

Sustainable Building Materials and Practices, Towards a Greener and More Resilient Built Environment

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"Lets discuss sustainability"

Presentation Outline

1. Introduction to SIRDC
2. The Challenge: The Environmental Impact of Construction
3. What is Sustainable Building? The Core Principles
4. Innovative Materials: From Low-Carbon to Regenerative Materials
5. Best Practices: Designing and Building for Sustainability
6. The Benefits: Beyond Green – Economic and Social Value
7. Case Studies: Putting It All Together
8. The Way Forward: How Do We Get There?



Brief Background & Mandate of SIRDC



Carrying out strategic Research and Development (R&D) for the benefit of manufacturing, agricultural, mining and service sectors of Zimbabwe;

Collaborating with other local and international institutions, and universities in strengthening local R&D capacity and its application to industrial processes;

Promote technological partnerships and quality culture in business; and

Commercializing research products and processes for the benefit of Zimbabwe;

SIRDC was established by the Government of Zimbabwe in 1993 under the provisions of the Research Act [Chapter 10:22] of 1986

SIRDC ORGANOGRAM

Office of the President and Cabinet
Line Minister
Hon. Vice President General (Retd) Dr. C. G. D. N. Chiwenga

Board of Directors

**Chief Executive
Officer (Director
General)**

**Executive Director
Technical (Deputy
Director General Tech)**

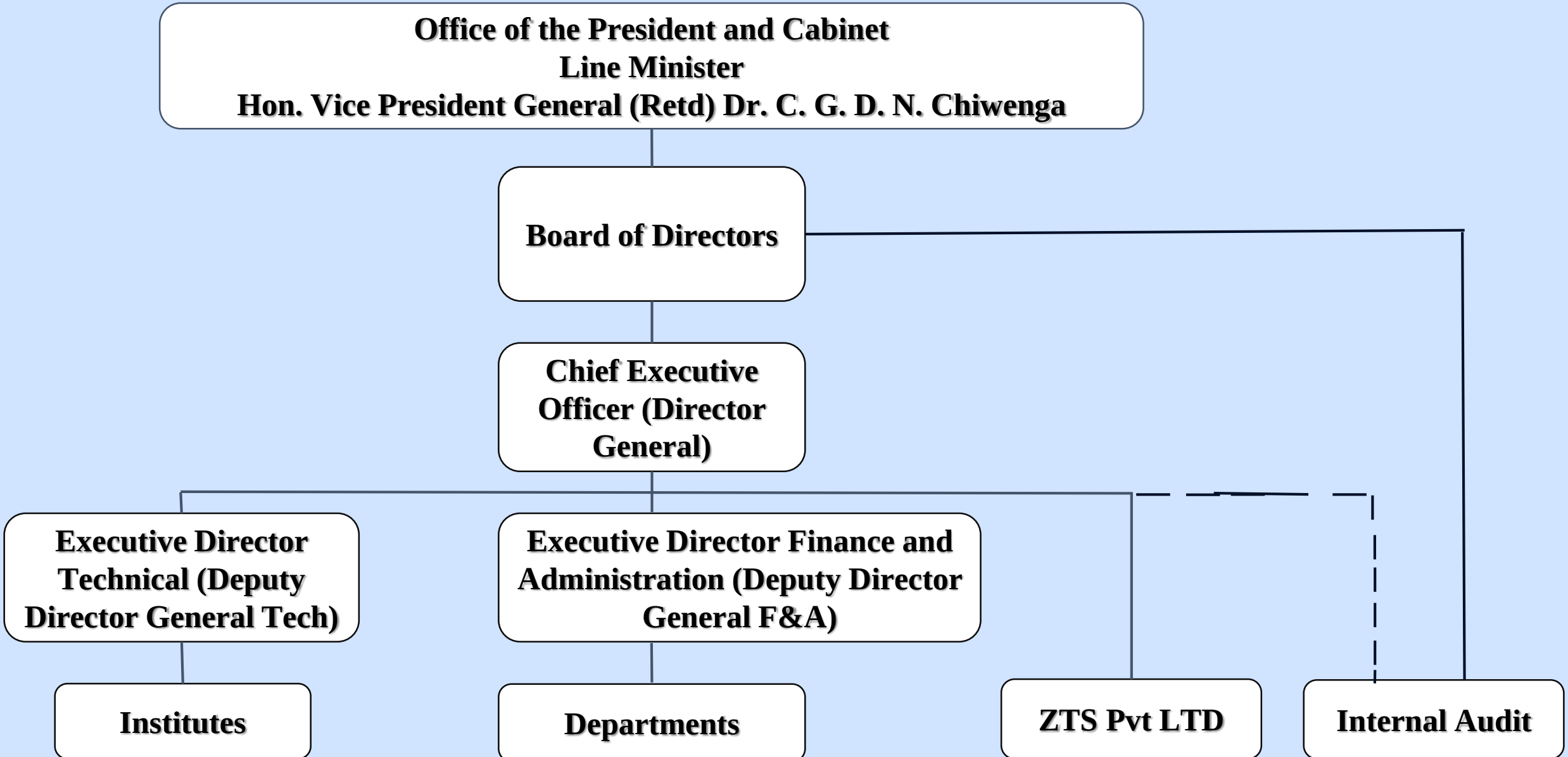
Institutes

**Executive Director Finance and
Administration (Deputy Director
General F&A)**

Departments

ZTS Pvt LTD

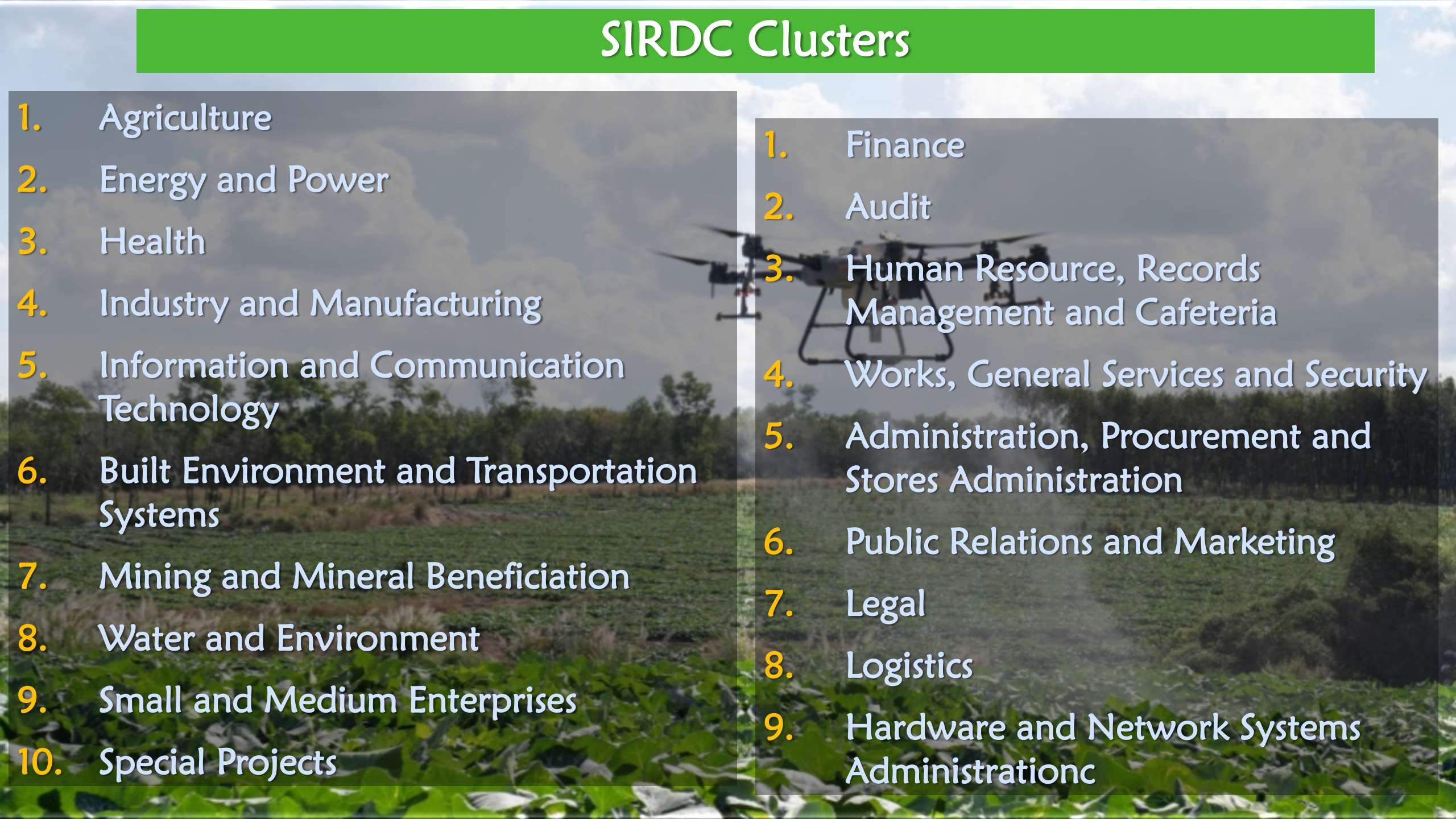
Internal Audit



SIRDC Institutes

1. Biotechnology Research Institute (BRI)
2. Building Technology Institute (BTI)
3. Energy Technology Institute (ETI)
4. Environmental Science Institute (ESI)
5. Electronics & Communication Institute (ECI)
6. Food and Biomedical Technology Institute (FBTI)
7. Geo-Information & Remote Sensing Institute (GRSI)
8. Informatics Institute (II)
9. Metallurgical Research Institute (MRI)
10. National Metrology Institute (NMI)
11. Polymer & Material Science Institute (PMSI)
12. Production Engineering Institute (PEI)

