

# Teaching Experiences at Liverpool and Bradford

Richard Dodds, RAEng Visiting  
Professor in Engineering Design for  
Sustainable Development at the  
University of Liverpool



# Approach by 'Stealth'

- Half-module in MSc product design course (plus projects)
- Sanity checks with external lectures to Branch IEEE/IMechE meeting and Astra Zeneca engineers seminar
- Proposed component of new common design module for first year Mech Eng/Materials engineering (2003-2004: 2<sup>nd</sup> semester:130 students)
- Potential component of modules for first year civil, electrical/electronic engineers (2004-2005)
- All first year engineering students 2004-5 onwards

At the end of the assignment the intended Learning Outcomes are :

- The ability to create a Sustainable Development impact assessment of a product or service 'from scratch'
- The ability to express the technological opportunities for the improvement of a product or service in the context of social, economic, environmental and regulatory factors.

- Refer to separate Word document entitled  
“Example of First Year Assignment at  
Liverpool”

# Project Based Learning Bradford University



# Arup's Relationship with Bradford

## Royal Academy of Engineering; Visiting Professor

To share personal experience of Sustainable Development with the students and teaching staff.

To provide access to experience of Engineering Design for Sustainable Development from within Arup.

To raise awareness of issues associated with Sustainable Development.

To bring current practical thinking and best practice to Bradford University on Sustainable Development.

To support outreach from the University to feeder schools, VI Form Colleges, EA, YWS and Arup.

To provide an insight into future career opportunities associated with Sustainable Development.



# Project Based Learning: Whitby Feasibility Study

## Stage 3 BEng/MEng Module

### The Project

- Run since 1992.
- Sustainability a key theme.
- Supported by Scarborough Borough Council (SBC).
- Masterplan proposals for regeneration of Whitby.
- Students required to produce solutions (or conceptual designs) to challenging complex problems, driven by sustainability considerations.
- Emphasis is placed on developing robust solutions.





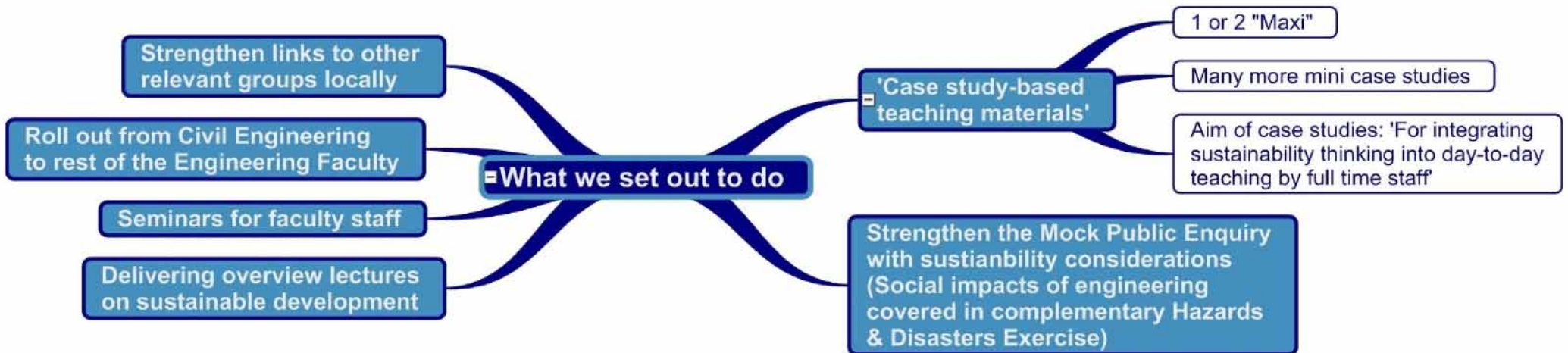
# Project Based Learning: Whitby Feasibility Study

