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Media Release

SET for Socio-Economic Growth

National Science and Technology Forum

SA's advanced manufacturing industry takes charge

4IR and SA advanced manufacturing and automation: potential and challenges

#automation #AM

The manufacturing industries in South Africa need very specific skills. This is an environment where companies have to continuously improve efficiencies and productivity to stay in business. It's a sector that embraces technology and where Fourth Industrial Revolution (4IR) technologies are already deployed by some. There are many opportunities while government ponders and debates the way forward. However, when it comes to skills development, the advanced manufacturing industry sector is tackling skills development head on.

A National Science and Technology Forum (NSTF) Discussion Forum addressed how new technologies, and 4IR in general, have the potential to revolutionise manufacturing industries in South Africa. The aim was to look at what is realistically feasible considering the challenges. The event took place from 11-13 September 2019 in Cape Town. It was done in partnership with the NSTF engSET sector (Professionals in science, engineering and technology) and the SA Innovation Summit. The Summit and the NSTF engSET Event took place at the Cape Town Stadium.

The NSTF provides neutral collaborative platforms where issues and sectors meet

- One of the National Science and Technology Forum (NSTF) functions is to hold discussion forums, bringing the private and public sector together to address important issues and engage with government policy.
- Feedback from these discussion forums is given to stakeholders.
- Recommendations are put forward to government as part of the SET community's lobbying efforts.

4IR and advanced manufacturing

There is still no standard definition for 4IR, although the 4IR Presidential Commission is currently working on one appropriate for South Africa. However, 4IR can be understood as cyber-physical systems, networks, and artificial intelligence (AI) embedded in new ways within larger societies, communities, and even in the human body.

During the Discussion Forum, **a common theme when defining 4IR was the emphasis on human development.** Ms Ike Kang noted that, whereas previous technology revolutions were about machines and the development of technologies, 4IR looks at the role technology plays in the life of humans. Ms Kang is the Chief Director: Future Industrial Production Technologies, Industrial Development Division (IDD), Department of Trade and Industry (the dti). (See her complete presentation and notes on sources.)

Technologies disrupting the industry

- Big Data
- Augmented reality
- Simulation and digital twins
- Internet of Things
- Cloud computing
- Cyber security
- Systems integration
- Additive manufacturing ie 3D printing
- Autonomous systems
- Cryptocurrencies

As provided by Mr Johan Maartens, Director and COO: Society for Automation, Instrumentation, Measurement and Control (SAIMC) – member of the NSTF.

However, when referring to the manufacturing sector, Kang pointed to Industry 4.0 as defined by German Trade and Invest: "INDUSTRIE 4.0 connects embedded system production technologies and smart production processes to pave the way to a new technological age which will radically transform industry and production value chains and business models."

Kang says that it is clear that robots will replace people in factories. At the same time, policies shouldn't focus on protecting jobs but on protecting the person. Smart factories include the cloud, computers, sensors, robots, and machines. It's the Internet of Things (IoT) and automation, with no people on the production line. Humans will be peripheral and focus on high-end skills – maintaining equipment, programming, designing, re-designing, developing apps and so on.

Manufacturing in SA

Research published in 2016 by the dti shows that manufacturing output volume has only increased marginally since 2004. In general, we're not manufacturing locally, and South Africans and South African companies are buying outside the local market. Kang says that an added component is that South Africa is not manufacturing goods that are in demand globally and this needs to change. Private investment challenges, due to restrictive labour regulations, inadequate educated workforce, and poor work ethics in the national labour force (IMF country report no 18/246).

The dti aims to grow the manufacturing sector – a particularly important sector for job creation, new business, and skills development. **The dti is currently working on the Digital Industrial Policy Framework**, along with labour, industry, other government departments, civil society, and the international community. The framework looks at developing an ecosystem that includes smart factories, legislation and regulation, digital transformation, and policy coherence.

Future of jobs in SA manufacturing industry

Karg says that South African data, across industries, shows an increasing gap between skills demand and skills supply. This is critical considering the industry sees talent driving manufacturing competitiveness. (Talent being the quality and availability of highly skilled workers that fit the current and future requirements of industry.)

