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The 4IR: Assessing the landscape to grasp opportunities and navigate threats

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April 2022

Overview

- Brief review of academic institutions and the 4IR
- Benefits and considerations of 4IR
- South African perspective
- Review of needed skills and core competencies required
- Functional practices to channel 4IR technologies

Academic Institutions and Libraries

- Custodians of knowledge
- Various opportunities to scale collaborations across fields
- However, challenges exist
  - Exacerbated not only by emerging technologies
  - COVID-19
- South African landscape is in a "**Watch Out**" Economy
  - Skills and infrastructure challenges
- As knowledge centric environments, how can libraries navigate this paradigm?

What is the 4IR?

4IR describes technological disruptions driven by increased automation of labour and increased digital connectivity.

At the core of which is its disruptive/ smart technologies.

Benefits

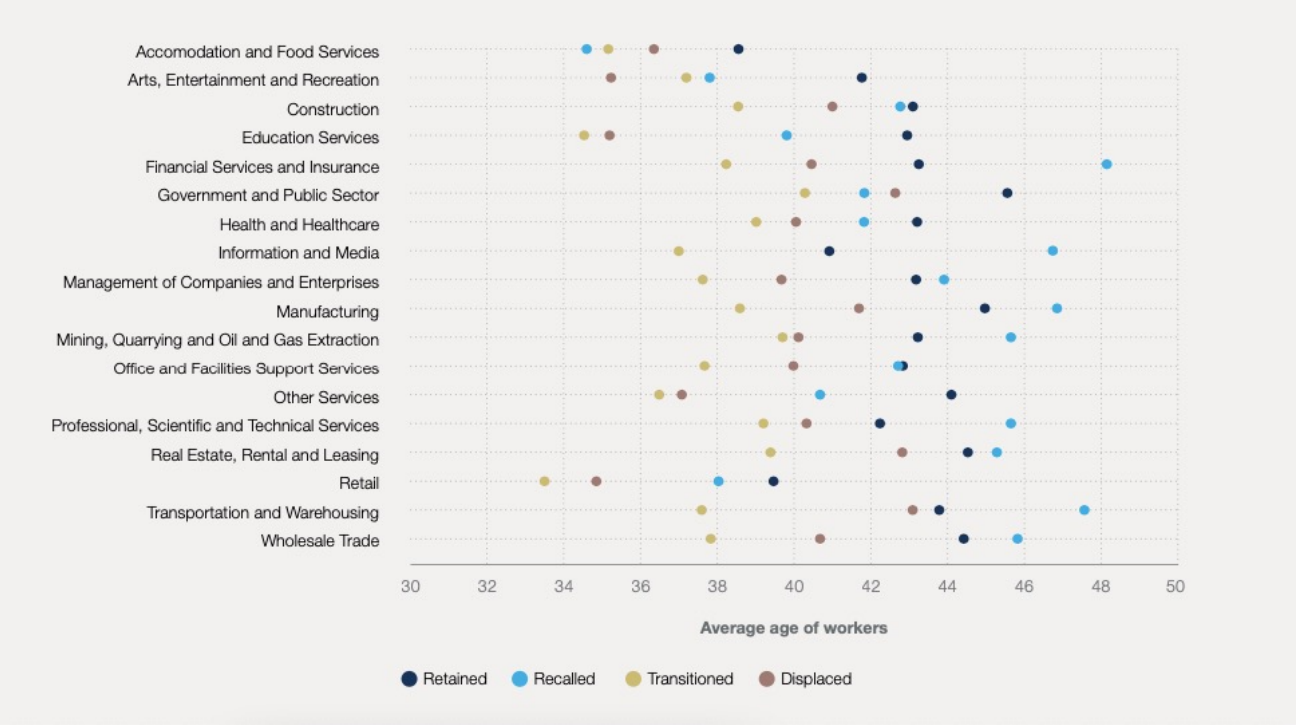
1. Vastly improved **operational efficiency** (e.g., improved uptime, asset utilization) through predictive maintenance and remote management

2. The emergence of an **outcome economy,** fuelled by software-driven services; innovations in hardware; and the increased visibility into products, processes, customers and partners

3. New **connected ecosystems**, coalescing around **software platforms** that blur traditional industry boundaries

4. **Collaboration between humans and machines**, which will result in unprecedented levels of productivity and more engaging work experience

Effects on Future of Work



WEF

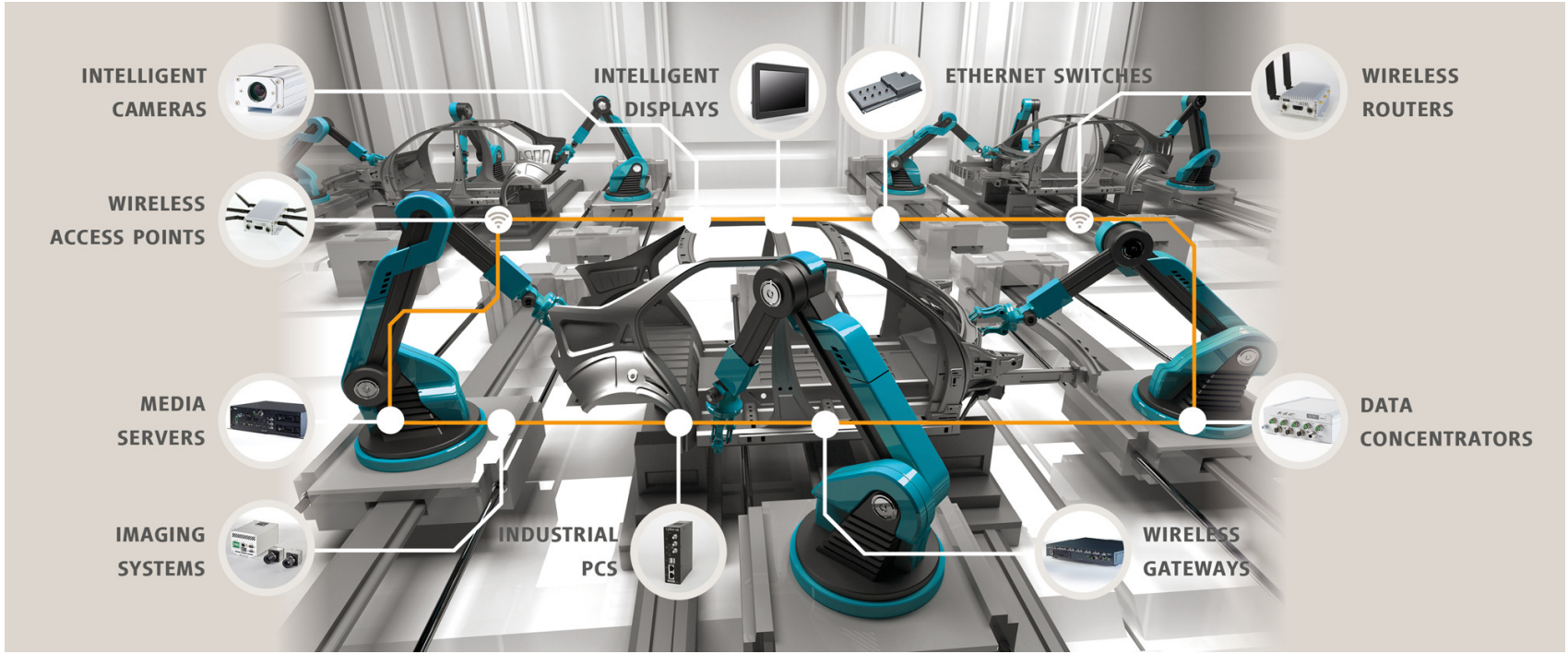
Disruptive Technologies of the 4IR

- A disruptive technology is an **innovation** that displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry.

