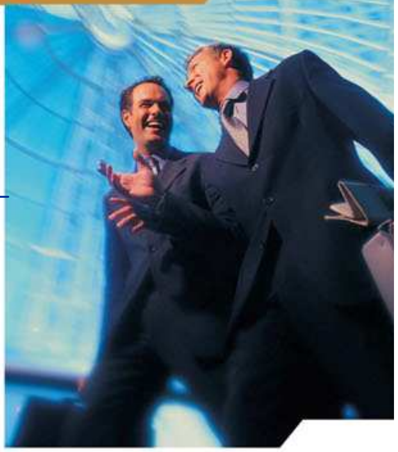
TECHNOLOGY LIFE CYCLE MANAGEMENT:



Challenges to manage the R&D process

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our future through science

University of Pretoria

Graduate School of Technology Management

GSTM

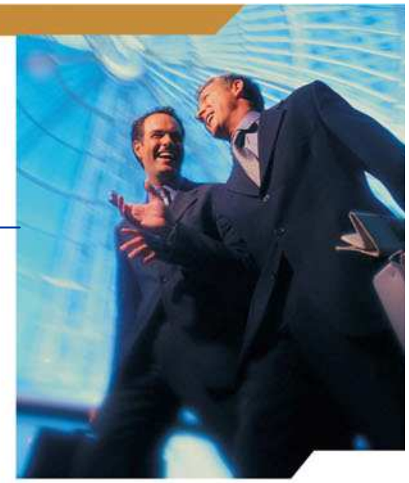
Previous reported research

- Established a conceptual framework of the technology management field of knowledge, and coupled tools and methodologies
  - As it relates to sustainable development
- Introduced a criteria framework of what sustainable development entails in different resource-based sectors where technology management occurs
- Identified the departure point for further research in terms of incorporating the concept of sustainable development into the technology management field of knowledge

