## SCEPTrE, Guildford
# Learning to be Professional

## A Curriculum for Coping with Complexity

### An interdisciplinary pilot scheme

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Combining the strengths of UMIST and
The Victoria University of Manchester



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## Wicked problems (after Rittel and Weber, 1973)

- **No definitive formulation**
- **No clear end**
- **No 'right' or 'wrong'**
- **No test of resolution**
- **Consequences to every solution**
- **No well-described set of solutions**
- **Unique**
- **Symptomatic of another problem**
- **Causes with no unique explanation**
- **'Owner' expected to find the 'right' answer**

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## Wicked global problems
### (after Brundtland GH:1987)

- Reduction of biodiversity;
- Pollution of air, soil and water, with detrimental influences on the environment;
- Growth of the world's population, accompanied by increasing poverty in the developing world;
- Competition for limited water supplies, resulting in threats of armed conflict.

*These developments stimulate extremism, terrorism and migration that affect social stability*
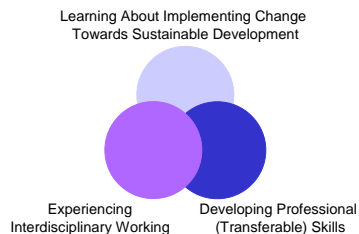
**Global citizenship and sustainable development – inter-professional links**



**The Engineering Profession**

- **Engineering Council (2004) 'UK Standards for Professional Engineering Competence'**
- **US National Academy of Engineering (2005) 'Educating the Engineer of 2020'**
- **Declaration of Barcelona**

**Designing the Curriculum**



Learning About Implementing Change Towards Sustainable Development

Experiencing Interdisciplinary Working

Developing Professional (Transferable) Skills

**Delphi consultation**

- *Thirty experts from around UK*
- *Four rounds*
- *Sustainable development for engineers*
  - Definition
  - Challenges
  - Responsibilities
  - Tasks
  - Skills
  - Designing education
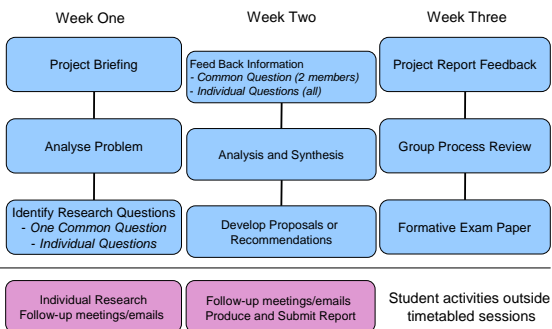  - Evaluating education
  - Embedding education

## Delphi results

Main points
- Soft skills (communication, managing change)
- Systems approach
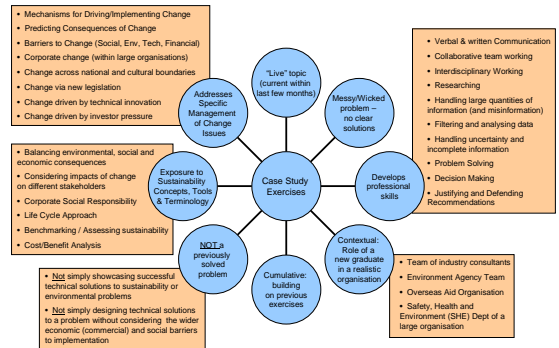- Student-centred (PBL, role play, case studies)

## Student – centred



## PBL Process

| Week One | Week Two | Week Three |
|---|---|---|
| Project Briefing | Feed Back Information<br>- *Common Question (2 members)*<br>- *Individual Questions (all)* | Project Report Feedback |
| Analyse Problem | Analysis and Synthesis | Group Process Review |
| Identify Research Questions<br>- *One Common Question*<br>- *Individual Questions* | Develop Proposals or Recommendations | Formative Exam Paper |
| Individual Research<br>Follow-up meetings/emails | Follow-up meetings/emails<br>Produce and Submit Report | Student activities outside timetabled sessions |

## Case Study Exercise Development

Addresses Specific Management of Change Issues
- Mechanisms for Driving/Implementing Change
- Predicting Consequences of Change
- Barriers to Change (Social, Env, Tech, Financial)
- Corporate change (within large organisations)
- Change across national and cultural boundaries
- Change via new legislation
- Change driven by technical innovation
- Change driven by investor pressure

Exposure to Sustainability Concepts, Tools & Terminology
- Balancing environmental, social and economic consequences
- Considering impacts of change on different stakeholders
- Corporate Social Responsibility
- Life Cycle Approach
- Benchmarking / Assessing sustainability
- Cost/Benefit Analysis

NOT a previously solved problem
- Not simply showcasing successful technical solutions to sustainability or environmental problems
- Not simply designing technical solutions to a problem without considering the wider economic (commercial) and social barriers to implementation

Case Study Exercises

"Live" topic (current within last few months)

Messy/Wicked problem – no clear solutions

Cumulative: building on previous exercises

Contextual: Role of a new graduate in a realistic organisation

Develops professional skills
- Verbal & written Communication
- Collaborative team working
- Interdisciplinary Working
- Researching
- Handling large quantities of information (and misinformation)
- Filtering and analysing data
- Handling uncertainty and incomplete information
- Problem Solving
- Decision Making
- Justifying and Defending Recommendations

- Team of industry consultants
- Environment Agency Team
- Overseas Aid Organisation
- Safety, Health and Environment (SHE) Dept of a large organisation

## Interdisciplinary pilot scheme

- Evaluation
  - Questionnaires
    - Readiness for inter-professional learning
    - Learning styles
    - Self-perception
  - Nominal Group process

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### Interdisciplinary pilot scheme - Evaluation

NGP Results

- Key points from students
  - \+ Inter-disciplinary
  - \+ Teamwork
  - \+ Mode of assessment
  - \+ Realistic content

  - \- Timetable (9am !)
  - \- Unassessed work
  - \- Timing of assessments
  - \- Blackboard Vista (2007/8)

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### Interdisciplinary pilot scheme - Evaluation

NGP Results

- Key points from facilitators
  - \+ Problem based learning
  - \+ Communication skills & group learning
  - \+ Imaginative, varied tasks
  - \+ Multidisciplinary participants
  - \+ Encouraging team work
  - \+ 'Teaching' experience for research staff

  - \- Lack of different disciplines
  - \- Lack of specialist knowledge
  - \- Student issues with assessment
  - \- Narrow range of topics
  - \- Pay! (2007/8)

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## Interdisciplinary pilot scheme

- The pilot scheme was Highly Commended in the UK's Green Gown Awards ;
- Good feedback from RAEng with respect to professional aspects;
- Our Report and Appendices are designed to enable others to replicate the approach to see to what extent the educational approach is transferable.

http://www.eps.manchester.ac.uk/tlc/sd

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## Thank you

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