WATER SECURITY FOR PROSPERITY: POWERING AFRICA'S DEVELOPMENT THROUGH CLEAN WATER AND SANITATION

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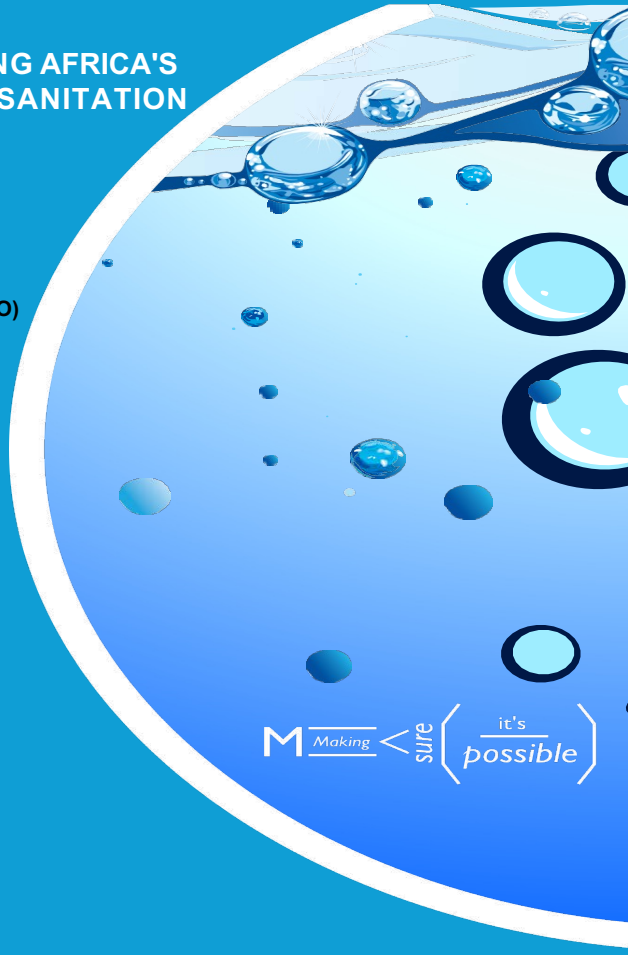
Chair – WFEO Capacity Building Committee
Chairman of Chinhoyi University Council and Ziscosteel Board
Past President – Zimbabwe Institution of Engineers (ZIE) & Past Chairman of The Engineering Council of Zimbabwe (ECZ)



International collaboration under the World Federation of Engineering Organisations (WFEO) Engineering Capacity Building for Africa Programme: The impact of water infrastructure and artificial intelligence to achieve SDG6

Dr Eng. Martin Manuhwa, Pr. Eng (Z), FZwIE
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WFEO Chair, Engineering Capacity Building Committee
Distinguished Fellow (FAEO) | F.ASI (USA) | F.AETDEW | F.AAET (ASEAN) | Aff. MASCE
Chair, Ziscosteel Board | Chair, CUT Council, Zimbabwe

Presenter profile

Dr Eng. Martin Manuhwa — Professional Engineer, Distinguished Fellow, and Global Engineering Leader

- Martin holds an Honours Engineering Degree, an MBA, and a PhD in Engineering and Sustainability. He leads education and capacity-building efforts globally as Chair of the World Council of Civil Engineers (WCCE) Education and Training Committee and Chair of the World Federation of Engineering Organisations (WFEO) Capacity Building Committee. In Zimbabwe, he serves as Chair of the Ziscosteel Board and the Chinhoyi University of Technology (CUT) Council. He also represents the Scientific and Technological Community within Africa's Major Groups and Other Stakeholders, hosted by the United Nations Economic Commission for Africa.

- Martin previously served as Chair of the Engineering Council of Zimbabwe (ECZ) and led the Zimbabwe Institution of Engineers (ZIE), the Southern African Federation of Engineering Organisations (SAFEO), and the Federation of African Engineering Organisations (FAEO).

- Martin works in energy, construction, and project management. He is the Director and Managing Consultant of the Zimbabwe Africa Infrastructure Development Group (ZAIDG), a firm that manages engineering, procurement, and construction projects and provides consulting services. ZAIDG partners with Hatch Africa in Zimbabwe to deliver solutions in the power, mining, and public sectors. Together, they served as technical advisors on the Kariba Extension (now complete) and the Hwange Power Station Expansion.

- Martin is recognised by leading engineering bodies worldwide, including as a Fellow of the African Scientific Institute and of the ASEAN Academy of Engineering and Technology. He was also honoured as the founding president of SAFEO and awarded a medal for distinguished service to Southern Africa in 2025. He has earned many honours, including the WCCE Excellence Award, the ZIE Lifetime Achievement Award, and the SKF Award for engineering service. He has presented on infrastructure topics at major events across Africa, China, Australia, Japan, Switzerland, France, and the United Kingdom. In 2021, he received the FAEO Distinguished Fellowship and the FAEO Special Award for contributions to engineering across Africa.