- Coined 1997 Prof. C.M. Christensen

- Previous technological disruptions
  - PC
  - Windows OS
  - Email
  - Mobile phone
  - **In terms of Library disrupter: Google**

Industry 4.0



The Internet of Things (IoT)

What it is

- Are physical devices that can gather data and communicate it over a network. In some instances, these devices can manifest feedback mechanisms in the physical world

Forms of IoT

1. **Consumer IoT:** Examples include light fixtures, home appliances, and voice assistance for the elderly.

2. **Commercial IoT:** Applications of IoT in the healthcare and transport industries, such as smart pacemakers, monitoring systems, and vehicle to vehicle communication (V2V).

3. **Industrial Internet of Things (IIoT):** Includes digital control systems, statistical evaluation, smart agriculture, and industrial big data.

4. **Infrastructure IoT:** Enables the connectivity of smart cities through the use of infrastructure sensors, management systems, and user-friendly user apps.

5. **Military Things (IoMT):** Application of IoT technologies in the military field, such as robots for surveillance and human-wearable biometrics for combat

Number of devices

- GSM Association: 25.1 billion by 2025
- Ericsson: 30 billion connected devices in use by 2022, of which around 18 billion would be used for a diverse range of IoT applications
- Norton: 25 Billion 2020
- Healthcare: healthcare transformation, virtual visits" or online appointments with healthcare providers in the US was 36 million. In reality, that number is now on course to be closer to one billion

IoT Applications

Industrial IoT

- Manufacturing
- Oil and gas (Energy)
- Agriculture
- Transportation
- Healthcare
- Waste

This accounts for around two-thirds of the global economy

As these advance, it affects

- Digital-human workforce
- Advanced automation

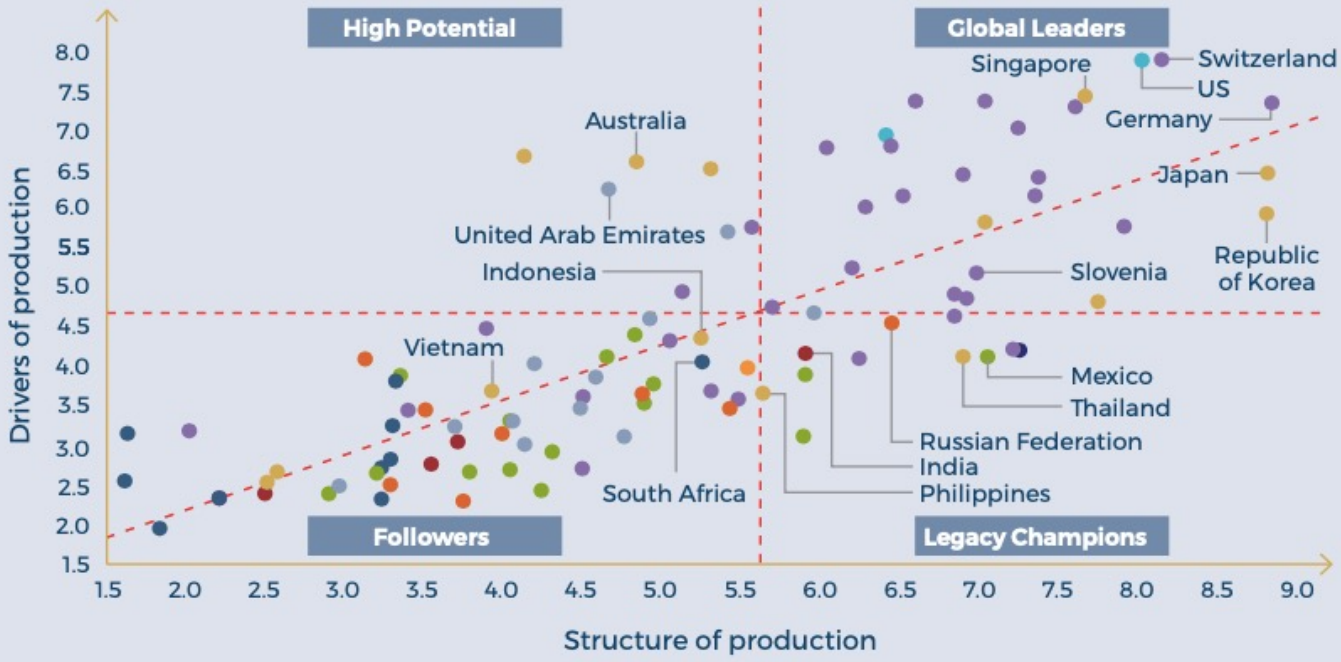
What about South Africa?

OverGlobal Outlook on Digital Evolution and Trust

- **Break Out economies** – Rapidly evolving evolving rapidly. With momentum and significant headroom for growth, they are often highly attractive to investors.
  - China, India, Indonesia, Poland and Russia

- **Watch Out economies** – Have a number of infrastructure gaps. Despite this, young people are showing enthusiasm for a digital future.
  - Nigeria, Uganda, Colombia, Peru, Pakistan, Sri Lanka and South Africa

