical Director, Coca-Cola, South Africa, presented several case studies of Coca-Cola over the past year in SA and Japan. The focus was on one brand strategy with a number of variants in the Coca Cola brand family and the lessons to be learnt in Innovation in products and packaging.

7.2 Panel Discussions and Paper Presentations: Inputs of Local and International Speakers
The EU adopted the Horizon 2020 programme, identifying projects that have excellent possibilities and that should be funded in areas like health, food secturity, energy, transport, climate action, inclusive and reflective societies, and secure societies. A need to distinguish between support for regions who are building up their capacity and those that are already doing excellent research and innovation was identified.

Dr Roman, DST Although the National System of Innovation is a world-leading initiative, there are areas in the system that needs improvement and change. To achieve this, the DST developed a new White Paper and a new decadal plan. DST to develop a more systems-based approach to waste management in terms of identified clusters such as strategic planning through to technology and logistics performance. We also realized that it is necessary to co-develop and co-create if we want the system to work, so we hosted a science-meets-industry workshop to discuss the various waste streams.

8. Theme 4: People, power and innovation for sustainable development

8.1 Session Theme Address
Prof. Fernando Leon Garcia, President of CETYS University, Baja California, Mexico - **Innovation and sustainable development in higher education: A transatlantic and transpacific perspective**
Most institutions address innovation as a response to real problems that are context specific. CETYS University hosted a seminar at which various themes were debated, namely the role of faculty and students, alternative models and technology, quality, accreditation and accountability, international partnerships, the roles of business and industry leadership and governance. The seminar highlighted that successful organisations have a sense of humility and constructive paranoia, always ensuring that they stay ahead of the game. It is necessary for institutions to have a culture of education and strong role models to help stimulate innovation. It is also necessary to recognise and reward innovation and build a tolerance for failure into the formula.

8.2 Panel Discussions, Paper Presentation and Partnership Projects: Inputs of Local and International Speakers

Entrepreneurship is important for economic renewal, economic development and social development. In South Africa, with a population of 55 million people, 30.4 million people should have jobs. Only 15.7 million people are employed in the formal sector. Self-employment (or entrepreneurship) is not just a good option; it is the only option for most people in South Africa.

The emergence of entrepreneurship as an academic field has necessitated the introduction of a significant number of courses worldwide. Trends revealed that while it is mostly offered in business schools, there is a growing trend to offer entrepreneurship courses in non-business schools. It is now also included in the curricula for training teachers in the EU, and it is acknowledged as a critical aspect of addressing a range of social and other problems.

The following selected partnership projects from the UoT sector were presented:

a. **CUT: The South African Additive Manufacturing Strategy: The impact on people and innovation.**
b. **CPUT: Sustainable development through engineering solutions: An example of modular solar powered aquaponics -** The project combines new and existing technologies to boost food production through aquaponics.
c. **TUT: Centre for Tissue Engineering (CTE) – the only multi human tissue bank in SA - providing in the ever growing need of tissue for transplantation** a partnership between TUT and Bone SA. The Centre provides tissue for transplantation to the SA medical fraternity and uses technological advances to improve the quality of tissues and the processes involved. The Centre implements tissue engineering techniques to produce tissues for clinical application.
d. **VUT: E-waste project at VUT Technology Station (Sebokeng)** has a diverse technology infrastructure to help foster a culture of innovation and is the first site of e-waste recovery in SA.
e. **NUST: Namibian solar electric utility vehicle – A solar taxi by the Innovation Design Lab** that weighs about 200kg and transports four people comfortably at a cost of 50 000 Namibian dollars. 1.2 billion people will be urbanized in Africa in the next few years and there is a growing need for environmentally friendly transportation.
f. **MUT: Sea wave energy harnesser** is geared towards industrialization to provide reliable power, as waves can be accurately predictable two or three days ahead. The project is run as a partnership between academia, industry and government and there is a considerable increase in research outputs. It would be possible to employ thousands of people in green jobs while using an abundant and clean natural resource to meet our energy needs.
g. **DUT: Tradition crop products development and commercialization -** Not only is more food needed but also more functional food and ingredients that are not only nutritious and affordable but also tasty. In addition to increasing the food base and increasing dietary diversity, new food products and ingredients can be developed and could lead to small to medium agro-processing enterprises.

9. **Conference closure**

Dr Padayachee closed the conference by extending a word of thanks to all attendees, students, staff of the UoTs, the SATN Team, and the service providers who made the conference a success. The University World News was also thanked for attending the conference and for giving the conference exposure.

The conference on the whole afforded great opportunities for informal networking and establishing new contacts. Delegates were satisfied with the breadth and quality of the talks and workshops and with the opportunity to meet and to exchange experiences and ideas with experts and others interested stakeholders

SATN will continue to offer several programmes in partnership with TIA and other agencies, including future Writing for Science Publications workshops. More information on these events will be communicated via the SATN website.

1.   **Opening**
      Dr Anshu Padayachee
      CEO, South African Technology Network (SATN)
1.1   Dr Anshu Padayachee, the CEO of the SATN, welcomed all attendees to the 9th SATN Annual International Conference.

      This conference comes at a time when universities in South Africa are grappling with a number of critical issues. Despite the upheaval in the system, it is essential that the academic project should continue while political and ideological issues are being resolved. The theme for this conference is therefore partnerships for innovation and development, making it matter, making it happen.

      Gratitude was also extended to CPUT, the host of the conference; TIA, for providing ongoing support to SATN's initiatives; and to other partners and sponsors, namely the EW SETA, the ETDP SETA and Coca Cola. The SATN Secretariat staff and service providers who worked particularly hard to make the conference a reality in difficult circumstances were thanked most sincerely.

2.   **Welcome and Context**
      Prof Lourens van Staden
      Chairperson of the South African Technology Network (SATN)
2.1   Welcome to the SATN Annual International Conference. Thank you to CPUT for hosting this event; the amount of work that went into this conference is evident. The theme of this conference is partnerships for development, and we will have various panel discussions on successful partnership models from Hungary, Nigeria, Mexico and locally. We will also hear from Finland about ways in which higher education can drive innovation in cities, and we will hear how entrepreneurship can be advanced from a range of international and local perspectives.

      The UoT sector is no longer a young sub-sector, and it continues to challenge and grow itself through events such as this conference. The sector will continue to develop by promoting entrepreneurship, building capacity and fostering technological innovations. To drive innovation and create a strong entrepreneurial system, it is necessary to strengthen leadership, coordinate initiatives across all sectors, and build strategic and vibrant partnerships with government and other agencies. To put quality entrepreneurship in place, universities also have to work in a multi- and trans-disciplinary fashion. It is also important to integrate successful entrepreneurs in the teaching arena, and to continuously adapt our approaches to teaching and learning. Universities need to actively encourage entrepreneurship, providing opportunities to take ideas from concept to action. Internationalisation is another key aspect of any university's entrepreneurship strategy. Innovation and entrepreneurship are key to addressing problems such as unemployment, low economic activity and poverty alleviation.

      Conference Keynote Address
3.   Mr Mokoeana
      Deputy Director General of Environmental Affairs
3.1   It is an honour to represent the Ministry and the Department of Environmental Affairs, to share what we do to support science research and technology development.

      The role of the South African UoT sector is paramount in producing the skills we require for a fully functional and balanced society. Without innovation, no organisation will stand the test of time. As with any paradigm shift, we also need to understand that the technology we use now may become obsolete in time. We are looking to your contributions as a sector in terms of waste recycling and innovation to address these problems.

      South Africa has historically been fertile breeding ground for several innovations that have won international acclaim, from the Kreepy Krawly to heart transplants. More recently we realised that waste recycling - across a

variety of waste streams - is becoming increasingly critical. Society and technology are changing, meaning that waste is also changing; business as usual in terms of waste management can no longer be the case, and we need new ways of managing waste. In 2011 a report was issued which identified that 97 million tons of waste were deposited in land-fills, which challenged our thinking in terms of waste recycling. We face a huge challenge in terms of changing our practices; as a throw-away society we need to make a paradigm shift, create awareness and provide focused academic programmes that will change the way we interact with the environment. The UoT sector is applauded for its efforts in this regard.

There is also a requirement for the country to implement our reviewed legislative instruments, which were revised in 2014. The amendments established a Waste Bureau to interact with the public, industry role players, and academia to develop solutions for the challenges facing us as a country. Our Minister has also Gazetted a strategy and a programme for industry waste management plans, which will allow us to systematically address the challenges relating to waste and the environment. We see the plans as one of the core regulatory measures to manage the large masses of waste that we produce, by seeing it as a resource rather than waste. A Regulatory Framework was also established to price waste appropriately and to discourage waste production. It is heartening to note that UoTs and other institutions have heeded the Minister's call at the E-waste Summit to enable the industrialisation of e-waste and advance natural resource management. We need to play a role in this space, which will be possible through innovative and collective approaches to waste management and e-waste. We also have to consider the impact of exporting e-waste to other countries, and find local solutions for the waste that we generate.

Government is committed to creating a conducive environment for recycling. We need to harness the opportunities that lie in waste recycling to establish businesses. Academic partners have critical roles to play in making the most of these opportunities by educating our communities, removing monopolies, and making recycling a worthwhile venture. This conference will provide the opportunities to come up with tangible plans and solutions.

4. **Q&A Session**
4.1 Comment: UoTs are encouraged to learn lessons from other parts of the world, such as Germany, where good progress has been made in waste recycling. It is not necessary to re-invent the wheel.

DEA: That is true, and the DEA is keen to enter to identify and enter into valuable partnership agreements. We will also harness the potential of job creation through these initiatives; there are discussions and plans underway in a variety of areas and initiatives to strengthen collaboration and develop joint action plans. TIA is working with us to develop a series of workshops and dialogues, which will strengthen our ability to collaborate.

SATN: SATN has signed an agreement with the DEA to launch programmes focused on e-waste in partnership with TIA and UoTs like VUT. CPUT and DUT. SATN and TIA will also partner with public and private enterprises to contribute to the e-waste plan, and are working with Japan, India and other BRICS countries. These programmes will be consolidated throughout the year. Applications for a Master's programme focused on e-waste will also open during this week.

5. **SATN/TIA Commercialisation Project**
5.1 TIA and SATN launched a joint project to allow students from various UoTs to collaborate on a project that would expose them to different thought leaders, addressing aspects like IP, product development and inventions, commercialisation of patents and designs, and reaching the right target market. The students were divided into groups, and were asked to develop a new product and present their product, which will be presented at a conference in Canada in 2017.

The group was tasked to develop a project for a textile company that would minimise the amount of waste water produced. A number of traditional solutions were revisited to develop a new product that would break down organic pollutants, require minimal intervention, and produce no secondary waste. A breakdown of the financial benefits that could be achieved by developing the product was provided. It was also proposed that by partnering with well-known companies such as Nanotech Water Solutions and Aurecon, the product could be taken to market. Jobs would be created, and the filter can be sold separately as a direct consumable to clients to ensure its sustainability. It is characterised by ease of operation, lack of waste water production, and high efficiency coupled with economic feasibility.

TIA and the EW SETA also provided assistance to facilitate the development of a lithium automotive battery. More information can be accessed on the ZARZSA website.

Theme 1: Portraits of success – partnership models
Session chair: Prof Thandwa Mthembu, Vice-Chancellor: Durban University of Technology

6. **South African Universities: At the Heart of an Innovating Society?**
    Prof Ahmed Bawa, CEO, Universities South Africa

6.1 Prof. Bawa shared his thoughts about universities as centres for innovation.

Sometimes the discussion about innovation is shrouded in mysticism, as a holy grail that we all hope to achieve but with little success. We tend to forget that we are constantly innovative in our daily lives, and that we should rather see innovation as a way of adding value to our society. The development of a movement or a national approach to innovation should be strengthened, rather than viewing innovation as something that is happening in a rarefied atmosphere by a dedicated group of people. We also tend to fixate on having the right structures in place that would allow innovation. A further critical aspect is the need for financial support for innovation, which is critical but not the only important point, since we also need facilitative policies. Apart from various innovations over the years that were developed on South African soil, we are still often presented as a society that does not invent and innovate.

The question is why innovations are not more pervasive in our society. There is a new Science and Technology Policy in the offing, which should stimulate debate on these issues. We should rather ask how a society that managed to produce the 1994 peace negotiations, Nelson Mandela and the #feesmustfall campaign can be characterised as not innovative. One of the most amazing innovations occurred in the cultural domain, where South Africa developed a local response to jazz. There is also creativity in the realms of fashion, arts and culture. Considering these inputs, how can South Africa be characterised as lacking in innovation.

In a panel discussion comparing the research production of South Africa and Brazil, it emerged that huge research output does not automatically translate into innovation, discovery and taking product to market.

The critical issue is to put a culture of innovation in place. This does not mean that the structural and systemic stimuli are not important, but it illustrates the importance of ensuring that innovation becomes embedded and ubiquitous in our everyday thinking processes. We in South Africa have dichotomised the ideas of creativity and innovation, viewing the one as superior to the other and relegating innovation to the position of second-class activity. Creativity and innovation are intertwined in each other, and contribute to each other.

Often the best innovations are those that improve the way in which we carry out the simplest of functions. One of the greatest explosions of innovation has been the CERN large hadron collider in Geneva. What we should remember is that there is no silver bullet to achieve this kind of result, but millions of small innovations each building on the next. When we think of innovation we often think that it has to be about high technology. While it is important to work on innovations in high technology, we should also innovate the simple things that can improve the quality of our daily life.

We also need to get young people to understand that they have the capacity to solve problems from a young age, and that the solutions they develop could improve society in general. We should turn emphasise innovation as a way to solve problems. The importance of the local context in innovation systems must also be understood. Considering that we have a water crisis in South Africa, why are we not finding solutions to solve this crisis? Where is the emphasis on solving existing problems, such as large-scale water wastage in some of our cities and provinces? This introduces the need for partnerships that will refocus our efforts in the local context. Universities can not only operate on the side lines, but must engage with society to solve actual problems. Engagement must be elevated to become a natural part of knowledge production.

We also have to build an understanding of complexity. The world we live in is complex, and somehow this complexity has to be incorporated in the process of problem solving. To solve difficult problems, it is necessary to take an inter-disciplinary approach. Years ago the UKZN partnered with the sugar industry to solve particular challenges, which they did by doing inter-disciplinary research and involving students at undergraduate and postgraduate levels.

The lessons for UoTs are:

- Universities have to be innovative in their own right if innovation is to be a key element of how they teach their students – students have to see innovation in action in the context where they are being taught;
- Universities have to give students opportunities to engage in innovative problem solving activity across the board; the biggest challenges in South Africa are at the social level, which opens up a range of possibilities for innovative development.
- Universities have to make the right appointments, and bring the right people on board who will see innovation as a key enterprise of the university. How do universities choose individuals who will bring the required level of passion to their academic work?
- Universities are encouraged to think of projects that span the student's entire study career, which can be woven throughout the curriculum in a multi-disciplinary, integrated fashion and can be adequately supported.
- It is also necessary to adopt a more focused engagement on context, identifying opportunities to work in an integrated fashion across a broad spectrum, and by engaging in-depth with various partners.
- It is one thing to insist on facilitative systems and policies but if an innovative culture is not in place a broad-based approach to innovation will not be achieved.

