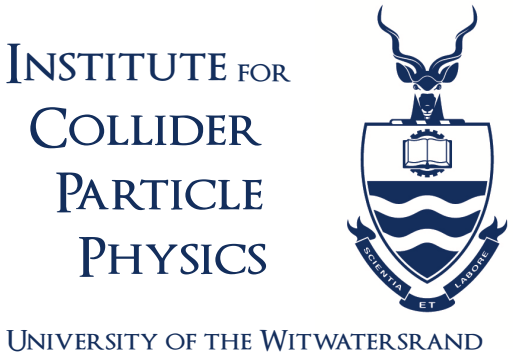
AI-powered Technology Transfer from the SA-CERN Program

Bruce Mellado

Wits and iThemba LABS

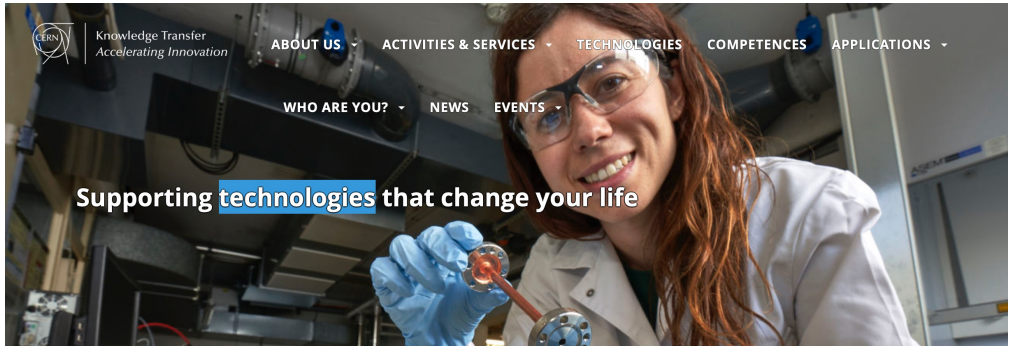


DIRISA 7th Annual National Research Data Workshop

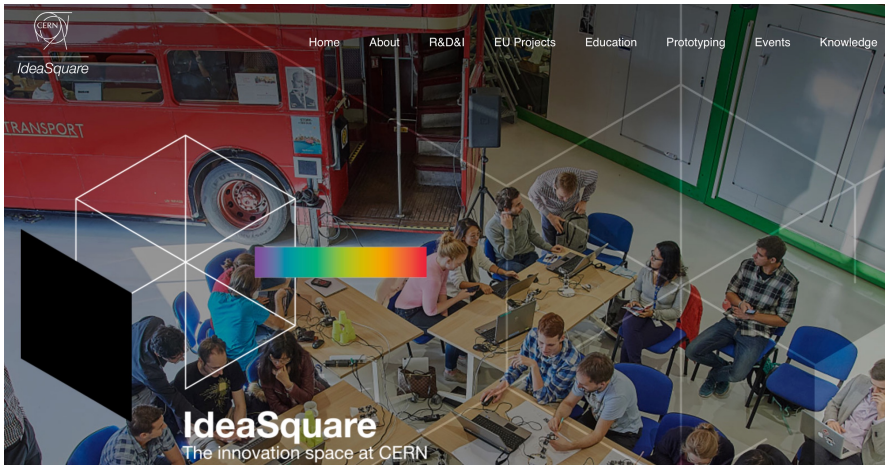
02/07/25

CERN's Tech Transfer Ecosystem

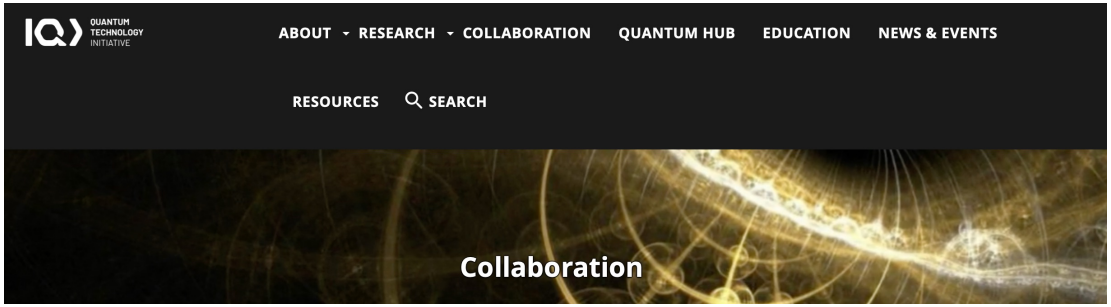
The Knowledge Transfer office
https://kt.cern



IdeaSquare, the innovation space
https://ideasquare.cern



The Quantum Technology Initiative
https://quantum.cern/collaboration



Scope of SA-CERN's TT Pillar

Transfer of knowledge from CERN research environment to other research environments

Include, accelerator physics, medical physics, FCC, etc… and CERN's Quantum initiative and cooperation with SA-QuTi

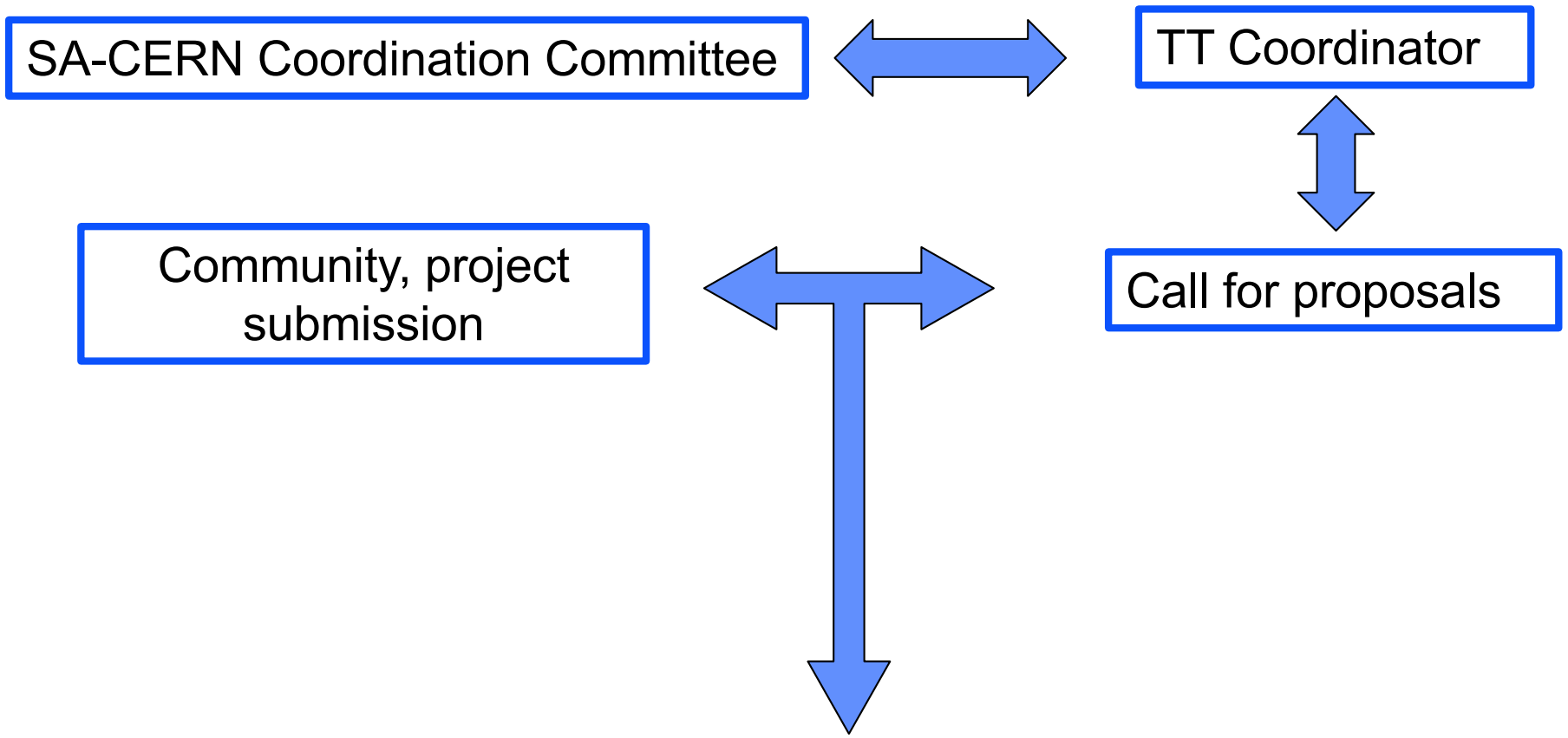
Tech and knowledge transfer to SA industry