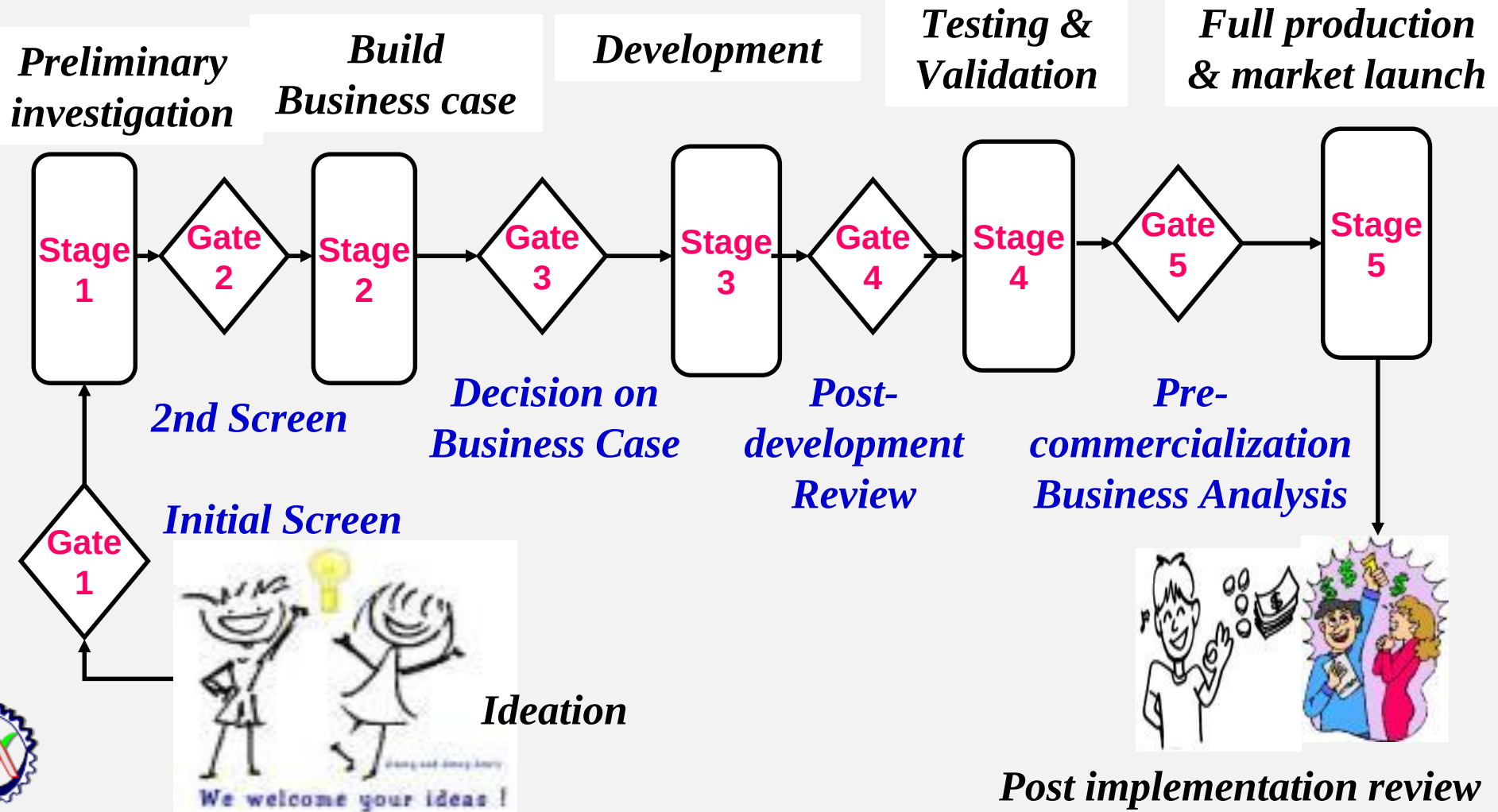
SIRDC Clusters

- 
1. Agriculture
 2. Energy and Power
 3. Health
 4. Industry and Manufacturing
 5. Information and Communication Technology
 6. Built Environment and Transportation Systems
 7. Mining and Mineral Beneficiation
 8. Water and Environment
 9. Small and Medium Enterprises
 10. Special Projects