Presentation outline

1. **Introduction & Current Reality**
2. **About WFEO**
3. **Water Infrastructure for Sustainable Development**
4. **SDG 6 and Engineering + AI**
5. **Capacity Building Programme for Africa**
6. **Recommendations and Key Takeaways**
7. **Conclusion**

Science, Technology & Innovation for the Sustainable Development Goals

Key Discussion Areas

- ***Scaling Up Water Partnerships and Financing Resource Mobilisation Strategies for Water Engineering & Sustainability Projects***
- ***How Engineering Innovation Drives Sustainable Water Delivery***
- ***Policy and Regulatory Frameworks for Sustainability in Integrated Water Resource Management***
- ***Capacity Building: Strengthening Research Infrastructures for Sustainable Development in delivery of SDG 6***

About WFEO

- The global organisation for the engineering profession, representing the interests of more than 30 million engineers
- Founded in 1968 under the auspices of UNESCO
- 100+ national engineering institutions
- 10+ international engineering institutions representing the interests of engineers along continental lines or specific fields of engineering globally
- 11 Standing Technical Committees and 3 Working Groups
- Supported by a Secretariat based in Paris with the Executive Director as Head and other Secretariat staff.
- Executive Board
- Executive Council
- General Assembly
- Established relationship with many UN Agencies/Bodies
- Established relationship with other international Non-governmental organisations

Introduction- Current Reality

- **Artificial Intelligence (AI)** is transforming the attainment of Goal 6 through predictive analytics, **precision forecasting, and digital advisory services** to address climate, yield, and sustainability challenges.
- Africa faces increasing urgency to adapt to **climate change**; between 2001 and 2011, half of its droughts were attributed to human-driven climate change.
- Without international collaboration, capacity building that involves communities and the adoption of modern technologies, we will continue to face challenges and consequences:

Key Challenges

- Limited access to clean and safe drinking water
- Inadequate sanitation infrastructure
- Rapid urbanisation and population growth
- Climate change impacts:
  - **droughts**
  - **floods**
  - **water scarcity**
- Ageing and underfunded infrastructure
- Rural-urban inequality in service delivery

Consequences

- **Health crises**
- **Reduced economic productivity**
- **Gender inequality**
- **Educational disruption**
- **Environmental degradation**

Water Infrastructure for Sustainable Development

Strategic Water Infrastructure Investments

Critical Infrastructure Areas

- Water supply systems
- Dams and reservoirs
- Smart irrigation systems
- Wastewater treatment plants
- Rainwater harvesting
- Rural water access systems
- Urban sanitation systems

Benefits

- Improved public health
- Increased agricultural productivity
- Industrial growth
- Poverty reduction
- Climate adaptation

SDG 6 - Overview

Ensure Availability and Sustainable Management of Water and Sanitation for All

Sustainable Development Goal 6

SDG 6 Targets Include:

- Universal access to safe drinking water
- Adequate sanitation and hygiene
- Improved water quality
- Increased water-use efficiency
- Integrated water resources management
- Protection of water ecosystems

Why SDG 6 Matters

- Foundation for health, food security, education, and economic growth
- Directly linked to multiple SDGs

Engineering as a Driver of SDG 6 -The Role of Engineering

Engineering Solutions Enable:

- Water treatment systems
- Dams and reservoirs
- Irrigation infrastructure
- Smart water distribution networks
- Wastewater recycling
- Flood management systems
- Rural borehole systems
- Desalination technologies

Engineers Are Critical For:

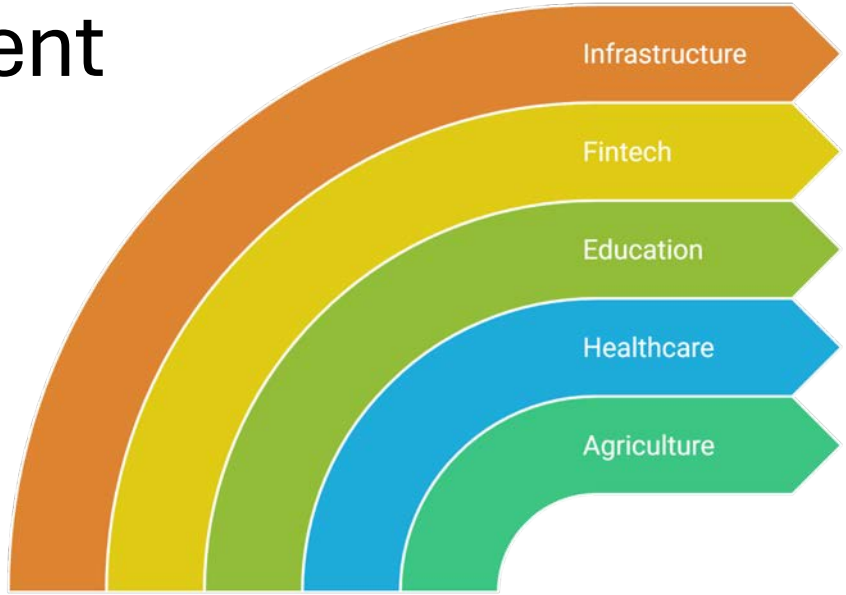
- Design
- Innovation
- Maintenance
- Sustainability
- Policy implementation

AI: Transforming Africa's Economic Landscape

Artificial Intelligence is poised to be a significant driver of economic growth in Africa by enhancing productivity, fostering innovation, and creating new opportunities. Its integration across various sectors can lead to improved efficiencies and contribute to sustainable development.