Projects with SA industry based on niche areas of expertise

Facilitation of incubation efforts

Relations with TIA, and incubation centres (TuksNovation, Tshimologong Precint, Propella, LaunchLab, Solution Space, Invotech, etc…)

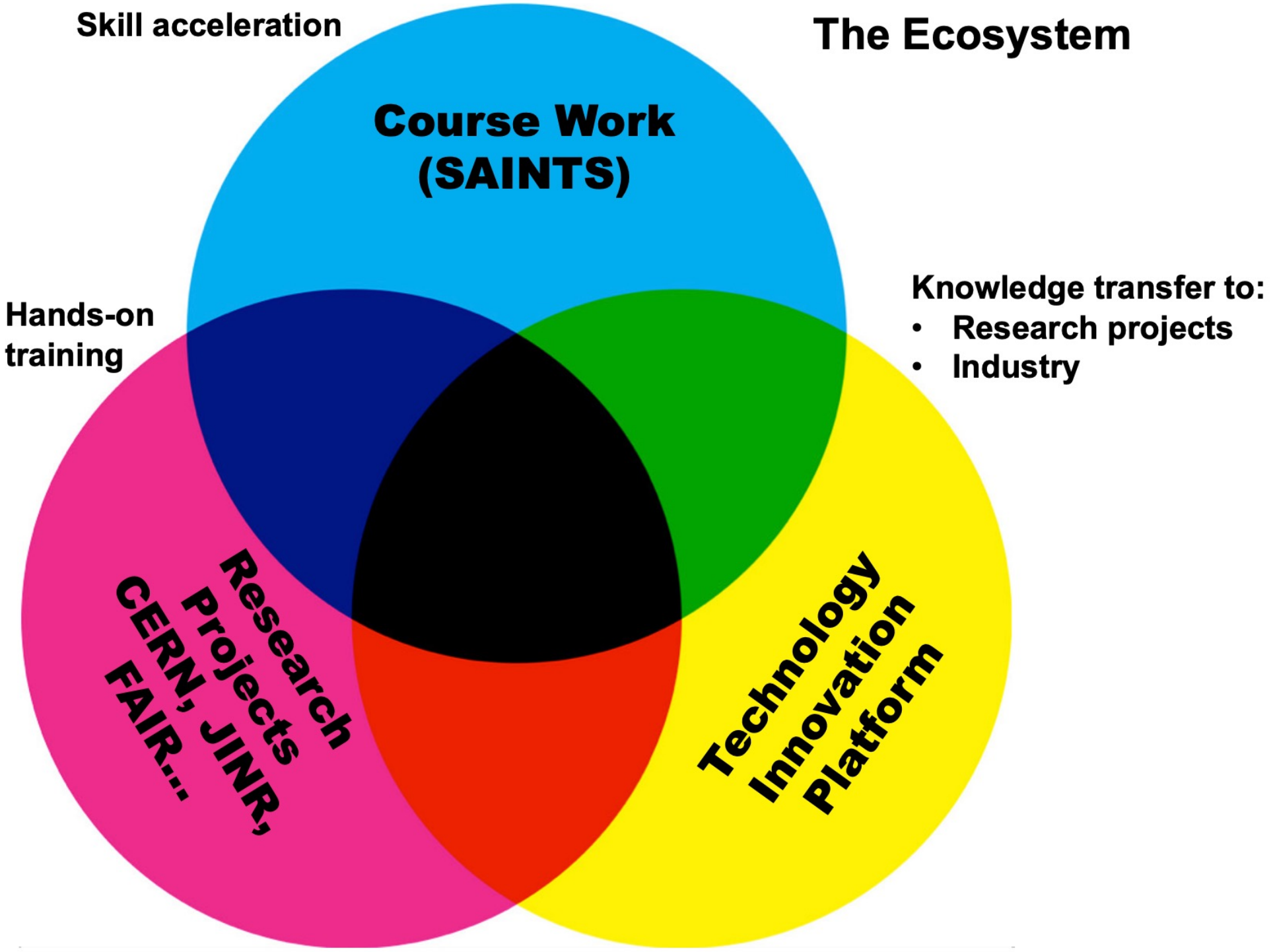
Initial Governance



The SA-CERN technology transfer pillar concerns itself with CERN-related activities in a wide range of disciplines that include, but are not limited to:

- Data Science, Big Data and Artificial Intelligence
- Electrical Engineering
- Accelerator Physics
- Medical Physics
- Quantum Computing

The Technology Innovation Platform


Skill acceleration
The Ecosystem
Course Work
(SAINTS)
Hands-on
training
Knowledge transfer to:
• Research projects
• Industry
Research
Projects
CERN, JINR,
FAIR...
Technology
Innovation
Platform