Karg introduced the Intsimbi Future Production Technologies Initiative. This is a partnership between government (the dti and Department of Higher Education and Training) and industry. It is a talent-driven innovation model and the pilot is already showing success with over 80% throughput of students. The aim is skills development and enterprise competitiveness, focusing on the advanced manufacturing sector. It is seen as one of the systemic solutions to industry's demand for talent. Over 2000 students have gone through the pilot and successful graduates are internationally certified within manufacturing.

This is a significantly different model to the current approach to managing skills development. Here industry has taken the lead. For a while now, manufacturing companies have been setting up their own training facilities and are also holding a great deal of the industry's technical research and development. It's a result of numerous issues with education.

When looking at tertiary education, issues range from a silo approach when the need is multidisciplinary to the focus on numbers (the amount of people) rather than quality. According to Mr Johan Maartens, there is also outdated equipment, a focus on teaching the basics, and lecturers with little industry experience. (Mr Maartens is Director and COO: SAIMC.) The current system isn't producing the talent needed by advanced manufacturing.

SA manufacturing industry 4IR response to skills development

Intsimbi is run by the National Technologies Implementation Platform (NTIP). NTIP is a project management company that falls under the Production Technologies Association of South Africa (PtSA). Mr Dirk van Dyk, NTIP CEO, says Intsimbi exists as part of the solution to ensure South Africa actually has manufacturing industries in the future. The programme is the manufacturing sector's response to 4IR and it is already in process. It provides training in highly advanced manufacturing skills.

South Africans are the lead and the innovators on this international programme pilot, which includes working with some of the biggest manufacturing countries in the world. (Think USA, Japan and China as examples.) The International Production Association mandated South Africa to do a pilot of a futuristic skills solution based on technology – a way to revolutionise the competency environment as part of 4IR.)

Intsimbi is a systems solution underpinned by sustainability. It moves across skills systems, enterprise development systems, and funding systems. It starts with identifying talent. It then follows these phases: industry competitive development; skills development system; new business; talent and skills development, and transformation. The outcomes are to create innovation capacity in the sector. (See Mr van Dyk's complete presentation.)

The difference lies in how it will actually work. There is a country-level nodal network that sits on an ICT platform. All devices and data (involved in the programme) will stream to this. This creates a Big Data scenario allowing AI and other 4IR technologies to play a significant role in assisting students along their learning path, as an example.

The learning pathways are centred around competencies needed by industry and customised to the individual and their talent profile. Van Dyk says it's about packaging curriculum content into frameworks that meet industry needs. Intsimbi is using existing international standards rather than "taking years to develop a South African standard".

Students work on modules (on the platform) and the training is free. Van Dyk says that companies have put their training material on the platform and have provided equipment for the practical learning labs/factories. The exchange here is clear: if companies want students to understand their systems, they must supply the material. Van Dyk says that industry provides the curriculum content and the methodologies. The flexible modular system means that content can be quickly upgraded.

Students will be able to book time, select a company to work with, and train on high-end machinery. The guided programmes include a minimum of 40% time on the factory floor. There is theory, practical sessions in advanced labs, and on-the-job training. This is all completed in a year regardless of whether the student is an engineer or machine operator.

Part of the Intsimbi approach is the individual taking education into their own hands. They are in control, not the teacher. Furthermore, AI built into the system will track the student and suggest what's needed to assist with skills development and building confidence levels. Support is also built in. For example, teachers can be booked as facilitators, remedial help will be available and extra content for difficult areas. On the note of teachers, the current thinking is that engineers and highly skilled and experienced people will be used for assisting with theory and in the labs.

It's a creative environment where students are allowed to test and stress, says Van Dyk. This is where innovation and learning comes in, allowing for the development of an innovation track.

With all the student's information on the system, companies can scrutinise potential employees and competency levels. Part of the Intsimbi approach is company incubation. Where there are entrepreneurial skills, these will be developed through supplier development programmes. The platform will lead the individual through this. Students will also be trained in personal skills. Furthermore, a social worker for every 25 students will deal with the life challenges that students face.

Van Dyk says that the current student retention rate is 80% with 86% permanent placement rate. The system tackles failure by providing extra support and remedial work. He says that in the time the student is in the programme, they will reach the competency level needed. People don't go home without something that will get them a job.

The individual is employable after a short period of time and then keeps building on the employability. They can migrate in and out of the system. It's a completely modular, flexible, and self-regulating system.

