



S.E.T. for socio-economic growth

National Science and Technology Forum (NSTF)

media release

Artificial intelligence – to be feared or favoured?

Artificial intelligence (AI) is bionic – part human, part machine. For now at least. Few topics can simultaneously presage the (unfortunate) end of humankind as we know it, while celebrating the unlimited possibilities of creative problem-solving.

The [National Science and Technology Forum \(NSTF\)](#) unpacked the progression, potential and pitfalls of AI during its recent [Pitfalls of AI Discussion Forum](#). The almost 200 attendees at the online event attested to the relevance and timeliness of the topic.

Ms Jansie Niehaus, Executive Director of the NSTF, said, “This discussion forum provided a platform to share knowledge and insights on the connections between AI, its use in and contribution to the economy, and its potentially negative impact on society.”

Niehaus referred to the rapid changes in the world of work introduced by 4th industrial revolution (4IR) technologies and the robust discussions elicited around the many unknowns (and even knowns!) of these technologies. Recent media coverage of chatbots ChatGPT and Bard AI has added considerable fuel to the fire.

So, what are we to do? With the genie out of the bottle, so to speak, decision- and policymakers’ best recourse seems to be to build well-considered regulatory frameworks, ferociously fast, with clear communication imperatives. To do so, equally fast familiarisation with the potential and risks of AI is required.

Conniving code? Mobile machines? Brain in a box?

Mr Ziaad Suleman, Group Chief Commercial Officer of network solution company EOH, explained that AI is an umbrella term for computer science and data analytics. “It is about using the hardware and software of technology to apply the knowledge and data, how we get it to think and behave to support and benefit human beings. In essence, as it digests this multitude of information, it breaks it down in a way that helps us as human beings to plan and problem-solve. AI and the 4IR are interconnected. 4IR includes many technologies – cloud, AI, automation, the Internet of Things etc. It is about the

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 sectors together to address important issues and engage with government policy.
- Feedback from these [discussion forums](#) is disseminated to role players and stakeholders.
- The NSTF represents about [130 member organisations](#) participating as key stakeholders of the SET and innovation community.

convergence of data from various sources and deriving value from that data.”

Prof Deshen Moodley, Associate Professor: Department of Computer Science, University of Cape Town; and Co-Director: South African National Centre for Artificial Intelligence Research Unit (CAIR), added, “It is important to distinguish between autonomous AI and augmented AI. The latter takes a more human-centric view. This is where AI works together with the human to, for example, enhance cognitive performance that includes learning, decision-making and new experiences.”

He explained that traditionally, the goal of AI was full automation. “This is where much anxiety originated that AI will replace humans. It was seen as competing with humans because it supposedly would work independently from humans. But augmented AI looks to leverage the strengths of both, providing a different view of AI where intelligent machines amplify instead of replace human cognitive power.”

Also touching on the data-intensive nature of AI, Moodley referred to the ‘semantic web’, (a term coined by Tim Berners-Lee for a web of data for which much of the meaning is machine-readable.) Moodley said, “One of the key issues the semantic web was concerned about was interoperability. ... it wasn’t just about data integration, it was about how different systems could interoperate, ... the semantic web focused on meaning but neglected pragmatics (the intentions and conversations) and the social world (the beliefs, expectations, law, culture etc.), which are so relevant to AI systems.”

Fear not

Suleman reiterated a point also made by other speakers: “How we use technologies lies in the hands of the users – the people and the leaders. So we could either race towards danger or we could utilise it in a productive manner that benefits people.”

Up productivity, up economic growth

“We are increasingly dependent on technology to create more efficiency within our lives and our business processes, thus driving economic growth. According to Accenture, AI could increase productivity by up to 40% by 2035. Eventually, what we have is an enhancement of automation and productivity, our supply chains and economic growth should therefore multiply. Studies show a greater growth rate because of technology. Not simply because economies are changing but because we can drive better outcomes that are more predictable in a shorter period.”

Retail, financial services, mining, health, education

How can business benefit? The retail sector could benefit from customised retail offerings, to optimising the workings of call centres by analysing caller sentiment and routing calls effectively, as well as end-to-end solutions for invoice management etc.

In terms of financial services, AI can revolutionise banking and deepen digitisation where, for example, language-processing software in client communication determines customer needs, products can be refined, new value chains developed and customised financial advice offered.

“AI is also transforming the mining industry where, for example, AI integration enhances rock analysis and predicts ground movement; AI-powered cameras and autonomous vehicles improve safety and efficiency underground; and applications enable real-time monitoring, data analytics, predictive maintenance, and resource optimisation,” Suleman added.

