

# Integrating Sustainable Development in Education for Undergraduate Engineers

The development of teaching materials focusing on sustainable development for use with undergraduate engineering students using case studies drawn from the minerals sector



UNIVERSITY OF  
**BATH**

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# Outline

- What engineers already learn
- Initiative by the Royal Academy of Engineering on integrating sustainable development into engineering education
- The case studies used a Bath
- Design of the teaching materials
- Your ideas: Approaches to encouraging adoption by engineering academics

# What undergraduate engineers already learn

- Engineering Council accreditation specification – ‘UKSPEC’
- What a course looks like (Chemical Eng’g)

ENGINEERING COUNCIL UK

UK Standard for Professional Engineering Competence

# Chartered Engineer and Incorporated Engineer Standard

regulating the engineering profession

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Detail of Self Edge Stone, Birmingham.  
Photo: © David Lavers/TBG



# UK Standard for Professional Engineering Competence

- Chartered Engineers must be competent to:
  - A. Use a combination of general and specialist engineering knowledge and understanding to optimise the application of existing and emerging technology...
  - B. Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems...
  - C. Provide technical and commercial leadership...
  - D. Demonstrate effective interpersonal skills...
  - E. Demonstrate a personal commitment to professional standards, recognising obligations to society, the profession and the environment.
    - E3 Undertake engineering activities in a way that contributes to sustainable development...

# E3...contributes to sustainable development

- This could include an ability to:
  - Operate and act responsibly, taking account of the need to progress environmental, social and economic outcomes simultaneously
  - Use imagination, creativity and innovation to provide products and services which maintain and enhance the quality of the environment and community, and meet financial objectives
  - Understand and encourage stakeholder involvement.

# Chemical Engineering at Bath (MEng)

## Applied Subjects

Subject	Year: 1		2		3		4	
	S1	S2	S1	S2	S1	S2	S1	S2
Transport phenomena		C	I		H			
Particle technology				I (0.5)				
Separations processes		C		I				
Instrumentation & control		C(0.5)						
Process dynamics			I					
Laboratories		C (0.5)	I	I (0.5)				
Technical Review					H			
Research project						H (5)		
Design & safety				I				
Management				I	M			
Environmental management					H			
First year design project		C(0.5)						



# RAEng Visiting Professors

- Funding appointment of top practicing or recently retired engineers to visiting chairs
- Three schemes, of which the second is Engineering Design for Sustainable Development (EDfSD)
- 26 appointments since 1998, 3-5 years each

# Aims of the Scheme

- “It is clear that there is no universally held understanding of what ‘sustainable development’ means...”
- “... sustainable development should eventually come to underlie the way in which all engineering is taught. Sustainable development should not be considered as a separate issue to be addressed by special courses.”
- “... a body of well-researched case studies is one of the best ways to highlight the relevant issues and to show how engineering principles and practice can be used to address those issues.”

# Outputs from the Scheme

- “From such a body of case studies, it is to be expected that some high level ‘Principles for Design for Sustainable Development’ could be elucidated.
- “The purpose of this scheme is to develop teaching materials, based on case studies, which will enhance both the understanding and the practice of teaching of Sustainable Development.

# RAEng VP at Bath - Aims

- to draw together case studies which especially address the social and cultural interfaces of industrial developments
- illustrate the envelope of social and development issues
- provide examples of current best practice in participative engagement with stakeholders, impact assessment and investment decision-making

# Rössing Uranium

- In the Namib desert on west coast of Namibia
- Water requirement for developing business and communities
- Rössing takes 70% fresh water available
- Little fresh additional water around



# Diavik Diamonds



- Canada NWT, Lac de Gras, 200km south of Arctic Circle
- Pristine Environment
- First Nation Peoples (Aboriginals) and Northerners
- Consultation



# Lihir Gold



- Island of PNG 3° S of the equator
- Deposit in an extinct volcano adjacent the sea
- Small undeveloped local population
- Previous company bad history in PNG



# Availability & Use of 'Case Studies'

## **ICMM (International Council on Minerals and Metals)**

<http://www.icmm.com/casestudies.php?cat=128>

## **WBCSD (World Business Council for Sustainable Development)**

“... to inspire others to contribute, in a proactive way, to SD”

[www.wbcsd.org](http://www.wbcsd.org)

