

Summary of Main Themes, Topics & Case Studies

BREE 420: Engineering for Sustainability

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Basis of Course

1. Overview of **principles + frameworks + methods** in ES beyond those gained from a traditional first engineering degree.
2. Complement other engineering courses at McGill in water, energy, design, etc....
3. Try to **firmly root course** in practical experience & draw heavily on real examples in addition to theory.

Approaches of different engineering firms + other organizations.

What is being done in practice.

What is not being done.

Etc.

Main Topics Explored in BREE 420

Topic:

Role of Engineers in Sustainability

1. Overview of sustainable development.

2. Overview of engineering for sustainability.

Main principles of engineering for sustainability.

3. Role of engineers in sustainability.

Topic:

Stakeholder Engagement

1. **Engaging stakeholders** in engineering project design + implementation.
2. **Issues/challenges** with engaging stakeholders in engineering projects.

Multi Stakeholder Methods & Processes

To Engage Different Types of Stakeholders in Engineering Product/Project Design & Implementation

1. Different stakeholder levels:

Product/project; Company; Supply Chain; Market; Wider level (local stakeholders, ..)

2. Participatory methods:

Internal Team Workshops; Eco-Charrettes; Supply Chain Workshops; Forums; Group model building, etc.

3. How to select a participatory method based on:

Participatory goals; Level of participation; Stakeholder type/number

4. Formulating a coherent & logical participatory process plan.

E.g.: *Scientific storyline* using *group model building* as method

5. Phases in managing a multi-stakeholder process.

Topic:

Life Cycle Assessment

1. Life cycle assessment as an SD tool in the engineering sector.

LC costing + LC assessment

2. LCA examples / case studies.

Environmental engineering field
Various products

Topic:

Frameworks to Design & Deliver a Sustainable Engineering Project

Operationalizing sustainability at the project level.

1. FIDIC Project Sustainability Management System
2. GoldSet – SD decision support tool for engineering projects

FIDIC PSM:

Process to Develop SD Engineering Project Goals & Indicators.

1. Framework of 'core' project SD goals & corresponding indicators

Both map back to whole-society priorities & goals of Agenda 21, & corresponding CSD UN sustainability indicators.

and

2. Process for adjusting these SD project goals & indicators

Making them consistent with vision & goals of project owner, compliant with Agenda 21, & tailored to local issues, priorities & stakeholder concerns.

PSM process addresses life cycle of the project from concept development through to design, construction, operation, deconstruction & disposal/re-use/recycling/.....

Topic:

Systems Thinking & Modeling

1. Systems Thinking

2. Systems Dynamics Modeling (SDM)

Qualitative modeling: causal loop diagrams; feedback loops; etc.

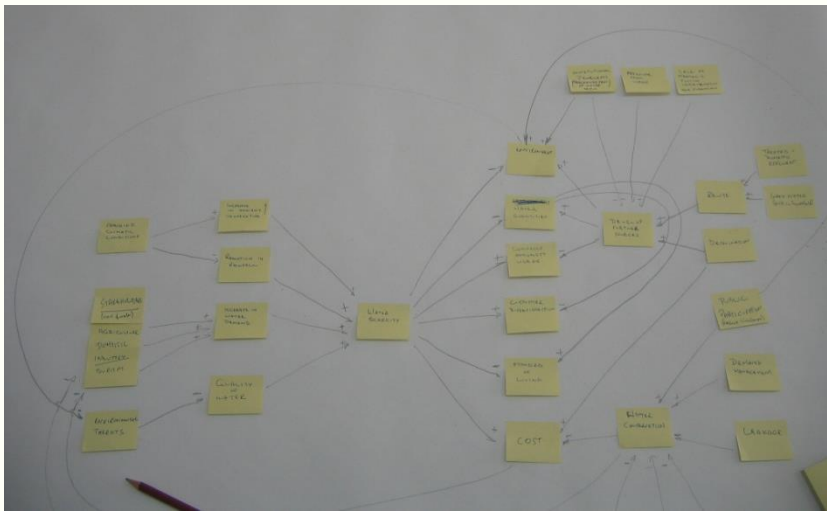
Quantitative modeling: coupled physical-SDM models