7. **A concerted effort to build capacity for internationalization of higher education in South Africa through the Internationalisation and Modernisation Program for Academics, Leaders and Administrators (IMPALA) Project**
Authors: Ms Merle McOmbring-Hodges, Ms Annelien Dewinter and Mr Varkey George, Cape Peninsula University of Technology (CPUT)

7.1 We heard of the importance of appointing or collaborating with the right people. That is what this project is all about. The Internationalisation and Modernisation Program for Academics, Leaders and Administrators (IMPALA) Project is funded by the EU, and was preceded by the Erasmus Mundus Project, which enabled South African students to collaborate internationally.

The IMPALA EU-CBHS Project incorporates a number of previously disadvantaged universities. Funding was also approved for 5 consecutive years; we think that we received this generous support because the project covered a cross-spectrum of South African universities, had a visionary idea, and is well managed. The project team was challenged with conceptualising its own solutions and write its own proposals.

The Impala was adopted as the avatar for this project, because it is agile, look after each other, and run their lives in an efficient fashion. The SA partner universities are CPUT, University of Limpopo, University of Fort Hare and the University of Venda. The European partners include the University of Antwerp, University of Graz, Alma Mater Studiorum, University of Bologna, Utrecht Network, and the Academic Cooperation Association.

The aim of the project is to build a network of European and South African institutions and organisations to respond to needs in the SA higher education community, and to develop clear solutions to improve academic development structures. A project management team was set up to oversee overall financial and administrative management. CPUT will act as the SA coordinator, through a steering committee that will act as the main management agency. An advisory board will address quality assurance for each internationalisation strand, while an external quality expert will be appointed to evaluate the project throughout its life-cycle.

Four strands of internationalisation will be addressed, focusing on :

- Staff training on internationalisation of higher education;
- Policy development and implementation site visits for senior management;
- Workshops on academic issues;
- Mobility toolkit.

Training sessions and workshops will be accessible to all partners, as well as non-partner universities in early 2017. Five working groups have been created, with one SA and one EU facilitator/partner. The responsibilities of these working groups are to define the target group for each training session/workshop; giving suggestions for trainers and coaches for the workshops, and to assess the quality of the workshops.

The themes of the workshops will focus on:

- Strategies and site visits;
- Short-term programmes and summer schools;

- Internationalisation of the curriculum, on campus and through the internet;
- Project writing and management skills to access funding; ensure that it would be applied to best effect, and to ensure long-term sustainability;
- Mobility toolkit to allow a more structured movement to other countries and to provide coping skills to students that would allow them to function in a different environment.

Different working groups from the various partner universities will focus on each of these themes.

8. **Q&A Session**

8.1 Q: Government institutions are often approached by universities to assist them with innovations and to come up with solutions for electricity, water or sewerage problems. Everybody is on the innovation band wagon and we reiterate the same things every year, but we seem to make little headway. If we look at Harvard, which generates huge passive income per annum, what are we doing wrong? We had a visiting professor from a private university in Mexico recently who told us that they manage to teach 120 000 students and be sustainable. Do we not need an open forum where more people can address the problems we face? Should we not have other mechanisms to address the problems? Our progress appears to be slow.

Q: I think the point was made that we need to appoint and collaborate with the right staff, but I did not hear about collaborating on innovation with European countries.

Q: Prof. Bawa mentioned that South African universities of technology must embed a culture of innovation as they continue to develop. Where must this culture of innovation be embedded?

Q: I believe that we need a distinction between management and leadership, because all collaboration will be dependent on strong leadership. If we suggest that the number of PhDs does not automatically equate to much economic value, the question is whether innovation can be taught?

Ms McOmbring-Hodges: I think we need to establish collaboration between different networks of universities. We have good examples of universities that are innovative in their thinking. We also need to think of how we cost and package our knowledge and market it in a more effective way. We are thinking of academic mobility, which should include social entrepreneurship to create third-stream income for universities. We need teams of people to think about this notion.

I mentioned that there will be training sessions and workshops for all levels of staff. There is also another funding source, Erasmus Plus Credit Mobility, which allows people from universities to move to other contexts to learn what they are doing well. DVCs and other academic staff must access this information and find a way for their universities to become part of these initiatives.

Prof. Bawa: Universities have to be innovative if they want to produce innovative individuals. Students have to see universities operating in an innovative manner, in the same way that children that are brought up in a specific culture will adopt the characteristics of that culture. The University of Monterey have an annual project where students and the university collaborate on the construction of houses that they raffle, managing to generate millions of dollars in income. All the construction needed on campus is also done by the university, who have been able to develop techniques that cut down on cost, get the job done quicker, and also contributed to their research and innovation outputs. It is not enough for us to produce papers; we have to transcend the idea that knowledge production can only happen through rarefied research. Knowledge production must happen across the spectrum by solving real problems.

Some examples exist from our past. The apartheid government mobilised resources and human capacity to develop and create a number of atom bombs. That was a major achievement. The technology for deep mining, which was developed at Wits, is unique to South Africa. Another example is the sugar industry, where they squeezed out every single efficiency from growing sugar cane. We have numerous examples of innovation, but my point is that we need to broaden the base of innovation to span a variety of disciplines.

A lot depends on leadership. We need to broaden the base of leadership to include a range of individuals within the institution at various levels, and not only to focus leadership on the Vice-Chancellor. We also need to realise that knowledge production is not only about the number of PhDs we produce, but the level of innovation that we can stimulate. At the heart of innovation is the simple requirement for problem solving.

Theme 1: Portraits of success – partnership models (continued)
Session chair: Prof Urmilla Bob, Dean: Research, University of KwaZulu Natal

9. **Panel discussion: Evaluating progress made by Countries**
- Dr Tibor Döry, Associate Professor and Chairperson of the Knowledge Management Council in the Department of Leadership and Organisational Communication and Managing Director of Mobolis Közhasznú Non-profit Kft, at the Széchenyi István University (Sze), Györ, Hungary
- Dr Marius Kudumo, Director of International Relations, Namibia University of Science and Technology (NUST)
- Prof Ryk Lues, Director: Centre for Applied Food Safety and Biotechnology (CAFSaB) and Coordinator: Regional Innovation Forum for the Free State (RIFFS), Central University of Technology, Free State (CUT)
- Prof Gauhar Raza, Chief Scientist, CSIR, India
- Dr Kaluke Mawila, Executive Director: Institutional Engagement and Partnership Development, National Research Foundation (NRF)
- Mr Chief Mabizela, Chief Director: University Policy and Development, DHET

9.1   Dr Tibor Döry delivered a presentation entitled 'Success, Good or Bad Practice', detailing some conclusions of triple-helix activities at the Széchenyi István University.

The major roles of universities are defined as follows:
- To educate students who are well prepared for the job market;
- To produce high quality research results and papers;
- To have an impact on local society, serve community needs and contribute to solving societal issues;
- Take up a high position in international university rankings.

The Széchenyi István University is located in the most dynamic economic area of Hungary. It has a young, dynamic university leadership, which is quick and flexible in reacting to demands. It collaborates with a key partner, AUDI, which started through small-scale collaboration 20 years ago. It has contributed 1 500 graduates over the years to AUDI's operations, and continues to grow research contracts. From 1 institute it has grown to establish 6 institutes and the AUDI Faculty, which offers both MBA and Doctoral programmes.

The University supports student competitions and has established a Formula Student racing team. The University also has a SZEnergy project to develop an alternative drive vehicle, as well as the SZEngine project, which aims to develop a one-cylinder engine.

The University failed in terms of traditional technology transfer, and opted to focus less on patents and more on application-oriented collaborative projects with industry. The University adopted a zero-budget planning process, which although at first resisted by staff was eventually adopted and made to work. Frequent engagement with local government has stimulated joint investment, resulting in a new stadium and dormitories being developed for the European Youth Championship.

9.2   Dr Marius Kudumo, Director of International Relations, Namibia University of Science and Technology (NUST), shared some perspectives on partnership models as employed by NUST.

Strong collaboration is one of the NUST's goals, and partnerships are viewed as important mechanisms to promote internationalisation. Governments and universities continue to be concerned about quality, equity, relevance and the responsiveness of higher education, while the Sustainable Development Goals emphasise education for global citizenship.

Partnership models are explored at several levels. At the local level, WIL is a curriculum requirement which aims to integrate academic theory and knowledge with work experience to achieve explicit educational outcomes and enhance the curriculum's responsiveness. WIL is facilitated through focused interaction between the university and workplace representatives. A study in 2011 identified that 80% of graduates obtained jobs by the second year after graduation, and that more than 60% of students had WIL exposure.

B360 Education Partnerships is a non-governmental and non-profit organisation based in Switzerland to support capacity building in higher education, promoting international cooperation and knowledge sharing. The focus is to bring short-term volunteer guest lecturers and industry experts to NUST. This initiative makes not only private

sector knowledge and experience available to students, but also promotes internationalisation. Students also gain access to internships in companies based in Switzerland. 30 NUST students have benefited from Swiss internships since 2011. B360 covers the main costs of both visiting guest lecturers and interns.

Challenges include:
- Namibia is a small economy, limiting the number of placement opportunities for students, especially in the human Sciences;
- Lack of a national internship policy;
- Lack of a common understanding of the purpose and benefits of WIL among the public;
- Lack of funding, and
- Challenges in terms of the attitudes of students and the broader public to support the project.

9.3   Dr Ryk Lues shared some perspectives on partnerships and collaborations that exist between CUT and other entities both locally and internationally.

One principle that emerged is that partnerships and collaborations are always about the people that work in the sector, and the issues that influence their thinking. The issues that can affect a person's desire to collaborate and make a contribution are generally personal in nature, and is seldom systemically inspired. If one starts talking to the human factor and aim to address the issues that affect people, you have a greater chance of a positive engagement.

Relationships exist at the institutional, regional, national and international levels, contributing to the creation of a quad-helix structure. People operate at various levels, with a range of responsibilities and stimuli. There are critical differences at a regional level, while interactions between an institution and structures like TIA or government departments also differ.

CUT's Vision 2020 identified a number of critical pre-conditions for innovative partnerships. Social and technologically innovative programmes must inform academic, research and skills development initiatives.

CUT is in the process of establishing a craft brewery, and participated in a national craft beer competition. While the students did not win the prize for the best beer, they did get the prize for the best team spirit.

CUT works closely with both local and national government, and over time identified that in order to be responsive in its service offerings, it must focus on the needs of the local government offices, and build a strong, trust-based relationship.

At an institutional level, infrastructure, sound financial management and strong leadership are critical and should be developed. In a discussion with the Chinese government on possible collaboration, various business plans and ideas were discussed, but it transpired that more often than not the kind of people who would be involved in the project is the most important consideration.

Lessons learnt from these various engagements include:
- Show up and engage;
- Adapt and include;
- Listen and provide advice, but don't criticize – give advice that solves the problem;
- Balance honest pride versus a 'know it all' attitude, and provide sustained contributions in terms of expertise and resources;
- Provide strategy and leadership;
- Be clear whether the engagement will be a serial or a parallel association;
- Establish and maintain trust;
- Culture - 'this is the way we do things around here'.

9.4   Prof Gauhar Raza, Chief Scientist, CSIR, India gave a presentation on innovation in the public understanding of science.

India is a multi-lingual, multi-ethic, multi-religious, multi-cultural and geographically diverse country, with a population of 1.27 billion people, 29 provinces and 7 union territories. It has 22 official languages, and more than 25 000 dialects.

In India the agents of science communication can be divided into four categories, namely government institutions; NGOs, including entities like the People's Science Movement (PSM); the formal education system; and the media.

The People's Science Movement is a very large network of NGOs. It started taking shape in the 1970s in India, and communicates science through a 'transmitter model'. By 1983 some among the leadership of the PSM started asking simple questions, such as:
- What science should be communicated and why?
- Why do some scientific ideas propagate faster than others?
- Which ideas can be communicated easily through songs, drama and films?
- Is people's structure of thinking a clean slate on which one can write anything and get away with it? These questions were not articulated as clearly as they are put here today.

The second half of the 1980s was the period when Jon Miller and many other colleagues were trying to probe the level of scientific literacy in western countries. By the mid-1990s Miller et al developed categories of scientific literacy (civic, cultural, etc.) This led to the categorisation of citizens as scientifically literate or illiterate, and became known as the deficit model of science education.

In India the most important question was how to develop scientific literacy among the population. Four categories of responses were identified, namely scientifically correct responses; scientific but incorrect; extra scientific; and don't know. This led to a cultural model of the public understanding of science.

Scientific knowledge that was produced within the formal system of knowledge production versus people's cultural cognitive structures were categorised as intrinsic versus demographic.

Intrinsic factors were identified by means of:
- Complexity involved in explaining a phenomenon;
- Control at the collective or individual level;
- Intensity of the intervention in the quotidian life of citizens; and
- The lifecycle of a phenomenon.

The next challenge was to measure this cultural distance empirically. A method to measure relative cultural distance was developed and implemented at a large event known as Kumbh Mela, which was attended by a large number of people from all over India. This method was used to bring the cultural aspect of the public understanding of science at an international level to the table. It was also possible to use the same framework to compare inputs from two or three countries, which led to the conclusion that the public understanding of science in China was far more advanced than in India. The efficacy of channels of information versus cultural distance was also tested, and found that some ideas can be communicated through popular media while others would not be translated effectively in this manner.

These simple conclusions have been reached over many years, and indicate that most people cannot be categorised as completely scientifically illiterate.

9.5 Dr Kaluke Mawila, Executive Director: Institutional Engagement and Partnership Development, National Research Foundation (NRF) introduced her presentation by referring to the preceding presentations, highlighting that they spanned the range from conceptual to very practical. It is evidently important to consider all these aspects when thinking about innovation.

The NRF started a programme with the dti known as the Technology, HR and Innovation Partnerships Programme. This programme has the goal to create training mechanisms and funding opportunities between industry partners and the academy. After running for 20 years the project recently ended, but it is important to note that it succeeded for so long because it provided a joint programme for the NRF and the dti to focus on multi-disciplinary research. It addressed the objectives of developing researchers, doing research and developing products for the market place between knowledge producers and those whose purpose is to apply

that knowledge. The project eventually leveraged R 250 million from industry, apart from the investment from government.

The iThemba Laboratories run a nanotechnology programme with a strong continental focus on research and development, the training of researchers in material sciences, and multi-disciplinary research. It has a lot of sub-disciplinary research projects and supports a variety of projects and multi-modal research projects. The NRF Websites (www.nrf.ac.za) has more information on these projects. Information on the THRIP project can also be accessed on the NRF website.

The nanotechnology programme has brought together scientists and academics from across the African continent, and could be expanded to exchange knowledge between South Africa and a host of other countries on the continent. The programme has been in place since 2004, and the Minister continues to encourage knowledge and infrastructure sharing across the continent.

It is important to note that the political environment in South Africa is very supportive of research and innovation, and that there is political will and strong leadership to create a conducive environment for scientific development. It is therefore important to reconceptualise our collective thinking about innovation, to make it relevant to our own contexts and communities. The majority of our country's problems tend to be of a social nature, meaning that we should attempt to solve problems from a social perspective. Greater collaboration between researchers and technologists in the social sciences would be necessary. It will also be necessary to address issues like equity, by bringing women into the conversation on innovation and feminising technology. SATN is challenged to identify and support more women to play a role in innovation.