## **LEAD Organisation**

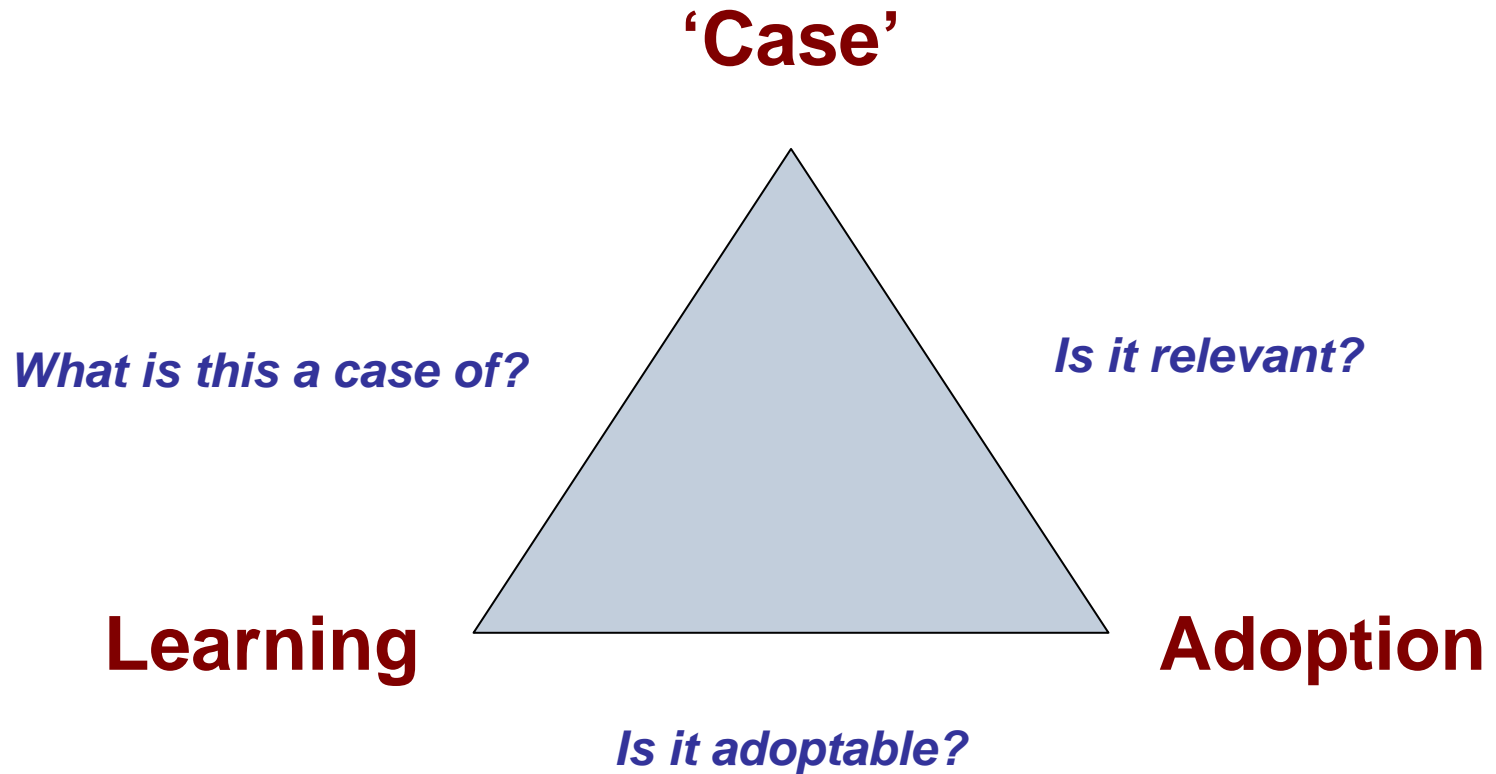
Reading and site visits (stakeholders) as learning approach