Figure 2 WEF 4IR country archetype analysis

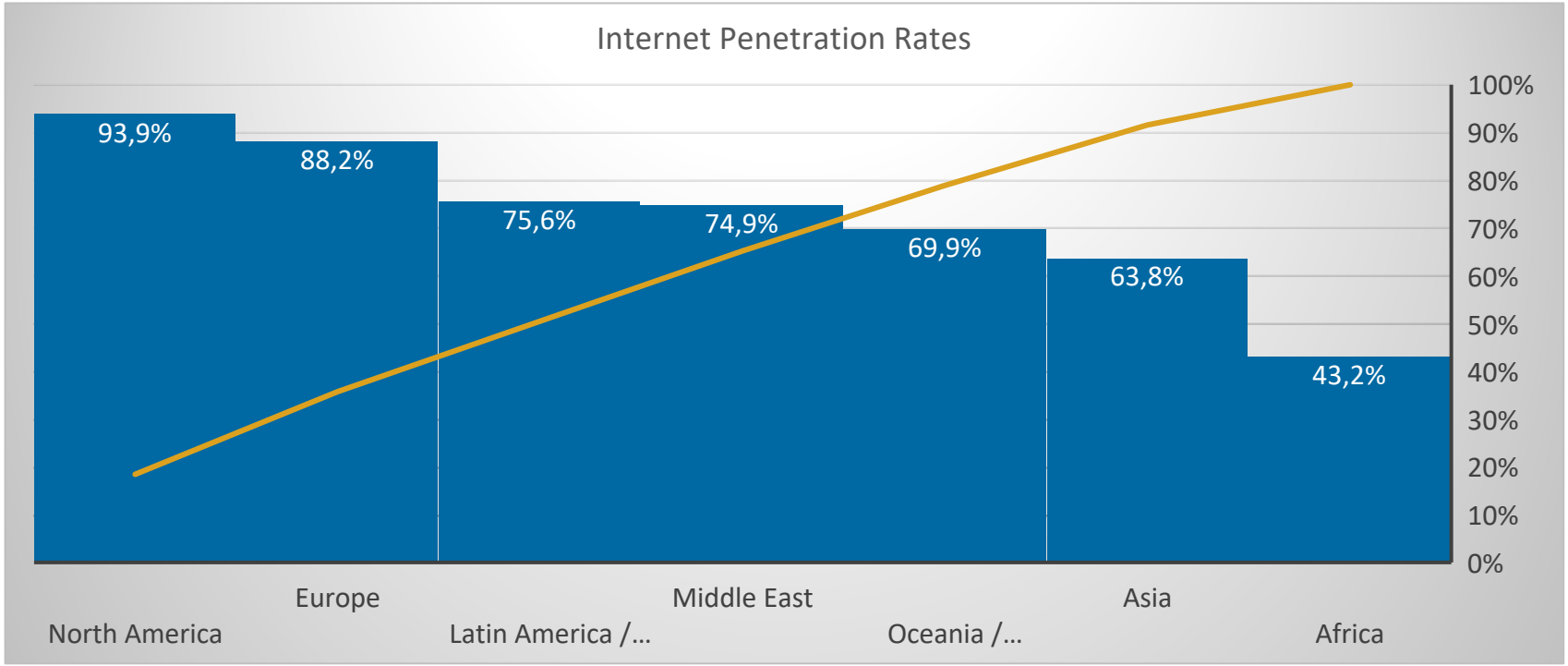


English speaking North America high-income · Latin America & the Caribbean · Europe · Eurasia · Middle East & North Africa · Sub-Saharan Africa · East Asia & the Pacific · South Asia

Note: Axes are on a 10 point scale but have been zoomed to show variances between countries; country archetype lines drawn on average drive and structure scores for top 80 countries

Source: Saunders M, 'Shaping the Future of Production in South Africa: Preliminary Country Readiness Results', CSIR, '2017

South African Landscape: 2021



The official unemployment rate was 35,3% in the fourth quarter of 2021.

Statistics South Africa

‘Real’ matric pass rate is **51.4%**, as the official results do not take into consideration the high dropout rate.

Credit: Business Tech

Bleak load shedding forecast for South Africa

Staff Writer 25 April 2022

Credit: Business Tech

Despite these challenges.

South Africa continues to leverage 4IR

Gaming and applications	eCommerce	Digital services

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triggerfish animation studios

Sea Monster™

Over

rubybox SURPRISE YOURSELF

YUPPIECHEF.COM

takealot.com GREAT STUFF @ GREAT PRICES

zando

SweepSouth®

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WumDrop

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Through Technological Innovation

FinTech	Education	Healthcare and Bio

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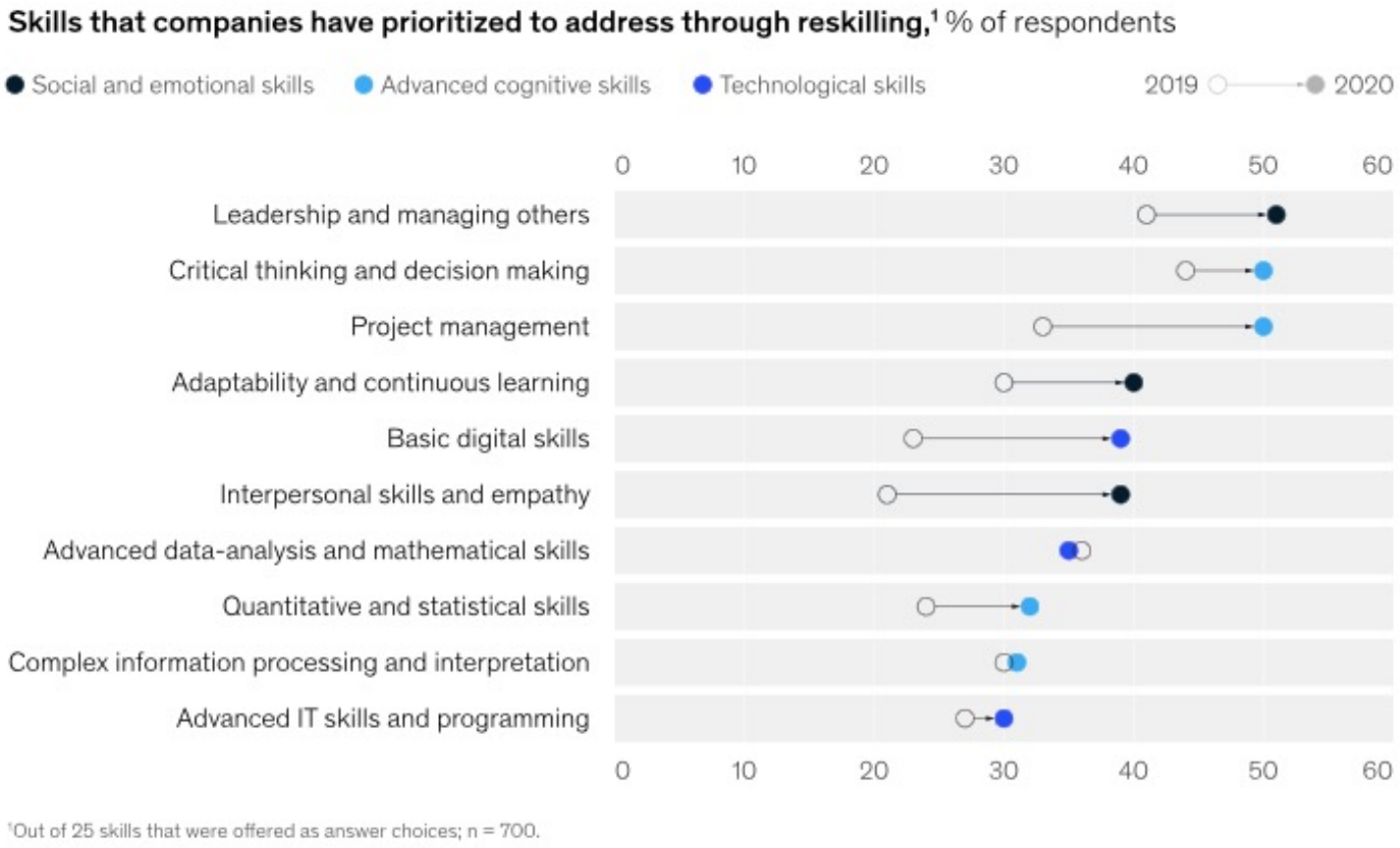
To leverage 4IR:
Certain core competencies are required