The communities in which we operate, our society in general, must also be able to consume the technology, science or innovations that we produce. It is becoming more and more important to communicate our new solutions to the public, to ensure that they would adopt and use these products. Science engagement has become a crucial pillar of the NRF's work, and everyone should think how they can build a relationship with the South African public to not only use our products, but also to see their value.

9.6   Mr Chief Mabizela, Chief Director: University Policy And Development, DHET, addressed the meeting.

The DHET's policy on internationalisation has not yet been finalised, even though a draft document had been drafted. Plans to convene a workshop on internationalisation has also been delayed, and is likely to take place in early 2017. The higher education sector would be asked to submit comments on the policy.

There are about 75 000 international students in South Africa, as well as a large number of visiting professors and other academics. Apart from increased mobility of academics, students and professionals, there are various collaborative research projects and other studies in place. The Internationalisation Policy was envisaged as a framework for individual universities to develop their own policies aligned to the framework.

It should not be the primary purpose of the university system to profit from internationalisation through the direct sale of courses and charging of exorbitant fees to international students. The principles that should guide the system is that universities should think how internationalisation can benefit themselves and the broader system. A study a few years ago showed that within the BRICS family, South Africa's researchers and scientists rate the highest, despite being the smallest in number. Internationalisation should not be implemented to the detriment of South African students; the policy should prioritise access to local students, and emphasise the importance of a positive outlook for students. Academics should be equipped with the knowledge and skills that would improve their research output, attract highly qualified academics, and purposefully engage counterparts to go beyond collaboration on education, but also to benefit other parts of society as widely as possible.

UoTs were challenged to come up with their own imperatives for internationalisation. Collaborative qualifications are being offered in terms of university partnerships, and these must be retained as long as they have value to add. Qualifications being offered in South Africa should be part of an institution's PQM, meaning that it should have been approved by the DHET and accredited by the CHE. There are various permutations of collaborative qualifications, but one permutation that the DHET does not encourage is dual qualifications (in effect two qualifications for the price of one issued by both participating institutions).

10.   **Q&A Session**

10.1   Question: What are universities across the country doing to generate income from third-stream initiatives, and in particular in terms of charges to international students?

Prof. Dory: Less than half of our budget comes from government; the other portion comes from other projects and collaborative partnerships with businesses. Only a small portion of income is from student fees. The government contribution is bound to reduce even further, so third-stream income is becoming very critical for us.

Dr Kudumo: In Namibia we are focusing on ways to consider other ways to partner with industry to increase our resources instead of relying on cash contributions.

Q: I think we could do a lot more to market our universities as part of academic tourism. We must mobilise all other aspects to increase our efficiencies.

C: I am from the British Council and we work with many bodies. I think that the notion of expanding our relationship building to identify new areas of research must be supported by a proper portal or mechanism, apart from relying on people's existing networks. We need to move out of our existing comfort zones.

C: Academics and administrators must understand that when we talk about third-stream income, we want universities to be more entrepreneurial in how they approach their innovative ideas to generate income for the university. We have to move beyond the idea that we must rely on the state for grants. Grants from government will continue to reduce, and it is a worldwide trend.

Prof. Lues: We need to talk about third-stream income in the South African context, and particularly how universities will use third stream income. Will it be used to appoint more staff, or will it be used for project funding, or are we talking about third-stream income only to drive research? Often I get the idea that third-stream income must be profit that the university management can use to fill other gaps, without there being any residual funding left over for other areas.

Theme 1: Portraits of success – partnership models (continued)
Session chair: Dr Prins Nevhutalu, VC, CPUT

11.   **Business / Academia roundtable discussion**
       Participants:
       - Prof Lourens van Staden, Chairperson, South African Technology Network (SATN) and Vice-Chancellor of Tshwane University of Technology
       - Professor Suki K.K. Mwendwa, Deputy Vice Chancellor, Technology Innovation and Partnerships, Technical University of Kenya, Nairobi and member of the Commonwealth Association of Polytechnics in Africa (CAPA)
       - Prof Waswa Balunywa, Principal, Makerere University Business School Uganda
       Business Partners:
       - Ms Donnee Kruger, Manager, Trade and Investment, KwaZulu Nata
       - Mrs Lindiwe Rakharebe, CEO, Durban International Convention Centre (ICC)
       - Ms Farzanah Mall, Director of KPMG SA/President of The Business Association of South Africa

11.1   The following key questions were directed to the panel.

Question: What are the key fundamentals that have to be in place to create a strong relationship between UoTs and industry? How will this partnership mature into a sustainable relationship?

Van Staden: We can learn a lot from entrepreneurial universities and the literature. A culture of support for vibrant partnership has to be enabled by a focused, designed strategy for partnerships. It is also essential to focus on regional growth areas when looking for a partner – for TUT this was identified as the automotive industry. All these elements contribute to a diversified funding base. Other universities may focus on other areas or activities, where synergies should be identified with partners that could generate income, create opportunities for WIL and increase take-up of students.

Mall: Having specialised in business optimisation from a teaching and learning perspective, we looked at gaps between business and universities. The biggest thing is to understand the purpose of the relationship, and what outcomes we want to achieve. Do you want industry to comment on the curriculum or to give support in terms of

money or other resources? Business and industry have great capacity to support universities, but sometimes universities are not fully capitalising on the available resources and not making their needs clear. Relationships are often strained by multiple stakeholders' inputs, preventing the ability to capitalise on strategic partnerships. Beyond finding opportunities for students to benefit from workplace exposure, there are also other opportunities such as advisory boards and funding assistance that could benefit the institution. There are broader questions that need to be asked, and opportunities for businesses to generate more sustainable income through interaction with business must be supported.

Rakharebe: How does one build key relationships with partners? The intellect lies with you, as universities, and we believe that you have been able to change the lives of people through various research projects over the past few years – just think of the progress that was made in terms of HIV/AIDS research. Partnerships with universities allow those interactions, and we should focus on building stronger partnerships between businesses and universities to benefit society. We need to think how we can groom our young people to bring them into the world of work through WIL and internships and impart aspects like a strong work ethic and other soft skills to them.

Kruger: While the intent is important, the service offering of business and the university also have to be considered. Some of our international partnerships with countries like China and India have been very successful, particularly in the ICT space. We also have a formal agreement with Germany, in particular areas and with particular institutions, focused on engineering. We also developed a decision support matrix with NWU to address particular issues relating to trade exports and to identify the marketing potential in the region. This benefited both NWU and our company. We have a technical assistance fund where we make grants available to conduct research into feasibility of particular projects. We also have an internship programme for students. Some universities have contributed content as part of our Ted Talks type programme. We have an annual export week programme where we collaborate with business schools. There are many partnership opportunities for trade and investment opportunities to be researched, and to provide students with workplace-based exposure. We also recently collaborated with the University of Pretoria on energy projects and policy development. There is further scope for programme development with the foundations of universities, which may require funding and where we can identify possible funders to assist them. We would be keen to engage with all of you on possible collaborations.

Balunywa: We have to demonstrate the benefits of participating in a partnership for all participants.

Mwendwa: One has to be clear that academia and business have two different cultures. The academic institution has to clarify what it wants to achieve, and how business can help it to achieve these outputs. Lots of industry partners indicate that they want technical skills, but more often than not they also want people with soft skills. It has to be somebody's fulltime job to think about partnerships; you need to be continuously engaged with your partners to ensure that they deliver what you need, but also to ensure that you are able to evolve with them and deliver on their needs. If we are going to engage industry we need to provide the competencies that they require, which may require a different approach to teaching and learning. Once we started competency-based education and training we found that there are other ways to engage with industry and improve on what they needed to achieve. We have various international academies in place, and it is important to illustrate what you can do within a limited time frame. If you cannot show that you will deliver on what the business partners want and add value to their business, they are unlikely to partner with you. Some universities have been approached by industry to say that they would make infrastructure available for their use, but this is generally only after a long time. It is a slow, incremental process that requires continuous engagement.

Summary: You need to be clear, as a university, what you want from the partnership and what you can provide to them. What is in the mutual interest? Are your cultures compatible, and will the relationship mature adequately to continue delivering on all parties' needs.

Question: **Many partnerships are established with grandiose objectives. How does one ensure that these relationships will be sustainable over the long-term?**

Mall: It is important to focus on the actual implementation and impact of the project, rather than the broad outcomes. Implementation is critical. When you enter into a relationship with business, you have to understand their budgeting timeline before they agree to make funding available. Once the funding cycle is understood, you will be able to write it up in a way that will reflect the outcomes clearly, focusing on delivery. Academics tend to focus on the high-level concepts rather than implementation.

Van Staden: You have to convince the partner from the business world that you have a team in place that will be able to deliver, and that will take pride in their ability to deliver. They have to be aware that you earn trust by performing with integrity and delivering a high-quality product.

Rakharebe: I think it is important to understand what the objective of the relationship is, and what goals one is trying to achieve. Are we trying to create jobs? How many? Are we bringing other skills to the table? These expectations have to be stated upfront and evaluated from time to time.

Question: Once you have a relationship, what must you do to sustain the relationship?

Kruger: We work with stakeholders by adopting a three-year strategy plan or tangible events such as workshops. We meet with them regularly to assess progress. We also regularly ensure that our projects are still contextually relevant and responsive to the needs for trade and investment.

Balunywa: Usually a partnership succeeds if there are clear objectives that can be measured.

Mwendwa: When there is a MoU without a schedule, it shows that people have not thought about implementation. I want any plan to translate into actions that can be carried out and monitored. We have two types of MoUs – those that are more focused on academic research, and then we have MoPs that are focused on outcomes, with time-frames, and meeting expectations. Once the MoP's outcomes have been cleared, it has to be signed quickly and efficiently to put the process in motion. Our institution has a high-level office to monitor our partnerships and ensure that activities are being implemented and that they deliver. One also has to realise that some partnerships are not for ever, and that if they do not work, they must be terminated.

Question: If one looks at the annual reports of a few South African universities, there is a huge disparity between income generated from third-stream income and support from industry. Although this is only a proxy indicator, what more can we do as a young university sector to unlock our partnerships with industry? What are the things that we should strengthen to unlock value from our partnerships?

Mall: The first thing to ask is what the university has to sell in terms of infrastructure, people, skills and value. If you look at third-stream income, a university should also try and identify what it can commercialise to generate further income for the institution. In the South African university sector we have institutions with lots of infrastructure that is expensive to maintain, and we should think how these can be harnessed to generate income. An alumni database can also be used to generate income, and there are other aspects of the asset base that can be commercialised. It is also important to clarify whether the university has a reputation for business success that will encourage other businesses to engage with them. Often a university has to think how it can restructure its internal structure to optimise these opportunities.

Van Staden: I think that reputation is important. The PWC report identified that UoTs fare the worst in terms of generating third-stream income, while the big five universities generate large portions of their income through partnerships. There is also a case to be made for being clear about your niche or focus area, and avoiding academic or programme drift. UoTs are sometimes hard on themselves, but we have to address mission drift. A number of traditional universities have established private companies to generate third-stream income by design, and by focusing on the integrity and quality of their offering.

Rakharebe: I think to unlock partnerships with business, universities should focus on what they do best. It is important to focus on your niche areas and interact with business to consider ways to provide resources. We must meet each other halfway, through dialogue.

Kruger: It is important to focus on the aspect of regional and contextual relevance, tapping into investors who have resources available. We also have to streamline decision-making to make projects happen.

Balunywa: One has to be clear about what the benefits for the company will be. They may give money to students, but they may not wish to give money for research. Universities must make themselves relevant and deliver something that the business partner will want.

Mwendwa: The coming of the extractive sector has done Kenya a favour, as much as we worry about the implications for the long-term. As an institution we need a parallel system that would be responsive to industry and help to address its particular needs. It has to respond quickly and appropriately. We only have two technical universities in Kenya, so there is a lot of pressure on us. We focus not only on teaching and learning but also on training. Once we have established relationships to address the competency base, we can focus on research at a later stage. We may have to focus on small elements such as welding or instrumentation, but gradually we can build up a full set of competencies. Although business and industry are keen to pay for a gradual build-up of skills, we need to ensure that the training we provide remains affordable for those that have to pay for it themselves. Once you have shown that you can provide in industry's needs, they will be keen to participate in other initiatives with you.

Question: What should we do as a country to be the first destination for businesses in Africa? The business environment experiences continuous and rapid change, while the universities offer programmes spanning three to four years. How will we ensure that we deliver employable graduates? Prof. Bawa stated that we have to be the solution providers to industry, and this can be done by launching competitions that would provide university students with opportunities to learn based on actual problems.

Question: What about the role of the student in this equation? Students are not involved in problem solving, and they have no idea of the business to which they must contribute. Students must be involved through internships and research opportunities if they hope to be employed in business in future. They could also provide a way to negotiate future partnerships with the university.

Question: Our teaching and learning component in UoTs are fairly standardised, and our value chain is fairly strong. We have WIL, we have an appropriate focus on quality, and professional councils are doing periodic audits. The question relates to the innovation, tech transfer and business development mandate, and what it must deliver in terms of third-stream income. Are we saying that we want UoT staff and students to establish spin-off companies that can generate income for the university to cover our expenses, or are we saying that we will rely on funding from the state and use companies only to cover the research agenda and make a difference in society? I think we should answer these answers first.

Question: How can industry and universities encourage inter-institutional partnerships?

Comment: I want to raise three concerns. Universities and industry are not monolithic or uniform and they do not perform in the same way. There are multi-national industries that operate outside the country; we have government-led companies, and private companies, all of which operate in different ways. Another issue is that the objective of industry is to generate profit, which must feature. The objective of the university is to train students and produce knowledge. Relationships will always be a skewed, which may be exacerbated by the pressures of globalisation. The discussion must clarify these understandings so future generations will be aware that they cannot expect harmonious, homogenous relationships.

Comment: I have been reading in my research about the influence that entrepreneurship and commercialisation have had on the financial sustainability of universities in South Africa. Apart from the usual funding sources there are various third stream income sources, and we also have to tap into our alumni. However, UoTs do not operate on the same platform as the traditional universities; many of the people that we are negotiating with and hope to establish relationships with are alumni of traditional universities, so they do not understand what our value proposition is. We cannot expect strong alumni relationships if students do not have good relationships with the university while they are still studying. We also have to ensure that UoTs are more practically oriented than traditional universities; their research must solve society's problems which should allow them to build their own niche areas.

Comment: You mentioned the importance of involving students in developing innovative ideas, and providing support to make these ideas a reality. In China there are countless opportunities for students to develop ideas and take them to market. I think China and India have taken the lead in this area.

Van Staden: Universities are not there to generate profit. They exist to develop human resources, but the fact that our income from the state is dwindling makes it difficult to provide students with the experiences that they need and deserve. There are various mechanisms to create these opportunities for students. All UoTs are fairly

new institutions, and some are newly merged institutions, which mean that our alumni might not have made the transition to the values of the new university.