AI for National Development

AI transforms agriculture, healthcare, education, fintech, and infrastructure



Healthcare

AI chatbots, medical imaging, drug supply optimization

Agriculture

Crop yield prediction, pest detection, market analytics

Education

Local-language tutoring bots, adaptive learning

Infrastructure

Smart grids, traffic prediction

FinTech

AI-based credit scoring, fraud detection

The Emergence of Artificial Intelligence

Artificial Intelligence and Water Management

AI Technologies in Water Systems

- Machine learning
- Predictive analytics
- Internet of Things (IoT)
- Remote sensing
- Digital twins
- Smart sensors
- GIS and satellite monitoring

Why AI Matters

- Real-time monitoring
- Faster decision-making
- Reduced water losses
- Predictive maintenance
- Better resource allocation

The Emergence of Artificial Intelligence

Practical Applications of AI

AI Can Help:

- Detect pipe leakages
- Predict droughts and floods
- Optimize irrigation systems
- Monitor water quality
- Improve wastewater management
- Forecast demand patterns
- Enhance infrastructure maintenance

Example Areas

- Smart cities
- Agricultural water management
- Rural water systems
- Climate resilience planning

AI + Water Infrastructure = Accelerated SDG 6

Integrating Physical and Digital Infrastructure

Combined Impact

Outcomes

- Increased efficiency
- Reduced operational costs
- Improved sustainability
- Enhanced resilience

Water Infrastructure	AI Contribution
Pipelines	Leak detection
Reservoirs	Predictive management
Irrigation	Smart optimization
Treatment plants	Automated quality control
Distribution networks	Demand forecasting

What WFEO Is Doing

Encouraging capacity building and quality engineering education, fostering research and development, and promoting innovation are essential priorities for WFEO through its Engineering Capacity Building for Africa Programme which looks at:

- **Strengthening engineering education:**
- **Promoting engineering research and development:**
- **Integrating engineering into sustainable development projects:**

WFEO's Engineering Capacity Building for Africa Programme (ECPAB)

The CONCEPT

WFEO recognises the importance of **capacity building** for Africa to achieve the goals outlined in the Africa Agenda 2063 and to accelerate the implementation of the SDGS of the UN's 2030 Sustainable Development Agenda.

To address this need, WFEO has established a 10-year, 10 million Engineering Capacity Building for Africa Programme to train a minimum of 100000.00 engineering professionals, initially funded by the China Association of Science and Technology (CAST) with a call for Partners to grow the fund to start establish Centres of Skills Training in each region of Africa.

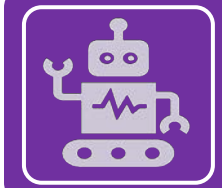
The Objectives

Enhance Capacity in Engineering Education

- to improve the quality and relevance of engineering education across the continent

Enhance Capacity in Continuous Professional Development

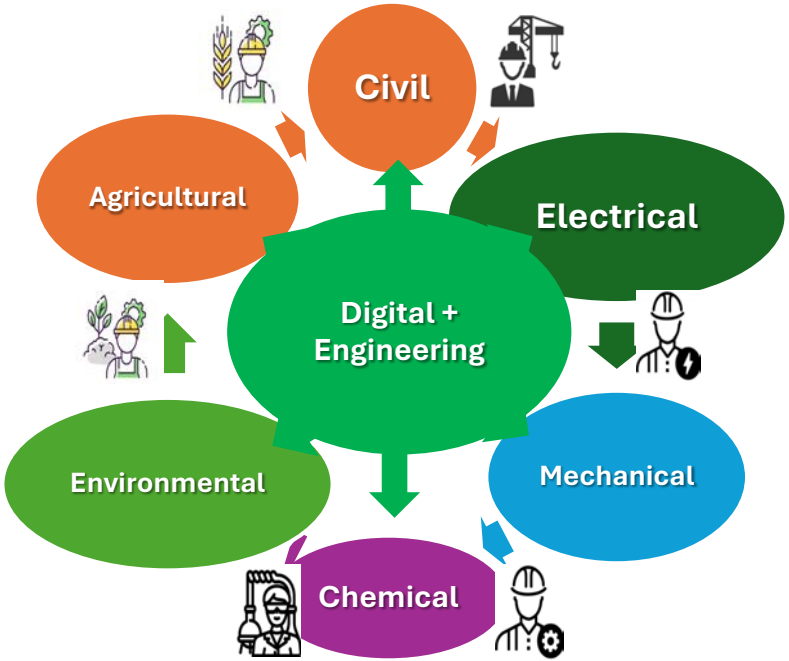
- To enhance technical and soft skills required for Africa's digitalization and green transition