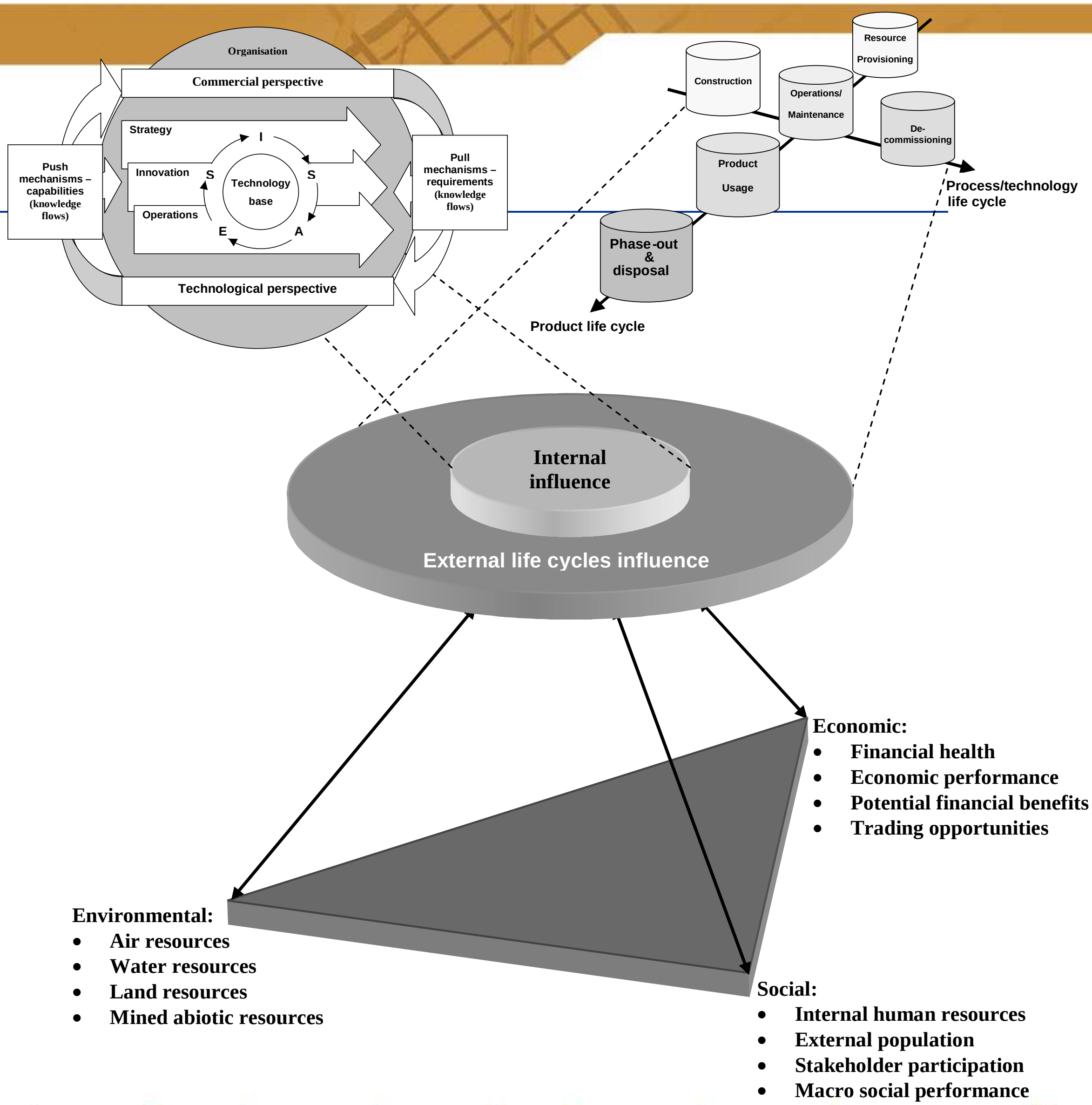
→ **Specifically for energy systems**

Brent AC, Pretorius MW (2007). Sustainable Development: A conceptual framework for the technology management field of knowledge and a departure for further research. International Association for Management of Technology, Miami, USA, pp. 623-642.

New proposed definition of Technology Management



Technology management addresses the effective identification, selection, acquisition, development, exploitation and protection of technologies (product, process and infrastructure) needed to sustain the competitive advantage of regional sectors in accordance with the sector, regional, national and international sustainable development objectives


Organisation
Commercial perspective
Strategy
Innovation
Operations
Technology base
I
S
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E
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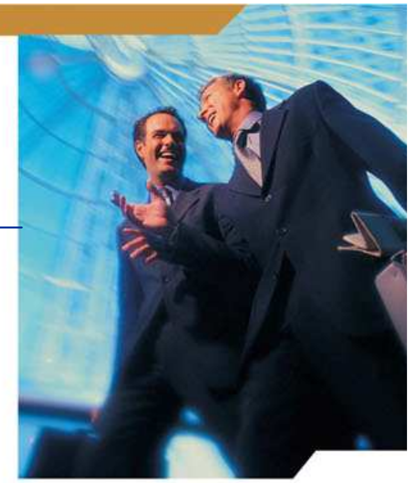
Push mechanisms – capabilities (knowledge flows)
Pull mechanisms – requirements (knowledge flows)
Technological perspective
Resource Provisioning
Construction
Operations/ Maintenance
De-commissioning
Product Usage
Phase-out & disposal
Process/technology life cycle
Product life cycle
Internal influence
External life cycles influence
Economic:
Financial health
Economic performance
Potential financial benefits
Trading opportunities
Environmental:
Air resources
Water resources
Land resources
Mined abiotic resources
Social:
Internal human resources
External population
Stakeholder participation
Macro social performance

Technology management and sustainable development in practice



- Integrated strategies across companies, sectors, regions, and, in some cases, across countries
- Selection of appropriate technological options across companies, sectors, regions and countries
- The transfer of technologies (and knowledge) across companies, sectors, regions and countries