1. Finance
2. Audit
3. Human Resource, Records Management and Cafeteria
4. Works, General Services and Security
5. Administration, Procurement and Stores Administration
6. Public Relations and Marketing
7. Legal
8. Logistics
9. Hardware and Network Systems Administration

Stage-Gate® Process

DRIVING NEW PRODUCTS TO THE MARKET



THE BUILT ENVIRONMENT



“A typical construction site”

The construction and operation of buildings are responsible for:

- 40% of global energy-related CO₂ emissions.
- Consumes 40% of global raw materials (3 billion tons annually).
- Generates one-third of the world's waste.
- Accounts for ~12% of global freshwater use.

THE CHALLENGE

- The Construction industry has a significant footprint
- A major contributor to carbon emissions, resource depletion, and waste generation
- The model of *'take, make, dispose'* is unsustainable



*"We cannot solve our problems with the same thinking
we used when we created them"*

Albert Einstein

THE SOLUTION

- Sustainable building materials and practices are essential for reducing the environmental impact of the construction industry
 - In Zimbabwe, there is demand for housing and infrastructure under Vision 2030
 - To meet this demand without harming the environment, the construction sector must transition to low-carbon, resource-efficient, and climate-resilient development
 - Sustainability in construction aligns with NDS1 – sustainable infrastructure development, environmental sustainability, and economic diversification.
- 

WHAT IS SUSTAINABLE BUILDING?

- A **holistic** approach that considers a building's **entire lifecycle** – from design and construction to operation and, ultimately, deconstruction.
- The Brundtland Commission defined **sustainable development** as the kind of development that **meets the needs**, of the **present without compromising** the ability of **future generations** to meet their **own needs** (*Brundtland, 1987*)



KEY SDGs RELATED TO SUSTAINABLE BUILDING

Goal 11: Sustainable Cities and Communities

- Promote **sustainable urbanization**, ensure access to safe and affordable housing.

Goal 12: Responsible Consumption and Production

- Ensure **sustainable consumption and production** patterns. reduced waste generation through prevention, reduction, recycling, and reuse.

Goal 13: Climate Action

- Improve education, awareness, and human and institutional capacity on **climate change mitigation**.

Goal 7: Affordable and Clean Energy

- Promote the **use of renewable energy** in building practices

Goal 9: Industry, Innovation and Infrastructure

- Build **resilient infrastructure** and encourage **sustainable practices** in construction and manufacturing.

INNOVATIVE SUSTAINABLE MATERIALS



- **Mass Timber (CLT, Glulam):** A **renewable resource** that sequesters carbon. Strong, fire-resistant, and reduces construction time



- **Low-Carbon Concrete:** Uses fly ash, slag, or new technologies to **reduce the carbon footprint** of traditional cement



- **Hempcrete:** A **biocomposite** made from hemp hurds and lime. Carbon-negative, insulating, and moisture-regulating

INNOVATIVE SUSTAINABLE MATERIALS

- **Recycled Steel:** Using recycled content significantly **reduces the energy** required for production
- **Reclaimed Wood:** Gives a second life to old barns, factories, and bridges. Adds beauty and history while **reducing demand for new lumber**
- **Bio-Based Plastics & Composites:** Made from agricultural waste (e.g., seaweed, corn). **Reduces reliance on fossil fuels**



BEST PRACTISES IN SUSTAINABLE BUILDING



1. Integrated Design: Architects, engineers, builders, and owners collaborate from day one
2. Passive Solar Design: Orienting buildings and using windows to maximize winter sun and minimize summer heat
3. Natural Ventilation: Designing windows and vents to allow wind to cool the building naturally

“East Gate Mall Zimbabwe - Ant Hill Concept”

BEST PRACTISES IN SUSTAINABLE BUILDING



“Green Building”

4. High-Performance Envelope: Superior insulation and airtightness to **minimize energy losses**
5. Water Recycling: Systems for **rainwater harvesting** and treating **greywater** for reuse in irrigation and toilets
6. Modular and Prefabricated Construction: **Off-site manufacturing and modular design**

THE BENEFITS: WHY IS IT WORTH IT?

ENVIRONMENTAL

- Reduced Carbon Footprint
- Conservation of resources
- Enhanced biodiversity

ECONOMIC

- Lower operating and maintenance costs
- High property value and ROI
- Risk mitigation

SOCIAL

- Healthier occupants (Improved air quality)
- Increased comfort and well-being
- Community resilience

CASE STUDY 1: THE BULLITT CENTER, SEATTLE



“The greenest commercial building in the world”

It operates like a forest: Generating its own energy, capturing and treating its own water, and creating zero waste

Goal: Living Building Challenge
Certification: Net-zero Energy, Water, Waste

Materials: FSC-certified wood, toxic-chemical free, 100% recycled steel

Practises: 100% rainwater harvesting and grey water recycling, composting toilets, large solar canopy, radiant heat

Result: Generates more electricity than it uses, has 250-year design lifespan.