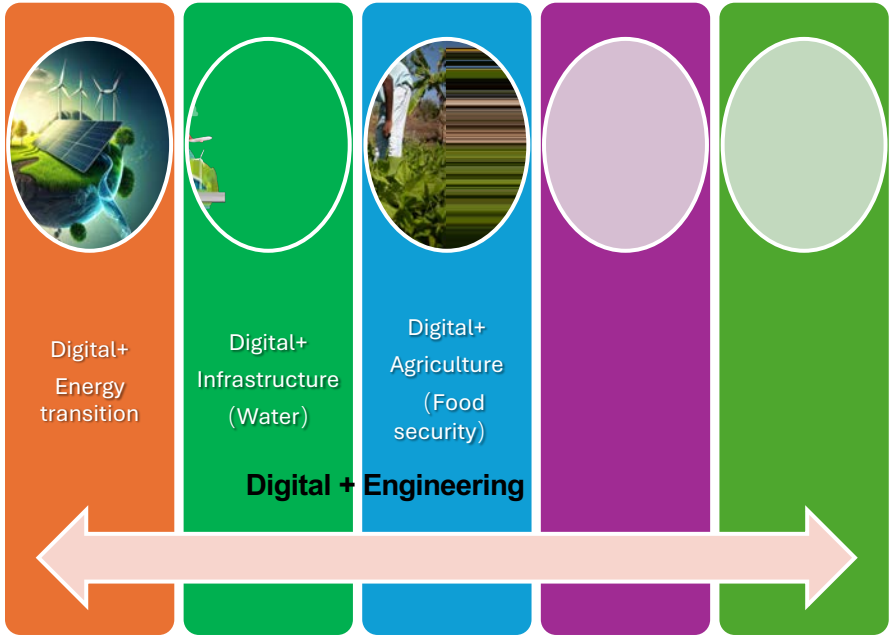


Enhance Capacity in Technology Transfer

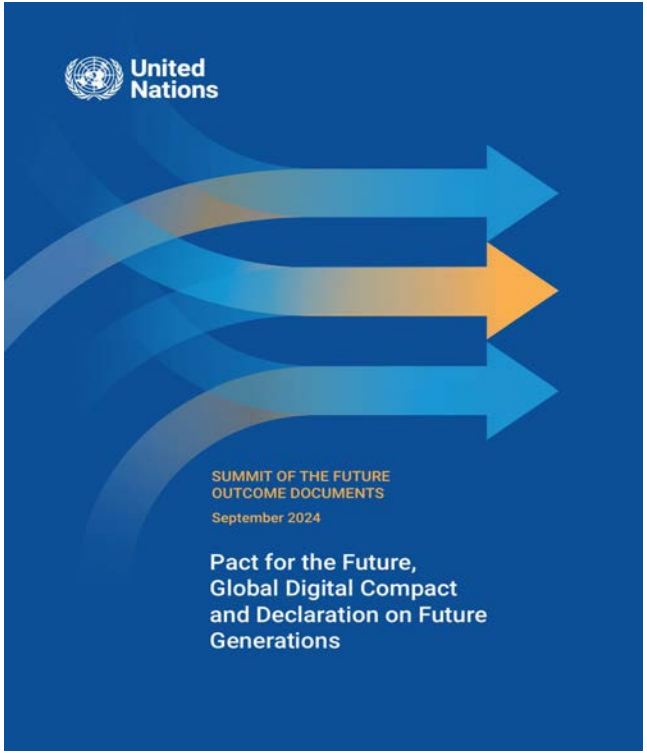
- to harness advanced technologies to address Africa's developmental challenges and promote innovation

The WFEO ECBAP Uniqueness is its Emphasis on Leveraging Digital + Engineering Capability to implement SDGs





Capacity Building is highlighted in the Pact of the Future and Global Digital Compact



Enhance international cooperation and capacity-building efforts to bridge t… securely seize t…

I… …ly developed c… do so, with c…

S… …d triangular c… …umstances to b… …hnology and innovation and … …rease resources for the implementation of technical and scientific initiatives;

We will enhance partnerships to ensure the provision of the required means of implementation to developing countries, including the mobilization of financial resources, capacity-building and the transfer of technology on mutually agreed terms;

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Digital capacity development in developing countries supports local content development relevant to local realities online and retains talent.

ECBAP 2025 AT A GLANCE

PARTICIPANTS TRAINED

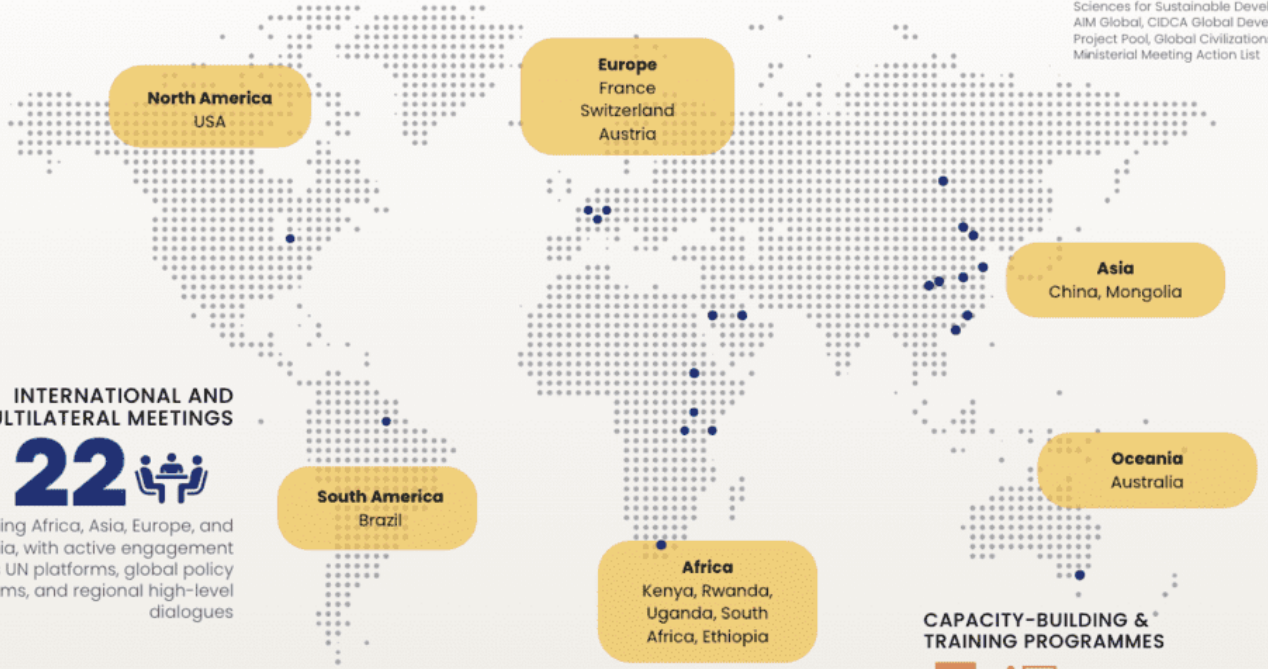
200+

including engineers, policymakers, researchers, and practitioners from multiple regions