Technology assessment and evaluation

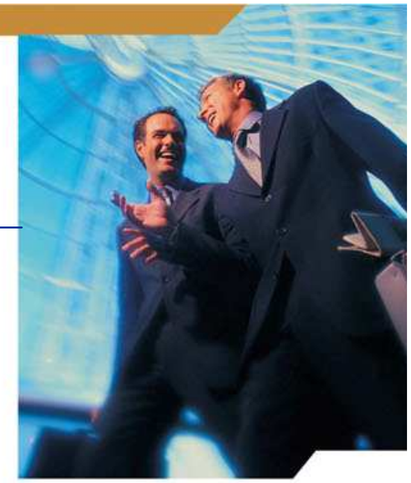
Issues of technology assessment and evaluation

- Technology is not judged by its existence alone, nor is its mere existence a sufficient condition for successful usage
- We cannot evaluate technology unless and until we put it in the context of social (and environmental) and economic phenomena
- Technology is not defined and evaluated by what it is, but by the criteria outside itself – by its actual and potential users

System expansion component of the conceptual framework → **Practical indicators to measure technological system performances should address the aspects of the emerging field of sustainability science**

Geisler E (2002). The metrics of technology evaluation: Where we stand and where we should go from here. International Journal of Technology Management, vol. 24, no. 4, pp. 341-374.

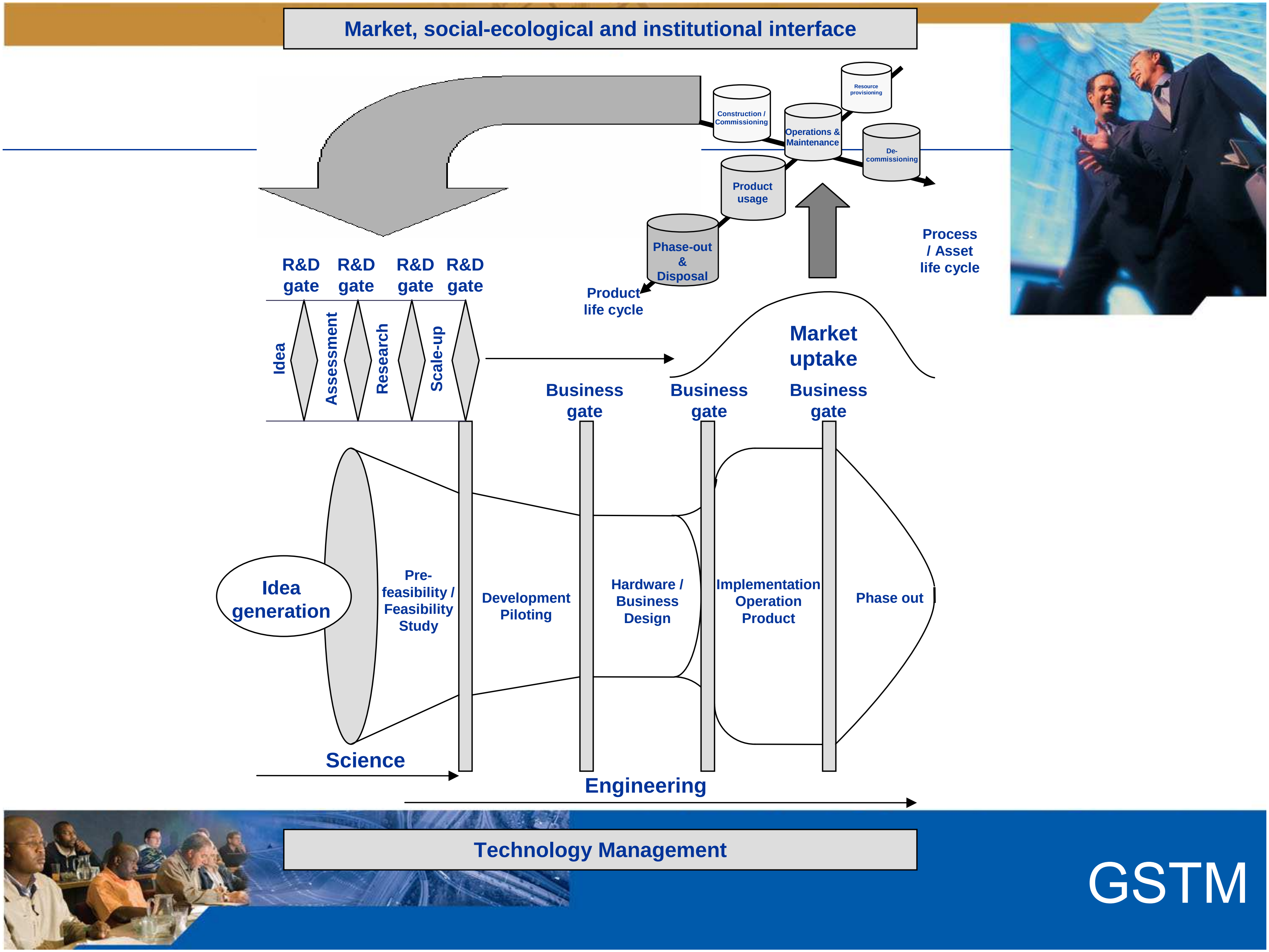
What is sustainability science?