Dr Ahmed Vahed, Director: Data Intensive Research Initiative of South Africa (DIRISA), Council for Scientific and Industrial Research (CSIR), listed several applications and benefits of AI, including drug discovery and diagnosis, personalised medicines, security-

related benefits, intelligent tutoring systems in the education space, automated production and manufacturing as well as other benefits like eliminating human error, 24/7 availability, freeing up human beings from repetitive jobs, reducing costs, and increasing production and efficiencies.

Mr Krish Chetty, Research Manager: Equitable Education and Economies, Human Sciences Research Council (HSRC), said another game changer is the benefits for small businesses regarding more efficient customer service, off-the-rack solutions, transformed marketing processes, cost and time benefits, and greater insights into competitors' business processes. With generative AI (like ChatGPT, Bard and others), small businesses can have access to expert knowledge on issues that used to eat up their budgets – legal, financial advice, marketing etc.

Looking at the education system, Chetty asked how can generative AI accelerate knowledge diffusion. "A well-executed AI system can connect business to the technical and vocational education and training (TVET) system where the TVET system can access business knowledge – especially to inform curricula to be more relevant and current to business needs (and thus recruitment strategies)."

Programming

Founder of RandControls, and Independent Consultant **Mr Pieter Steenekamp** spoke about the technical benefits offered to those developing AI systems. He quipped that AI in programming is like having a personal assistant who can read one's mind but is actually useful. "This technology wizardry takes care of the nitty-gritty details, allowing me to focus on the grand tapestry of creativity and using my imagination in the work that I do."

"AI can unleash our creative power and revolutionise the way we work with software. Used wisely, it is an amazing tool to make the human programmer significantly more effective and productive," he said. But he also cautioned, "However, that to expect AI to do everything that the human programmer can do is to invite disappointment. If you ignore AI, though, and expect to do programming without it, you will be left behind. To be effective and competitive, you have to embrace the technology."

In the shorter term, Steenekamp asserted, "AI in programming is likely to continue its rapid advancements and we can expect more intelligent code-generation tools that understand context and code developer intent, leading to increased productivity."

Manufacturing

Mr Vinesh Maharaj, Director: Operations Transformation Department, Smart Manufacturing, Price Waterhouse Coopers, looked at AI in manufacturing, which in SA, contributes about 12% to the gross domestic product. "For every one job created in the manufacturing sector, four other jobs are created elsewhere in the economy."

Unfortunately, manufacturing has been in decline as industrialisation slowed down since the 1980s. One challenge is inefficient processes driving up production costs.

He said, "Business analysis in 2020 showed that if we replaced just 5–10% of imports from the Asian and European countries and others, we could create an additional 346 000 jobs in South Africa."

Maharaj explained that the factory of the future will be a fully integrated ecosystem of stakeholders, "You will be able to connect to your suppliers' supplier and your customers' customer."

The structure of the 'factory of the future' will comprise, among others, "A planning and execution control tower that will aggregate data into a well-connected system where, for

example, a consumer buys the last pair of a particular sandal at a fashion store. The store's system sends a signal to the warehouse to alert it to the stock need, a signal is sent to the manufacturer for a re-order. The manufacturer will then alert its material suppliers. Normally, this will be a step-by-step process, but in future this will be a parallel process where everyone along the chain will get the signal simultaneously and a response can be much more proactive, reducing bottlenecks and creating more efficiencies in the entire value chain.

“To support this, you'll need advanced procurement, a 'smart' factory, digital logistics, digital asset management services, digital product development and lifecycle management, and so on.”

Opportunities offered by AI include increased efficiency (production planning, resource allocation etc.), quality improvement, predictive maintenance (minimising downtime), and supply chain optimisation.

South African AI ecosystem

Moodley spoke about establishing an AI innovation and capacity development ecosystem in South Africa. “There is lots of potential for AI to help with development in South Africa, but implementation has been slow. How do we navigate the complexities and where do we focus?”

He referred to the World Economic Forum's guidance that public leaders must promote external development of AI in an open innovation ecosystem; that skills development in building AI competencies is key; and that creating an entrepreneurial culture to leverage AI is also important. CAIR is expected to play a role in this regard to support responsible AI development and implementation in South Africa.

“The CAIR is the Department of Science and Innovation's research and capacity development programme comprising 10 research groups and two emerging groups across eight universities. Key objectives include developing a world-class AI research and teaching capability in South Africa, supporting sustainable and effective socioeconomic development, and building an accredited national and international AI research network that promotes AI research and technology in South Africa.”