CASE STUDY 2: DUBAI SUSTAINABLE CITY



“Sustainable City, Dubai”

Goal: To create an **ecofriendly, self-sufficient**, urban community

Materials: FSC-certified wood, toxic-chemical free, **100% recycled steel**

Practises: Solar power, water conservation, and waste management to achieve **net-zero carbon emissions**

Result: **Reduced carbon footprint**, water efficiency, high waste recycling and local food production

CASE STUDY 3: MASADAR CITY



“Masadar City, Abu Dhabi”

Goal: To create a carbon-neutral, sustainable urban community model for future cities

Materials: Recycled aluminium, locally sourced materials and solar panels

Practises: Passive design, automation systems, solar and wind energy, desalination and reuse and public transport

Result: High-quality life with minimal environmental impact, clean technology and renewable energy



SIRDC Built Environment Research and Development Services

- SMART and Sustainable Master Planning
- Smart Rural and Urban Planning
- Rammed Earth Technology
- Biogas Digester Construction and Maintenance
- Rain Water Harvesting Technology
- Grey Water Harvesting Technology
- Geo-technical Soil Testing
- Timber as a primary building material
- Rehabilitation of Buildings
- Sustainable Facilities Management
- Building Pathology
- Road Pavement solutions
- Prefabricated bridge design
- Alternative Building Materials: Cold-formed Steel, Recycled Materials, etc..

RAMMED EARTH TECHNOLOGY



“Pantic Architects
Office Building,
Borrowdale”

Goal: Durable, sustainable and environmentally friendly buildings using natural materials

Materials: Natural soil, timber poles and IBR sheets

Result: Regulates indoor temperature, energy saving and recyclable

Projects: Pantic Architects Office Building, Whitecliff Residential House, Rukanda High School (Mtoko) Teacher's house and Classroom Block, Community Hall in Insiza, SIRDC Chapel and Kiosk

RAMMED EARTH TECHNOLOGY



“Model House: Operation Garikai/Hlalani Kuhle,
Whitecliff settlement, in 2005”



“SIRDC Kiosk”

BIOGAS DIGESTERS



**“Fixed-dome Biogas Digester
Construction”**

Goal: Management of Waste to energy

Materials: Brick and mortar, PVC

Result: Renewable energy production, improved sanitation, waste treatment, sustainable energy source.

Projects:

- Schools: St Marys High (Wedza), Waddilove High (Wedza), Solusi High (Mat North), Gloag High (Mat North), ZRP High
- Homes: Chief Nechambo (Mtoko), Chief Khumalo (Bulawayo), Chief Mathe (Gwanda)