Mall: There has been a shift in the focus between universities and business. If we do not create the right environment for learning, businesses will suffer, so there is a realisation that they need to engage with universities to develop students that would be workplace ready and that would be able to contribute in a constructive manner. Apart from technical ability, there is a realisation that they need to invest in the development of soft skills that would make them more employable. The right questions have to be asked to the right people.

Balunywa: In response to the question about the role and involvement of the students, I think that all these partnerships are intended to benefit the students. Universities have to think about speeding up their approval processes. Human development cuts across all fields, and we need our governments to develop very good human resource development plans to inform planning processes.

Rakharebe: Partnerships are meant to benefit students. We take students on specifically to provide them with the experience that they need to get a job in future. These engagements are structured and monitored to instil discipline in them. Those who have finished their degrees and cannot find jobs also have an opportunity to be involved in a learnership, when they can earn a stipend. Those who perform well and grab the opportunities with both hands are being placed because they have the right attitude.

Kruger: Businesses should be flexible in terms of the internships that they offer, to allow continuous exposure that would gradually build experience.

Mwendwa: We need a multi-pronged strategy to solve the problems. We have adopted a strategy focused on competency-based education and training in Kenya, which is based on industry demand. Industry in effect act as the verifiers. We have an industry-based learning strategy which is based on both internal and external skills level agreements. We also identified the need for short courses that will respond immediately to industry's skills needs, from which we can develop inputs to the main-stream. We also consider skills that would allow people to be self-employed. People must be provided with time to upgrade their skills as technicians and technologists to move up a level. Students should also be allowed to twin with people in industry, and learn to apply their skills in the workplace. A valuable contribution can be made by the informal industry and the community, as distinct from the formal business world.

Chair: We need to think of the skills that our professors need in order to teach. While we must consider what industry needs, and what its culture and ethos are like, we may learn that the students that we produce are not meeting their needs. Should we not encourage our lecturing staff to spend time in industry? As part of the THRIP funding criteria, professors were required to immerse themselves in industry and understand what outcomes they have to achieve. I want us to ponder that issue as well, and how we can make our professors also responsive to industry needs.

Theme 2: Entrepreneurial innovation driving global, regional and local change: advancing the implementation debate
Session chair: Dr Anshu Padayachee, CEO, SATN

1. **Globally connected, locally engaged – universities and innovation, entrepreneurship and local and regional development**
    Ms Jaana Puukka, Innovation Engage (FR), Expert of the European Commission and World Bank

1.1 In the European context, a revitalised policy agenda was adopted to modernise higher education, focusing specifically on aspects like the quality, relevance, impact and responsiveness of higher education institutions. These institutions are required to play a role in the regional knowledge triangle, facilitating linkages between innovation, research, and teaching and learning. Universities are also required to act as centres for regional innovation and economic development. A Smart Specialisation Strategy was implemented to make funding from the government available for regional development, and to encourage local partnerships between industry role-players and universities

The role of civic society in this area has not been sufficiently considered. In the past, universities did not fully engage with civic partners to be co-creators of knowledge, something that would need ongoing attention. In the European context the official voice of professional HEIs in Europe, EURASHE, has also been given a remit to promote the regional agenda. Some very traditionally oriented higher education institutions still need to be integrated in the broader system, and the effects of BREXIT on the broader higher education system have also not been felt yet.

European universities are also the victims of a frenzy of rankings, evaluations and accreditations, impacting on their ability to carry out their core functions. The World Bank Group is currently implementing 6 pilot projects to track the economic impact of higher education. The most recent development is a separate accreditation organisation for entrepreneurial and engaged higher education institutions, of which the outcomes is as yet uncertain.

The OECD Cities and Regions Review attempted to assess development in traditional industrialised countries versus the rest of the world, focusing on collaboration and new membership. More than 35 reviews of higher education institutions worldwide have interrogated the broad role of higher education institutions, drilling down into issues such as education and skills; social, cultural and environmental engagement; research, development and innovation. Most universities experience an ongoing and steady decline in public funding, meaning that they are no longer able to serve the traditional markets and focus areas of the past. However, universities are also not meant to focus on research and innovation for industry partners only. The OECD reviews considered the universities' responsiveness to the needs of local industry and society, taking note of contextual elements such as environmental or social issues. Universities can lead by example; if they are environmentally friendly institutions themselves, they will impart these values in their teaching and learning. The capacity of HEIs to engage in partnerships with local governments to address critical aspects were interrogated, and the study also looked at how partnerships were created, who were involved, and what the local context involved.

Examples of entrepreneurial and innovative universities of different sizes and in different contexts – Germany, Mexico and Spain – identified that cooperating closely with industry and keeping the context of the university's location in mind, enabled universities to respond to various imperatives in a positive manner. The various benchmark institutions produce students who have low dropout rates, high employability and good prospects for top positions. The German example, DHBW, uses modern business practices such as Key Account Managers to engage with industry on a regular basis. Mondragon University in Spain is a non-profit, cooperative university, and staff members have a financial stake in the institution, which helps to ensure that innovation and entrepreneurship are embedded in the university's DNA. ITSON, Mexico, a Technological University next to the US border, implemented a strategic plan for the region with local governments, and has implemented innovation eco-systems based on local assets with global potential.

The realities of universities differ greatly, depending on their context and placement. Some challenges faced by universities may be due to:

- A lack of strategic anchors within the universities' own policies, but also in the broader higher education policy at national level;
- A lack of system coherence and coordination within universities;
- A disconnect between knowledge transfer and regional growth;
- Focus on supply-driven education instead of responding to the actual needs of the context or the industry that they serve;

Successful universities implement a place-based knowledge exchange model, working with SMEs and large corporates alike. The measure of their success is clear in terms of the sustainability and transformation of the societies in which they operate.

Key lessons and some steps for universities to move forward:
- Foster long-term partnerships and aim to understand partners' needs;
- Foreground innovation, entrepreneurship and regional development in the core functions of the university;
- Engage with the community and people;
- Work towards long-term and continuous university transformation.

At a national level, universities have to be supported by:
- Autonomy and accountability;
- Leadership, governance and management;
- Incentives to the university and individuals;
- Partnerships and monitoring; and
- Continuous evaluation for improvement.

At the university level the following steps should be taken:
- The institution should make a commitment to develop and support the region where it is located;
- It should understand the needs and opportunities of the region and its own capacity to address them;
- Map the university's linkages, and do a gap analysis;
- Set targets and develop an organisational structure to support the new agenda; and
- Develop a continuous feedback system – evaluate, benchmark and improve.

2. **Towards an innovation and entrepreneurship ecosystem at a University of Technology: Implementation of a strategy to enhance socio-economic development**
   Authors: Prof. AB Ngowi, Prof. HJ De Jager, Prof. TZ Mthembu, and Prof. C Chipunza
   Central University of Technology, Free State

2.1 According to the Global Entrepreneurship Monitor (GEM) 2015 Global Report, some African economies showed the highest social values towards entrepreneurship (Uganda, 55.4%; Malawi, 51.3%) while South Africa had the lowest score, at 23.3%. At least 60% of the youth population in all countries except South Africa showed an entrepreneurial propensity.

CUT's Vision 2020 states that CUT shall be an engaged university focusing on producing quality social and technological innovations for socio-economic development, primarily in the Central region of South Africa, by 2020.

CUT assessed its teaching methods to assess their relevance for teaching entrepreneurship. Desirable teaching methods include company visits, guest speakers, business plan preparation, start-up your own business assignments, role play, WIL, using social media, and inter-disciplinary learning. Lessons from the international arena identified that to become entrepreneurial, entrepreneurial thinking must be infused throughout the entire curriculum. An entrepreneurial university actively seeks to innovate in how it goes about its business. Students should be able to apply the ideas and knowledge that they acquire in the classroom to develop innovative outcomes. Students must be able to develop an idea to come up with a product or service. Apart from being creative and taking risks, they must also be able to plan and manage. This requires efficient and effective education and training, which in turn requires a driving spirit characterized by creativity, critical thinking, initiative, innovation and risk taking.

The literature identified the following challenges to entrepreneurship:
- Inadequate funding;
- Insufficient coverage of entrepreneurship in the broader curricula;
- Acute shortages of facilities and equipment;
- Lack of infrastructure; and

- Lack of skilled staff.

Enablers for promoting innovation and entrepreneurship at CUT were identified as:
- Basic technical abilities, imparted through academic training;
- CUT-based learning, including training courses, operational tasks (manufacture and assembly), and innovative tasks such as design and development.
- Operational capabilities to enhance the innovative and production skills include basic research, applied research, marketing and other soft skills.

The university identified the need for an innovation and entrepreneurship ecosystem. To address this need, several initiatives were launched, including:
- The CUT Idea Generator, to create a vibrant atmosphere for collaboration, creative problem-based learning and design thinking. Another intervention is the FabLab, which provides a support structure to enable CUT students to develop ideas, projects and prototypes, going from ideation and conceptualisation of their products to implementation.
- A CUT Incubator Programme on the various CUT campuses, to support SMMEs in virtual incubation, physical incubation, and in terms of post-incubation support.
- CUT Innovation Services is the commercial arm of the university, a trust with the university as the sole beneficiary, to commercialise intellectual property.
- CUT has launched an entrepreneurial week to allow students and staff to showcase their ideas and concepts.
- Collaboration with external partners is also a critical part of CUT's innovation and entrepreneurship ecosystem. There are various success stories of companies with which CUT cooperated, and various awards and kick-starter programmes that have achieved great success.

The overarching challenge to high impact and relevant entrepreneurial teaching is the development and successful implementation of an innovation and entrepreneurship ecosystem, buy-in from all internal and external stakeholders, and dedicated resources to ensure success. Such a system will create jobs and enhance the socio-economic growth of the region, and eventually, the country.

3. **Portraits of Success: French South African Technology Institute (FSATI)**
   Authors: Dr Prins Nevhutalu, Dr Ben van Wyk and Yves Blanchard, Cape Peninsula University of Technology, Tshwane University of Technology and FSATI/ ESIEE Paris

3.1   FSATI happened as follows. One Wednesday afternoon I was looking for the manager of the THRIP programme at the FRD. I went to his office, and was told that he was in a meeting with the French delegation. I stumbled into their meeting, and the French told me that they were in the country to establish relationships with local universities, and that their next stop was Stellenbosch University. I told them that if they wanted to make a contribution to South Africa, they might need to consider a different approach. They listened, and the next morning they came back to me with an idea.

In 1994, during the Mandela administration, a cooperation agreement was signed between France and South Africa, covering areas such as Education, Sport, Culture, Science and Technology. We highlighted that there were three Technikons in the greater Pretoria region that could benefit from their assistance in terms of Science and Technology. The areas that we focused on included technology, information and engineering with a focus on telecommunication and automation. We developed a Diploma, B Tech, Master's and Doctoral programmes. We also identified the need to focus on staff development, and increased industry support through THRIP.

One of the key mechanisms that was built into the programme was a FSATI management board, consisting of relevant stakeholders such as industry role players (who had to make a considerable financial contribution); the FRD; the then Technikon Pretoria (the TRG fell out); the French Embassy; the Paris Chamber of Commerce; the French Ministry of Education; the Institute of Electrical Engineering (ISEE); and a French appointed director.

At first, the majority of students enrolled in the B Tech programme, and their prime objective was to access jobs. There was very little throughput to the Master's and Doctoral programmes. In 2007, the situation changed to incorporate more students at Master's and Doctoral level. From 2003 to 2009 the number of enrolments and graduations at the Master's and Doctoral level increased.

Key success factors of the programme included:
- Commitment by all parties;

- Earmarked funding, supplemented by funding from the French government;
- Industrial support;
- Management board;
- Regular monitoring through 2 meetings per annum;
- Participation from other partners;
- The various French directors of the project contributed greatly to its success over the years.
- Major industry funders over the years included companies like Eskom, Telkom, Alcatel, Molapo Electronics, Johnnic, and Billiton, who contributed funding for specific projects as well as bursaries. These companies also served on the management board of FSATIE.

Where are we now?
- The programme has grown substantially over the years. Both CPUT and TUT are now involved, in programmes focused on energy, satellite technology and astronomy.
- In 2012 the management board was replaced by an executive board, chaired by the Vice-Chancellors of the participating institutions.
- The decision to have an Executive Board has caused a withdrawal from industry role-players, which would have to be addressed going forward.
- The programme has been successful, and now incorporate 5 to 7 research chairs, funded by industry partners.
- The programme has led to the establishment of joint Master's and Doctoral programmes between South African and French institutions. In 2016, 58 doctoral students were enrolled in the programme.
- Going forward, the FSATI programme should be extended to include other UoTs, including study areas like water. It has also been proposed that more French universities should come on board to offer joint degrees.
- The ongoing support of the French government continues to be a valuable asset. This agreement has been one of the most successful in terms of joint knowledge exchange and collaboration.
- The factors that contributed to the success of the FSATI project include institutional commitment at the highest level; a structure that continues to monitor effectiveness; and well-defined areas of cooperation.

4. **Q&A Session**
4.1   Question: I want to ask about incentives for inventors and innovators – how are these incentives provided in other contexts? How do other universities manage disclosure of their inventions, and how should South African universities manage disclosure? We might have to revise our system to adopt an examination system. What are your responses to these questions?

Dr Puukka: I think incentives for university staff would help to ensure that they engage in relevant education and RDI. Countries may have to revise their HR policies to focus on employing the right kind of people, but some do highlight former achievements in relevant industry areas. At this time the focus is still predominantly on generating publications instead of developing new inventions. Here it is important for the government to set the right incentives; what you incentivise is what you will get. Although some countries have very elaborate systems to give points for inventions, their systems are still not moving in the right direction. You need to create the right entrepreneurial eco-system, culture and opportunities for people to participate. We also need a culture within institutions that would give staff the time to do things. In certain higher education institutions staff have such high teaching loads that there is very little time for anything else, or engaging students. I have some examples of countries that have implemented IP rights which had the wrong effect.

Prof. Ngowi: Although our promotion criteria will foreground entrepreneurship as a condition for progression, this is not the only mechanism. We have to incentivise people by using the funding that they generate through their inventions to support their further work.

Dr Nevhutalu: The issue of an entrepreneurial ecosystem is very valid. Some universities overseas structure their remuneration models so that people receive only part of their salary as a guaranteed portion, and have to generate the remainder through their own initiatives. We should perhaps allow our staff members to start generating part of their salary by taking an entrepreneurial approach, to create businesses and be innovative. The second issue is that ownership of IP has to be shared. We have an interesting model in place at CPUT, but I don't know if it will work in other contexts. At TUT one of the professors developed a gadget that controlled the temperature of water in geysers, and he wanted to own 100% of the business and run the business, despite us cautioning against it. Now I don't know if the business is still operational. Perhaps we need to move into a more stringent system; we cannot have a two-tiered system that incorporates the examination system.

24

Question: The youth entrepreneurship stats for South Africa are depressing, but perhaps there are some historic reasons for that. My second comment relates to the enterprises that we incubate – since many of the enterprises remain in a survivalist mode, we need a national strategy to make them profitable and sustainable. They just do not grow and develop. What can we do to ensure sustainability?

Prof. Ngowi: I agree that our statistics are low. In our CUT eco-system the focus is on giving students more support to take their ideas to fruition.