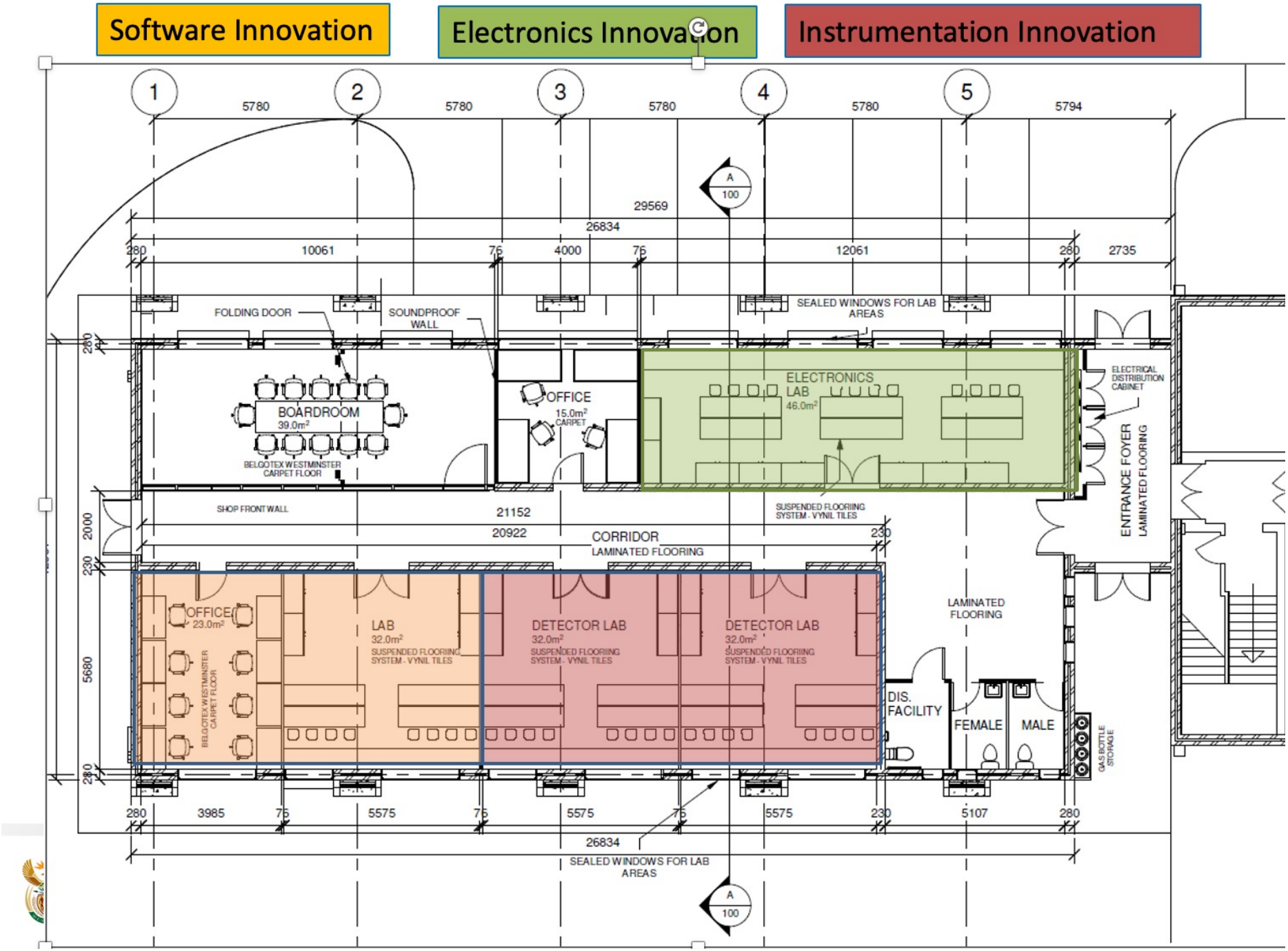
Technology and Innovation Platform

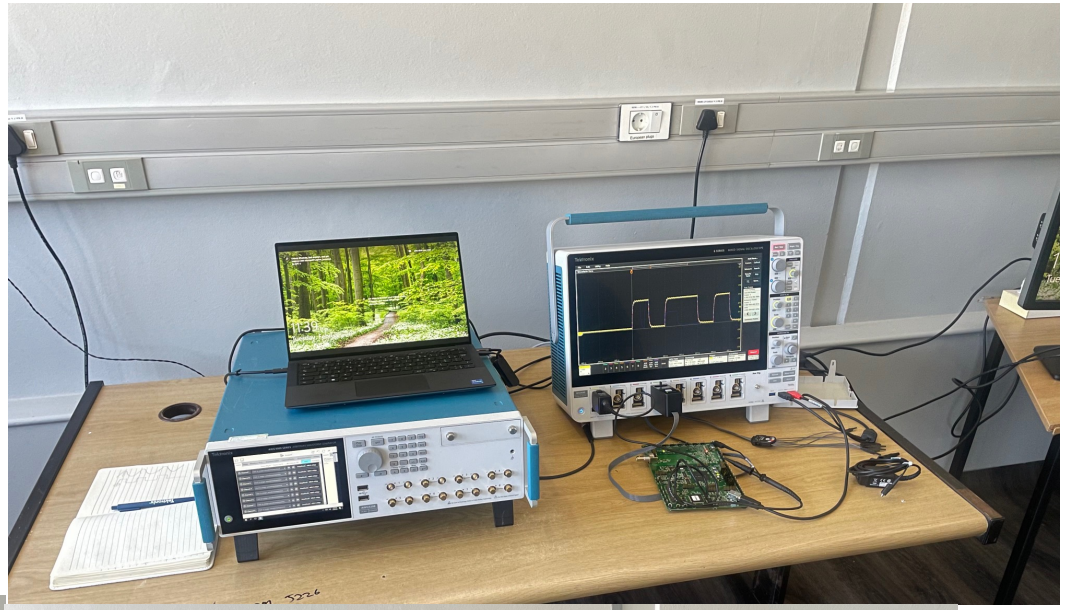
- ❑ Developing innovative technology skills and know-how
- ❑ Sharing of technology with other facilities and universities
- ❑ Transfer of technology to industry

Software Innovation

Electronics Innovation

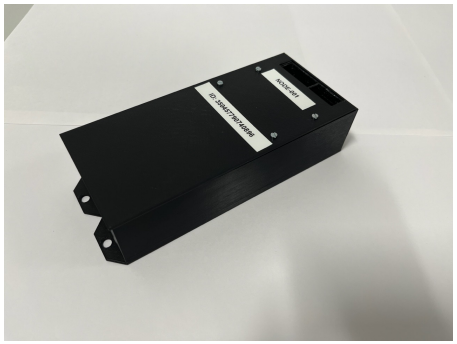
Instrumentation Innovation





Research - Innovate - Deploy
The first project

Tribute to late Prof. Danny Adams

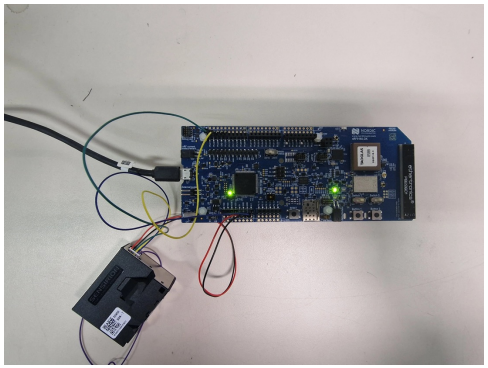


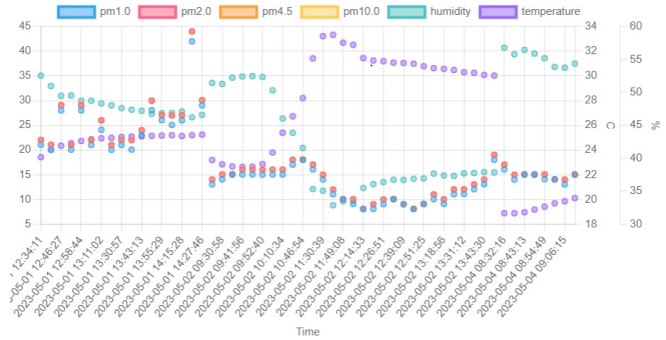
AI_r: An African Solution for AI Health

https://www.sacaqm.org

AI_r is an integrated system

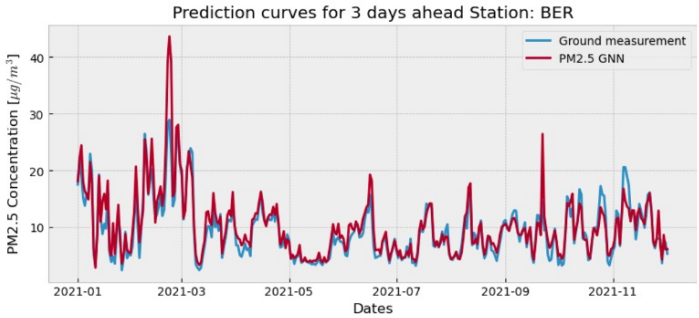
Air Quality Sensor → IoT Communication through 4G + LoRa → Dashboard + AI modelling





GC-0036

Predictive Deep Learning



Cost of hardware is at least 2.5 times cheaper than competitors in the market.
No offerings in the market provide integrated AI-modelling.

SA's AI_r system is the first project of CERN's Green Village

Air Quality Nodes & Dashboard

A consortium of AI, hardware, and public health experts have collaborated to develop a groundbreaking solution to air quality monitoring in the Global South. The Air Quality Nodes & Dashboard project utilizes low-cost air quality sensors, IoT-based technologies, and machine learning to provide real-time air quality measurements, as well as predictions based on trends.

The project, in collaboration with CERN Green Village and the University of Witwatersrand, will combine hardware components with an online web service application to process and display the data in a graphical format. This allows machine learning methods to be used on the data, developing models to predict air quality in the future. The project has already developed and deployed ten prototypes, which have been shown to be accurate and functioning ideally. The next stage is the deployment of these sensors in areas of low air quality in South Africa.

The project's expected outcome is the mass-production and deployment of these nodes throughout the Global South, particularly in areas that have been neglected in studies on air quality. The project will help inform decisions about public health, mining, real estate, and numerous other industries in the private and public sectors. The project is expected to last for two years.

With the Air Quality Nodes & Dashboard project, the consortium aims to bridge the gap in air quality monitoring and benefit the Global South through innovative technologies and scientific research.

https://idrc-crdi.ca/en/news/researchers-south-africa-champion-device-ai-powered-air-quality-monitoring

IDRC · CRDI

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Researchers in South Africa champion a device for AI-powered air-quality monitoring