McKinsey

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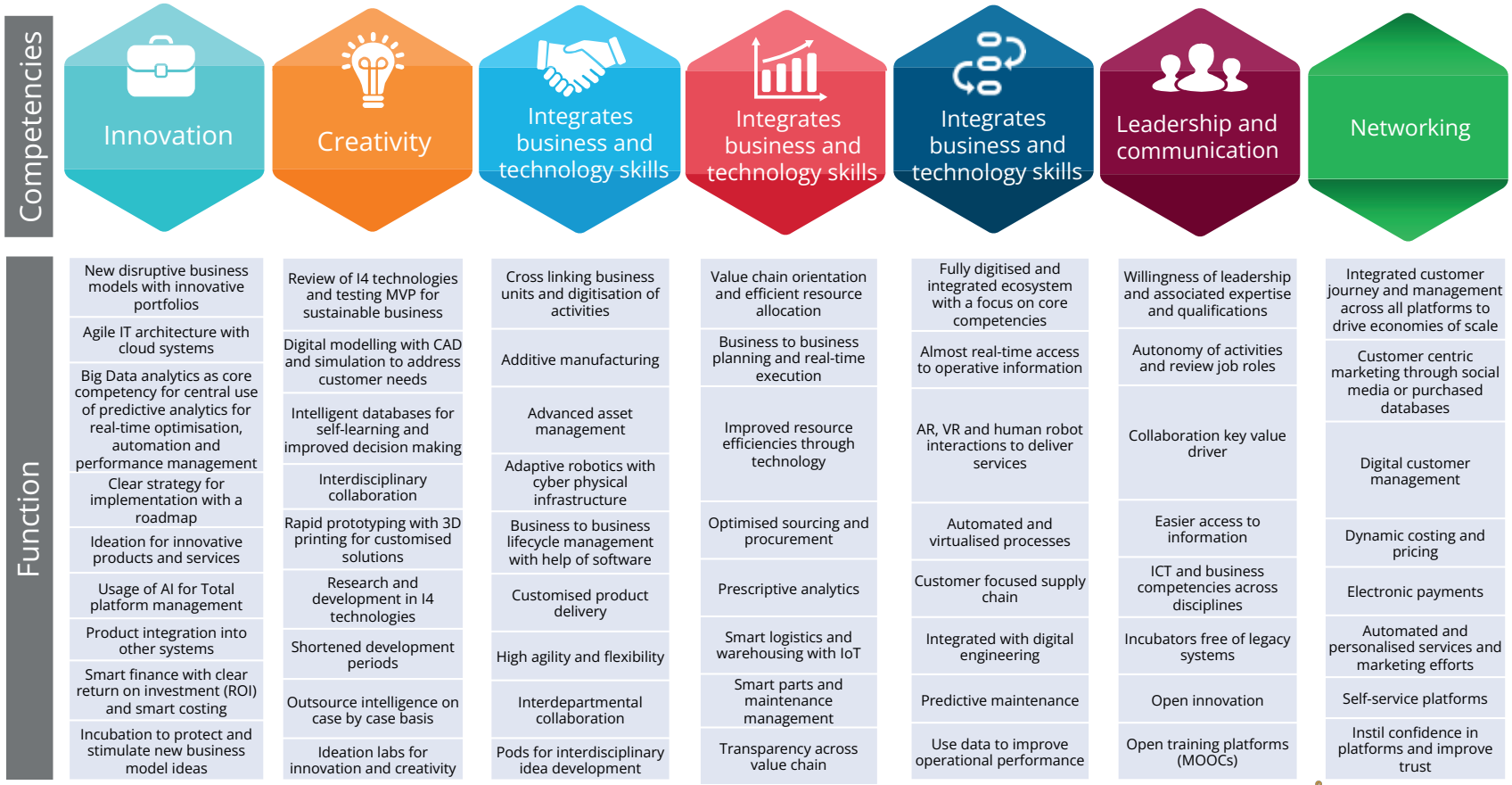


Innovation

New disruptive business models with innovative portfolios

Agile IT architecture with cloud systems

Big Data analytics as core competency for central use of predictive analytics for real-time optimisation, automation and performance management

Clear strategy for implementation with a roadmap

Ideation for innovative products and services

Usage of AI for Total platform management

Product integration into other systems

Smart finance with clear return on investment (ROI) and smart costing

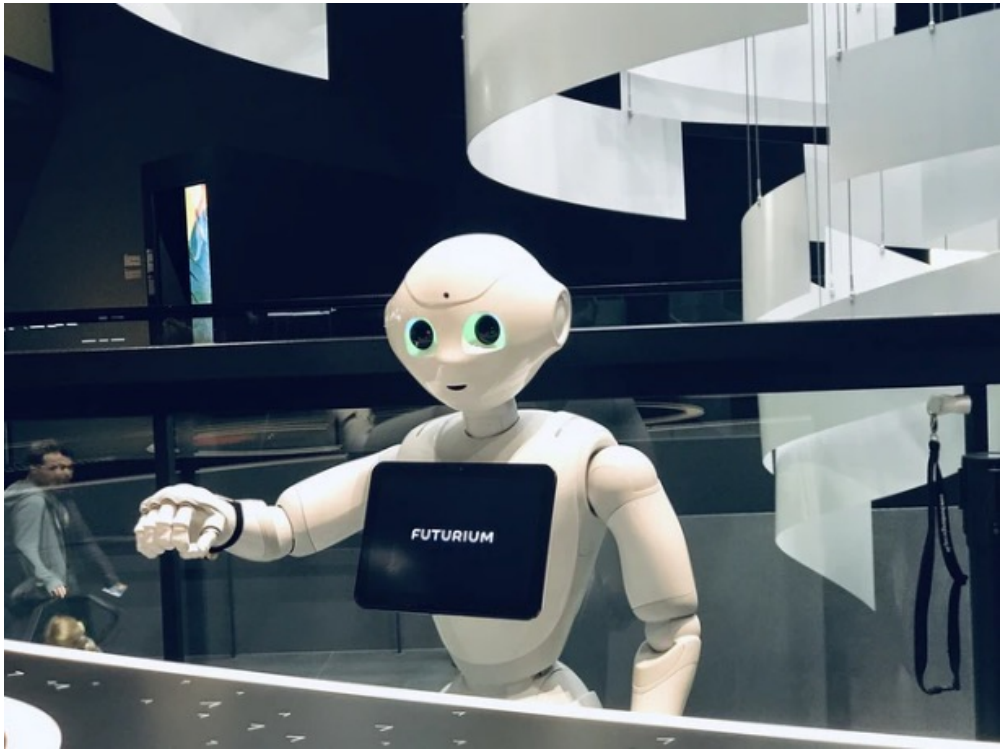
Incubation to protect and stimulate new business model ideas