- **The study and integration of particular issues and aspects of radical, systemic approaches to innovation and learning for ecological and social sustainability**
  - **Recognises negative feedback loops associated with social-ecological systems and technology**
  - **Role of technological life cycles to enhance the sustainability of complex social-ecological systems**
    - **Concentrating on the design of devices and systems to produce more social good with less environmental harm**

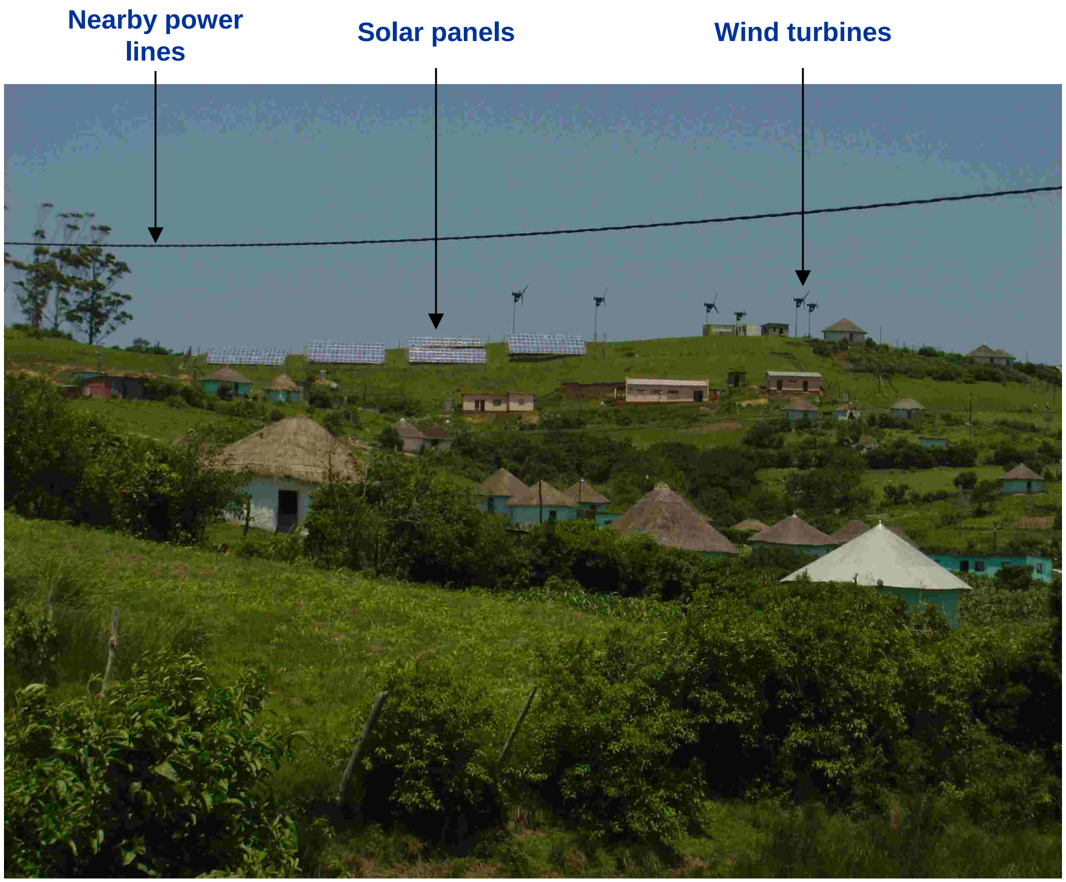
Technology management

Kates RW, et al. (2001). Sustainability Science. Science, vol. 292, no. 5517, pp. 641-642.