Comment: I am from the Business School, and there are several reasons why South African entrepreneurship statistics are not as high as they should be. There is not enough support for SMMEs, and it is important for UoTs to strengthen their Business Schools to give support to students with new and innovative ideas. Presently there are students with good ideas that will never see the light of day. Businesses should also engage with UoTs regularly to learn what ideas have been generated. Incubators are very important, and also need stronger support.

Dr Puukka: I agree that we need to match universities and businesses to take good ideas further. Israel is very good at taking new ideas and commercialising them. They believe that some people are meant to do research, and that there are professional entrepreneurs whose talent is to commercialise ideas and convert them to businesses.

Dr Nevhutalu: I am sure that the notions of entrepreneurship and innovation will continue to be relevant for UoTs. Perhaps we need case studies to try and understand what make successful projects work, so that we can develop models to infuse our teaching. At CPUT we have a concept similar to the CUT FabLab, which has come up with wonderful innovations. Design should become a way of life, and should be supported by our policies and processes.

Technology Innovation Agency Panel Discussion
5. **Going global: Driving change at systemic, regional and local levels through successful partnerships for innovation**
Chair: Ms Moonsamy, TIA
5.1 Mr Altman: The word 'entrepreneurship' is often used in South Africa, but the country has very little indigenous capital. There is often talk about adopting a Silicon Valley mindset here, but they have money there, and when one talks about failure, bankruptcy laws there are much different from here. If you fail there, you can start again; in South Africa anyone declared bankrupt cannot start again before 5 or 6 years have passed.

We have very clever people able to write policy, but they are weak at implementation. I went to Stanford, where I found that several Deans went to Wits and UCT, which provided me with a way in. I went there armed with outlines of the NDP, and ended up at the School of Engineering. I said that these are the plans, and asked what tools they had to help people implement the policies in South Africa. We started collaborating with Stanford and Stellenbosch University to implement these management tools; the first group of people were a mix of people from civil service, but also from several of the banks.

In December we launched, in partnership with TIA and the National School of Government, a hybrid of the Stanford programme and some of the American University's leadership programme (ranked higher than Harvard's). As a South African I had to look at how we can afford this programme, considering the weak exchange rate. We identified that by training the trainers, we could expand the reach of the programme to our local universities, appointing them as Adjunct Professors to the US institution. This would not only be cost effective, but would expand the network.

Ms Moonsamy: We are looking for additional candidates to register on the programme.

Student: Having participated in the first session that was provided in Johannesburg last year, a highlight was that the course provides one with valuable approaches and tools that can be applied in one's own contexts. When one talks about the tools, you actually get a small manual with diagrams that you can apply to whatever exercise you are given to do. The training allows people to find solutions for problems that arise in their daily jobs, by applying the tool to their particular challenges and coming up with practical solutions. The training is highly interactive. The tools can be used to design policies or strategies; to design effective teams; for mind mapping and strategy development. Different elements can be unpacked to devise practical steps that can be implemented to deal with particular challenges. The tools are easy to implement and are practical.

Dr Ramsuran: I have been involved in the UNIDO programme as a mentor. This programme has led to systemic change. One also has to remember that this programme is not about the destination, but the journey. The global think-tank programme is meant to build capability in TIA, which will, after a period of three years, be the regional host. We hope to invite African partner countries to participate in the programme in future. The programme is meant to foster SMMEs with innovative solutions in the areas of renewable energy and waste regeneration. It is run in conjunction with six other development countries, such as Armenia, Turkey, Thailand, Pakistan and others. A number of companies participated in the project; we supported 78 SMMEs to go to Silicon Valley to interact with financial backers. The programme is based on volunteer mentorship, and we had very positive support from both generalist and specialist mentors. Training is hosted by Stanford University and provided through webinars, which allow students from across the world to connect with each other. TIA wishes to invite partners from across the African region to participate in this programme.

Dave: I came to the programme early last year through a link from the Gauteng Innovation Hub. I was one of 30 people that went through the 40 hour programme. Many of us had weird and wonderful ideas about technology, which the programme allowed us to test against the business model. In life we have both technology and business innovation, and if the two do not meet, the idea will not work. The GCIP programme spent a lot of time assessing whether the technology is market ready and will disrupt the model, rather than focusing on the actual technology. I am now also mentoring somebody working in the same area as me, and the whole process aims to understand whether one's invention is ready to be taken to the market and will be supported by an effective business model. I am grateful for the opportunity to visit the TESLA plant in Silicon Valley. It is important to realise that Uber and similar projects are business innovations, where the idea was evaluated and worked well. I have been a serial entrepreneur, and I think that at the age of 56 last year I learnt so much that could have benefited me earlier in my career. The chance to network with people from Pakistan and Armenia has also been hugely valuable, probably more than engaging with American businesses.

Ms Moonsamy: Under the UK Newton Fund, which is run with the British Council, entrepreneurs are also provided with an opportunity to commercialise their products. Let's hear how the British Council supported these initiatives.

Ms Mall: There are several young female inventors in Africa ready to respond to our challenges in Africa. We live in a changing space, and countries face a range of differing challenges where there is a lot of distrust, mistrust and 'must-fall' movements. When we talk about internationalisation and collaboration, we have to understand who would benefit from the interaction. The Next Einstein initiative is a project to try and develop our young scientists. If there is one thing that we must understand it is that internationalisation should benefit both parties, and that it is critical to face the challenges in South Africa and build the capacity that we need here, at home. Whether we address the universal Sustainable Development Goals or our own concerns of the moment such as drought and food security, we need focused research, innovation and partnership to address these issues. We have to be careful about the partnerships that we engage in, and have to be clear what our partners will bring to the relationship. The DST and TIA partnered with their counterpart in the UK in a project involving 16 countries, with a value of GBP 75 million per year, with the objective to promote economic development and social welfare in partner countries. By working together on bilateral and multi-lateral programmes with a science and innovation focus, the UK and partner countries will build strong, sustainable systemic relationships. Capacity from Oxford University would also be brought on board to help establish spin-off companies, which could greatly enhance the commercialisation of innovative ideas. The partnerships with TIA include the Newton Fund Partnership, which offers intensive commercialisation, entrepreneurship training and coaching for innovative research. Newton/TIA Institutional Links allow new technologies to be spun out to create enterprises that can offer practical solutions to address particular needs affecting low income communities, while the Newton/TIA CHUMA programme is a professional development and engagement programme to focus on developing capacity in spinout programmes.

Ms Zenzele, CPUT: I recently completed a Master's degree at CPUT. I am part of the CHUMA programme, which entails exposure at TIA, business exposure, legal training, and international exposure at Oxford University. Research outputs are assessed for commercialisation, where the technologies with commercial impact are identified and developed. Intellectual property management forms part of the programme. Universities are encouraged to strengthen their collaboration with companies to ensure that emerging technologies address the needs of our country, resulting in commercially successful products, expanding our capacity and generating income for the country. At a personal level, I have been enabled to understand how I can make a difference in the country, and to develop thinkers.

6. **Q&A Session**

6.1 Comment: I am currently running a PhD programme at CPUT, but I am also part of the CHUMA programme. I would like to say that what TIA is trying to impart with the CHUMA programme is that we should be innovative. We generally focus on our policies, without understanding what it takes to actualise our programmes and innovations. We participated in the student programme earlier in the week, where we developed new ideas, but they will never see the light of day because they will get caught up in the university's red tape. We need to bring intellectuals together to innovate and think creatively, using a bottom-up approach. I am a Nigerian student, and I know that we have similar problems across the continent; this is why internationalisation and partnerships are critical to expand our reach and involvement. We need more than technology and innovation skills, but also business innovation skills.

Question: What is the cost of the Stanford programme you are talking about?

Mr Ackerman: There is no cost; it is fully funded. To qualify you have to have a Master's or be in the process of completing a Master's, because you have to qualify for an Adjunct Professorship at American University. There is a couple of faculty members here who have participated in elements of the programme and could share some feedback with you.

Theme 2: Entrepreneurial innovation driving global, regional and local change: advancing the implementation debate (Continued)
Session chair: Dr Chris Nhlapo, Deputy Vice Chancellor: Research and Innovation, Cape Peninsula University of Technology

7. **Roundtable discussion: how to advance the implementation debate**
Ms Kirstin Wiedow, Co-Founder and Director, FABlab Design and Technology Centre, Namibia University of Science and Technology (NUST);
Prof. Dr Neal King, Chairman of the Board of Directors and President Emeritus, International Association of University Presidents (IAUP)
Prof. Gauhar Raza, Chief Scientist, CSIR, India
Mr Errol Gradwell, CEO, Energy and Water SETA
Mr J Baril, Haitian Ambassador

7.1 **Ms Wiedow, FABlab:**

When thinking about innovation and collaboration, cooperation is key, and ego has no place. Community and a sense of passion are similarly crucial. FABlab is a fabrication lab that we set up and equipped within 5 months. It is a maker space, but also provides training and consulting on special projects. The FABlab process is based on developing plug and play technology to allow people to invent and solve their own problems. It is connected to over 800 labs across the world, coming up with solutions for issues as simple as sanitation or building problems. It aims to provide entrepreneurial support to mostly unemployed youth. A set of criteria were developed to take people from the community on board. A couple of successful case studies from a three-month course was provided. The programme is offered free of charge, and small courses are offered through some business partners.
In order to build a start-up culture, Addventure was established, providing a hard-hitting business expert, investor, mentor, partner or service provider to assist new business owners to take their businesses to the next level. 27 pitches have been delivered so far, and received the equivalent of R 34 million in funding.

7.2 **Prof. King, IAUP:**

The IAUP has a business meeting in South Africa, starting tomorrow. I am delighted to be present at this engagement. The IAUP is 50 years old, and rotate the presidency every three years. The next president will be from Georgia, and the one after him will be from Mexico. The IAUP is about finding solutions to managing faculty. The heart of IAUP is the internal partnerships that are established between individual VCs and institutions. We were early partners in establishing an organisation that aimed to establish a post-colonial education system. We did have a partnership with Microsoft in the past where we sought to articulate and exemplify the public/private partnership arena. We are also on the National World Consortium, an international think tank of scholars, creators and corporate leaders attempting to re-imagine irrelevant elements of the higher education sector. Their findings will find their way into the literature as time goes by. We are also part of the UN and participated in developing guidelines for higher education.

There is a new paradigm developing in the demographics, wealth and power throughout the world, which will affect the way that higher education is delivered. Technological advances have created digital natives, which means that the way in which people learn, consume and create knowledge is changing. These people think differently, socialise differently, and are almost completely out of sync with the professoriate. There is an increasing generational divide between the people that come into universities to be taught, and the people running those institutions. This is a crisis for the system, which we must address. When technology is available to the entire world, education will be turbo-charged.

At the end of the year, we will meet with one of the largest video-game producers in the world. They are keen to take the business world and create a university out of it, to formalise their knowledge. We as people in universities have to start playing games, to be aware of what their worlds are like. We need disruptive leadership at all levels. I have nothing but love and respect for faculty, but they are slow to adopt and adapt and are not anxious to go back to school to learn new things. We need to support these people by giving them the courage to disrupt and make room for the new age that is coming.

We need a commitment to education for all people; throwing out the idea that higher education is only for the elite. We also need a commitment to provide opportunities for all people to have a chance to pursue education. There has been a world-wide dramatic decrease in the amount of public funding for higher education which we also need to address. We have to stay current and constantly learn new things in order to teach new concepts. Digital literacy has become a fundamental skill, and we have to create an environment in which global citizens will be comfortable.

7.3 **Prof. Raza:**

India made a political and scientific commitment to become the best in the world, a commitment that needed a lot of money to achieve. In 1958 a scientific policy was passed by Parliament, and we have never looked back.

We established a number of laboratories for each of the various sectors. We established an atomic commission and a space agency. We have progressed also in pharmaceutical development, and in agriculture. We became self-sufficient, despite starting out as a very poor country. The political commitment and the commitment from universities have helped us to advance greatly.

India also became a major player in computer software development, and we can compete with anyone else in the world. In defence technology, we also did very well, despite being blocked by various other countries. Without the support of the people of the country and the scientific community, large projects would not be possible or sustainable. If you create a situation in a country where people lack scientific understanding, there will be no buy-in and support. In discussing these structures, ensure that plans are humanised and form part of the inclusive programme of the country.

7.4 **Mr Gradwell, EWSETA:**

We listened to the inputs from academic partners this morning. I want us to reflect on the inputs from our captains of industry on the traits and characteristics that we expect from innovators. We need to also reflect on implementation. I want to encourage the organisers of this conference to consider providing an opportunity for young innovators and entrepreneurs to showcase their ideas at the next conference. We could assist them to network and find money to take their products to the market. The ability to produce new ideas, find solutions and pilot new products is what innovation is about. The common traits of innovative entrepreneurs is that they constantly look for patterns, or subtle threads, that produce new ideas. They are brilliantly lazy; they always try to find an easier way to do a hard job. They work smarter, not harder. They are obsessive note-takers; Thomas Edison left more than 30 000 note books when he passed on. The human mind can only process limited amounts of information at a time, and taking notes is an important mechanism to innovate. They also preach perfection, but practice progress. They also use fear – whether of failing, bankruptcy or losing staff - as a boost to the next level. It stimulates an unbreakable commitment to survival. Great innovators constantly work on improving what they have. They understand the creative process's four pillars – preparation, incubation, elimination and implementation. Never take your eye off the ball in innovation; incubation requires mental disengagement to synthesise all information in a detached fashion. Multiple streams are pursued, and they possess a healthy arrogance. Implementation is often more critical than the good idea; and embracing paradoxical thinking allows innovators to see both ends rather than a conventional black and white method of thinking.

The EW SETA are in the preparation stages of several projects, with a range of other partners. We hope to involve key players in a pilot project over three provinces where we will do simple things like establishing small businesses to repair electrical appliances, but we are also thinking of participating in the e-waste recycling project. More information will be made available to all UoTs at a later stage. We also have a project to train young people in the solar energy industry, and we will also train them to be entrepreneurs. Other companies and other stakeholders are also coming on board; a useful example in this regard is the insurance industry, who is particularly keen to participate in a project focusing on the repair of broken boilers and geysers. The Northern Cape has been identified as the solar corridor of the country, where we wish to establish a Solar Centre of Excellence and an R&D Centre, in which 8 universities will participate.

7.5   **Mr Baril, Haitian Ambassador:**

It is important to encourage universities to move beyond the traditional professions, and to rather opt for technology and innovation. I am hoping that we will be able to collaborate with TIA and SATN to strengthen the importance of technology, since it is critically important to have the right people to implement technology. Technology is often taken lightly, and not given the due consideration that it must enjoy as a solution for the problems that many countries face. E-waste management is a further area where it would be important to focus future education initiatives. Very often service delivery is the job of people who are not actually affected by the lack of service delivery – the people responsible for service delivery do not experience the problem first hand, so the problem is not critical for them. We need to involve people who are experiencing problems first-hand in the conversation on the best solutions for our problems, and what the best implementation strategy will be.

8.   **Q&A Session**
8.1   Comment: If we use the examples of India and China, both of whom have large numbers of students studying at the best technological universities in America, we could greatly increase our exposure and networks.