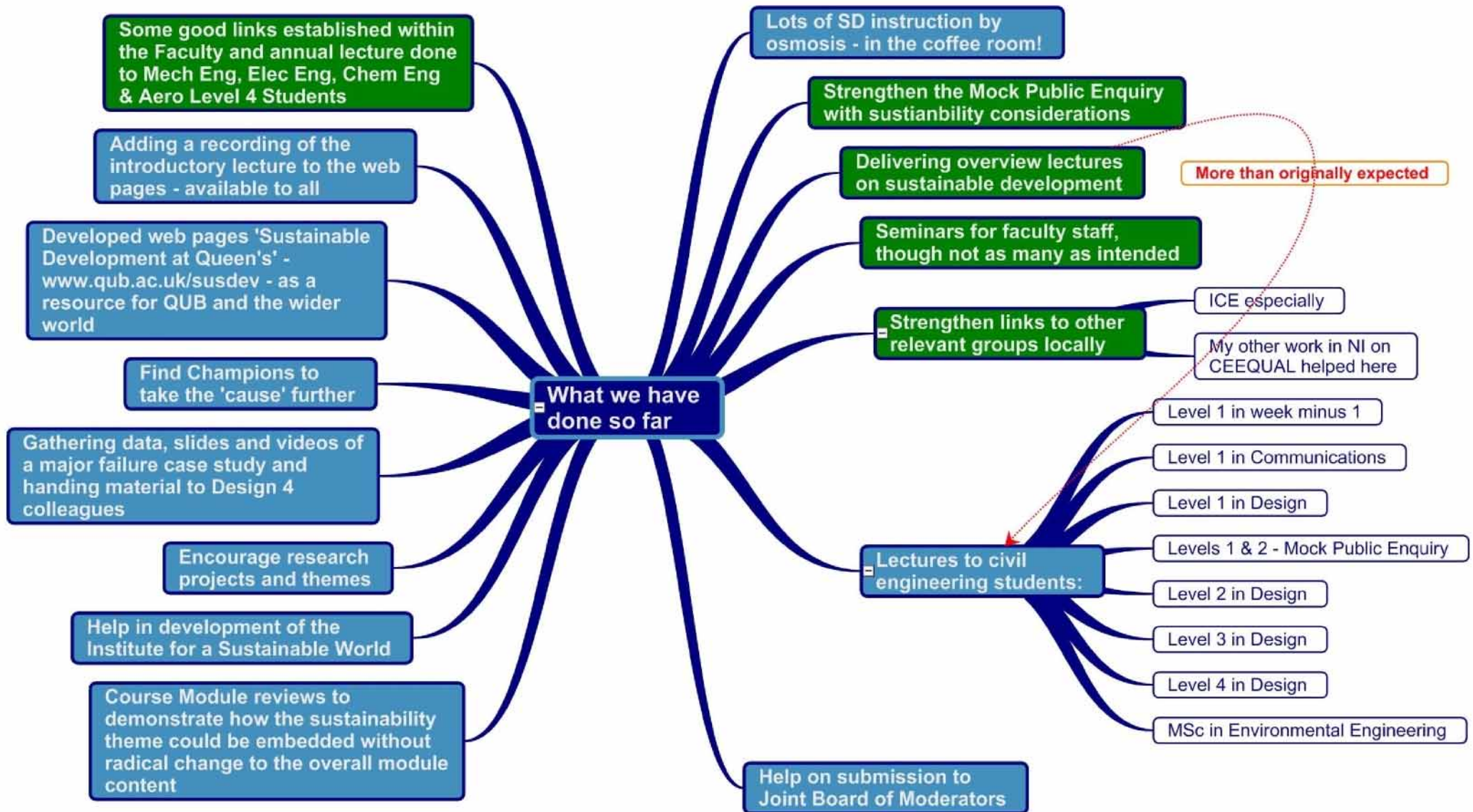
## The Outputs

- **Sustainability assessment.**
- **Detailed engineering drawings with supporting analysis and detailed Outline design/masterplan proposals.**
- **design calculations.**
- **Students gain experience in the broad and detailed aspects of the design process.**
- **Detailed feasibility study report.**
- **Oral presentation given to the SBC area engineer and to Mark Fletcher.**