Van Dyk emphasised that this is the system supported by industry: "This is what we see for solving unemployment and the declining manufacturing industry." He says the model works but needs to be part of the mainstream system, as well as the policy environment.

Solutions for basic education

Mr Sarel Havenga presented on a skills solution where intervention is earlier – at school level. Mr Havenga is the Idea to Product (I2P) Facilitator and Prototype Specialist: Technology Transfer and Innovation (TTI), Vaal University of Technology. This approach looked at what can be done with existing structures and centres around a 3D printing pilot programme.

The basic education phase largely ignores technology developments. Havenga says this is a result of a lack of funding and resources (for example, schools without desks or even water). There are also time constraints (due to the large amount of content in the current curricula) and outdated assessment methods. Teaching by overworked and underpaid educators results in a lack of interest, fear of new technology, and a lack of skills among the learners.

To address the limitations, Havenga proposes looking at the pre-university education system. This includes an accredited model with short learning programme qualifications and the ability to become a facilitator to train others as a revenue-generating opportunity. A pilot for educators has already been run. The focus is on LSTMs – learner teacher support materials. The participating schools are now introducing the system into their classrooms.

A key point made was that traditional skills are still needed, as well as learning the fundamentals. Skills for new technology are then added into this pool.

Considering the two skills development approaches

The two approaches took at different spaces, with NTIP focusing on the post-school advanced manufacturing environment. Van Dyk sees the current schooling system as a numbers game where the aim is to have a very large number of children pass through the system. The result is large class sizes and a 'one size fits all' approach. The focus is not on quality. Add the SETA system to this and it becomes a sausage system, says Van Dyk. He notes that Intsimbi focuses on quality rather than numbers.

Opportunities beyond effective skills development

4IR holds many opportunities and the discussions went beyond skills development. According to Dr Hein Möller, most of the materials still need to be developed for additive manufacturing (3D printing). He is Senior Lecturer: University of Pretoria (UP) – member of the NSTF, representing UP's Department of Material Science and Metallurgic Engineering.

The country has an opportunity to develop new additive manufacturing materials, technologies, and systems. Note that additive manufacturing is being used in many industries including the space exploration, aerospace, automotive, medical, marine, and oil and gas industries.

South Africa has critical raw material deposits that are important for 4IR technology and renewable energy solutions. They are also valuable to the Africa context where forecasted urbanisation will need massive infrastructure, as well as water and energy resources, to name but a few things. Creating supply and value chains for the various materials needed in 4IR is part of the debate around viable opportunities for South Africa.

Case study - Opportunities for SA companies in the 4IR space

Jendamark builds future focused production lines (assembly systems) with a focus on the automotive industry. Their machines are built to international standards. The company had €56 million turnover last year.

This is a South African success story where everything is designed and built by Jendamark in South Africa. The company also exports about 95% of the production lines. They have been coming up with solutions that fit the South African and African context and that can then be exported globally.

See Mr Yaneeh Naidoo's presentation for the full story. (He is the Sales and Design Director: Jendamark.)

Various presentations dealt with this:

- Prof Paul Nel, Associate Professor: Economic Geology Research Institute, School of Geosciences; University of Witwatersrand
- Prof David Reid, Professor: Department of Geological Science; University of Cape Town
- Mr Davis Cook, CEO of The Research Institute for Innovation and Sustainability (RIIS), representing the Minerals Council South Africa
- Mr Brent Jellicoe, Principal Consulting Geologist: Merkara Exploration and Resource Consultants

When it comes to manufacturing, South Africa also has a role to play in developing appropriate technology that results in low-cost devices. It's about context and responding to Africa-specific challenges. Dr Trudi-Heleen Joubert sees it as designing solutions to local problems but with global relevance. (Of interest, she also notes that additive manufacturing is becoming microelectronics. See her presentation for more information.) Dr Joubert is the Senior Lecturer and Acting Director: Carl & Emily Fuchs Institute for Microelectronics (CEFIM), UP.

Speakers can be contacted through the spokesperson, Ms Jansie Niehaus. Video clips with the full presentations can be found on the NSTF website.

There have been previous NSTF Discussion Forums on related topics:

- Chemical elements for South Africa's Future, 18-19 March 2019
- Implications of the 4th Industrial Revolution for SET, industry, society, and education, 11-13 September 2018
- Sustainable Energy for All in South Africa, 16-17 April 2018

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