INTERNATIONAL RECOGNITION

4

including UN International Decade of Sciences for Sustainable Development, UNIDO AIM Global, CIDCA Global Development Project Pool, Global Civilizations Dialogue Ministerial Meeting Action List



INTERNATIONAL AND MULTILATERAL MEETINGS

22

spanning Africa, Asia, Europe, and Oceania, with active engagement across UN platforms, global policy forums, and regional high-level dialogues

CAPACITY-BUILDING & TRAINING PROGRAMMES

3

focusing on digital transformation, engineering leadership, and applied skills development.

INTERNATIONAL RECOGNITION

International Decade of Sciences for Sustainable Development

2024 - 2033 International Decade of Sciences for Sustainable Development

Global Alliance on Artificial Intelligence for Industry and Manufacturing (AIM Global)

AIM GLOBAL Global Alliance on AI for Industry & Manufacturing

China International Development Cooperation Agency (CIDCA) Global Development Project Pool

国家国际发展合作署全球发展促进中心 GLOBAL DEVELOPMENT PROMOTION CENTER OF CIDCA

Global Civilizations Dialogue Ministerial Meeting Action List

全球文明对话部长级会议 Global Civilizations Dialogue Ministerial Meeting

> *Give people a fish is not as good as teach people to fish.*

Empowering Action: Modular Capacity Building Fully Launched

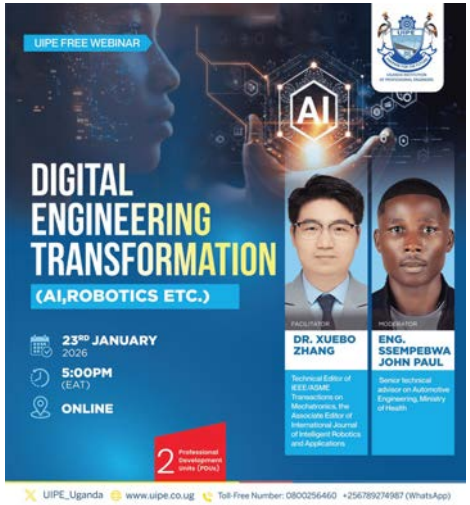
Successfully delivered highly relevant, need-based, practice-oriented capacity building programs.

(Kenya)

"AI for Engineers" 5-day intensive training, with 46 selected engineers participating in practical exercises.

(Uganda)

"AI-Assisted Agricultural Production" CPD training



(Uganda)

"Digital Engineering Transformation" webinar

The 1st Pilot Training on “AI in Engineering Practices” in Kenya from March 10-14, 2025

STI4SDG Baseline Assessment and Roadmap Development Workshop in Cabo Verde

ECBAP, in collaboration with the United Nations Department of Economic and Social Affairs (UN DESA), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the United Nations Economic Commission for Africa (UN ECA), organized this capacity building workshop. Focusing on science, technology and innovation (STI) capacity building for Small Island Developing States (SIDS), **the workshop highlighted the impact and importance of engineering at the policy level**.

Empowering Action: Online Learning Platform Established

Part 1 – ECBAP Online Training Series | Digital Transformation...

无人观看 • 5天前

Eng. Joseph Mbugua – Remarks at the WFEO ECBAP Launch

380次观看 • 3周前

Eng. Jacton Mwembe – Remarks at the WFEO ECBAP Launch

53次观看 • 3周前

Eng. Erick Ohaga – Keynote Address at the WFEO ECBAP...

257次观看 • 3周前

Eng. Shammah Kiteme - Welcome Remarks at the WFEO ECBAP...

414次观看 • 3周前

Eng. Erastus Mwongera - Keynote Speech at the WFEO ECBAP Launch

513次观看 • 3周前

Eng. Margaret Ogai - "The Africa We Want: Developing Our Engineering...

228次观看 • 3周前

Dr. Peggy Oti-Boateng – Remarks at the WFEO ECBAP Launch

52次观看 • 3周前

Eng. Mustafa B. Shehu - Opening Remarks | Official Launch of the...

Dr. Zhou Daya – Engineering Capacity Building and Internationa...

Eng. Martin Manuhwa – WFEO Engineering Capacity Building...

Prof. GONG KE - Introduction of the Engineering Capacity Building for...

ECBAP online courses are available through its official **YouTube channel**, providing open and convenient access to recorded webinars, expert lectures, and training sessions.