Current Research on Portable Biogas Digesters

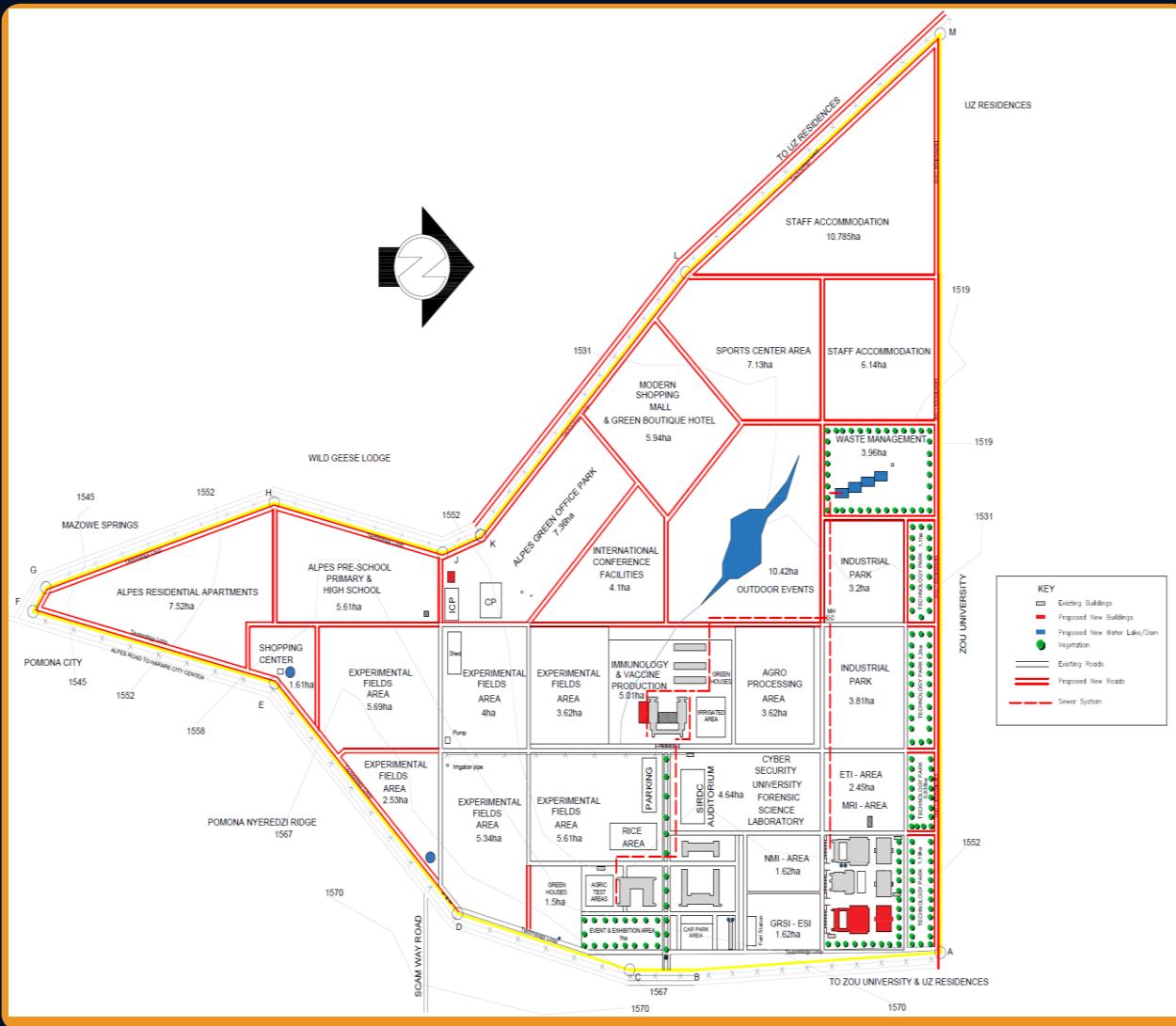
SMART MASTER PLANNING

Goal: Development planning that integrates technology, sustainability and community needs.

Key Elements: Green spaces, environmentally friendly practises, Intelligent transport