Innovation and the digital world of the 4IR

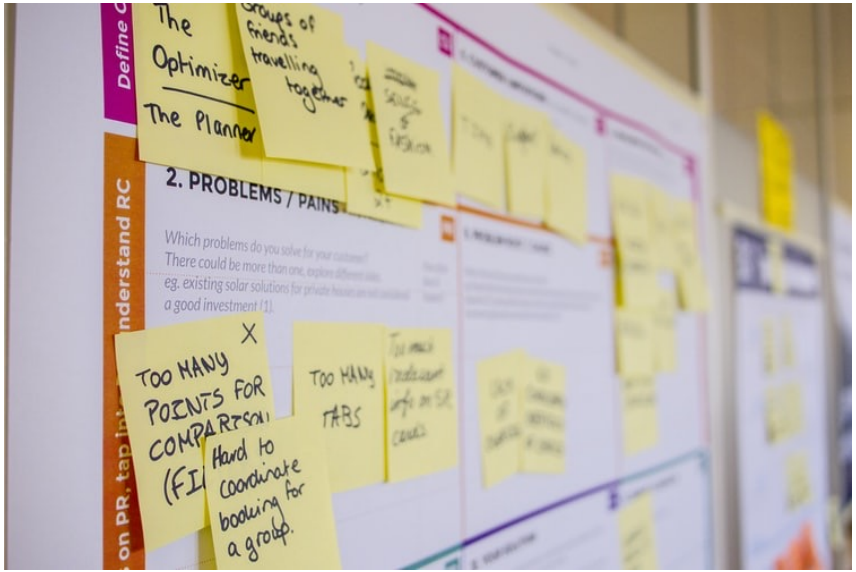
Innovation is a key force for economic growth and development. Not only can it lead to greater efficiencies and productivity, but it also stands to fundamentally change how products and processes benefit individuals' lives. This has been furthered by the digital transformation brought on by the 4IR.

Kruger and Steyn (2021)

What do you see as innovation?



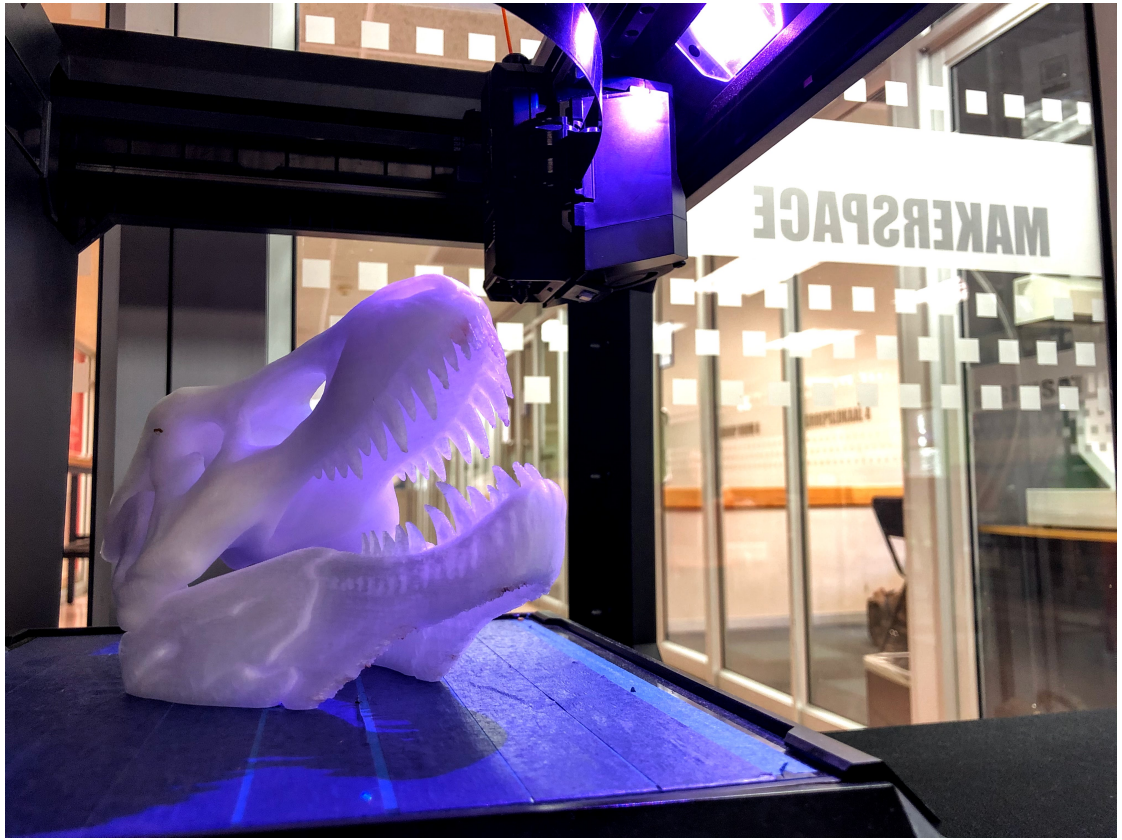
What can you do on a functional level to stimulate innovation to navigate the 4IR?



Functional Practices

- Support ideation
  - Giving a voice or face to efforts
  - Collaboration within ecosystems and industry
  - Through access to key technologies
  - Ensure staff competence

Functional Practices: Give a Voice to Innovation



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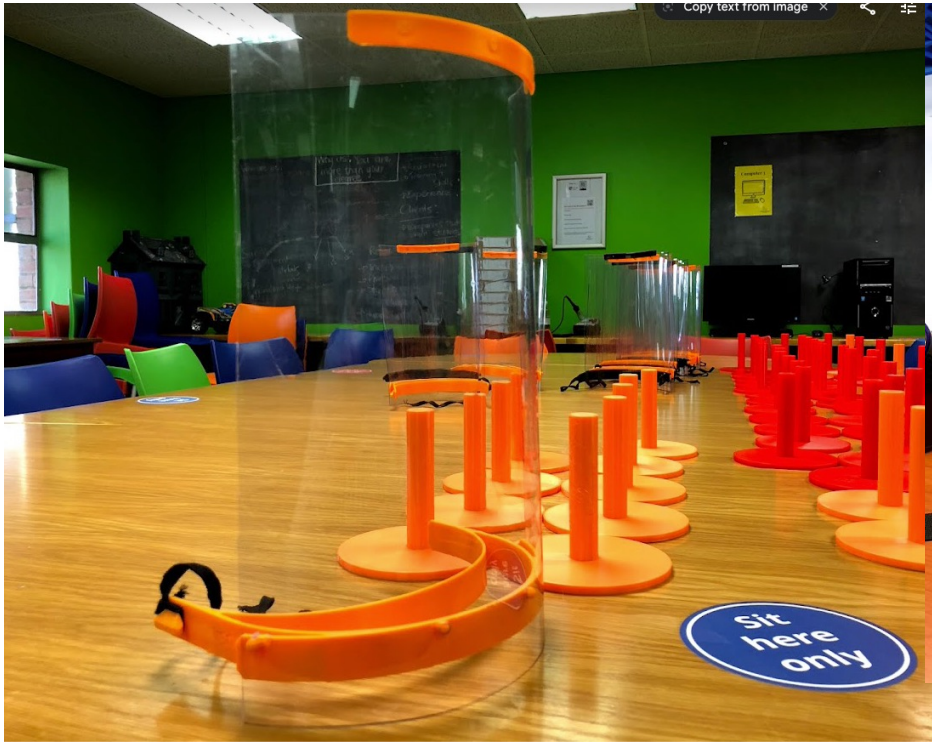
Functional Practices: During COVID