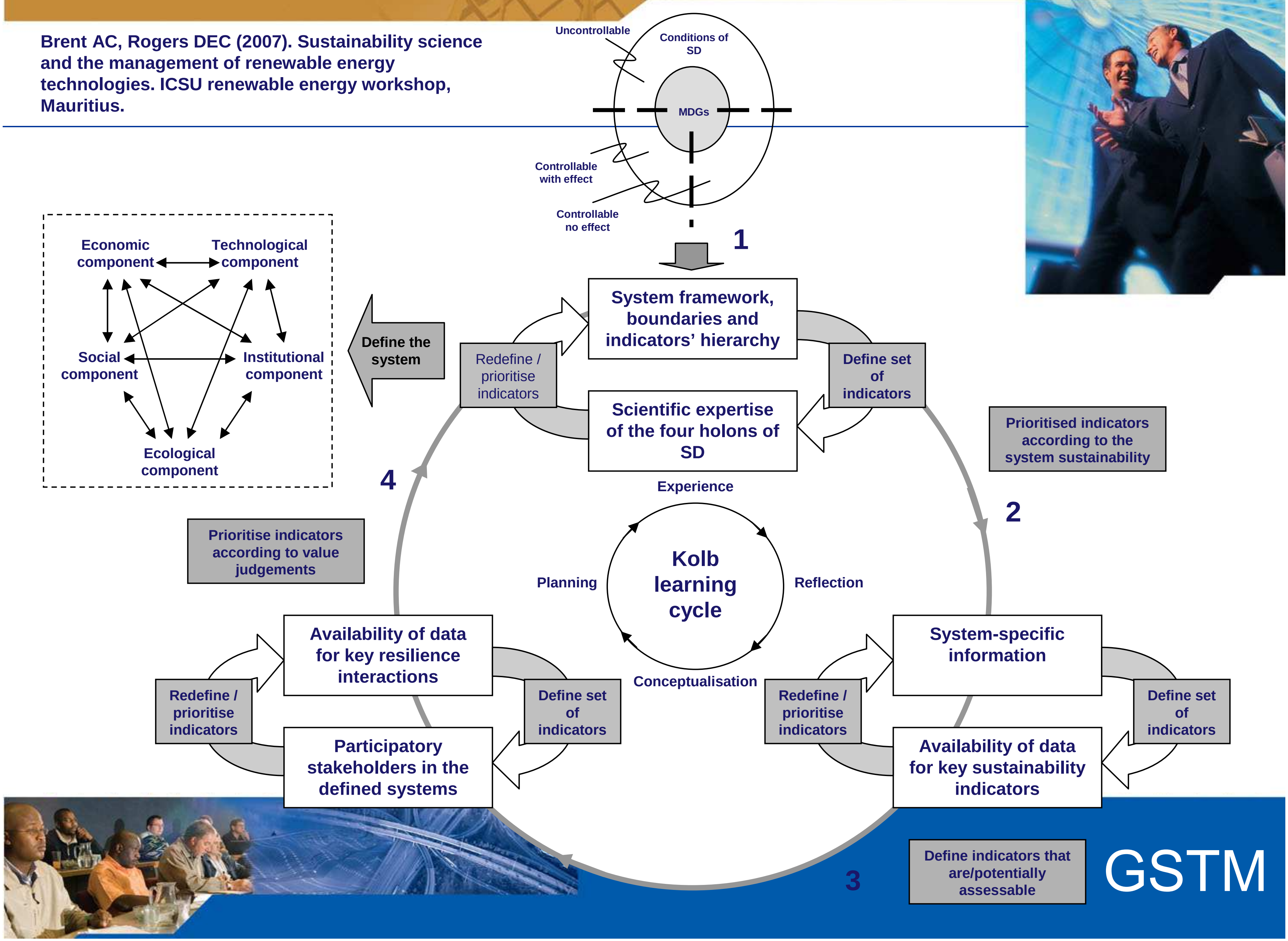


Market, social-ecological and institutional interface
Construction / Commissioning
Resource provisioning
Operations & Maintenance
De-commissioning
Product usage
Phase-out & Disposal
Product life cycle
Process / Asset life cycle
R&D gate
R&D gate
R&D gate
R&D gate
Idea
Assessment
Research
Scale-up
Market uptake
Business gate
Business gate
Business gate
Idea generation
Pre-feasibility / Feasibility Study
Development Piloting
Hardware / Business Design
Implementation Operation Product
Phase out
Science
Engineering
Technology Management
GSTM

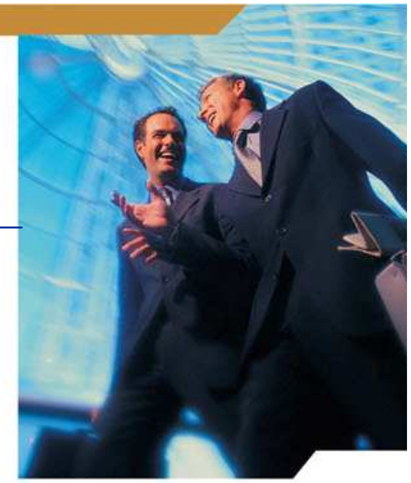
Descriptive case study - Lucingweni village



Brent AC, Rogers DEC (2007). Sustainability science and the management of renewable energy technologies. ICSU renewable energy workshop, Mauritius.



Comparison of prioritised indicators with overall integrated system performance

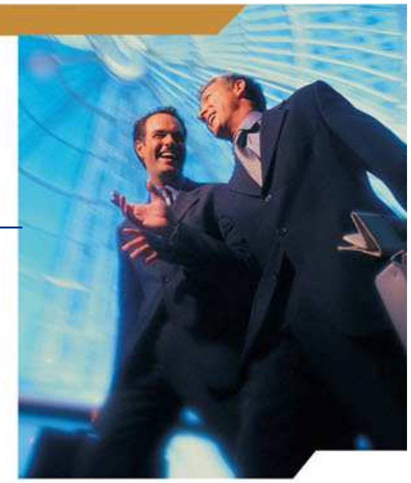


- **Most important aspects were identified as:**
  - **Economic beneficiation of the technological intervention to the community**
  - **Ownership of the technological system by the community**