systems, smart infrastructure, renewable energy production and vertical construction.

Projects: SIRDC Master Plan & Institute of Agricultural Engineering Masterplan

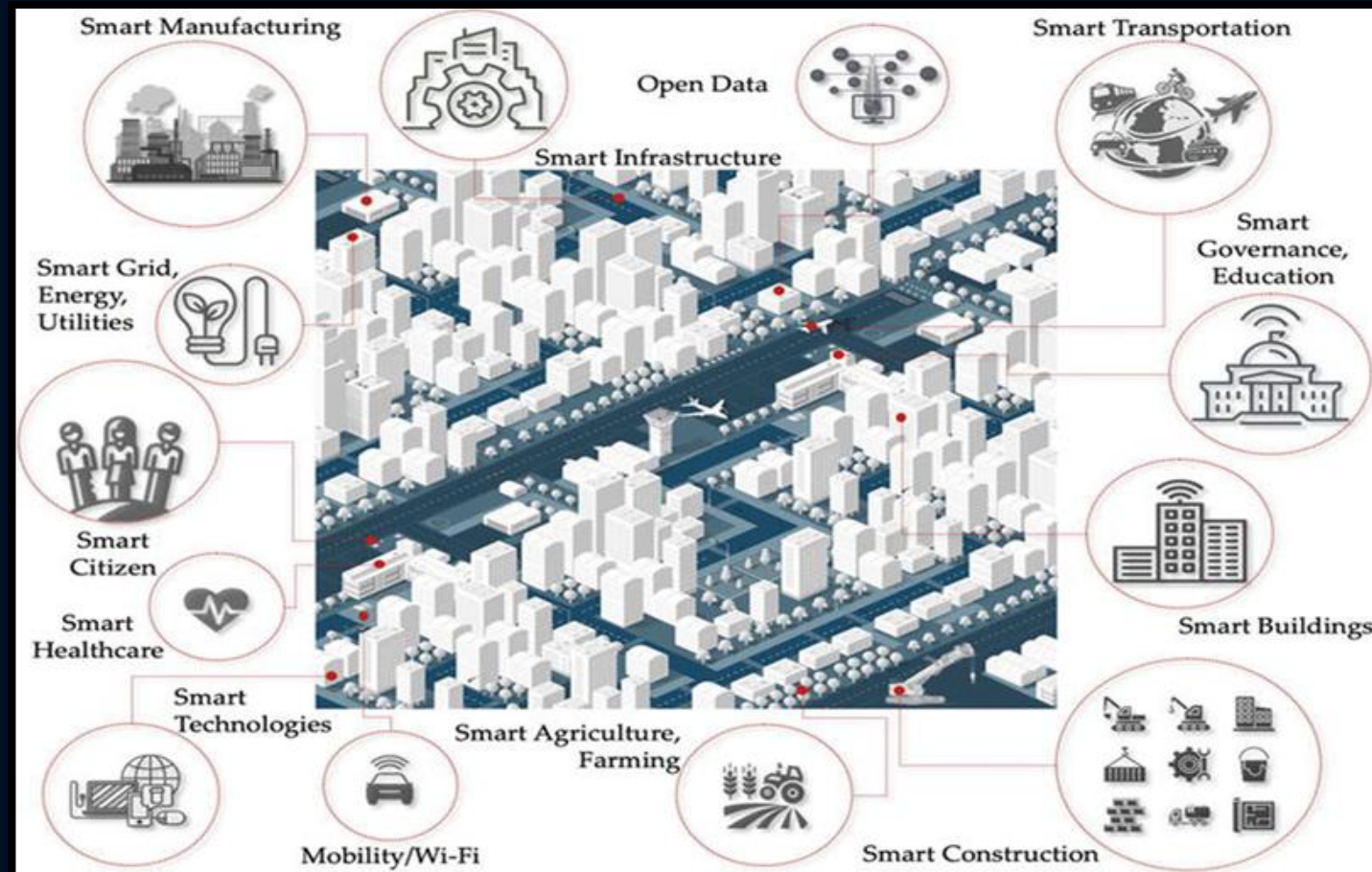
The master plan is designed and constructed to be resilient to the impacts of climate change