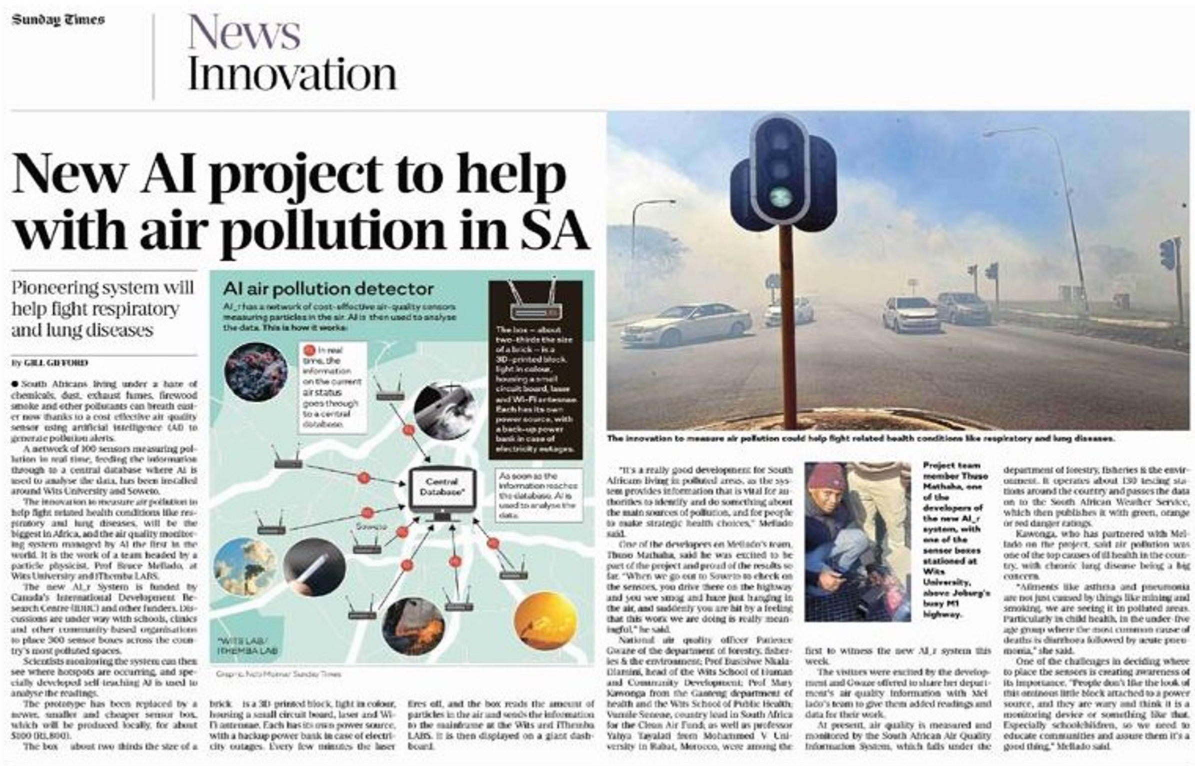
January 23, 2024

An IDRC-supported team in South Africa, part of the Global South AI for Pandemic Preparedness and Response (AI4PEP) Network, has produced a technological innovation that monitors air quality, providing a tool to help address a broad range of public health issues.

SOUTH AFRICAN CONSORTIUM OF AIR QUALITY MONITORING

The AI_r system monitors air quality.

Production of the **air-quality monitor**, powered by artificial intelligence (AI), is a groundbreaking initiative because it demonstrates the ability of the Global South to provide leadership in pandemic preparedness and response.



Sunday Times

News Innovation

New AI project to help with air pollution in SA

Pioneering system will help fight respiratory and lung diseases

By GILL GIFFORD

● South Africans living under a haze of chemicals, dust, exhaust fumes, firewood smoke and other pollutants can breath easier now thanks to a cost effective air quality sensor using artificial intelligence (AI) to generate pollution alerts.

A network of 100 sensors measuring pollution in real time, feeding the information through to a central database where AI is used to analyse the data, has been installed around Wits University and Soweto.

The innovation to measure air pollution to help fight related health conditions like respiratory and lung diseases, will be the biggest in Africa, and the air quality monitoring system managed by AI the first in the world. It is the work of a team headed by a particle physicist, Prof Bruce Mellado, at Wits University and iThemba LABS.

The new AI_r System is funded by Canada's International Development Research Centre (IDRC) and other funders. Discussions are under way with schools, clinics and other community-based organisations to place 300 sensor boxes across the country's most polluted spaces.

Scientists monitoring the system can then see where hotspots are occurring, and specially developed self-teaching AI is used to analyse the readings.

The prototype has been replaced by a newer, smaller and cheaper sensor box, which will be produced locally, for about $100 (R1,800).

The box — about two thirds the size of a brick — is a 3D printed block, light in colour, housing a small circuit board, laser and Wi-Fi antennae. Each has its own power source, with a backup power bank in case of electricity outages. Every few minutes the laser fires off, and the box reads the amount of particles in the air and sends the information to the mainframe at the Wits and iThemba LABS. It is then displayed on a giant dashboard.

AI air pollution detector

AI_r has a network of cost-effective air-quality sensors measuring particles in the air. AI is then used to analyse the data. This is how it works:

In real time, the information on the current air status goes through to a central database.

The box – about two-thirds the size of a brick – is a 3D-printed block, light in colour, housing a small circuit board, laser and Wi-Fi antennae. Each has its own power source, with a back-up power bank in case of electricity outages.

Central Database*

As soon as the information reaches the database, AI is used to analyse the data.

Soweto

*WITS LAB/ ITHEMBA LAB

Graphic: Nolo Moima/ Sunday Times

The innovation to measure air pollution could help fight related health conditions like respiratory and lung diseases.

"It's a really good development for South Africans living in polluted areas, as the system provides information that is vital for authorities to identify and do something about the main sources of pollution, and for people to make strategic health choices," Mellado said.

One of the developers on Mellado's team, Thuso Mathaha, said he was excited to be part of the project and proud of the results so far. "When we go out to Soweto to check on the sensors, you drive there on the highway and you see smog and haze just hanging in the air, and suddenly you are hit by a feeling that this work we are doing is really meaningful," he said.

National air quality officer Patience Gwaze of the department of forestry, fisheries & the environment; Prof Basiswe Nkala-Dlamini, head of the Wits School of Human and Community Development; Prof Mary Kawonga from the Gauteng department of health and the Wits School of Public Health; Vumile Senene, country lead in South Africa for the Clean Air Fund; as well as professor Yahya Tayalati from Mohammed V University in Rabat, Morocco, were among the first to witness the new AI_r system this week.

Project team member Thuso Mathaha, one of the developers of the new AI_r system, with one of the sensor boxes stationed at Wits University, above Joburg's busy M1 highway.

The visitors were excited by the development and Gwaze offered to share her department's air quality information with Mellado's team to give them added readings and data for their work.

At present, air quality is measured and monitored by the South African Air Quality Information System, which falls under the department of forestry, fisheries & the environment. It operates about 130 testing stations around the country and passes the data on to the South African Weather Service, which then publishes it with green, orange or red danger ratings.

Kawonga, who has partnered with Mellado on the project, said air pollution was one of the top causes of ill health in the country, with chronic lung disease being a big concern.

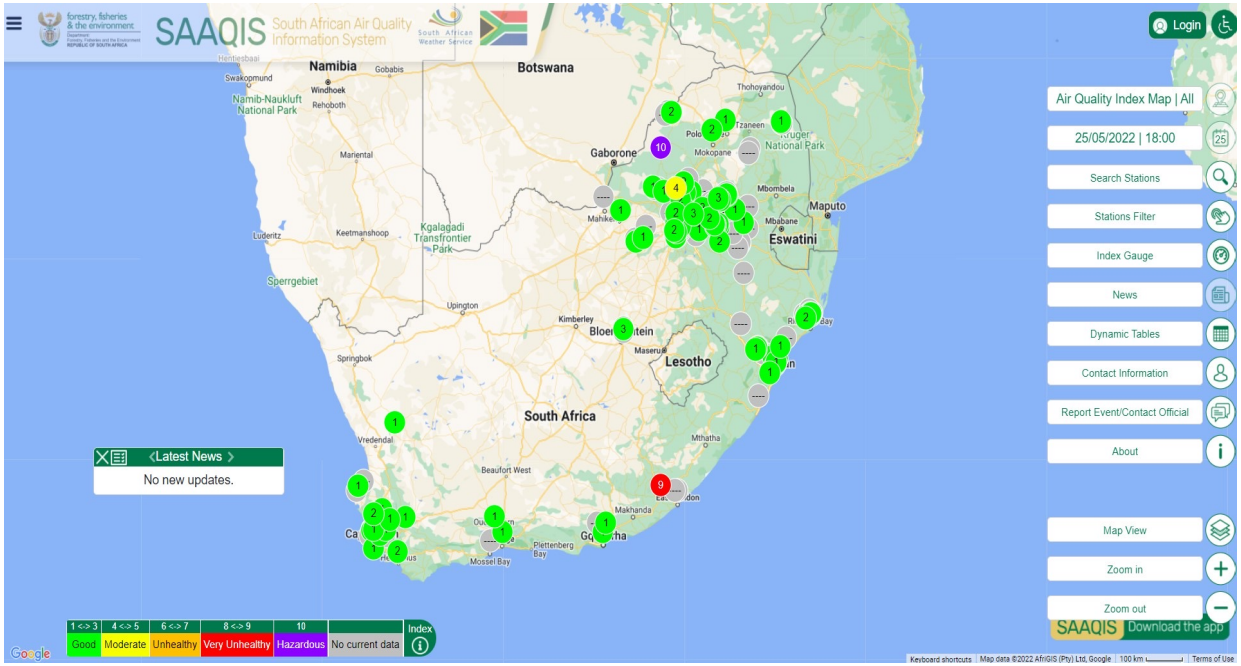
"Ailments like asthma and pneumonia are not just caused by things like mining and smoking, we are seeing it in polluted areas. Particularly in child health, in the under-five age group where the most common cause of deaths is diarrhoea followed by acute pneumonia," she said.