But don't ignore the threats

Agreeing with other speakers, Maharaj added that risks include job displacement for especially repetitive and manual tasks (but new job and skill opportunities open up too), data security and privacy because AI relies on massive amounts of data, technical challenges such as data compatibility or lack of skilled personnel, and ethical considerations such as accountability of AI-generated outcomes.

Suleman said, “AI could also be a tool for great misinformation because of the many different sources of data, and therefore it is important for us to make sure that the generative AI products are utilised in the right manner.”

Vahed highlighted that, “We know that AI has significant societal implications. There is a shift in human experience as everyone is 'clicking' more and more. There is a general shift in the way human beings interact and go about their daily lives.

“Significant risks that AI poses are that of autonomy – the ability of AI to make decisions on its own, such as self-driving cars and so on, the difference between machine goals and our goals, and machine bias: “... gender bias, racial bias. We must remember that AI systems learn from data that humans produce and that data inherently contain bias. What we see in AI systems is a reflection of that. Unintended consequences might include AI systems going rogue. We have not yet experienced something like that, but it should be

considered.”

Examples of applications gone wrong include: “An interesting case study was done on self-driving car accidents – 9.1 accidents per 100 trips for self-driving cars compared to 4.1 for humans. ... Another example is the gender bias against women by the Amazon recruiting tool.”

Vahed said the notion of generating text or narrative has been around for some time – ChatGPT and Bard are but the most recent advancements of text generators (chatbots). One example of an existing threat using ChatGPT is a personalised phishing feature to elicit personal data from the recipient of the targeted communication. “Other threats include cybersecurity threats like accelerated hacking, bot takeovers, and malware infections. Predictive policing and social grading are already happening. And we have seen autonomous weapon systems where drones are proliferating and some of these drones can make decisions on their own. There have been cases in the Iraqi war, for example, where weapon systems have shot down their own planes.”

Ethical conundrums

Plagiarism, moral imperatives, human agency

One of the concerns about chatbots has to do with ethical questions should, for example, a student ask the chatbot to write a proposal on a certain topic. Vahed asked, “Should the student disclose where the content came from? How will it be monitored? What about other artistic or intellectual endeavours passed off as the user’s own work?”

One solution could be to stipulate that generative tools used should be cited like authors. Whatever the eventual decisions are, a lot of training and communication will be necessary.

“Criteria for ethics and moral status of AI will consider, for example, transparency, justness and fairness, non-maleficence, beneficence, trustworthiness, consent, privacy and security, and deep fakes,” Vahed listed.

From the programming side, Steenekamp said, “Ethical consideration and the need for human oversight and control will remain paramount; striking a balance between human ingenuity and AI assistance will be crucial to ensure the development of secure, reliable and ethical software systems.”

Legal considerations

Prof George Borges, Managing Director: The Institute for Legal Informatics, Saarlandes University, Germany, elaborated on challenges to the law posed by AI systems. “AI is challenging our traditional law, for instance: if images are created by AI these are not copyrighted. AI is also challenging the doctrines of legal transactions, for example, is a contract made by an AI system valid and what if there is an error on the side of the AI? In traditional law, it would be the human. Is a legal status necessary for robots, as already suggested by a European Parliament resolution?”

He highlighted risks varying from those posed by self-driving cars to improper statements made by chatbots that would be criminal offences if made by humans. “How would we deal with that?” He also referred to the bias where, for example, an AI identifies a person as a suspected criminal based on geographic or racial information and not based on actual contraventions of the law.

In the autonomous vehicle example, Borges related that a survey some years ago asked the question: if an accident was unavoidable and pedestrians could get hurt, who should get preference – the pedestrians or the ‘driver’? The majority of survey respondents opt for the driver being ‘sacrificed’, rather than hurting a larger number of people. The next

question was, what kind of car would you like to buy, a car that protected the driver in all circumstances (a 'selfish' car) or the 'morally acting' car that would sacrifice the driver when necessary? The majority said they would prefer the 'selfish' car to protect them as the driver.

"We have to regulate this because if we don't then car manufacturers will build 'selfish' cars and that is not what we want on the roads. The German legislature intervened and prohibited the manufacture of cars that can make such decisions," Borges said.

"The Draft Act prohibits the use of certain AI practices such as harmful and detrimental social scoring or biometric identification systems in publicly accessible spaces. The biggest part of the Act concerns the protection of high-risk AI systems where the provider is obliged to provide a risk and quality management system. The Draft Act also has transparency obligations for certain AI systems such as the designation of deep fakes."