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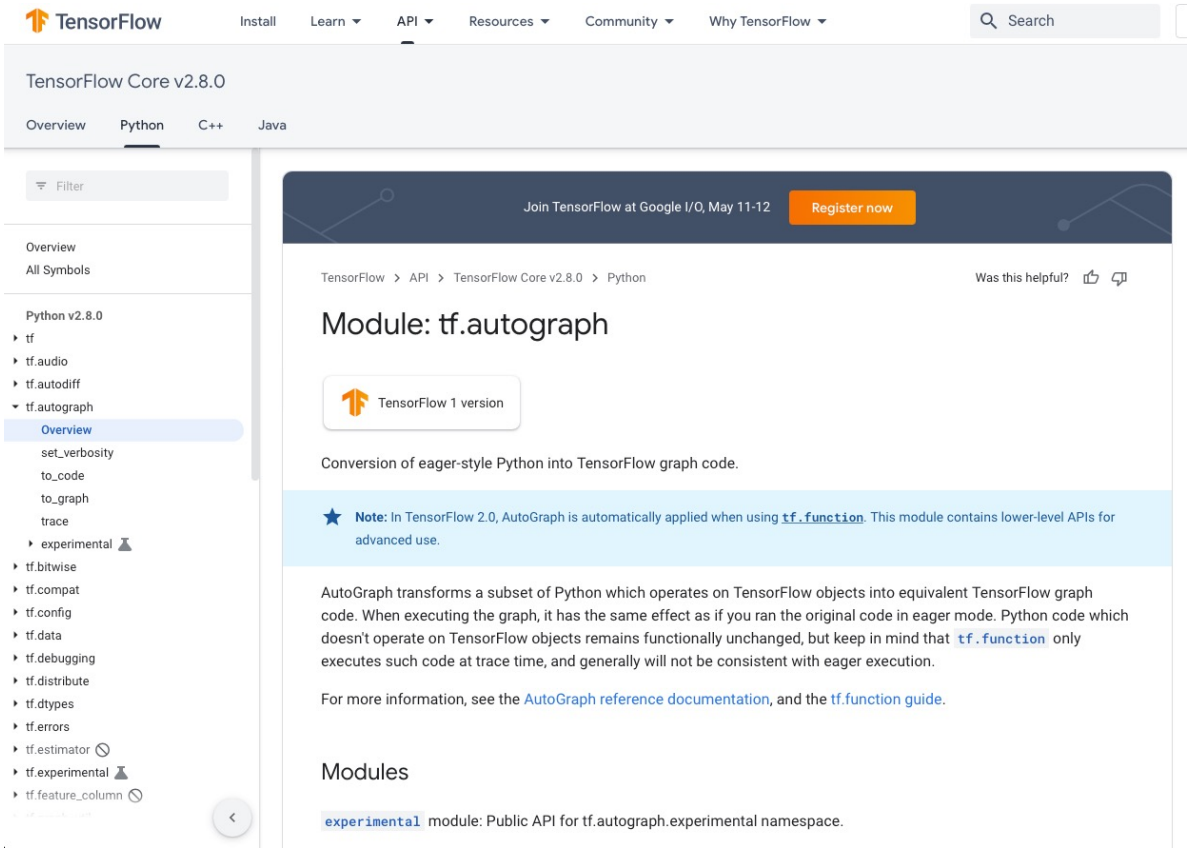
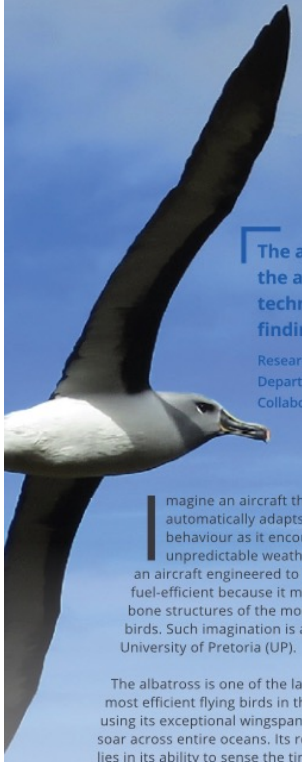
Functional Practices: During COVID



Functional Practices: Collaborate



COLLABORATION SOARS AT MAKERSPACE

The albatross is one of the most energy-efficient travellers in the animal kingdom. With the knowledge of Mother Nature, technology and interdisciplinary collaboration, UP researchers are finding ways to make future air travel cheaper, cleaner or faster.

Researchers: Janine Schoombie, Dr Lelanie Smith and Professor Ken Craig, Department of Mechanical and Aeronautical Engineering
Collaborator: Department of Library Services

Imagine an aircraft that automatically adapts its flight behaviour as it encounters unpredictable weather. Imagine an aircraft engineered to become more fuel-efficient because it mimics the bone structures of the most efficient birds. Such imagination is at play at the University of Pretoria (UP).

The albatross is one of the largest and most efficient flying birds in the world, using its exceptional wingspan to glide and soar across entire oceans. Its real talent lies in its ability to sense the tiniest changes in air pressure and wind direction. While some studies have studied albatross wing scans and applied this to drones, accurate measurements under varying conditions of albatross wings are currently not easily accessible.

Creativity at work

Enter UP's Library Makerspace, a collaborative space synonymous with innovation, interdisciplinary research and creativity. In discussion with Janine Schoombie of UP's Department of Mechanical and Aeronautical Engineering, the Makerspace suggested it could capture an accurate 3D digital representation of the albatross's anatomy for detailed study.

Initial scanning was performed in a static environment in the Makerspace to generate a still scan of the wings and feathers. Later, another scanning session took place inside the University's wind tunnel facilities in the Department of Mechanical and Aeronautical Engineering to compare the differences in flex and shape under flying and gliding conditions.

"This gives us quantitative data on the aerodynamic forces acting on the wings of this specific albatross species [the grey-headed albatross] under varying conditions," Schoombie says.

"These findings have several implications in the aerospace industry, where aerodynamics – the study of how objects move through the air – plays a vital role in the design of next-generation aircraft, among other applications," adds Dr Lelanie Smith, Schoombie's supervisor.

While 3D scanning is quite common, it is the fusion of biology and mechanics that makes this collaboration novel. "Thanks to access to equipment, such as the EinScan Pro 3D scanner and the University's wind tunnel, we can begin creating digital models of the albatross wings and broaden the study even further using computational simulations," Schoombie says.

What's next?

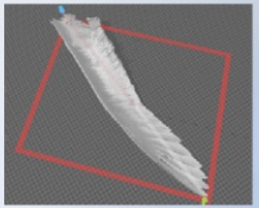
The next phase is to compare the surface 3D scans to internal scans. The team is collaborating with UP's Faculty of Veterinary Science on the Onderstepoort campus to use its CT scan machine.

With the research outputs, there will be further collaboration with the Technology Transfer Office at UP to determine industry interest.

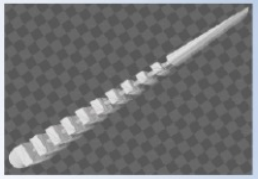
Why is this research important?

The albatross has a special tendon in each shoulder that allows the bird to lock its wings in place – a quality it shares with fixed-wing aircraft. Understanding the physical principles that explain the behaviour of the wings would help engineers redesign the wings of aircraft or develop more sensitive wind sensors, both of which could make future air travel cheaper, cleaner or faster.