WFEO ECBAP

WFEO ENGINEERING CAPACITY BUILDING FOR AFRICA PROGRAMME

ECBAP actively participated in major UN and international platforms — including the STI Forum, WSIS, the High-Level Political Forum, COP30, World Economic Forum and others

The ECBAP Model:
A Systemic Approach to Capacity Building

Local Needs Identified

Govt • Industry • Eng. Bodies

ECBAP Prioritization

Expert & Thematic Working Groups

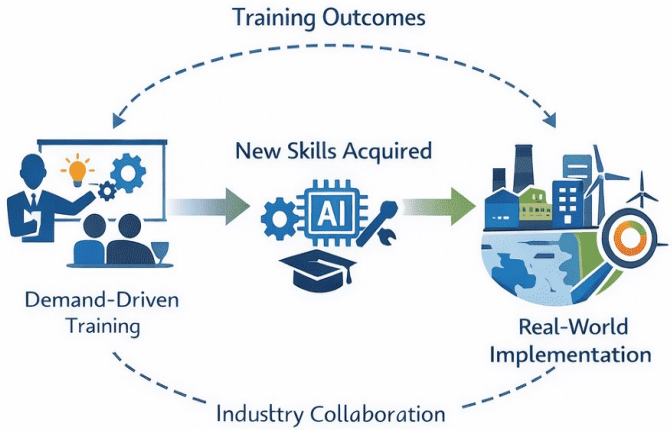
Tailored Capacity Building Programmes

CPD • Training • Knowledge Exchange

Local Implementation with Partners

Engineering Bodies • Academia • Industry

Real-World Application & SDG Impact



Capacity Building → Real-World Implementation

Enabling Mechanisms

Digital Learning

Knowledge Dissemination

Multi-Channel Communication

Demand-Driven & Local Ownership

Digital-Driven Capacity

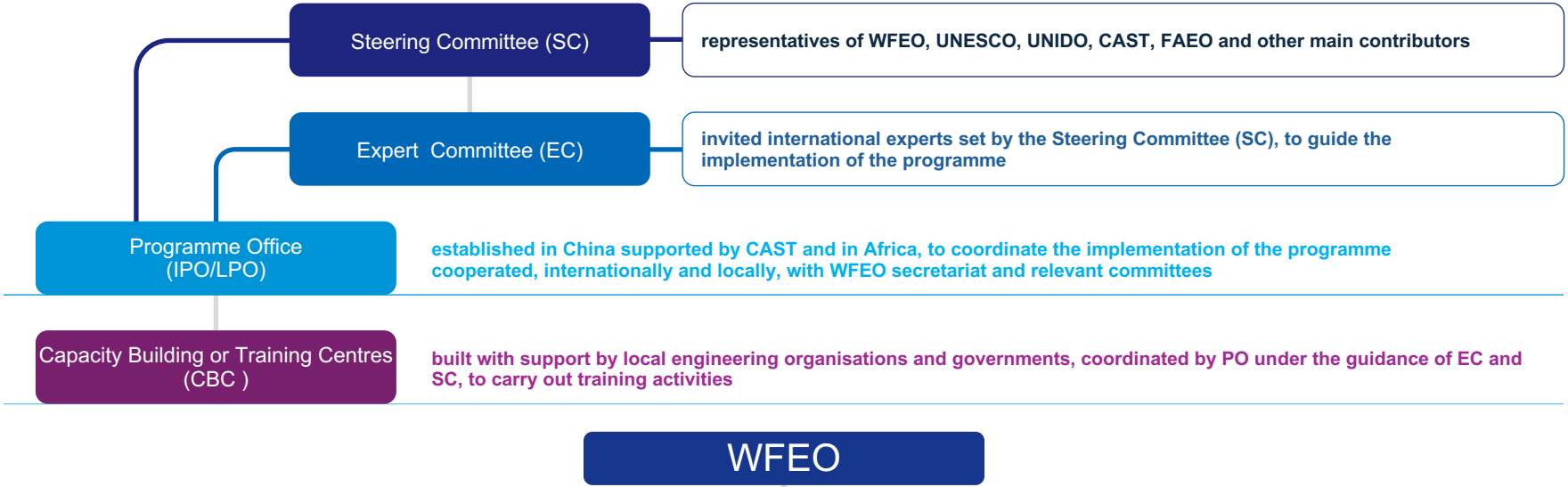
AI & Digital Transformation

Multi-Stakeholder Cooperation

Institutional & Governance Framework

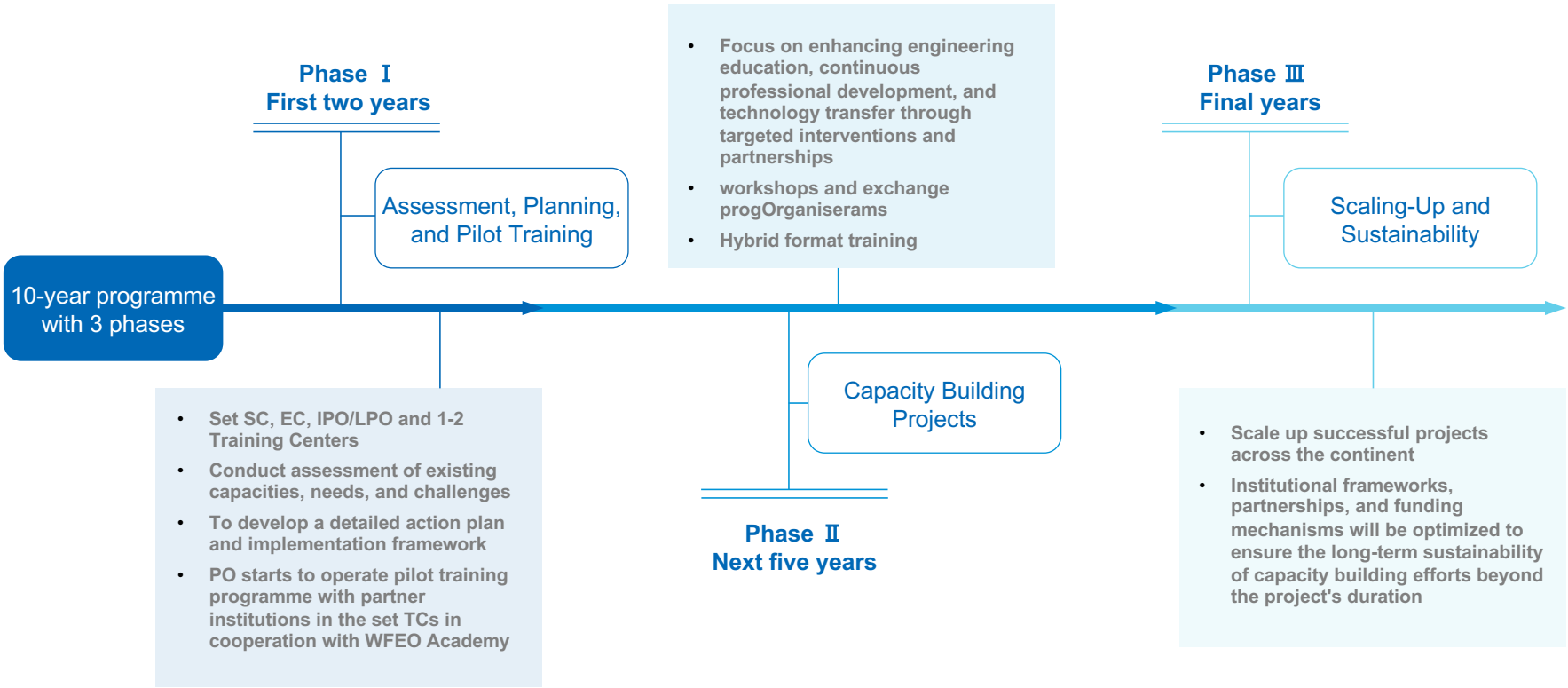
Long-Term Sustainability

Organization Chart



As the project organizer, I will work with partners to oversee implementation and collaborate with national engineering organizations, government institutions, and other stakeholders to ensure effective execution. WFEO's STCs and its member organizations will provide technical support, expertise, and guidance throughout the programme's duration.

Implementation Timeline



Importance of International Collaboration – Pilot Studies with RSA DSI Plus Others

Why Global Partnerships Matter?

It Supports:

- Technology transfer
- Knowledge exchange
- Skills development
- Joint research
- Infrastructure financing
- Capacity building
- Regional integration

Key Partners

- FAEO
- WFEO
- UNESCO