Question: In the previous discussion the point was made that we should learn lessons from our current programmes. I believe that we need to leverage our existing success stories, such as the technology stations, where we may already have systems and capacity in place, for new projects.

Prof. Raza: the issue of brain drain has long been an issue in India, when we tried to encourage students to remain in India to serve the country. Eventually the policy makers let up, or they may have recognised that we were producing intellectual workers for the entire world. They may have realised that the number of scientists that we produce is huge, but that we might not be able to keep the brightest of them to innovate and support industry. The debate is not yet settled, and although we keep losing the brightest of them, most of them eventually come back.

Mr Gradwell: I think that strengthening relationships between SETAs and UoTs have to be a particular focus area for SATN. SETAs have the mandate to be the link within the specific sector, and we must pursue this relationship to bring alignment to the economic development project.

Dr Padayachee: I agree that we have a lot of work to do. There has long been a silo mentality in South Africa, with universities operating in their own silos and industry in theirs. SATN is well placed to identify new initiatives, and to explore avenues and linkages both locally but also with international partners. It is always difficult to find money to send students abroad, but we might be able to bring people from abroad into South Africa – we spoke of engaged institutions, and this type of relationship building could greatly expand our ability to engage.

Comment: It is wonderful for CUT to hear that the Northern Cape is becoming a development area, and we would be keen to participate with the EW SETA. There are numerous projects that we could develop further. Secondly, in terms of renewable energy a lot of work can be done to bring the mining sector, north-west of CUT, on board to develop mine-impacted land. We found Harmony Gold resistant to the idea of collaborating with CUT; they said that despite investing money in university partnerships all they had to show for it are theses and publications, and no concrete solutions.

Closing remarks:
- The issues that need to be addressed have been made clear, and UoTs should take collective responsibility for acting upon these issues.

- CUT is already involved in some wonderful projects on renewable energy and will certainly explore ways to further existing relationships and explore new ones. Partnerships are critical.
- It is very helpful to have organisations like SATN and TIA to act as change agents. UoTs should make full use of their capacity and willingness to assist. BRICS provides a platform that can increase the basket of experiences for member countries, since it allows opportunities to learn from each other. Cultural differences would have to be addressed, and cooperation should be fostered.
- Leaders recognise the critical role of education to form and inform people's lives. The potential of higher education as a transformative force must never be overlooked, because it can open up access to the world as a broader construct. Universities have the capacity to help the world navigate the political, social and economic waters and emerge better on the other side.

Theme 3: Innovation: Powering the global economy
Session chair: Prof. Suki Mwendwa, Technical University of Kenya

9. **Innovation in products and packaging – several case studies of Coca-Cola over the past year in South Africa and Japan**
   Dr Casper Durandt, Franchise Technical Director, Coca-Cola, South Africa
9.1 Dr Durandt shared some of the Coca Cola company's latest innovations:

- One brand strategy - a strategy to provide a number of variants in the Coca Cola brand family;
- Ice bottles, in which actual ice bottles are created to provide a refreshing drinking experience.
- Bow labels are being designed to be launched over November and December, in time for the festive season. This innovation was developed in Europe, and can be replicated in other markets to allow the consumer to be involved with the package. It turns a beverage into a gift or a limited collectable item.
- The plant bottle was developed by the University of Minnesota, in response to environmental concerns about the use of plastics made from non-renewable fossil fuels. The University of Minnesota developed a sustainable solution from plant-based material that can be composted, recycled and used for energy. A bioPET bottle was developed for use by the Valpre brand, in partnership with the Department of Energy and Water Affairs. Research is underway to manufacture a bottle exclusively from plant materials, whereas the current bottle still uses some recycled PET. The use of plant-based bottles would be a disruptive innovation for good.
- An instant freeze machine has been developed to turn Coca Cola into an ice cold drink at the push of a button.
- An innovative cap closure that requires another bottle to open the bottle cap was also developed.
- A productive use of free time or the theory of non-constraints was also highlighted. Most people would have heard of the theory of constraints, which focuses on the bottleneck in any system. In a large coupled manufacturing line, there are as many as 45 000 bottles in progress at any given time, and a bottle neck occurs when bottles have to be filled, which is in the middle of the process. This means that the other processes have to wait for the bottle-neck to move on, and in a typical 8-hour shift this could result in 3 to 4 hours when a machine might be unable to work. An algorithm has therefore been developed to illustrate to the workers that they can do maintenance or cleaning work in that free time, without affecting the other processes. This prevents these processes from becoming the bottle-neck. The productive use of free time allows the system to fix problems on the productive line while the process is underway. This is why the process is called the theory of non-constraints, because the average start-up time for every day's production is 15 minutes faster. It is also possible to track whether operators are using the free time optimally, and to translate this into savings in terms of time and money. Considering that there are 17 plants with at least 5 production lines in force, this translates to considerable savings for the company.

10. **Challenges of innovation and entrepreneurship from a European perspective. The case of Hungary**
    Author: Dr Tibor Döry, Associate Professor and Chairperson of the Knowledge Management Council in the Department of Leadership and Organisational Communication, and Managing Director of Mobolis Közhasznú Non-profit Kft, at the Széchenyi István University Sze), Györ, Hungary
10.1 Innovation landscape of the EU and key STI policy principles:
- The EU may be considered less innovative than South Korea, the US and Japan, but it is fast catching up and still has a considerable lead over many other ocuntries, including China. Switzerland is still one of the most innovative countries in the EU. Other leaders include the Scandinavian countries and Germany. Hungary is among the group of moderate innovators. Sweden is a leader in HR and the quality of academic research; Finland in financial framework conditions; Germany leads in investment in innovation; Belgium is the leader in innovation networks and collaboration. A conceptual framework of grand challenges identified that there is a need for innovation in terms of science and technology, industry and in society.

- The EU has adopted the Horizon 2020 programme, identifying projects that have excellent possibilities and that should be funded in areas like health, food security, energy, transport, climate action, inclusive and reflective societies, and secure societies. There is also a need to distinguish between support for regions who are building up their capacity, and those that are already doing excellent research and innovation. Countries that are still working on establishing their research and innovation profiles participate in the project but qualify only for Cohesion funds.
- Another concept that was adopted by the EU is Smart Specialisation, which is a policy objective to help policy makers identify domains and activities for potential specialisation. It has been found that imitating or copying other regions does not have the same level of effectiveness in other contexts, and that a strategy of spreading money over all constitutencies does not lead to prioritisation.
- Composite indicators for innovation performance in Hungary versus the rest of the EU shows that Hungary does well in certain areas, such as networking and internationationalisation, but lags somewhat in product generration.
- Entrepreneurship in Hungary has had some international success stories, with a growing number of start-ups and adequate availability of venture capital. Weaknesses include lack of knowekdge, education and experience of running a business, among others.

The main issues to be tackled by the RTD policy are:
- Fostering innovation in domestic enterprises,
- Enhancing cooperation between science, higher educaiton and business
- Reinforcing the R&I governance and transfer mechanisms, and ensuring that staff are not overloaded with teaching and administrative activities. There is too few dedicated research positions, and a lack of a critical mass of research teams.
- A further challenge relates to exploitation of research results through technology transfer. The old model still prevails where researchers only focus on research and not on the exploitation of their results.
- Entrepreneurship courses are not fully integrated in curricula, and transfer of skills and problem solving is still lacking. Building the institutional innovation and entrepreneurship ecosystem still needs attention.
- There is no quick fix. Holistic development of institutional innovation and entrepreneruship systems would be necessary to set the vision, mission and strategy and ensure that staff understand what is expected from them.

11. **Criticality, reflectivity and praxis of sustainable development in a transformative higher education system**
Author: Ms Abigail Edem, Central University of Technology, Free State (CUT)

11.1 No South African university properly understands the notion of holistic sustainability. If the students currently fighting for free higher education understood the effects of their struggle on future generations they might give it a second thought. It applies to educators too, who may approach the development of a curriculum that is adequately responsive and transformed in a different way. We cannot continue doing things the same way and expect different results.

Sustainable development is not a new concept. It started 50 years ago, when it was called environmental education. It went through various iterations to arrive at the present understanding of sustainable development, and in South Africa the concept gained traction when the national sustainable development summit was held in 2002. Sustainable development is a holistic term that concerns society, the economy and the culture of the society. That brings us to an important aspect of higher education systems, which is that the methods we have been using are no longer working for us, and need to change. We should firstly identify what we need in society, and in aiming to understand the environment, take note that democracy, policy, peace in society and conservation of the biophysical are all important contributing factors.

In 1977, the 12 Tibilis principles were decided upon. These include that the environment is defined in its totality (including social, economic, political, cultural-historical and moral) and that it is a continuous, lifelong process that must promote value. Good planning is essential, and should allow the development of critical thinking and respect for the universe.

In terms of tansformative learning, it is viewed as problem solving by defining a problem or by re-defining or reframing the problem. Sustainable learning is complex and interdisciplinary in nature, while sustainable development is all about awareness and skills, which have to be approached by problem solving in teams, but in a holistic manner.

Criticality does not mean criticism, but revieiwng to improve. It means to extract main ideas, evaluating them in terms of the argument being made, and synthesizing those ideas into a logical argument. Praxis refers to critical reflective practise which will bring about rreflective learning through critical thinking, which involves planning, acting, reflection and re-planning, when one or all of the other elements need revision.

12. **Q&A Session**

12.1 Question: what is the best appraoch to pre-seed funding, which is a big challenge in South Africa. Do you have strategies to share with us?

Döry: In the last five years, Hungary spent a lot of money on venture capital. It is not clear how effective this has been. We now have a new funding cycle that will better track the distribution of venture capital. There are 8 companies which collaborate with univesities to focus on the innovation pipeline. These include start-up events, mentoring services and complex proposals. We think that this will also cover consulting services and other processes. We will focus on nurturing companies for the foreseeable future.

Theme 3: Innovation: Powering the global economy
Session chair: Prof. Alfred Ngowi, Acting DVC Research, Innovation and Engagement, Central University of Technology, Free State

13. **Round table discussion**
Dr Henry Roman, Director, Environmental Services and Technologies, Department of Science and Technology (DST)
Mr Raman Sharma, Director, Exigo Recycling Pvt. Ltd, India
Ms Sharon Dell, University World News (UWN)
Ms Valerie Flanagan, Chief Technical Advisor for the Sustainable Enterprise Development Facility (SEDF), South Africa

13.1 **Dr Roman, DST:**

- I am responsible for Environmental Services and Technologies. Our message is that the DST coordinates the national system of innovation, as we move into our new Decadal plan, and we would like to hear your views on the innovation system and how effective it has been.
- In 1996 the White Paper for Science and Technology introduced the National System of Innovation. We knew that we needed an agency to drive innovation in the country, and it also introduced the concept of Centres of Excellence and the SARChI programme. In the ten-year innovation plan we introduced a number of concepts that were expanded in the policy, including global change, energy, social science, bio economy and space science. In 2012 a Global Change Research Plan was developed for the period 2012 to 2021, following a systems thinking approach. We also developed two RDI roadmaps, for water and waste.
- The NRF, CSIR, HSRC, TIA, NIPMO and SANSA all report to the DST. Industry, business and universities also form part of the system.
- Innovation is understood as an iterative process, and no longer as a linear process. Although the NSI is a world-leading initiative, there are areas in the system that needs improvement and change. To achieve this, the DST developed a new White Paper and a new decadal plan.
- We also want to develop a more systems-based approach to waste management, in terms of which the DST identified various clusters, from strategic planning through to technology and logistics performance. We also realized that it is necessary to co-develop and co-create if we want the system to work, so we hosted a science-meets-industry workshop to discuss the various waste streams. We asked industry to speak first about what their problems are, to enable researchers to develop real solutions to those problems.

13.2 **Dr Sharma, Exigo Recycling, India:**

I think it is important to think about how ideas would be made more relevant to the context and the global economy before commercialisation.

13.3 **Ms Sharon Dell, University World News:**

I propose that the media no longer has the exclusive responsibility and role to communicate science to a broader public.

13.4 **Christo Viljoen, Economist, KPMG:**

I am not an expert on politics or legal matters, so I focused on the possibility of offering free higher education over the past few weeks. I think we should look at innovative ways to expand education and training and bring down the cost of education and training.

13.5 **Ms Pillay, TIA:**

We work to put people with ideas into contact with collaborators to help commercialise their ideas.

14. **Q&A Session**

14.1 Dr Padayachee: Most universities are using online education platforms to make education accessible. We have UNISA using open distance learning to enable people who cannot study fulltime to do so. However, the cost of this mode of study is not funded. Our big challenge is the cost of online learning. Online teaching is expensive, and requires strong connectivity. We need innovative solutions to the current situation that would reach the furthest corners of the country.

Dr Mwenanda: I have a student who is developing a platform to be used on a mobile phone that would allow students to improve their product. One of the ways we tried to improve this was through the medium of Fremium, which starts off free. Students can progress at their own pace and gradually progress to the next leveL One has to ensure that the content is continuously updated and improved. We are looking for an investor to open up access for the informal sector and entrepreneurs.

Comment: I think the lessons regarding innovation and entrepreneurship are mainly focused on tertiary institutions, and might have to cascade to school level. This would allow school pupils to become more entrepreneurial in their outlook and to expand their knowledge, rather than just getting an education. If we could stimulate an entrepreneurial mindset early on we could focus on just expanding people's knowledge, rather than focusing on attaining a qualification.

Response: TIA developed a programme at various levels, starting from school through to UoT and the world of work. We developed a platform to stimulate collaborative and entrepreneurial thinking.

Comment: If innovation can create employment and alleviate poverty, it would have achieved the desired outcome.

Question: We have been talking about innovation at SATN since I can remember. I fail to see what impact it has made either in the economy or in the lives of people. As the previous speaker has said, unless we ensure that our innovations improve the economy and people's lives, they will remain expensive toys for clever people.

TIA: We have several projects underway with various universities. We are determined to ascertain the impact of the grant money that we have made available. We did a programme review in this year and found that of the total R 26.9 million spent, a large portion was spent locally, 73 jobs were created, and a considerable contribution was made to household income. We follow a similar process in other projects.

Comment: I think we need more information on the National System of Innovation.

Dr Roman: It is quite shocking that universities are not aware of the NSI. It has been around since 2002 as a concept, responding to the need identified then that South Africa needed a National System of Innovation.

Question: Where does the waste management plan fit into the DST's national plan.

Dr Roman: It fits into the overall plan, and the intention is that a portion of the levies that would be collected would fund R&D.

Mr Sharma: One thing that I would like to emphasise is the need to incentivise products, but there is a need to think about an innovative policy and innovative ways to incentivise waste management and recycling, and to incorporate the community.

Question: What strategy would you propose for an effective, integrated strategy to communicate the National Innovation Strategy more broadly, and also to tell the public what universities are doing in this regard?