3. Engaging Stakeholders in Engineering Design via Group SDM

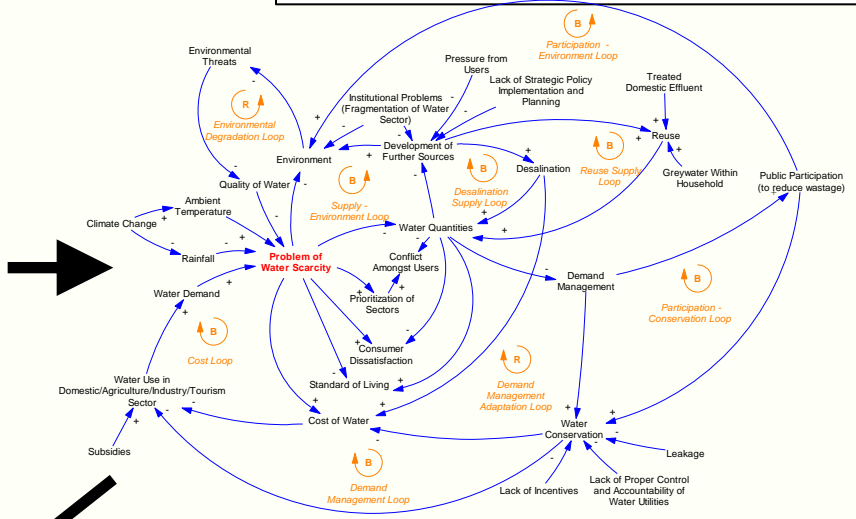
Group model building via causal loop diagrams

Group case studies

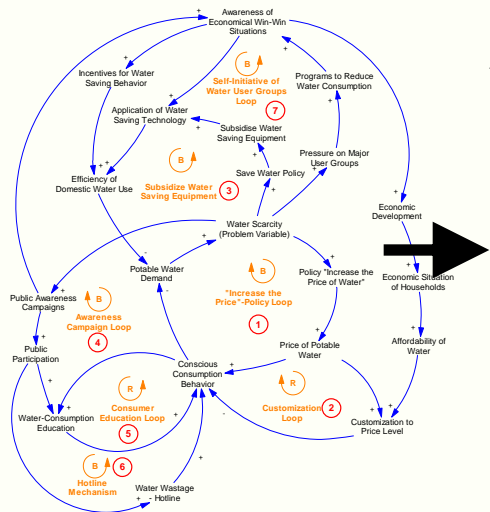
“Mental model” - What a person thinks about the system



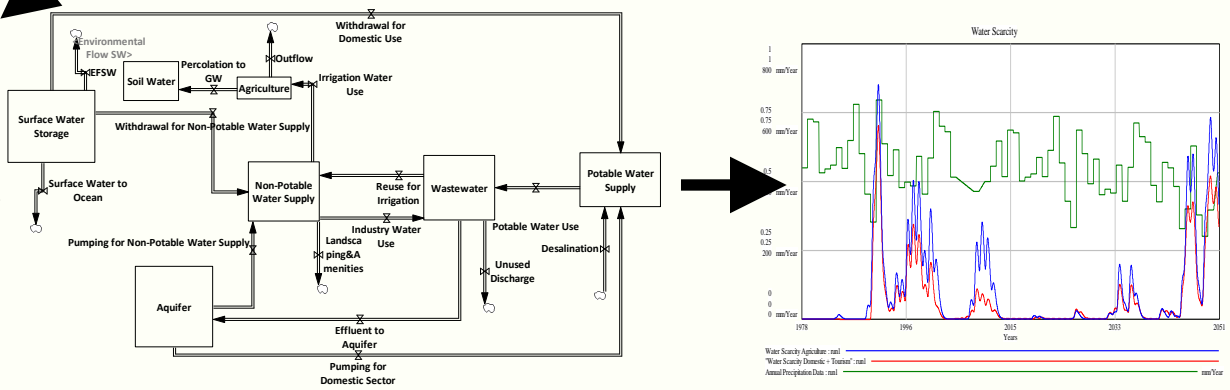
Mental model – Individual Causal Loop Diagram



Group Causal Loop Diagram



Group Quantitative SD Model



Topic:
Multi Criteria Decision Analysis

Topic:

Leading Change Towards Sustainability in an Engineering Company

1. Bottom up change via a better understanding of CC attributes.
2. Top down change via CC programs based on understanding of CC attributes.
3. Windows of opportunity + experimenting in niches.
4. Steps & tools for change management.

Basic understanding of: acting as a change agent/champion + change management.

Case Studies of Implementation of ES in Different Sectors

Main case studies:

Urban engineering:	City of Montreal Division of SD
Energy engineering: Renewable energy, nuclear, conventional, etc.	Envint Consulting
Agricultural/Biological engineering:	McGill
Water engineering: Wastewater treatment	Amec Land & Water Golder Associates
Highway engineering:	Amec Land & Water
Green infrastructure/development/construction:	Exp Engineering
Building engineering:	Colorado School
Transportation engineering:	Velo Quebec
Construction engineering:	Exp Engineering
Cleantech sector	Ecotech Quebec