Education and assessment

Mr Niel Kramm, Faculty Member: Centre for Higher Education, Research, Teaching and Learning, Rhodes University, gave a perspective on what AI means for higher learning and assessment. "Questions asked focus on the ethics; should we be using it; should we control it; should we ban it; who made it; who has been exploited in the building of this, for example, the outsourced labour to countries like Kenya, India and Venezuela who develop these models at a pittance of the cost. And then the biggest debate is possibly around how generative AI will challenge assessment security – how will it enable student cheating?"

"The relationship between higher education and AI is complex. I think we will be in constant change for a while until we make sense of what is happening with these new technologies. We need to take our time and be careful in our response. We must not only focus on the short-term issues like securing assessments, but we need to realise that from a higher education perspective, we are in a position now to make decisions that will shape what higher education will look like in future."

To answer these questions, Kramm suggested that the starting point is to look at the purpose of higher education, the role of knowledge in higher education, and how one assesses knowledge and ensures academic integrity.

"Universities are influenced by the bigger context – our country. Some see universities as a means to get a credential. If this instrumentalist view is all that higher education is, there is a problem and then generative AI can pose serious risks to what we do. In this instrumentalist view, knowledge is a commodity that universities sell and students buy.

"However, providing credentials is only a small part of what higher education does. Higher education must provide a public good and that is done by providing knowledge that is useful to society and engages us in answering some of the country's wicked problems. If we understand universities according to broader, transformational terms of what students need (critical thinking skills, better understanding by the student of their place in the world etc.), we better understand how to respond to AI as well. When we think about AI, the question is, how will AI change how we create these transformational conditions for students?"

He held that the learning curve for higher education is very high and touches on what this means for the standard assessment paradigm – writing tests, exams etc. He highlighted that the problem with this traditional approach is that it uses data to learn about student proficiency in one or more traits, it takes a snapshot of learning that is not an authentic representation of the whole experience. It also often assesses a skill that is already obsolete, and it relies on an artefact (e.g. essays) as a proxy of the whole experience of learning. AI will thus change the way we relate to and offer education.

Chetty added, "AI in the education process should not be how to 'catch anyone out'. That would be going backwards. We need to think about how we integrate AI in the education process, how we build the skills and how these tools can contribute to our development."

Getting a grip on AI itself

It is clear that much work still needs to be done, not only by decision- and policymakers but also the information and communications technology (ICT) community in the form of research.

Prof Duncan Coulter, Head of Department: Academy of Computer Science and Software Engineering, University of Johannesburg, presented on 'An explicable AI train of thought', which is the movement within AI research to try and create AI systems whose output is more understandable to human beings and can be challenged and verified, and the decision-making processes can be understood, thus: 'explainable AI'.

"The major trends in AI research that have delivered some of the great games that we've had in the past 10 [to] 15 years, unfortunately, lend themselves towards a 'black box' style AI which is opaque to human understanding and, therefore, runs the risk of making decisions that are counter to the wellbeing of human beings. In more general terms, there is a need to keep the values pursued by an autonomous system aligned with the values of those who create the system," Coulter said.

He added that this alignment problem is a global concern of all of IT not only AI that needs active research.

Inclusivity

Suleman commented, "If AI is getting more sophisticated and becoming more intertwined within humanity, society, business and our individual lives, how do we [all] get this benefit? We cannot be exclusive as we advance our economies; we cannot leave behind a whole lot of people. Inclusivity is fundamental. And the way you get inclusivity is by making it applicable to and reachable by many people."

Chetty questioned what AI means for increasing inequality in South Africa. "This inequality transcends into the digital space where the divide is more stark. Statistics from 2018 say that 65% of households in South Africa have no access to the internet, although there is growth in accessing the internet via a cell phone. Thirty-six per cent do not access the internet due to a lack of skills and confidence, while 33% have no interest in the internet as they say they don't need it. Only 20% cited cost as a prohibitor to using the internet.

"To make the best of this opportunity, you need internet access and the proper device to access the internet, and you need knowledge of how to access these tools and how to ask the right prompting questions."

Moving forward

Ignoring developments in AI or putting on the brakes seems impracticable. "The first industrial revolution took 100 years, the second one took us 80 years, the third industrial revolution took us 20 years. And now we're in the 4IR and we're already starting to talk about the fifth industrial revolution which is premised on data in terms of variety, volume and velocity," Suleman said.

Responsible decision-making

What about machines displacing jobs, he asked. "Where you have automation in a business there is no doubt that certain skill bases need to change. This means that we as humans and leaders must be responsible, as we see our environment changing, to save jobs we need to upskill [or reskill] our people or put them in a different domain."