- **From an economic and institutional perspective the community expected that they would control a service similar to that provided by the national electricity grid**
  - **The capacity and reliability of the technological system proved insufficient to meet all of the community needs**

Behavioural changes

Examples of insufficient design

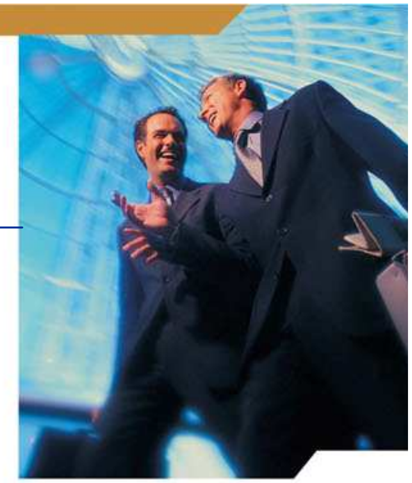


- **Small discrepancy between planned supply and demand**
  - **272 kWh/day vs. 267 kWh/day**
    - **Unstable technical systems**

- **System did not consider all of the community's energy needs**
  - **Energy needed for heating and cooking purposes was not planned for**
  - **Consequence was the continual dependency on biomass in and around the village with the subsequent degradation of the ecosystem**

Mabuza LOK, Brent AC, Mapako M (2007). The transfer of energy technologies in a developing country context – Towards improved practice from past successes and failures. Proceedings of the World Academy of Science, Engineering and Technology, Prague, vol. 22, pp. 237-241

Overall result of the case study



The technological intervention did not improve the conditions of the social sub-system, which resulted in the breakdown of trust between the cultural societal structures and the formal government structure