A more immediate application of albatross efficiency might be for drones, or unmanned vehicles in remote locations, that need to be constantly airborne to receive radio or telemetry signals.



Underside of the 3D-scanned wing with measuring points



Cross-sectional structural rendering based on wing attributes attained from scanning

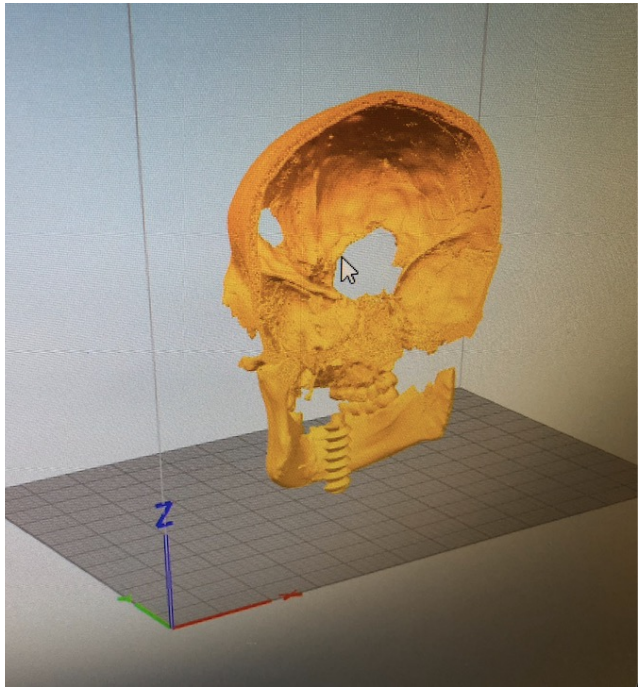
2.2 metres
Wingspan of the grey-headed albatross

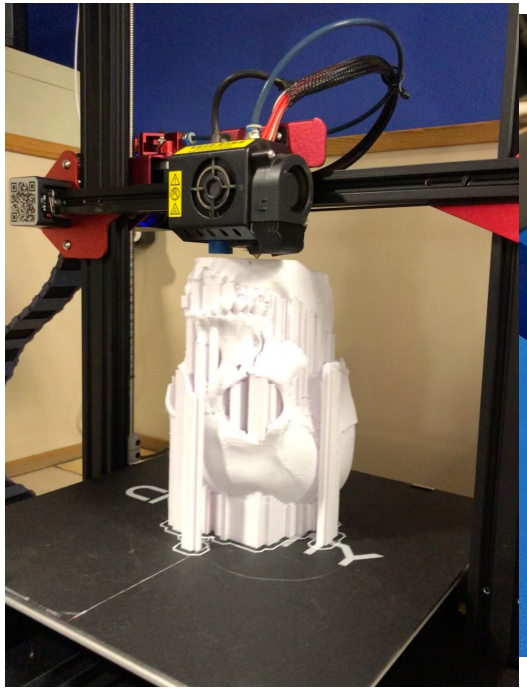
115 million
Number of cloud points for the largest quality scan of one albatross wing

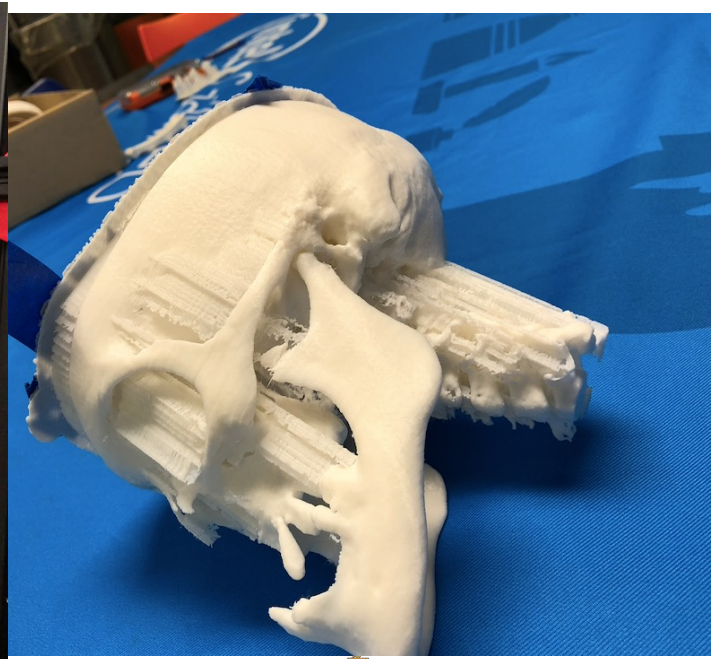
3.5 metres
The formidable wingspan of the wandering albatross

Photo Credit: J Schoombie

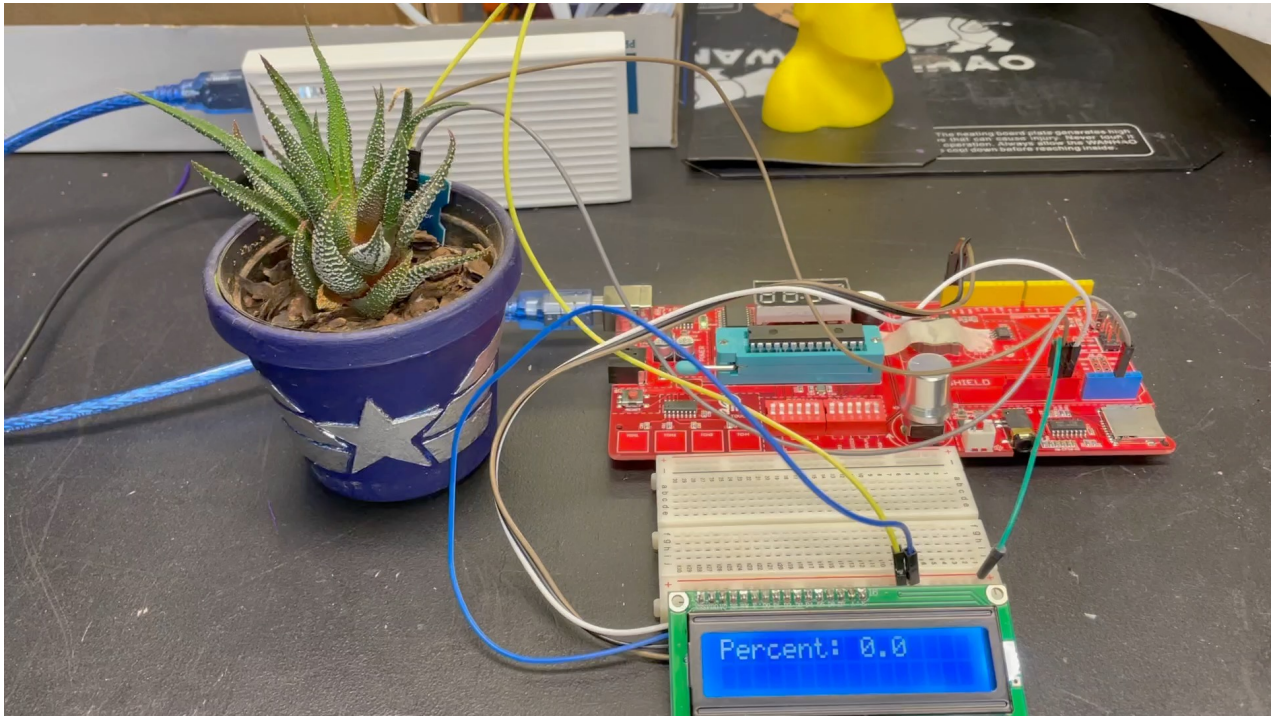
Functional Practices: Support Research Through Technology and Expertise