Suleman cautioned that leaders must still do their due diligence when deciding to go the automation route, “Leaders must ask themselves if they automate and it gives them a lot more production, is their market receptive to that or do they need diversification? And if they need diversification, then how do they think differently to benefit their local market as well as their international market? This is the benefit of technology. It allows us to scale but it requires that human mindset, application and context to derive the best outcomes.”

Vahed asked whether there should be a moratorium on development. Most people would say no, and Vahed agrees. Certification might be required to regulate AI algorithms; policies, standards, guidelines and other types of regulations might be required to ensure and promote the responsible use of AI.

Government-level leadership

Prof Anish Kurien, Node Director: French South African Institute of Technology, Tshwane University of Technology (TUT), spoke about the establishment of the AI-Institute of South Africa (AI-ISA) and its role in building AI capacity in the country. The institute acknowledges that the research and development into digital technologies and their implementation are critical and “must be embedded within the state”.

“Among other objectives, AI-ISA’s work will enable the generation of new knowledge and creative technology applications in sectors that are seen as beneficial to society such as health, agriculture, education, energy, manufacturing, tourism, and ICT,” Kurien explained.

Catalytic projects identified thus far will focus on:

- Government cloud computing;
- AI capacity building for public servants;
- AI motor industry infrastructure enhancements;
- AI biometric system;
- Criminal justice system development;
- Modernising public services;
- Coal renewal; and
- AI in farming and food production.

“In farming, for example, TUT – one of AI-ISA’s hubs – is working on a Quadcopter for intelligent chemical spraying/liquid fertiliser. The project focuses on precision operations and farm management that uses intelligence-based recommender systems using drones and AI. Another project is a cell phone-based intelligent plant diagnosis system that uses cell phone images to identify plant diseases using image processing and classification with robust AI algorithms,” he added.

Wide collaboration

Moodley also advocated for a coordinated approach to AI and development. Without coordinated interventions, innovative AI applications will develop in an ad hoc manner and will be constrained to specific application areas. Also, niche technology companies and start-ups will develop advanced expertise and compete to dominate the AI space, driving up the cost of AI and limiting it to specialised applications that require large capital investments. The establishment of local, regional and national AI innovation and development ecosystems is thus key for developing skills, remaining dynamic and agile, and accelerating innovation by making AI accessible to a broader community and lowering the cost of AI.

Learning from Germany’s legal road

Borges concluded that the law should address the specific risks associated with AI systems and a draft AI Act is an important element of the legal framework for AI systems. Liability is a cornerstone of the legal framework for AI systems as are compensation for

victims and incentives for minimisation of risks. The development of an adequate legal framework for AI is still a work in progress and must continue.

Education

In terms of education, Chetty said, “The large language model can be used to facilitate language diffusion and leverage collective AI strengths. It can cross language barriers by offering automatic language translation. The model is agile and responsive to the needs of the labour market, and it can be quite nuanced and culturally sensitive. If we can solve the digital access and digital divide problem, we can leapfrog decades of problems experienced in the education sector and provide our staff and our students affordable access to expert-level tutors and assistance.”

Manufacturing

Maharaj concluded that embracing AI in the manufacturing sector can create more meaningful and higher-paying jobs. It can potentially grow the economy at a higher rate through export-led growth, but it must be implemented responsibly to manage the risks.

Suleman captured the overall sentiment of the discussion forum: “All of this means that as we think about how we utilise AI, the sources of different data, we have to balance the benefits and the risks. We need to make sure that we collaborate in ways that ultimately control the technology – we maximise the benefits and make sure that we control the risk.”

Speakers can be contacted through the spokesperson, [Ms Jansie Niehaus](#). Further information can be found on the [NSTF website](#) and the [NSTF YouTube channel](#).

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- is a broadly-representative stakeholder body for all science, engineering and technology (SET) and innovation organisations in South Africa
- gathers stakeholders around burning issues of national and global interest, across the public and private sectors, including matters of public policy
- includes a network of professional societies in SET and STEM education (STEM = science, technology, engineering and mathematics) - the NSTF proSET membership sector.
- recognises, awards and profiles the outstanding contributions of individuals and groups to SET and innovation through the prestigious NSTF Awards
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- runs and supports the STEMulator.org which attracts youth and educators to Explore>Discover>Learn the world of STEM including careers. (Established by NSTF proSET)

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Non Profit Company Registration Number: 2007/029165/08

NPO Registration Number: 92042

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