- African engineering institutions
- Universities and research centres
- Development banks
- Governments
- Private sector

Water and Wastewater Treatment Process Management Pilot Programmes

Funders and implementing agents - All three courses:

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

FAEO

AUDA-NEPAD
AGENCE DE DEVELOPPEMENT DE L'UNION AFRICAINE

Funders and implementing agents: Victoria Falls, Zimbabwe:

World Federation of Engineering Organizations
Fédération Mondiale des Organisations d'Ingénieurs

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ENGINEERING COUNCIL OF ZIMBABWE
"Regulating Engineering Practice in Zimbabwe"

THE ZIMBABWE INSTITUTION OF ENGINEERS

SADC
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
TOWARDS A COMMON FUTURE

Funders and implementing agents - Windhoek, Namibia:

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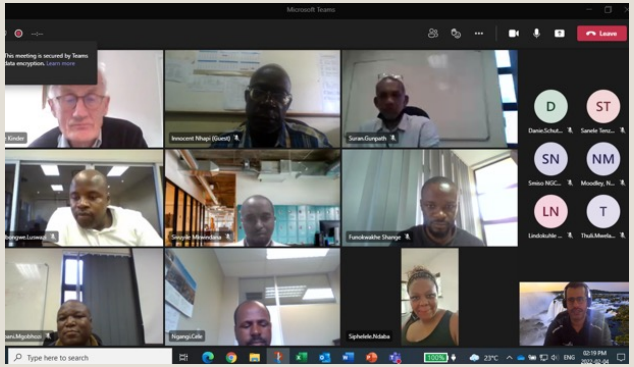
NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Water and Wastewater Treatment Process Management Pilot Programmes

uGu District Municipality

Logistics	
Delivery mode:	**Online**
Date:	**31 Jan - 4 Febr 2022**
Facilitators:	**Emanti Management Pty (Ltd)** **Dr Clive Kinder**
Site visit:	**NA**



Victoria Falls, Zimbabwe

Logistics	
Delivery mode:	Face – to - face
Date:	12 – 16 Aug 2022
Facilitators:	Prof Innocent Nhapi Dr Clive Kinder (guest speaker)
Site visit:	Victoria Falls Water Treatment Plant Victoria Falls Wastewater Treatment Plant

Windhoek, Namibia

Logistics	
Delivery mode:	Hybrid: Online component Face – to – face component
Date:	8 – 9, 20 – 23 Sept.
Facilitators:	Prof Innocent Nhapi Prof Zwelinzima Ndevu Prof Jose Quenum (guest speaker) Dr Clive Kinder (guest speaker)
Site visit:	Von Bach Water Treatment Plant in Okahandja