One of the challenges in deciding where to place the sensors is creating awareness of its importance. "People don't like the look of this ominous little block attached to a power source, and they are wary and think it is a monitoring device or something like that. Especially schoolchildren, so we need to educate communities and assure them it's a good thing," Mellado said.

environment, forestry & fisheries

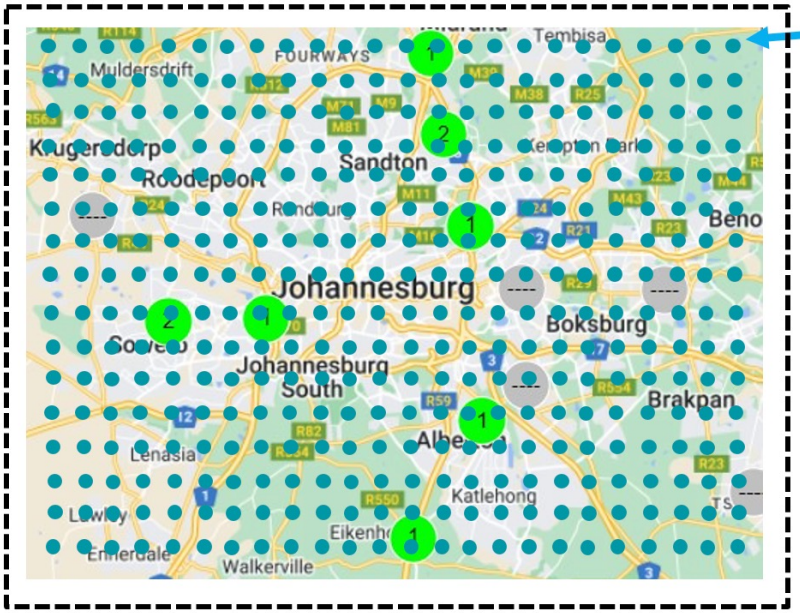
Department:
Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

SAAQIS South African Air Quality Information System

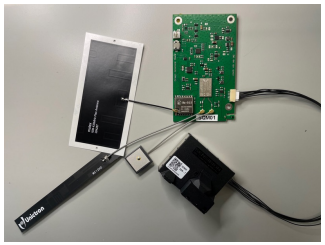


Strategy for SA:

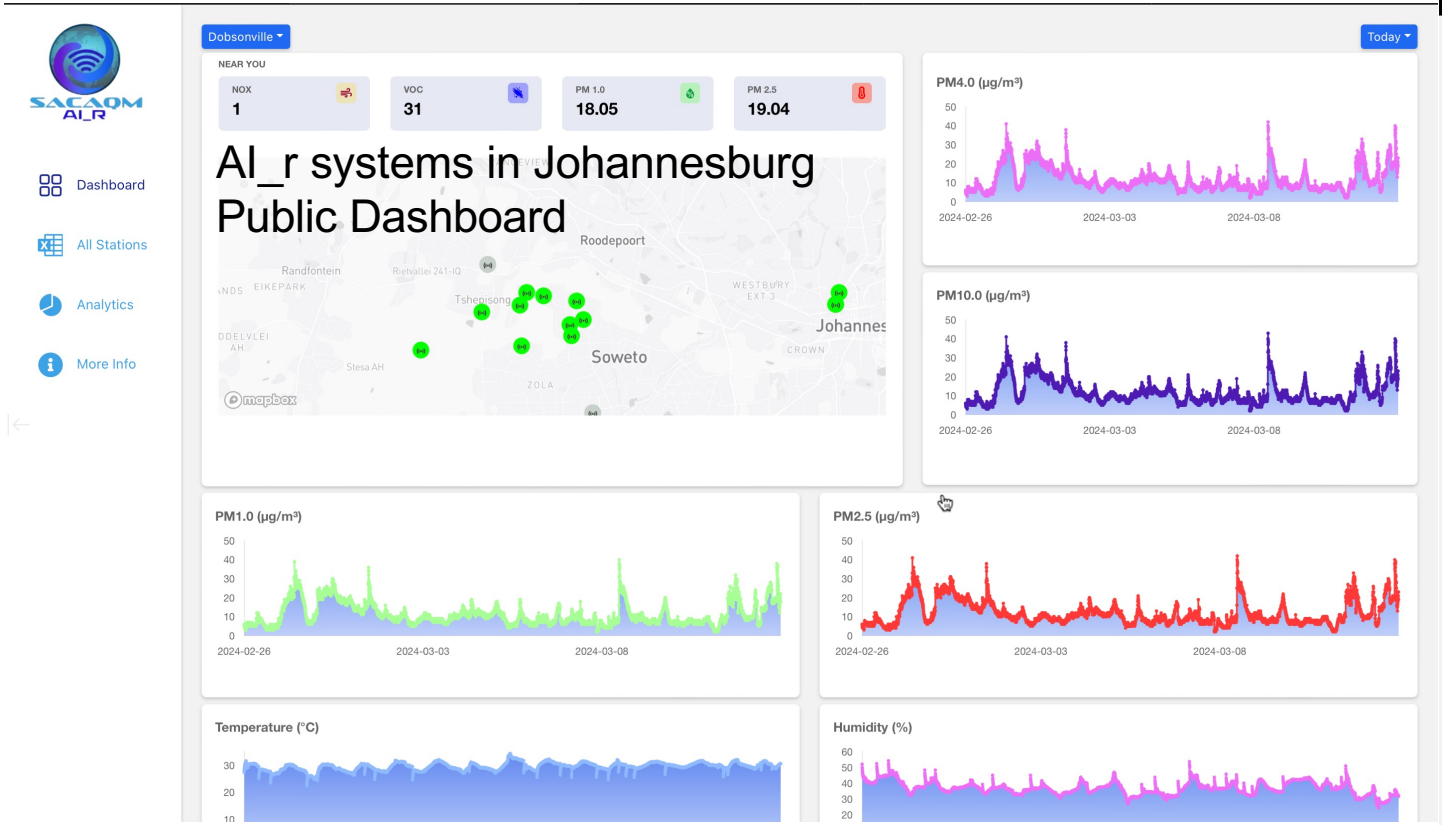
Enhance existing SAAQIS infrastructure with a dense grid of cost-effective AI_r systems