SMART MASTER PLANNING: SMART CITIES

The Master planning process also incorporates smart city designs. The designs promote sustainability by incorporating:

- i. Ecofriendly practices
- ii. Energy efficient buildings
- iii. Climate adaptable buildings
- iv. Waste management systems
- v. Renewable energy systems
- vi. Intelligent transport system
- vii. Circular economy



Geotechnical Soil Testing

SIRDC offers soil testing consultancy services for construction projects to assess the behaviour and properties of soils:

- i. Sieve analysis
- ii. Atterberg limits – tests to classify soils
- iii. Dynamic Cone Penetration (DCP) Test for soil bearing capacity

The centre also seeks a partnership to expand the laboratory capacity to cater for Civil Engineering Laboratory Tests

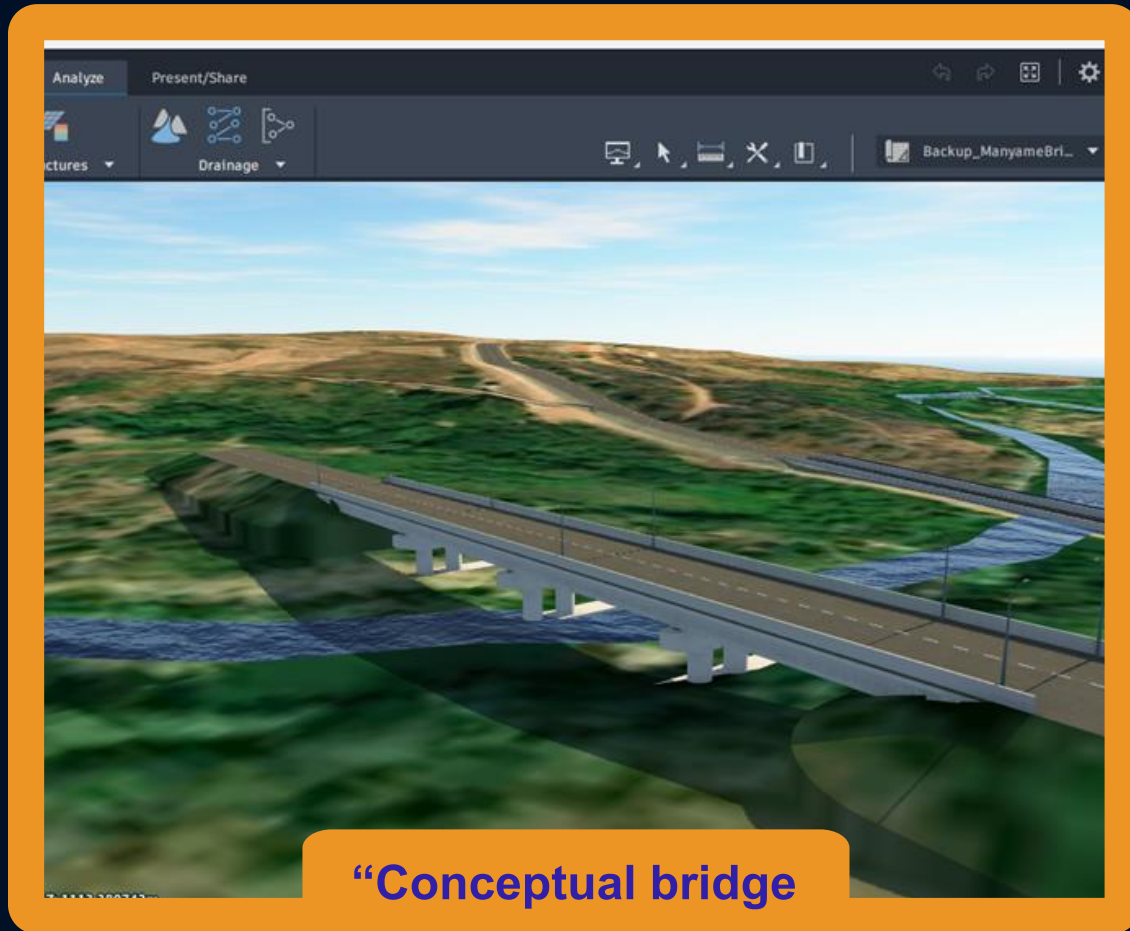


PREFABRICATED BRIDGE DESIGN

Goal: Enhancing efficiency, safety and sustainability of bridge construction and rehabilitation

Materials: Pre-stressed Concrete elements / Fibre Reinforced Concrete and steel

Result: Reduced construction time, cost-effectiveness, and enhanced safety and resilience to environmental challenges



“Conceptual bridge design model”

COLD-FORMED STEEL (CFS)



“Cold formed steel
residential apartments
building model”

Goal: Low cost housing solutions for residential buildings and demountable structures, e.g. greenhouses, tents

Materials: Cold Formed Steel and wood sheathing/ canvas/ polyester

Result: Durable, good strength to weight ratio, minimal maintenance, energy saving due to lower production energy requirements

TIMBER AS A CONSTRUCTION MATERIAL



“Timber Structure”

Goal: Explore the use of timber as a main construction material in Zimbabwe

Impact: Renewable resource, carbon sequestration, low embodied energy, biodegradable, thermal insulation and versatile

LOW-VOC AND LEAD FREE PAINTS



“Lead free paint”

Goal: Protect occupant health

Impact: Improve indoor air quality and reduce toxic emissions into the environment while still offering high durability and aesthetic performance

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT



“ESIA”

Goal: Assess the potential environmental and social impacts of proposed projects or policies

Impact: Informed decision-making regarding project approval, mitigation strategies to minimize adverse impacts, stakeholder engagement and ensure compliance with environmental regulations and standards

Rural Infrastructure Development Services

Design and Development services of:

- Modern greenhouses
- Animal quarters
- Chalets
- Shops
- Agro-based infrastructure
- Lodges
- Residential homes
- Gazebos





AI IN THE BUILT ENVIRONMENT

1. Policy simulation
2. Urban Planning and Permit Processing
3. Generative Design and Modular Housing
4. Operations, Maintenance and Tenant Services
5. Chatbots Systems
6. Regional & Emerging Market Innovation
7. Data Management

Specialised Training Services offered by SIRDC

- Sustainable Facilities Management
- Basic Construction Skills (Carpentry, Building and Construction, Welding, Painting, Tiling)
- Working at Heights and Confined Spaces
- Construction Project Management
- Biogas Digester Construction and Maintenance
- Rammed Earth Construction
- Concrete Technology
- Irrigation Systems Design and Maintenance



Concrete training – (Khayah Cement)

THE WAY FORWARD: OUR COLLECTIVE RESPONSIBILITY

1. POLICY & INCENTIVES

Advocate for stricter building codes and green incentives

2. EDUCATION & TRAINING

Upskill the workforce on new materials and methods.

3. DEMAND & INVESTMENT

Clients and investors must demand and fund sustainable projects.

4. CIRCULAR ECONOMY ADOPTION

Design for deconstruction and material reuse

5. CALL TO ACTION

"Specify, design, build, and invest sustainably."

CONCLUSION

- Sustainable building requires more than just new materials
 - It demands an integrated environmental management approach
 - Transitioning to a greener and more resilient built environment by combining material innovation, green construction methods, comprehensive impact assessment, skills development, and policy support
 - SIRDC is seeking partnerships to offer innovative research and training services to drive this transformation
 - **The Result:** Sustainable construction and resilient infrastructure that fosters environmental stewardship, economic opportunity, and climate resilience for future generations
- 



THANK YOU

*BUILDING TODAY FOR A
STRONGER TOMORROW*