Water and Wastewater Treatment Process Management Pilot Programmes

Target audience

	Ugu District Municipality	Victoria Falls, Zimbabwe	Namibia, Windhoek
Total number of participants	17	10	19
Affiliations	17: uGu District Municipality	8: City of Victoria Falls 1: City of Bulawayo 1: City of Harare 1: UNESCO	10: NamWater 4: SGSP-IWRM Doctoral fellows 5: Rundu Town Council
Job descriptions	3: Management 4: area managers, 4: superintendents 2: Foreman, 4: Others (1 engineer, 2 system and instrument technicians and a water and sanitation treatment officer).	Not specified	4: SGSP-IWRM Doctoral fellows 1: Area manager 2: Management 5: Superintendents 5: Artisans 1: Plant engineer 1: Scientist

Strategic Recommendations

Policy & Partnerships

Step 1

Develop a comprehensive National AI Strategy

Step 2

Integrate AI into education, infrastructure, local language support, and regulation

Step 3

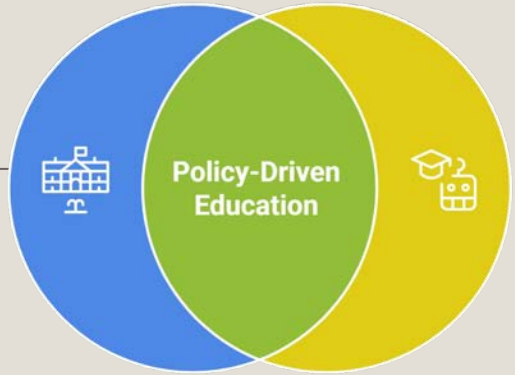
Foster public-private partnerships (PPP) with telecoms, banks, universities, and global tech

Government

Policy leadership and regulation

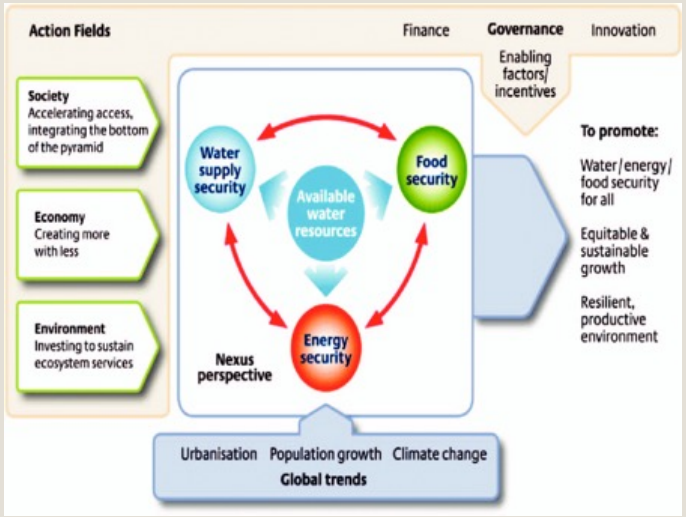
Academia

Research and education expertise



The Water-Energy-Food Nexus

The water-food-energy nexus is central to sustainable development. Demand for all three is increasing, driven by a rising global population, rapid urbanization, changing diets and economic growth. Agriculture is the largest consumer of the world's freshwater resources, and more than one-quarter of the energy used globally is expended on food production and supply (UN Water). This discussion will look at the SDG framework as completely integrated and there is need for the water, energy and food security to be looked at in an integrated manner. We further show that all the SDGs are related to food in one way or the other,



Source: Water-Energy-Food Security Nexus from Hoff (2011).

The Water-Energy-Food Nexus

One of the most prominent nexuses of sustainable development is between agriculture, water and energy. Water management and agriculture are an integral part of many if not all SDGs.

A way of viewing the Sustainable Development Goals and how they are all linked to food. All the SDGs are directly or indirectly connected to food. The goals for eradicating poverty (SDG 1) and hunger (SDG 2) require gender equality (SDG 5), adequate jobs (SDG 8), and a decrease in inequality (SDG 10).

Link between food security and all SDGs: Source (Rockström and Sukhdev, 2016).

Building Africa's Engineering Future

The Way Forward

Strategic Priorities

- Invest in engineering education
- Promote STEM development
- Strengthen research institutions
- Encourage public-private partnerships
- Expand digital infrastructure
- Develop AI governance frameworks
- Support youth innovation ecosystems

Capacity Building Priorities

- Technical training
- Professional certification
- Regional collaboration
- Knowledge sharing platforms

Recommendations for Stakeholders

Governments
- Prioritise water infrastructure investment
- Support digital transformation policies

Engineering Institutions
- Strengthen professional training
- Promote interdisciplinary collaboration

Development Partners
- Increase financing support
- Facilitate technology transfer

Academia
- Expand AI and water engineering research

Private Sector
- Invest in innovation and scalable solutions

Conclusion

- SDG 6 is essential for Africa's sustainable development
- Engineering remains central to solving water challenges
- Artificial intelligence offers transformative opportunities
- International collaboration is critical for success
- Capacity building must remain a strategic priority

Closing – We Can't Afford the Cost of Inaction

"Engineering innovation, international collaboration, and digital transformation can accelerate Africa's journey toward universal access to clean water and sanitation."

Without urgent AI & STI investment, the SDG financing gap will grow to $4.3 trillion by 2030. (UN DESA).

"What if I told you that 50% of SDG targets could fail due to AI & STI underinvestment?"

Our Call for Partnership with the WFEO ECBAP is aligned with the UN Technology Facilitation Mechanism and other Global Collaborations to Bridge AI Divide.

Let's shape the future of Ethical AI together!

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Thank you!

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