<http://casestudies.lead.org>

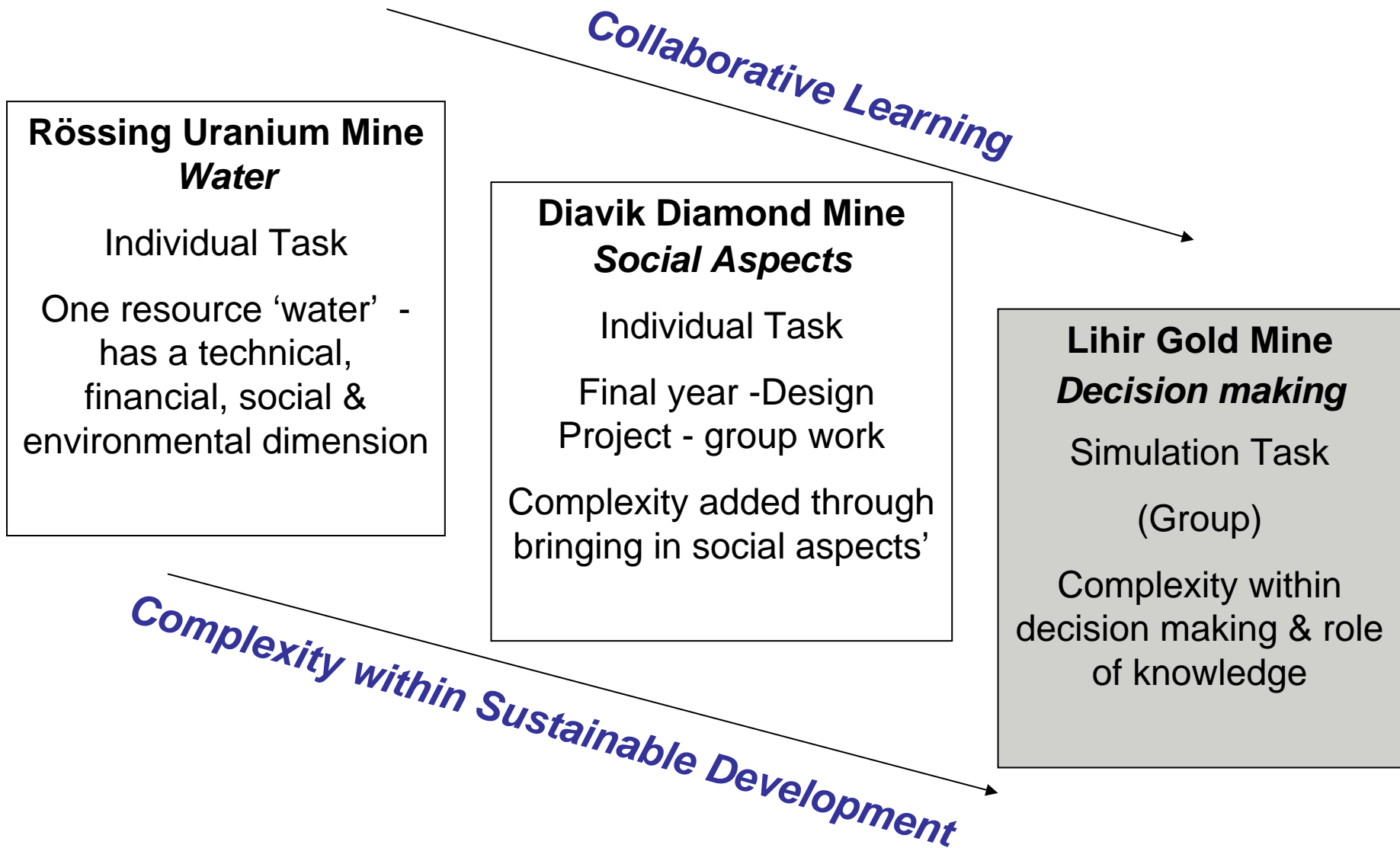


- exist & easy to access
- role in organisational/ sector learning (development)
- systematically written
- **information material** rather than **learning material**
- lack of engaging questions or activities

# *Dimensions* for developing learning material



# Progression 'across' the Learning Sets



# Structure of a 'Learning Set

Each set contains options how the learning material is used:

- an introduction to the content of the set: aims and alternative ways to use the material
- a set of slides
- additional material for a tutorial session, a seminar or a workshop
- a more in depth case study description
- one or more assignment tasks
- a summary (used within another learning set)

# Next steps...

- Complete the teaching materials sets
- Evaluation of effectiveness
- Develop transferability (e-availability)
- Substituting for the VP in person

# Questions

- What does SD mean?
- Student learning?
- Complexity and collaborative learning?
- Curriculum displacement?
- Adoption by others?

# Group Task

***Encouraging adoption?***