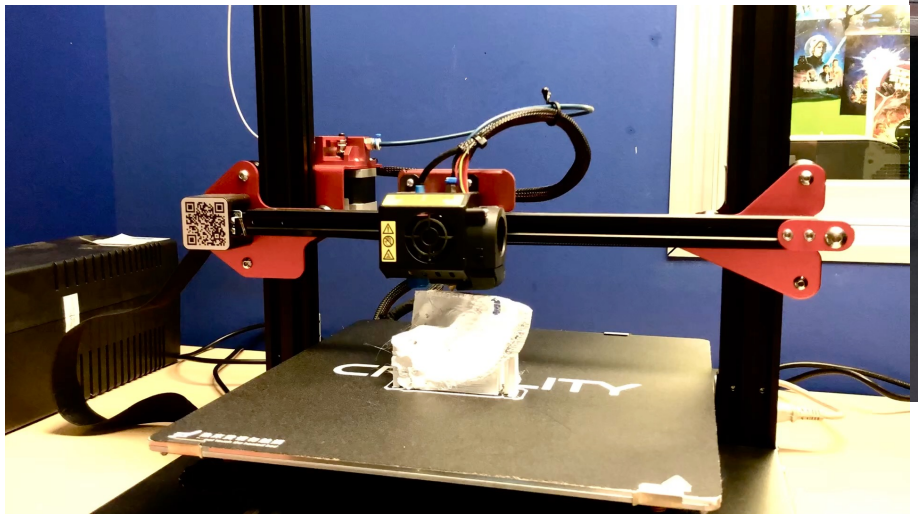


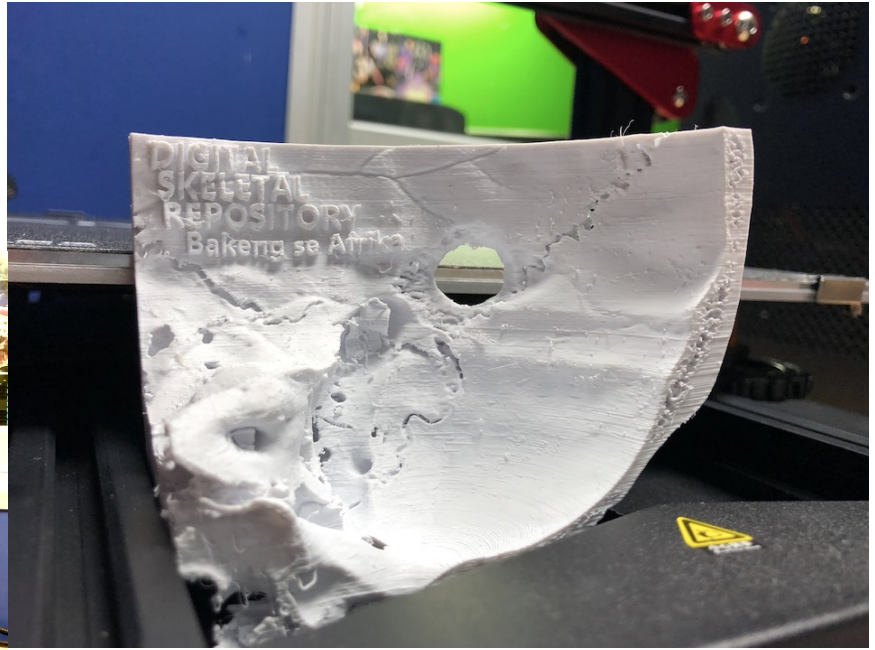
Functional Practices: Support Learning Through Technology and Expertise



Functional Practices: Teaching, Learning & Collaboration

- Teaching and learning





Strategic Perspective: Library Leaders

- Define and measure innovation
- Balance the new with need to improve (NB)
- Use innovation and create channels
- Improve how you develop ideas, but also execute them
- Get ready to fail, but ensure successes

DEPARTMENT OF LIBRARY SERVICES

SPACE TO CREATE

Innovation starts with an idea, and associated action. UP's Library Makerspace has helped many an idea leap off the page and into action.

The University of Pretoria (UP) opened the first academic Makerspace in sub-Saharan Africa in 2015 to provide an environment that all staff and students can use to not only generate ideas, but to put them into action with the aid of technology, expertise and collaboration.

The resulting environment continues to lead the way by fostering an inclusive place of productivity and creativity that promotes innovation capabilities.

As with most centres of innovation, Makerspace is constantly evolving to remain relevant in an ever-changing and demanding climate. At the core of this, is Makerspace staff, who keep abreast of various specialist fields and technologies in order to guide users in addressing their complex problems in the most efficient way, and to design and test concepts towards tangible outputs.

Critical to its success is access to novel technologies such as additive manufacturing (3D printers), internet of things (IoT) design kits and 3D scanners.

Makerspace designed an artificial egg that can be placed in the nests of vultures to understand ideal nest conditions and ensure optimal hatching of future eggs in simulated environments.

Putting ideas into action

The Makerspace team worked with UP's malaria prevention team to develop prototypes (using 3D printing and IoT kits) that can be used in the field to collect data on mosquitos more efficiently. They also collaborated with the Department of Zoology and Entomology and one of its subsidiaries, VulPro, which specialises in vulture conservation, to create an artificial egg that can be placed in the nests of vultures to accurately collect temperature, moisture levels and sit times. The data is being used to understand ideal nest conditions and ensure optimal hatching of future eggs in simulated environments.

Makerspace is a breeding ground for collaboration within the University ecosystem. "We assess where the design ideas of users reside and guide them in taking these ideas further," says Sean Kruger, coordinator of Digital Scholarship and Innovation. "There are so many functional and amazing capabilities within UP that users are not always aware of, or when to use them. The role of the Makerspace is to remain a strategic unit that develops a community that is digitally fluent for the 21st century, and provide an open, safe place for students and researchers to test their ideas and turn them into a reality."

Photo Credit: UserGI15613517 on iStock
Photo Credit: 3D-Printed vulture egg - Sean Kruger, Makerspace

21

Mistakes

- No definition of innovation
- Lack of clarity around **what** they're innovating and **why**
- Failing to appreciate how change and innovation go hand-in-hand
- No innovation framework
- Implementing ideation software or sessions without explicit use of creative thinking
- Being hard on yourself

Facilitating Innovation to navigate the 4IR

"Most importantly, institutions must incorporate participation in some of the programmes that are already under way as well as forums where these skills can be applied."

This includes libraries- and by extension, their staff.

Thank you

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