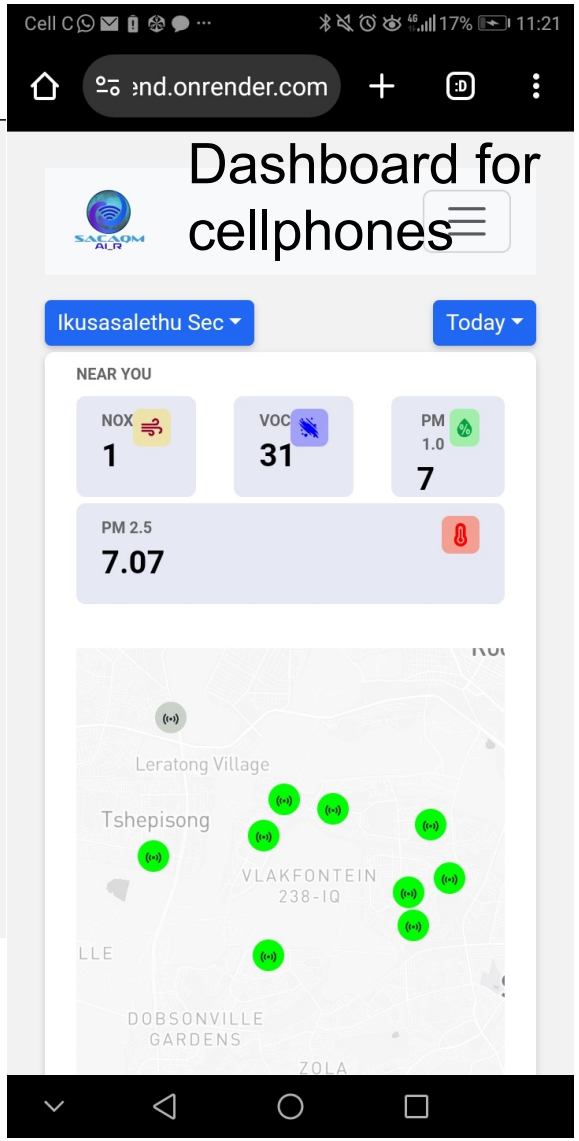


Air quality sensor node



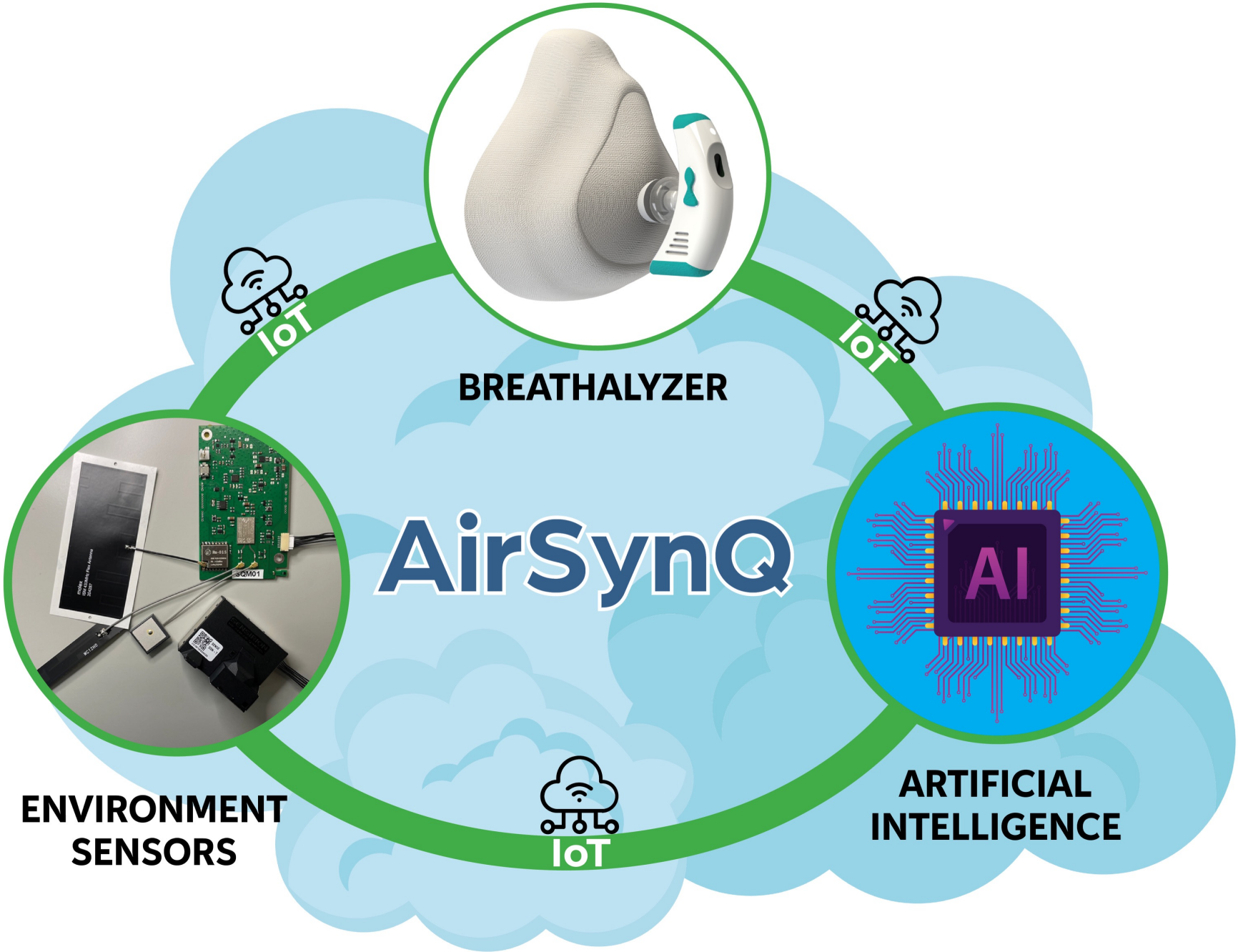
Towards large-scale deployment or AI_r





Partnered with the Canadian IDRC, UK's FCDO and the Pierre Fabre Foundation to deploy 500 AI_r systems in South Africa. This will be the largest network of air quality monitoring in Africa

Other AI-powered Projects


IoT
BREATHALYZER
IoT
AirSynQ
AI
ENVIRONMENT
SENSORS
IoT
ARTIFICIAL
INTELLIGENCE

Cloud based AI-Powered Real-Time Monitoring and Alert System

AIrSynQ

Monitoring Health, Monitoring Air with AI and IoT

aws

Mine

AI_r Environmental sensors

PMX

VOC, NOX,

CO, CO_2

SO_2, O_3

LoRa communications

Miner

healthmetryx

Clarinet breathalyzer:

Oxygen
CO_2
Air volume
Pulse Oximeter

Used before and after a shift

Complete breath analysis checkpoints

Clarinet wearable:

Used during a shift

Oxygen
CO_2

Bluetooth pairing

SAMSUNG

Samsung wearable
Heart Rate Monitoring
ECG, Blood pressure
Stress monitoring
Blood Oxygen Saturation

Technology transfer and comercialization

AI_r

AI4Air

An AI and IoT-powered system designed to monitor and analyze air quality, promoting healthier environments through real-time insights.

AI4Mining

A cutting-edge AI and IoT solution that optimizes mining operations, enhancing safety, efficiency, and sustainability.

AI4Spaces

An intelligent air quality management system for office spaces, ensuring a healthier and more productive workplace.

AI4Wifi

AI4Malls

An AI-driven platform for malls that predicts foot traffic and enhances customer experience through smart analytics.

AI4Varsity

A comprehensive AI solution for universities, streamlining campus operations and improving student engagement through data-driven insights.

AI4Mining and AI4Malls have been shortlisted by TIA for funding

The Technology Innovation Agency (TIA) has shortlisted two (AI4Malls, AI4Mining) of the solutions for funding with a total request of R23M.

Framework for Technology Transfer

AI4HEALTH, a showcase

Special thanks to DSI's DDG Imraan Patel and Director Glaudina Loots

The three-pronged mission is to ***research, innovate*** and ***deploy***– to develop accessible, affordable and equitable AI solutions and also bring breakthrough advances in AI and medicine to patients in Africa.

Research Ecosystem
Discovery
Generation of Ideas
Innovative Thinking
Concept Identification

DevOps/IT
Prototyping
Integration
Automated Testing
Scalability planning
Containeraization
Orchestration
Continuous Deployment

Business Development
Technology Identification
Market Analysis
Feasibility Assessment
IP Protection
Business Model
Business Plan
Value Proposition
Partnership Development

Translational Innovation

Licensing
Usage Permissions
Modification Rights
Attribution
Type of Use
Type of Rights
Royalties and Fees
Indemnification