Ms Dell: I think that academics have enormous opportunities to take control of the messages that are being communicated. Technology has turned the world upside down; we can no longer rely on old models to communicate our mechanisms. There are not enough journalists who have the capacity or the interest in innovation in higher education. One of the problems with journalism is that you can quite easily get a bad reputation for getting things wrong, and there is a lack of resources to support journalism. In the past one would have developed a relationship with a media house that shared the same values that you do. Those people no longer exist, and if they do, they are so stressed and deadline driven that they are no longer able to communicate properly. I think that universities should train staff to take charge of communication on their behalf. Newspapers generally take free copy and will publish it, as long as it is of good quality, because they are so shortstaffed. I think that we also have to move away from the written word and opt for graphic story telling and other forms of media to communicate the message. I am thinking of the Ted Talks format, which is something that all academics can produce quite easily to sum up the basis of their research and how it can impact society. It is always important to tell people how your research will affect society for the better, and since more and more people are getting their news through social and electronic media, this might be a better way to reach them.

Question: Do you think that a technology innovation programme could be created within the NSI? What would be the best strategy to get this to work?
Ms Naidoo: That is exactly what the process is meant to do; linking universities, bodies like the CSIR and local producers to focus on new technology development. It draws these parties into the NSI, including funders and technology stations. The TIP instrument is still new in TIA, and we are looking at various streams – we identify different thematic areas and try to match them to the most appropriate universities who have strengths in those particular niche areas. We try to identify the country's needs and collaborate with our university partners to address those needs. We use collaboration and networks to see where we can scale programmes up and commercialise them. It might be at a small scale at the moment, but we are working to expand the process.

Comment: We need to understand that we need to go beyond research, towards research and innovation. In general we only answer the problem statement, but we don't take it beyond that point to develop a response. We also need to understand that there is knowledge development, but also a spin-in that can be applied in business or government. Knowledge is dynamic and there are various elements that have to be understood.

Ms Dell: Speaking as a media person that is one of our biggest challenges – identifying what is newsworthy. Universities want stories that sell, rather than stories that are interesting to tell. That is a huge problem for researchers, i.e. selling the concept and the value of your research.

Comment: When we look at the papers we write in universities, there is a certain structure that is required. We have to think why we work in isolation, and why we do not collaborate with others in our universities to communicate a stronger message. If we collaborated more within our universities our messages might be stronger.

Comment: At DUT we have identified that in order to provide our students with a valuable learning experience, we have to ensure that innovation happens across the board and are supported by collaboration among various structures in the university. It takes a long time to get to the desired point where we have social innovation and entrepreneurship. I was encouraged by the comment that we need disruption at the faculty level. Universities have to be aware that there are design challenges that they can address and change people's lives, but that we need to take risks to meet those needs. If we talk about innovation and entrepreneurship, we need to get institutions to embrace risk and change. Partnerships, collaboration and inter-discplinarity are all fundamental to the success of innovation.

Mr Viljoen: I think that the student protests and fees must fall have highlighted that there is a need to change the traditional conceptualisation of university education, placing it in a different environment or providing it through different means. Technology is immediately held up as the answer but it is not as cheap as we like to think. We could say that we should all use internet or cell phones for people to learn, but we are also aware of the high costs of internet data. The ultimate issue is where the money will come from. Universities get the bulk of their funding from the state, from industry, and from fees. We need money to enable people to be innovative and to do research. We also need to think of the long-term versus the short-term outlook. There have been considerable changes happening in the global economy, and planning for the long-term often is not a realistic undertaking because the

world changes so rapidly. Collaboration across disciplines and across private/public organisations will be essential, because in the end it is about creating jobs to reduce inequality and poverty.

Comment: I have heard repeatedly that we use knowledge creation and preparation for a job interchangeably. We need to have a better informed understanding of what kind of university we want – do we want universities that enhance the world of ideas, or do we want institutions to prepare people for the world of work? We have one type of university which might not have a common purpose, which could explain the disjuncture between research and innovation.

Mr Viljoen: The research that KPMG has done has tried to answer whether universities currently create the people we need in the labour market and whether, if we could provide free education, we would produce the kind of students that the system needs. There is a disjuncture between what universities produce and what business actually needs.

Comment: In my personal opinion universities should create knowledge and at the same time should prepare people for a series of tasks that would prepare them for life. Times have changed from what universities used to be in the 18th and 19th centuries, and universities need to adapt as things change. Lecturers must not spend all their time on research, they must also spend time on teaching and learning that would prepare students for the world outside of the university. Community engagement could involve some aspects of innovation; universities should provide the cmplete package.

Comment: Maybe we should look at disrupting the term univrsity. We expect universities to undertake several activities, including innovation, research, teaching and learning. We could adopt a ratings system, which universities themselves could decide as the most appropriate for their own contexts or their financial resources. A university does not have to do all that, but they could focus on some aspects or focus areas.

Question: We applaud the DST's support in technology innovation. As much as the process has not gone smoothly, some attempt is better than none at all. Universities cannot cater for all the requirements for innovation, and have to partner with other role-players to achieve better results. The DST and TIA may have the best intentions, but if there is no alignment with other role-players, the process will not be successful. Will there be strong engagement with the downstream players?

Dr Roman: Yes, we have already started engaging with role-players and other government departments. We are also partnering with business organisations representing different sectors.

Dr Sharma: In response to the question whether universities are adequately equipping learners for the world of work, I think that they should not only be providing students with specific workplace-related skills, but with a broader set of skills that would make them employable as well as well-rounded citizens.

Theme 4: People, power and innovation for sustainable development
Chair: Prof. Marcus Ramogale, Acting Vice-Chancellor, Mangosuthu University of Technology

1.   **Innovation and sustainable development in higher education: A transatlantic and transpacific perspective**
     Prof. Fernando Leon Garcia, President of CETYS University, Baja California, Mexico

1.1   The US established the Association for the Advancement of Sustainability in Higher Education (AASHE). The AASHE conducts regular reviews of areas such as operations – broken down to focus on elements such as energy, waste, buildings, water – and engagement with students and the public. Less frequent reviews focus on planning and administration, and academic and research activities. Of course the Millennium Development Goals also inform the reviews.

A number of case studies that were part of the AASHE's focus on sustainable development in higher education, and the lessons learnt from them, were highlighted:
- Sustainability is not about sporadic actions, but rather long-term efforts;
- The University established a Council for Environmental Quality, Sustainable Development and Prevention of Risks, which also conducted some research. This project aimed to not only create awareness, but also to assess the impact of the initiatives.
- Another university established a centre for Regional Sustainability to drive regional collaborations in higher education, research, stewardship and outreach. It involved faculties and students, and began to incorporate some of the elements and principles of sustainability within the university.
- An undergraduate academic programme or major was championed by the Institute of Sustainability, which is offered through the College of Arts and Letters. It is taught by faculty from across the university.
- To embed the concept, it is necessary to secure and/or involve the community, and to interrogate the local and regional context to actively look for connections and environmental sensitivity. It is also necessary to seek not only expertise and learning, but action.
- In another case from Mexico, the university looked at embedding sustainability into its curriculum. One course in each level has to include sustainability material; training is provided to professors who have to teach the course; and all class materials are available in PPT, BB and YouTube.
- A separate study looked at a large research university versus a small private university to consider their advantages, organisational culture, and different approaches to sustainability. An interesting concept from this study was a Campus Living Lab which was developed by both institutions.
- Another study focused on a network of 15 universities collaborating on net-zero energy buildings and technology. The University of Maryland instituted programmes where students were encouraged to conduct action research by engaging with the community.
- Sustainability is an important matter which begins with each and every one of us as individuals, but also has to be done collectively.
- Regular review in the community, regional or local environment is necessary to ensure that the norms within which we operate are still relevant.

Most institutions address innovation as a response to real problems that are context specific. CETYS University hosted a seminar at which various themes were debated, namely the role of faculty and students, alternative models and technology, quality, accreditation and accountability, international partnerships, the roles of business and industry, and leadership and governance. The keynote speaker at this seminar highlighted that successful organisations have a sense of humility and constructive paranoia, always ensuring that they stay ahead of the game. It is necessary for institutions to have a culture of education and strong role models to help stimulate innovation. It is also necessary to recognise and reward innovation, and build a tolerance for failure into the formula.

2.   **Essential skills of graduate engineers in Namibia**
     Authors Mr Evan Strydom and Dr S John, Namibia University of Science and Technology (NUST)

2.1   NUST conducted a study on the essential skills that are required from graduate engineers in Namibia. Since it is intended that this should be an ongoing study, an initial pilot study in which we consulted engineers working in Engineering in Namibia was conducted.

What are skills? The ability to do something well; expertise, competency, capability, talent are synonyms. Skills also cover the cognitive, technical and interpersonal activities that are required from us on a daily basis. The problem is that employers have indicated that they are dissatisfied with the fresh engineering graduates that they employ, and that their greatest need is for basic employability skills. Literature that was consulted highlighted the most important skills as accountability, business skills, innovativeness, integrity, leadership, professionalism, problem solving, quality awareness, technical competence, and being a team player, among others. Although subjective, these give an idea of what is expected from a new engineer starting out in the profession. In addition to technical or hard skills, people also have to contribute professional and soft skills in the work place, such as personal or intellectual ability and interpersonal or people skills.

A breakdown of the Engineering population in Namibia indicated that the majority completed a B Eng qualification (37%); followed by BSc (33%), BTech (22%) and those with diplomas 8%. Of the total population of 1 200, 341 responded. Results of the survey highlighted the most critical skill as being problem solving, followed by professionalism and technical knowledge (with scores between 90 and 95%). Other important skills and values (with scores from 85 to 90%) included basic computer skills, analytical thinking, integrity, engineering design, project management, quality awareness and technical report writing. The industry placed basic financial skills, business skills and entrepreneurship at the bottom of all the critical skills, with scores of 68.5%, 52.5% and 45.9%. This might be because in Namibia there is not such a high prevalence of engineering from first principles, but this aspect will be investigated in a future study.

Considering that basic computer skills ranked 4 overall, it should be noted that it had different scores in the specific fields of engineering with Mechanical Engineers ranking it higher than Electrical Engineers. It was also clear that certain values or skills increased or decreased depending on the number of years that an engineer spent working in the field. Overall soft skills attained a slightly higher importance rating than hard skills, with problem solving, professionalism and technical knowledge leading the pack.

3. **Entrepreneurship in programme curriculum: Case study of selected higher education institutions in South Africa**
Authors: Olutoye Timi Ayodeji, Titilola Olusola Okusolubo and Teboho Pitso, Vaal University of Technology (VUT)

3.1 I believe that entrepreneurship is an important skill that we need to teach all graduates, to create not only work for themselves, but also for others. We have talked about innovation and agreed that while it is different from entrepreneurship, the two must be closely interlinked. Innovation has to infuse the entrepreneurial mindset; most entrepreneurs that have changed the way we lived had this outlook. I worked at a private HEI a few years ago, and I found that in the three-year curriculum for business and IT students there was not even one module on entrepreneurship. In effect, what the course did was to disempower the students who completed that programme. I found out that entrepreneurship was only included as a topic in one module in the first year of the Business programme. I thought that it would be necessary to look at other similar programmes.

Bygrave & Timmons, 1992, stated that 'entrepreneurship is the American economy's secret weapon. Since 1980, fast-growing entrepreneurial companies have accounted for nearly all of the 20 million jobs created by the US economy… and have altered the ways in which we live and work'.

Entrepreneurship is important for economic renewal, economic development and social development. In South Africa, which has a population of 55 million people, 30.4 million people should have jobs. Only 15.7 million people are employed in the formal sector. This means that 14.7 million are not employed in the formal sector. Of course statistics for self-employed or people employed in the informal sector range from 1.5 million to 4 million. This leaves 10.7 million people who are truly unemployed. Self-employment (or entrepreneurship) is not just a good option, it is the only option for most people in South Africa.

The GEM 2003 Report identified that SA had a low level of entrepreneurship involvement. Entrepreneurial thinking is a prerequisite for businesses and organisations to survive in the modern economy. Entrepreneurship education, which is essential to develop innovative leadership in graduates, plays a critical role in developing this mindset.

The emergence of entrepreneurship as an academic field has necessitated the introduction of a significant number of courses worldwide. Trends revealed that while it is mostly offered in business schools, there is a growing trend to offer entrepreneurship courses in non-business schools. It is now also included in the curricula for training teachers in the EU, and it is acknowledged as a critical aspect of addressing a range of social and other problems.

Entrepreneurship skills are lacking in both formal and informal educational structures, and particularly in STEM programmes. The GEM Report for 2015 identified that 63.9% of the youth population had a non-entrepreneurial outlook. It is also problematic that our socio-cultural norms do not encourage entrepreneurship as a career choice. Our policy makers responsible for guiding the educational system has to incorporate entrepreneurship as an important element in our education offering.

The following questions should inform how we think about entrepreneurship:
- How are South African universities contributing to the development of entrepreneurship, and does entrepreneurship form an integral part of the curriculum?
- To what extent and at what level is entrepreneurship included in the curriculum?
- What topics are covered in entrepreneurship modules and how is entrepreneurship education delivered in South African universities?
- What tools and materials are used to deliver the entrepreneurship curriculum?
- What is the background of the staff currently employed to deliver entrepreneurship in South African HEIs?
- How can HEIs improve their entrepreneurship curricula?

10 institutions, including 6 UoTs, 1 comprehensive university, 1 traditional university and 2 private higher education institutions will be asked to participate in the study.

Based on the literature study, it is clear that enterprising graduates are in general more employable. Universities have an important role to play in developing innovative leadership and entrepreneurial graduates. Many more graduates will need to develop career options that will enable them to start their own businesses. Entrepreneurship education should be included in the curriculum from basic to higher education, and across all disciplines. The degree of exposure may vary from one discipline to another, but it remains a critical feature.

4. **Q&A Session**
4.1   Question: Could you explain how community engagement is used in Mexico to instil sustainability and innovation?

Prof. Garcia: One way would be compulsory social service, which is what we have traditionally done. This means that there should be no student graduating from university who has not done some form of social service. Of course this is quite onerous, and over time of course some programmes may not have been as meaningful as they could have been and became more bureaucratic rather than effective. We realise that we should constantly review and improve, by embedding community service into the curriculum. Historically universities did not embed sustainability or innovation in the curriculum, and we realised that if we do want to make sure that it forms part of the curriculum, it should be embedded in a more integrated fashion. We are therefore finding that more universities are following the McGill model of integrating sustainability into the curriculum to have real impact.

Question: When we talk about innovation, is there a need to ensure integration between basic and higher education?

Prof. Garcia: There is certainly a lack of communication and articulation between basic education and higher education in many parts of the world. In Mexico there is a push for greater integration; the Minister of Education is trying to embed certain concepts at school level already, in order to ensure that those concepts would feed into the university curriculum. There is a need to adopt a long-term strategy for something that is essential and important.

Comment: I want to comment on the NUST study. It is not strange that soft skills are important in engineering; we found in an earlier collaboration with a German institution that they recognised the importance of soft skills, which had been incorporated in their curricula. Our own ECSA have also started incorporating soft skills in their programme structures.

Question: Long-term research has shown that there is some evidence that engineering studies might unintentionally enhance a lack of community-mindedness, which may indicate a lack of exposure to the humanities and social sciences, which could be addressed by exposure to other disciplines. How should the curriculum be organised to include the softer skills and aspects like entrepreneurship?

Mr Strydom: We all know the clichés about engineers' inability to socialise. ECSA's outcomes require students to function in groups, and that they should be exposed to industry and people to focus on problem solving and learning

from other contexts. It is also important to mix people up so that they work together with people that might not think in the same way that they do.