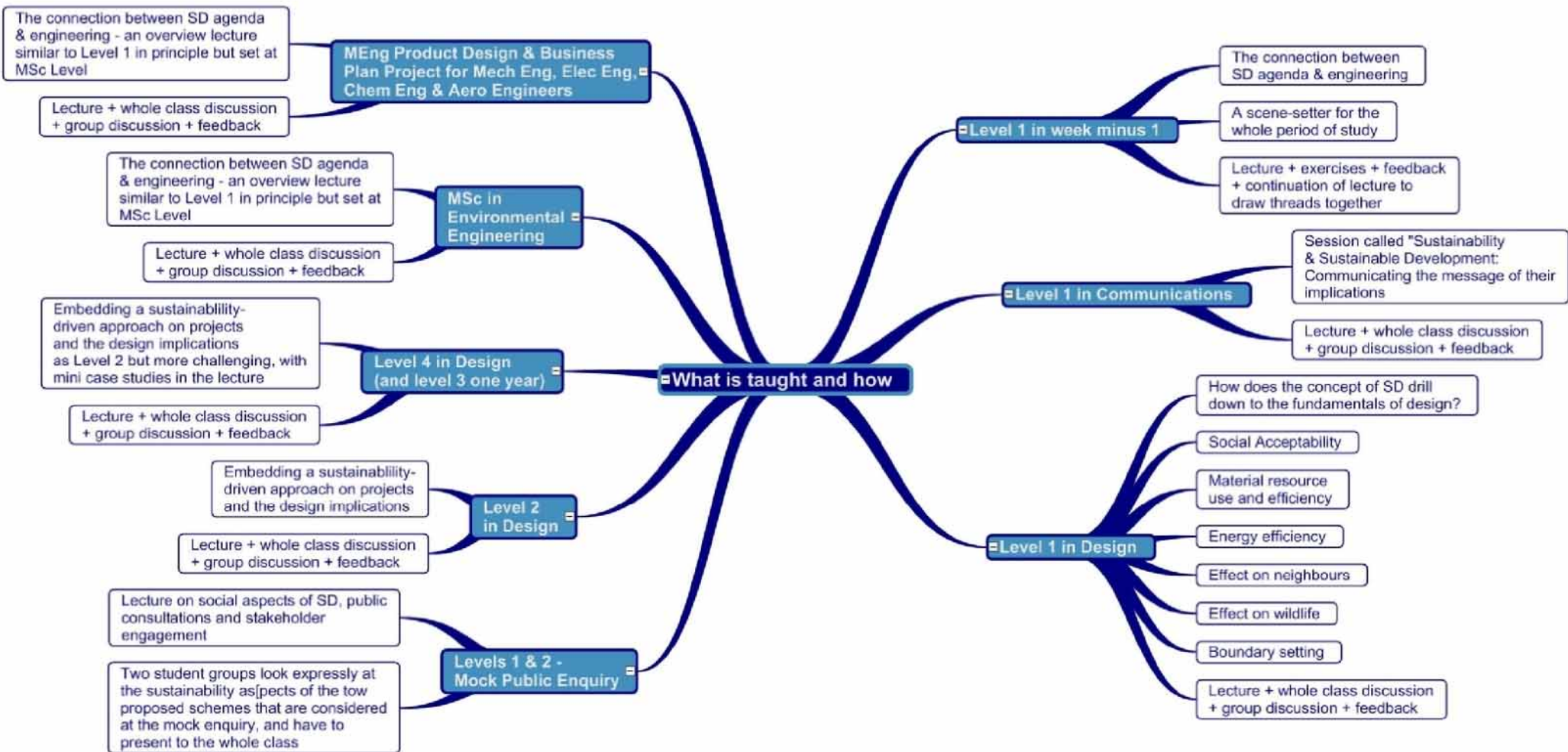


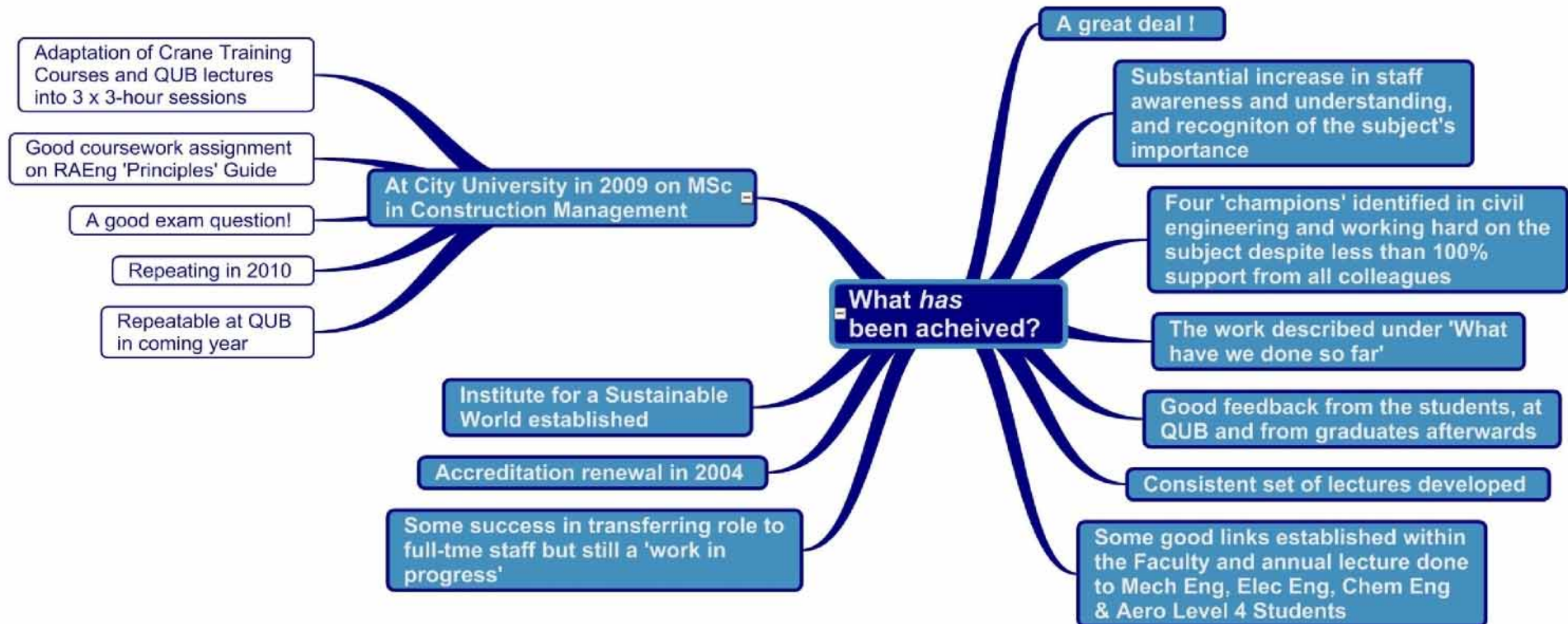
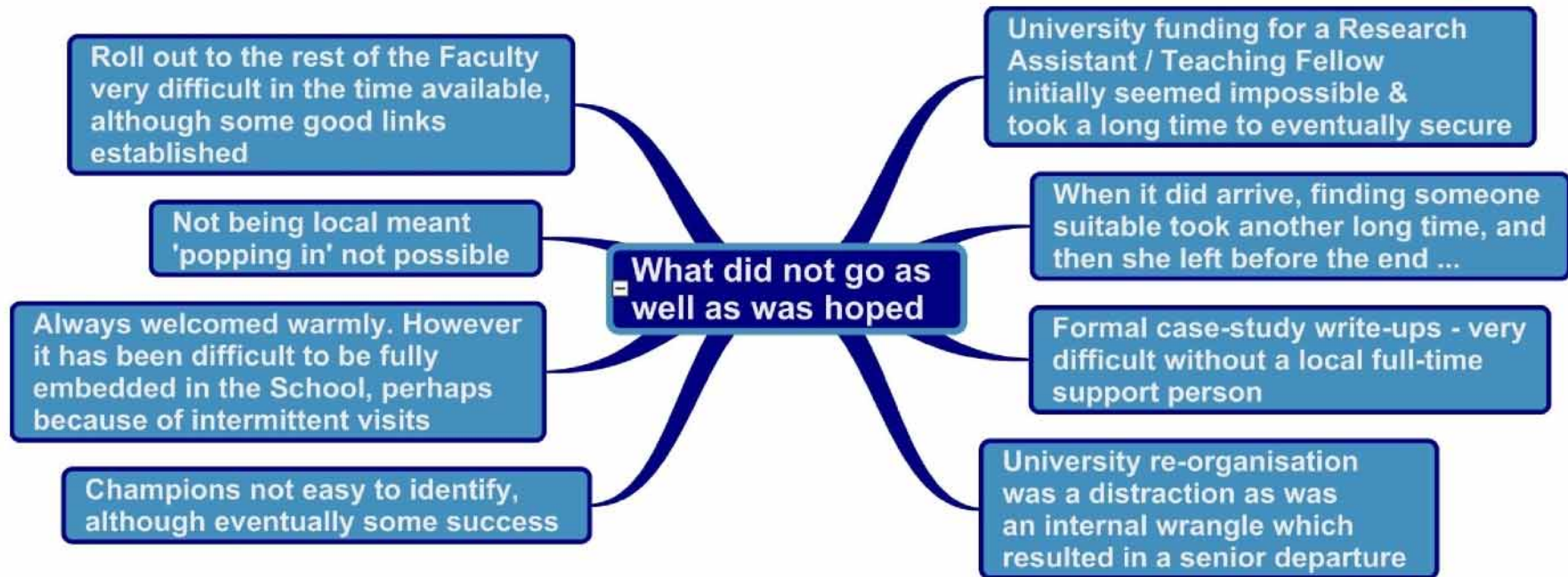
MindMaps as notes for RKV Talk on "Example of Effective Practice" to RAEng VP Conference Aston Uni 16 & 17 September 2009