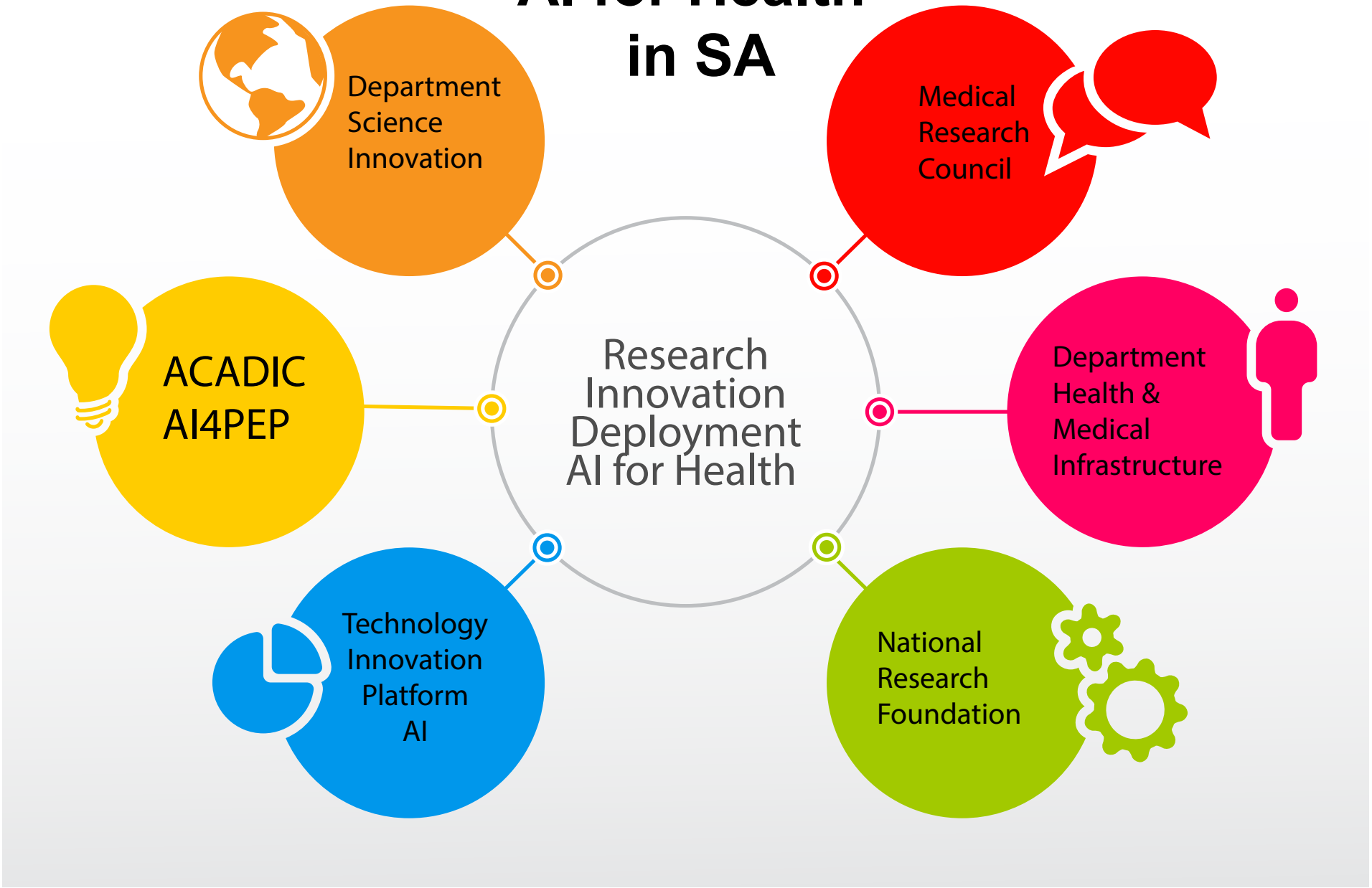
Co-development
Research Collaboration
Co-Development Agreement
Funding and Resources
Prototyping and Testing
IP Management
Commercialization Strategy
Knowledge Transfer

Incubation
Incubation Program
Prototyping
Business Model
Networking
Pitching
Market Validation
Monitoring and Support

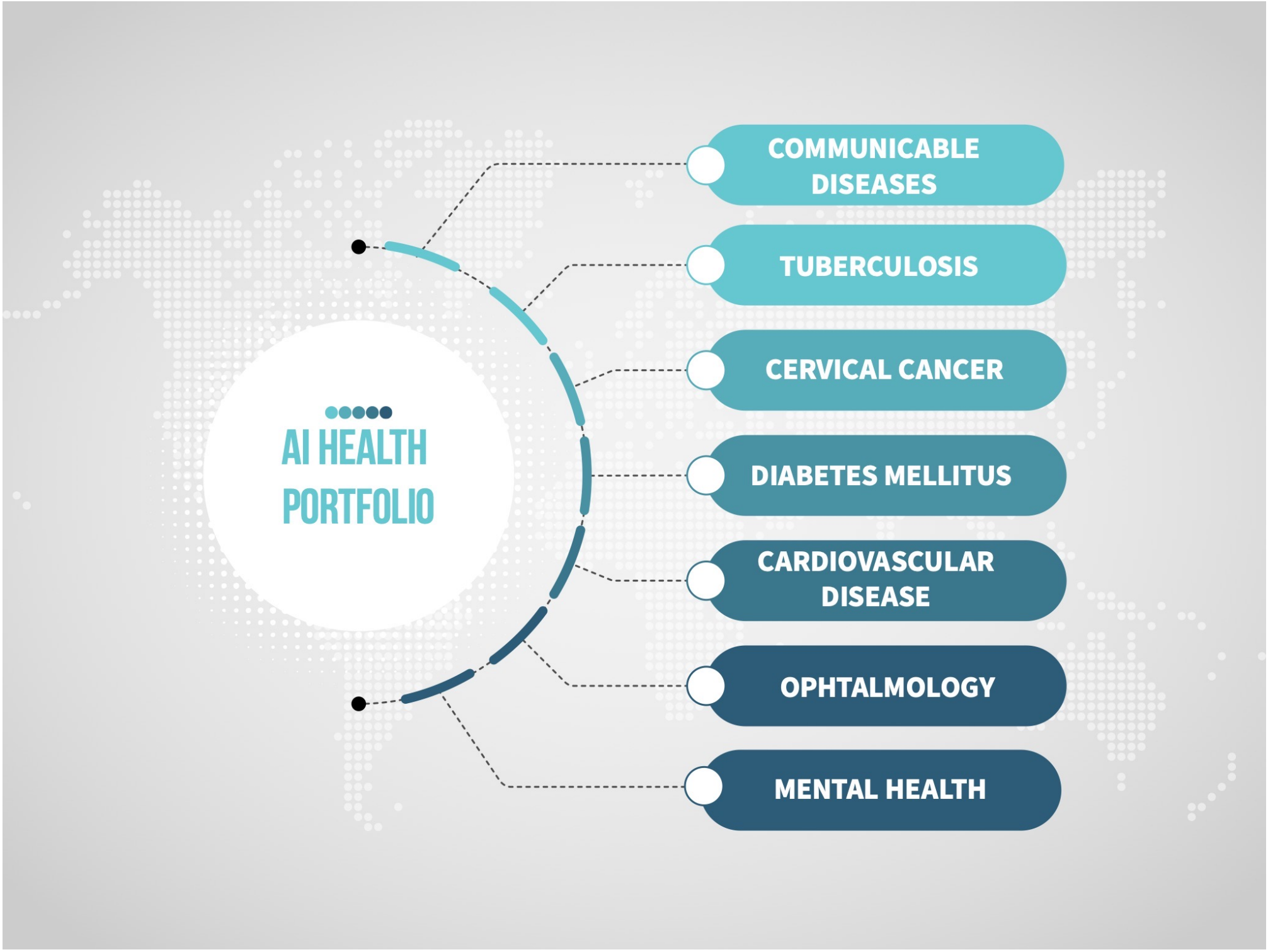
Agents of Research & Innovation

Deployment Pathways

AI for Health in SA



Canadian IDRC has indicated possibility of new funding package.
Working with Glaudina Loots to establish ecosystem.

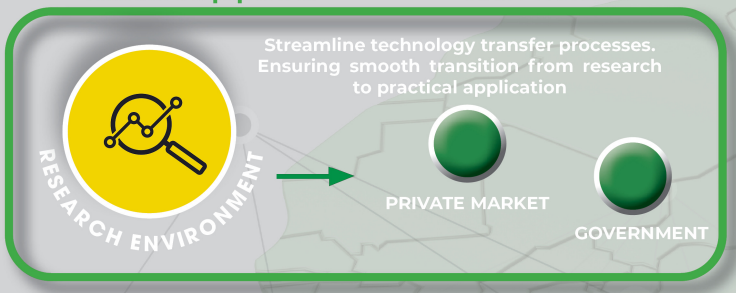

AI HEALTH PORTFOLIO
COMMUNICABLE DISEASES
TUBERCULOSIS
CERVICAL CANCER
DIABETES MELLITUS
CARDIOVASCULAR DISEASE
OPHTALMOLOGY
MENTAL HEALTH

AI4HEALTH

KEY FOCUS AREAS

Research pipeline

Tech Transfer



Shared stake

Startups
(Minimum Viable Product)

Financial Sustainability

FUNDING

Incubator will have an advisory board to assess long term viability

AI4HEALTH INCUBATOR

Resources to refine start-up business models, develop their products or services, acquire customers, and attract investment. Funding supports innovative research endeavors focused on AI for health.