Prof. Ayodeji: We want entrepreneurship to cut across all disciplines, from management to the humanities and engineering. We are mindful of the fact that a lot of innovation happens across various disciplines; if students are exposed to those skills, they will have some idea of taking their innovation to the market. That gives them a platform to interact with somebody who might be more entrepreneurial. We know that there are different types of entrepreneurs, and that they might not all be primarily innovative, which is why we have to bring these skills together.

Question: I just want to raise a cautionary note. We should guard against dichotomising entrepreneurship and innovation in our efforts to solve the problem. What is the role of mentoring in trying to enhance skills?

Mr Strydom: I think that mentoring is absolutely essential, in both soft and hard skills. It has the benefit that it also improves the skills of the mentor, by forcing people to think differently about the topic.

Partnership projects
Chair: Dr Anshu Padayachee, CEO: SATN

5. **The South African Additive Manufacturing Strategy: The impact on people and innovation**
   Presenters: Prof. Willie du Preez & Mr Gerrie Booysen, Central University of Technology, Free State (CUT)

5.1 Additive Manufacturing is defined as the process of joining materials to make parts or objects from 3D model data, using layer upon layer rather than subtractive or formative manufacturing. There is minimal material wastage, since there is no cut-away of material. There are strong drives internationally to adopt this kind of technology, and major companies like General Electric are using the technology to produce appliance parts. It is also being used to construct dental and medical devices. There is expected to be considerable increase in the adoption rate of additive manufacturing by industry. In South Africa the technology has grown dramatically since 1991. In 2009, the patents lapsed which meant that many more people could purchase 3D printers.

In 2013, the DST developed a strategy for the Additive Manufacturing Strategy. A core team of experts led the development of the roadmap, and will inform future decisions on investments in R&D and commercialisation of 3D additive manufacturing. Apart from applications in medical and aerospace, AM could play an important role in traditional and new materials and technologies development. Design and testing are enabling capabilities, and are helping to embed AM in the education system.

A collaborative programme in additive manufacturing was adopted among various universities, the CSIR and Aerosud, to design a programme for the first three years of implementation. The Collaborative Programme will cover three areas. The first is a qualification for Aerospace and Medical applications, to demonstrate reliable reproduction of parts. CUT is leading the initiative in this regard. Then there is Design for AM, which would establish the local design competence for AM produced parts, led by NWU. Polymer AM is the most mature part of the AM industry, also driven by NWU. Science communication would be driven by the CSIR.

The value of having a national team of collaborators is that there are at least 30 projects underway at any given time, being managed by a variety of contributors. Various examples of medical applications of AM was highlighted. CRPM was ISO certified, and was also granted a Research Chair. The certification allows CRPM to do more commercial work in terms of medical work.

In the Aerospace area, there is a need for large but by necessity light-weight structural wing components for which the largest additive manufacturing bed in the world has been created. Although able to create large components, it can be scaled down for smaller products. In the past, the process started with 271 kg of material to arrive at an eventual product weighing 4.24 kg. These structures can be constructed through additive manufacturing at high speed and with minimal wastage. The system should be finalised and operational by March 2017.

The SA Additive Manufacturing Strategy is providing strategic focus to R&D and innovation in SA. Ground-breaking work is being done on customised implants in the medical and aeronautical field, and the SARChI chair will deepen and strengthen research in this area.

6. **Sustainable development through engineering solutions: An example of modular solar powered aquaponics**
Presenter: Fareed Ismail, Cape Peninsula University of Technology (CPUT)

6.1 At the turn of the century the world's focus shifted to sustainable energy, food security, reducing our carbon foot print, and stimulating economic growth.

The project combines new and existing technologies to boost food production through aquaponics. Aquaponics is basically the symbiotic relationship between growing fish, which contribute phosphates and nitrates to water that is used to grow plants, i.e. vegetables and fruit. This has symbiotic benefits for both components. Renewable energy is used to generate power for the system, which drives water circulation, the control system and pumps. The project is broken up into two stages. We built a proto-type at CPUT, and simultaneously launched a pilot project in a community. The community works with us to develop the technology and implement improvements. The community supplies the labour, have to look after the system and take ownership of the system.

We are working on making the system more cost effective. There have been various challenges in the programme with fish that developed swim bladder disorder and bacterial infections. In order to measure the fish to determine the optimal growth rate, we developed a grid on the bottom of the pool so we no longer needed to remove them from the water to measure them. The plant growth rate reaches optimal rate at 35 days. There is definitely a market for this kind of technology.

The project also involves the community in the learning process. The community decided to add a number of tanks to the system in order to increase its output, but this put the system out of balance. This taught us that you cannot start up any project and leave the community to run it without training them to use it optimally and understand the impact that their actions can have on the overall functioning and sustainability of the project.

7. **Centre for Tissue Engineering (CTE) – the only multi human tissue bank in SA - providing in the ever growing need of tissue for transplantation**

Presenter: Ms Cleo Ndhlovu, Manager, Centre for Tissue Engineering, Tshwane University of Technology (TUT)

7.1 The Centre for Tissue Engineering was established in 2002, as a partnership between TUT and Bone SA. It provides tissue for transplantation to the SA medical fraternity, and uses technological advances to improve the quality of tissues and the processes involved. It implements tissue engineering techniques to produce tissues for clinical application.

The CTE is in the process of extending its scope to provide more treatment options in tissue transplantation to the SA medial fraternity, as well as specialised training to industry and students in tissue engineering and tissue banking processes.

Tissue and organ failure result from injury or disease, and is a major health problem. Tissue types that can be transplanted include corneas, bone and ligaments, skin, and heart valves. In 2013 only 231 corneas were transplanted, despite there being a need for 2 200 corneas. 268 new cases of skin transplants are treated per month, while in 2016 only 40 burn victims could be provided with skin grafts. Cornea donations have been declining from 1998 to 2013, while the demand increases. Bone and ligament donations peaked in 2002/3, but also declined thereafter and has not shown an upward shift.

There is an enormous need for human skin for the treatment of burn victims. Burn injuries account for 12% of all fatal accidents in South Africa, and is the commonest external cause of death in children. Donated skin can mean the difference between life and death for the patient. The CTE recently launched a skin banking programme, which would allow doctors to access skin when required.

Cardiovascular tissue such as valves can also be harvested and replaced in patients that need replacement of defective parts. The donation of these tissues declined even more markedly. South Africa has less than 5 donors per million people, which has to be addressed through public communication.

All people are encouraged to become organ donors to save a life. People should no longer look at organ and tissue donation as a taboo topic.

8. **Q&A Session**

8.1 Question: Do you rely only on donated tissue?

Ms Ndhlovu: We only deal with human donated tissue.

Question: This is an amazing project – about 35 to 37 years ago we started a tissue bank in Johannesburg. The question is whether those are cadaverous tissue – how long do you keep them frozen? Do you keep corneas?

Ms Ndhlovu: Our tissue bank is world-class. We deal only with cadaver donors who registered as an organ and tissue donor, rather than somebody who donated their body to science. There is no way that heart valves can be kept for many years, unfortunately. The longest we have had a cornea in the bank was three days, because there is such a high demand for them. Unfortunately we do not have tissue harvesting or tissue processing techniques, people still have to train in Spain.

Dr Padayachee: I assume there are very strict laws governing the use of tissue?

Question: What should one do to become an organ donor?

Ms Ndhlovu: We have somebody right here with registration forms. There is a summary of how the process works, and you can sign it immediately to register. South Africa now has only one register for organ donors.

Question: Regarding additive manufacturing – what are the defects of the parts? Are other materials other than titanium being considered for use?

Prof. Du Preez: The defects of additive manufacturing are typically porosity or delamination, where areas are not completely fused and could lead to failure of the material. For medical implants a nano-CT-scanner is used to pick up defects before implantation. In terms of other materials, some players have ventured into polymer-based composites; I am not aware of metal composites, but I know that some laboratories are working on multi-metal layers to optimise the properties of specific metals.

9. **E-waste project (VUT and UKZN)**

Presenter: Mr Heinrich van der Merwe, VUT Southern Gauteng Science & Technology Park, Vaal University of Technology (VUT

9.1 The VUT Technology Station in Sebokeng has a vast array of projects that it can showcase. It has a diverse existing technology infrastructure to help foster a culture of innovation, and VUT will be the first site of e-waste recovery in South Africa.

Electronic waste in South Africa forms part of the solid waste stream. It is not easy to control this type of waste at source, and it is readily found on dumps. E-waste include all electronic goods that have reached their end of life, and as such often contain hazardous and toxic materials and should not be allowed to pollute the environment. India imports 90% of their mobile equipment, being one of the largest importers of e-waste from developed countries like the US, UK and Japan, along with China.

There are many materials used in consumer electronics including lead, cadmium, mercury and plastics, all of which could be harmful if not recovered. It is interesting to note that 1 metric ton of e-waste contains more gold than 17 tons of gold ore. To produce one personal computer, one needs 20 kg of chemicals and 1.5 tons of water. Re-cycling of e-waste is infinitely better than incineration or dumping in land-fills. It is estimated that 50 million tons of e-waste is produced annually. The USA discards 30 million computers each year and 100 million phones are disposed of in Europe each year, yet estimates are that only 15 to 20% of e-waste is being recycled currently.

E-waste repurposing and training is being provided to people as part of the VUT initiative. Dismantling is employed to extract valuable metals from computers, which can be repurposed in South Africa.

VUT completed a study visit to India in April 2016, and will establish collaborations and partnerships with government agencies and relevant private companies to operate in the area of dismantling, recycling, data and information management and destruction, and policy development for the management of e-waste. TIA is a valuable training partner in this area.

Next steps:

- Identify potential technologies that can be adapted or adopted for the SA context;
- Develop an industry waste management plan for e-waste,
- Consider operational issues including transport and facilities;
- Develop curricula.

It would be essential to implement legislation and create awareness of e-waste recycling as a viable alternative. A proposed new VUT E-waste park is being planned, following a phased approach, and would accommodate government departments working in the area to advise on latest technological and legislative developments. Various buildings or plants for extracting the materials, and for beneficiation the metals extracted from e-waste, would be established.

10. **NSEUV – Namibian solar electric utility vehicle – A solar taxi by the Innovation Design Lab**
    Presenter: Prof. Pio Baronne Lumaga, Namibia University of Science and Technology (NUST)

10.1 Considering that 1.2 billion people would be urbanised in Africa in the next few years, there is a growing need for environmentally friendly transportation. NUST has developed a solar energy-driven utility vehicle that weighs about 200 kg and can transport 4 people comfortably. It is made in Namibia, at a cost of 50 000 Namibian Dollars, and a prototype has been finished ahead of schedule. In the next 20 months five working prototypes will be built to add more layers of intelligence and working to build a lighter, more efficient solar taxi. The project needs help in terms of tools, funding, expertise, and other inputs.

This is a mitigation project to increase the resilience of the African metropolis to climate change, connecting energy use to urban transport. It is also a useful mechanism to foster a new generation of researchers, technologists and entrepreneurs, and to produce original intellectual property to be shared with others.

In 3 years the NUST will produce 6 evolving working prototypes to materialise the work in progress research. Different teams, each with specific competences, focus on the solar and cell batteries, electrical and electronics, the car's intelligence, mechanical and composites, in a cross-cutting fashion.

It is necessary to understand as academics and teachers that we have to continuously revise the map that we follow to innovate. We embody our culture through our past experiences, and we are creatures of habit. Innovation is not something that can be made more efficient or optimised. We should however try to extrapolate from what we do now to try and predict the future of innovation, however unsuccessful predictions might be.

11. **Sea wave energy harnesser**
    Presenter: Mr Boniso Ngwenya, Mangosuthu University of Technology (MUT)

11.1 Our research focuses on sea wave energy, aiming to capture and use the kinetic and potential energy of the oceans. While work in this regard has been done in Australia, Scotland and Europe, it is relatively new in South Africa.

Wave energy is concentrated and could be harnessed through three types of energy conversion, namely float or buoy systems; oscillating column devices; and tapered channel system. This type of energy harvesting does not require any fossil fuels to be burned, meaning that there is no carbon emission. A power take-off unit delivers power through a generator to the grid.

The Wave Harnesser has been developed through the prototype stage, and is now in the stage where the prototype would be launched and tested on a platform in the sea, after which it would be refined and produced in greater volumes.

Benefits:

- Sea wave energy harnessing is geared towards industrialization to provide reliable power, as waves can be accurately predictable two or three days ahead;
- The project is run as a partnership between academia, industry and government;
- Economic and environmental benefits are significant;
- There is a considerable increase in research outputs;
- It would be possible to employ thousands of people in green jobs while using an abundant and clean natural resource to meet our energy needs.

12. **Traditional crop products development and commercialisation**
Presenters: Dr Eric Amonsou and his students: Samson Oyeyinka; Sithembile Shongwe: Faith Seke, Durban University of Technology (DUT)

12.1   The Food Science and Technology research project at DUT started in 2013, and focused on traditional food crops.

Our society experiences considerable challenges in terms of climate change, population growth, diets and lifestyle diseases, drought; malnutrition, food insecurity, lack of dietary diversity and other issues. In the US and other parts of the world, there is an increase in the number of obese people, while other parts of the world have hunger and food security concerns to address. The Millennium Development Goals highlighted the need to end poverty, ensure zero hunger and ensure good health and well being.

To address these issues, we need not only more food, but also more functional food and ingredients that are not only nutritious and affordable, but also tasty. Traditional food crops could provide the solution. Crops like cowpea, amadumbe, sorghum, and other neglected or unersuded crops may play a role in addressing the need. These crops are generally resistant to drought, nutrient rich, and can generate an income for people. They would also be more eocologically sustainable, and would increase dietary diversity and broaden the food base.

Amadumbe is an indigenous, edible aroid that has a high-resistance starch that is not digested and is good to prevent colon cancer. Tests were conducted to test whether different cooking methods reduced the beneficial properties of amadumbe starch. The research identified that biofilms from the nanocrystals extracted from amadumbe starch could be used to create products traditionally made from plastic. Other traditional plant materials could be used to increase the protein content in people's diets.

In addition to increasing the food base and increasing dietary diversity, new food products and ingredients can be developed and could lead to small to medium agro-processing enterprises.

13. **Q&A Session**
13.1   Dr Ramsuran: Regarding the wave project, TIA is in the process of signing an agreement with a number of other government departments to see whether we could scale that project up and take it to commercialisation.

Question: It seems that e-waste processing is a lucrative proposition.

Dr Ramsuran: Yes, and TIA will host a number of E-waste dialogues throughout the country, with two more coming up in Durban and Pretoria. We are working with the DEA to draft an E-waste plan to create opportunities for SMMEs and various other businesses. It is important that people should attend those dialogues; various recyclers, producers and researchers will be there.

14. **Conference closure**
14.1   Dr Padayachee closed the conference by extending a word of thanks to all attendees, students, staff of the UoTs, the SATN Team, and the service providers who made the conference a success. The University World News was also thanked for attending the conference and for giving the conference exposure.

SATN will continue to offer several programmes in partnership with TIA and other agencies, including future Writing for Science Publications workshops. More information on these events will be communicated via the SATN website.