**Green highlighting = items from original objectives, though not necessarily delivered as fully as intended**





## =Lessons learnt??

Meetings like this one to share experiences and learn from each other have been too infrequent and should continue *regularly*

However hard one works at the skills transfer to full-time staff, a strong feeling remains that the sustainability theme is best done by the VP as a 'visitor from practice'

Need to keep up the involvement and enthusiasm of your original sponsor

A 'shared vision' needed between the VP and Head of School / Department / Faculty

RAEng should make acceptance of the post by the receiving university conditional on their providing funding for an RA/Teaching Fellow as significant, preferably full-time, support

VP (and FT colleagues) needs to be flexible - original plans may not prove to be deliverable for many different possible reasons

Long-distance not a bar to successful outcomes, but perhaps local is better??

Real success needs enthusiastic support from Head of School / Department or a full-time senior staff member to manage the RA/TF and the whole relationship with the VP

## Welcome to Sustainable Development at Queen's

University Research Centres > Welcome to Sustainable Development at Queen's

- News
- Teaching
- Related Research
- Research Contacts
- Institute for a Sustainable World
- Student Experiences
- University Policies and Initiatives
- Downloads
- Events
- Website Contacts
- Q&A
- Useful Links

### Welcome to Sustainable Development at Queen's



Sustainable development poses some of the most serious challenges of the 21st century. QUB has prioritised research and teaching on sustainable development as a major focus of a wide range of activity for the coming years.

Our purpose in creating these pages is to provide information about, and links to, relevant work and activity within Queens and also to outside resources. This is all aimed at helping to drive forward sustainable development in the curriculum and more-sustainable working within the University, and to inform academics elsewhere, industry and business, and the wider public of the work on sustainability and sustainable development here at Queen's.

As part of this objective we are actively encouraging any member of the university community working on sustainable development or a related subject to participate in these pages by highlighting and providing us with links to resources, related research and other information to help us keep the site up to date, responsive to latest advances and thus constantly evolving.