Cost recovery model

RESEARCH

Generation of ideas and proofs of principle

Government
Not for profit incubation

DevOps, software development, business managers, data science.

Clinical test bed

Testing in clinical workflow, early adoption in clinical space.

TECHNOLOGY TRANSFER OFFICE

Intellectual Property protection, legal support and networking

AI4HEALTH INCUBATOR

Acceleration support to AI-enabled healthcare solutions in Africa

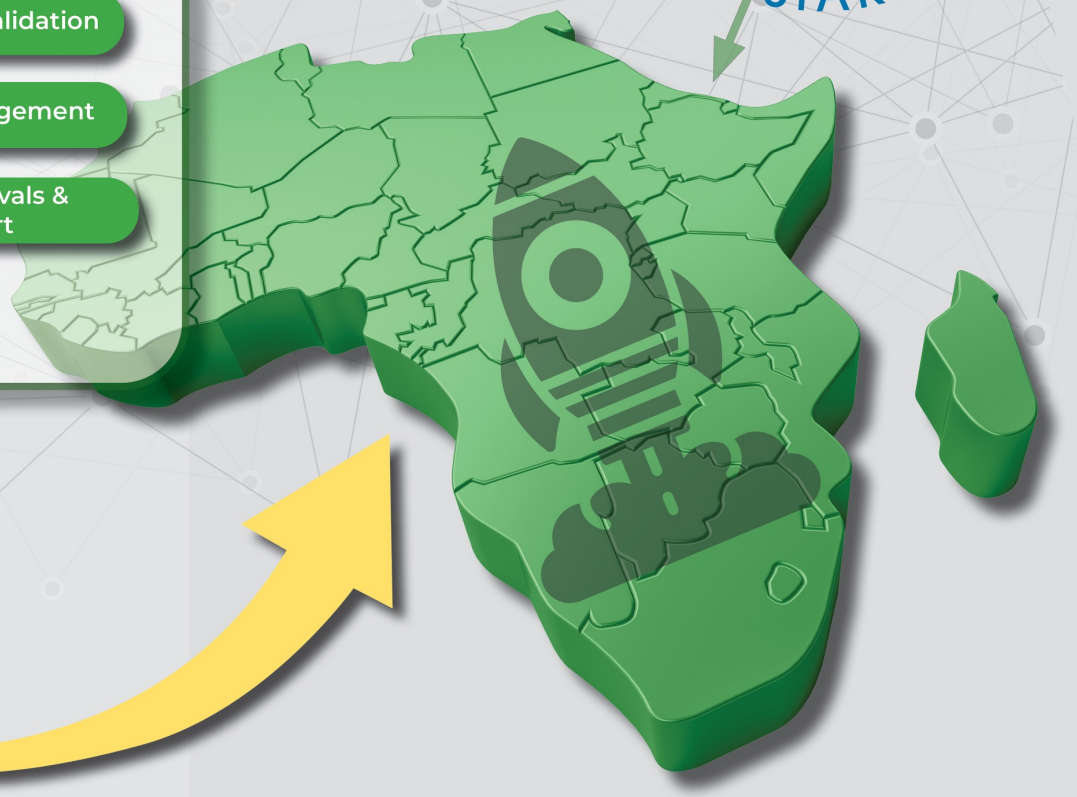
Incubation: The focus of incubation activities is to strengthen the internal structures of the startups and setting the groundwork for future growth.

Services Offered

- Quarterly diagnostic panels
- Value proposition validation
- Mentoring and access to networks
- IP/innovation management
- Business model and product development
- Regulatory approvals & policy support
- Investment readiness and transactions advisory support

SUPPORT TO START-UPS

- Needs assessment
- Incubation & acceleration
- Impact measurement
- Post-coaching support



- Screening & Selection
- Acceleration & Tech.
- Seed Capital
- Thematic Calls
- Ecosystem Building
- Market intelligence
- Fund management

Tailoring of support to generate largescale impact

AI4HEALTH ACCELERATOR

Acceleration: The aim of the acceleration activities is to prepare startups for investment by enhancing the "outward-facing" aspects of their business models.

Key Components of Accelerator Programs

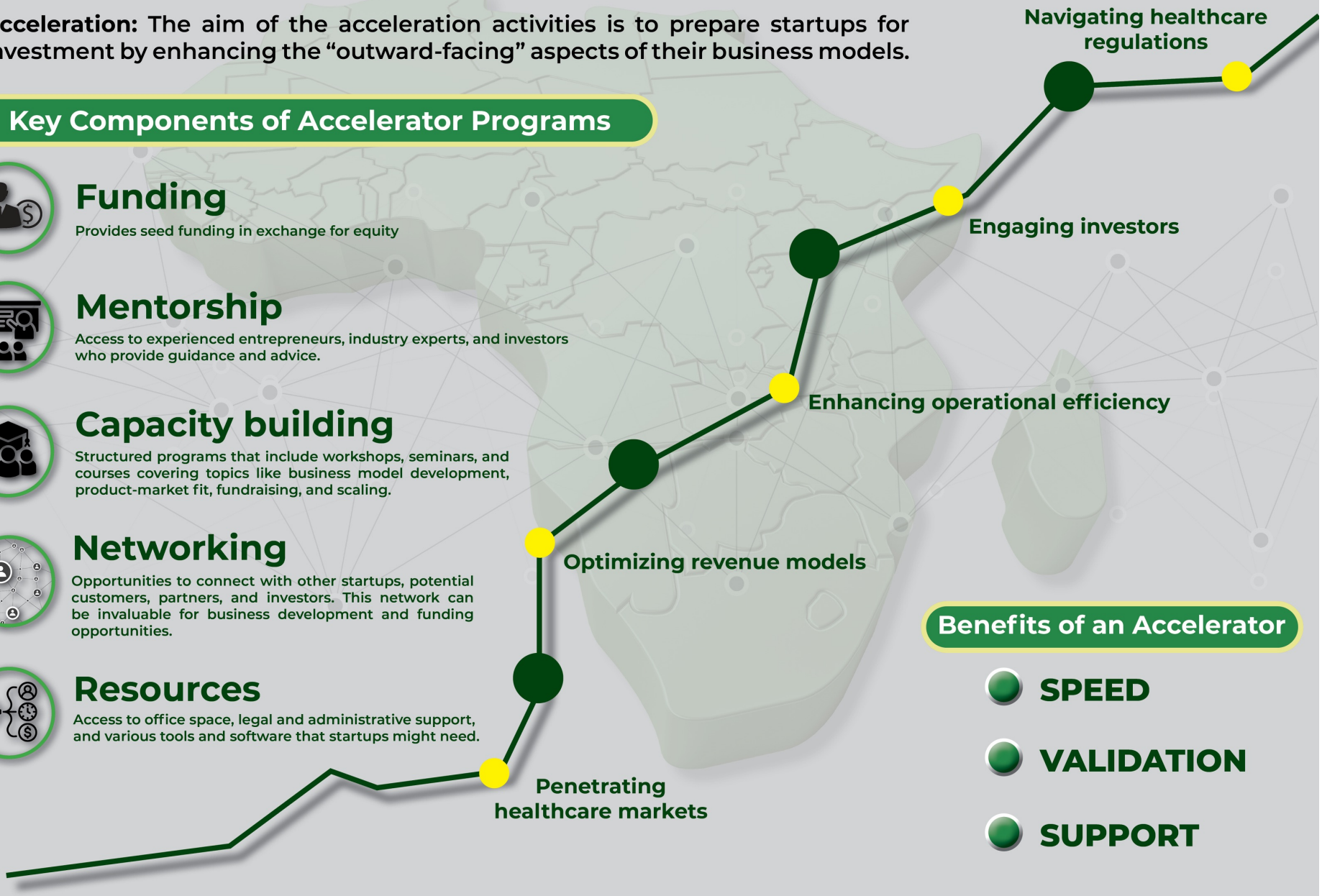
Funding
Provides seed funding in exchange for equity

Mentorship
Access to experienced entrepreneurs, industry experts, and investors who provide guidance and advice.

Capacity building
Structured programs that include workshops, seminars, and courses covering topics like business model development, product-market fit, fundraising, and scaling.

Networking
Opportunities to connect with other startups, potential customers, partners, and investors. This network can be invaluable for business development and funding opportunities.

Resources
Access to office space, legal and administrative support, and various tools and software that startups might need.



Benefits of an Accelerator

- SPEED
- VALIDATION
- SUPPORT