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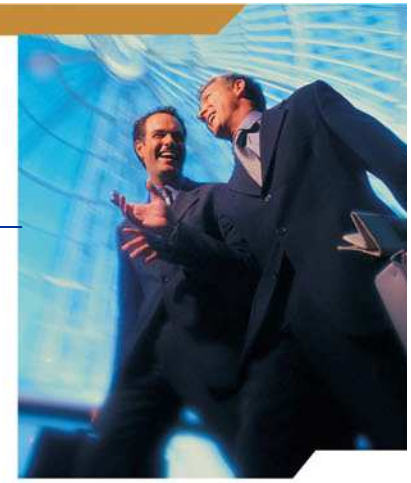
The disregard of almost all of the indicators in the design stage resulted in an overall unsustainable system

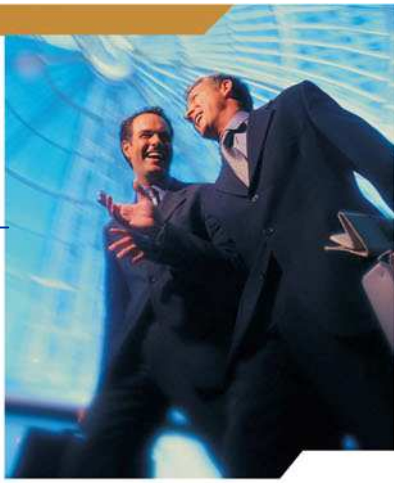
Considerations for the R&D phases of technological systems



- **The complexity of social systems**
  - **Combined traditional and formal political leadership structures**
  - **Results in uncertainty for project planners and system designers**

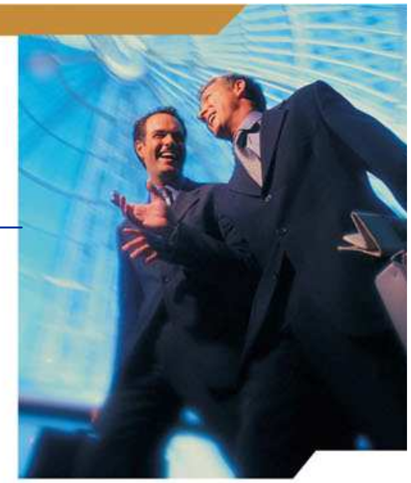
- **The lack of resilience of the technology system to the demands from the social, economic and institutional systems**
  - **Comprehensive needs analyses**
  - **Cost dynamics**
  - **Ownership**

Implications for policy-making to promote renewable energy technologies



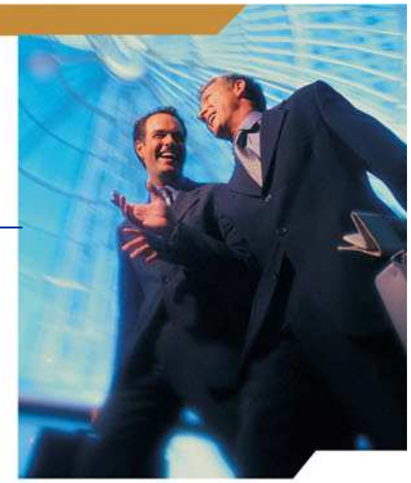
- **Because social-ecological systems are self-organising, their evolution rarely follows the path intended by policy-makers**
  - **Governments are not free to invest or establish institutions at will, but must take account of the political influence of all stakeholders to promote sustainable systems**
    - **The capacity of such systems to self-organise is the foundation of their resilience**

Implications for policy-making to promote renewable energy technologies



- **Rebuilding this capacity at times requires access to external resources**
  - **Excessive subsidisation can, however, reduce capacity**
  - **Cross-scale subsidisation should end when self-organisation becomes apparent, because cross-scale subsidisation can increase the vulnerability of the broader system**
  - **A long-term perspective is essential, i.e. cross-scale relationships should in the long term be mutually sustaining, neither exploitative from above nor parasitic from below**

South African on-going Sustainable Life Cycle Management research



Closure and questions