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Please send your ideas, comments and links to new resources to Siobhan Cox, School of Planning, Architecture and Civil Engineering ( [scox04@qub.ac.uk](mailto:scox04@qub.ac.uk) )

Sustainable Development at Queen's pages – quick link is [www.qub.ac.uk/susdev](http://www.qub.ac.uk/susdev)

A range of resources are held here, including a video of the introductory lecture given to all 1<sup>st</sup> years in Week -1 in Architecture, Planning and Civil Engineering

### Roger Venables

Professor Roger Venables  
Managing Director, Crane Environmental Ltd

+

Chief Executive, CEEQUAL Ltd  
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# INTERDISCIPLINARY SUSTAINABLE DEVELOPMENT

Charles Bland Tomkinson, Behnam Bastani, Mark Jabbal

**Visiting Professors (VP) Conference 2009:**  
***'Integrating the VP Schemes'***

Aston University, 16 September 2009

# A Different Starting-point

- Governments, and inter-governmental agencies, need the professions to aid the long-term tasks of mitigation and resolution of global problems
- Professions need to adopt an outward looking and proactive approach
- Professionals must acquire the abilities to adapt to change and to the management of change, especially on behalf of society at large
- Higher education must face the challenge of helping future graduates to develop new capabilities



# The Project Design

Based on previous inter-professional work\*, the project set out to explore:

- Relevant global issues in sustainable development for engineers of all disciplines
- The specification of abilities and skills needed
- The identification of related educational interventions
- The construct of a programme of interventions in an interdisciplinary course for engineers

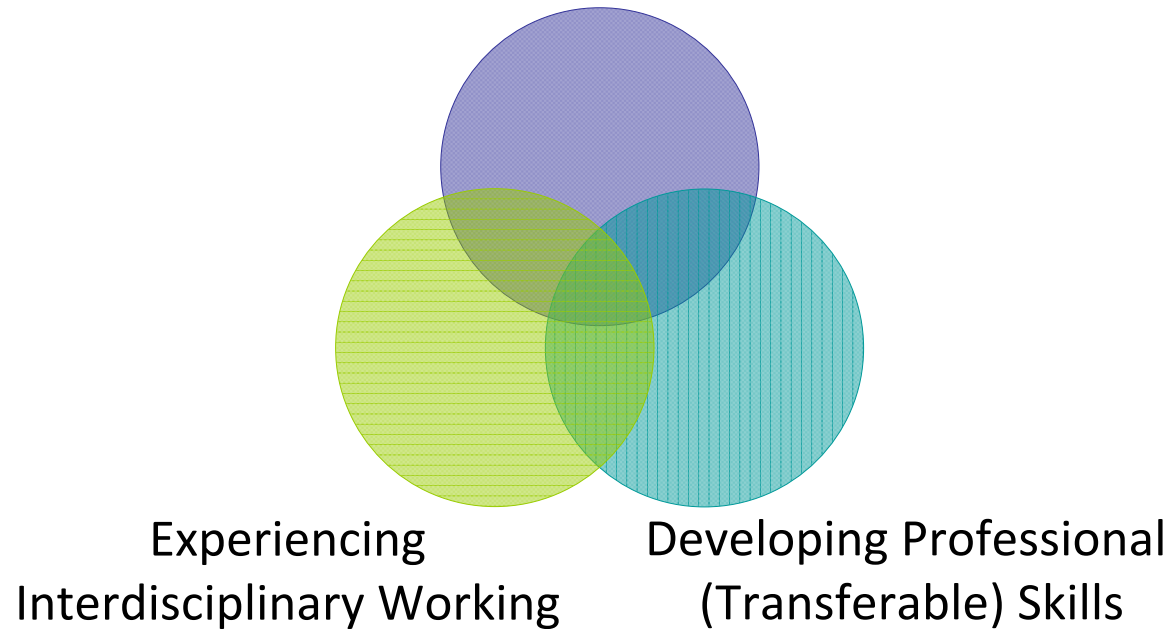


\*The report of the CAIPE project can be found at

<http://www.caipe.org.uk/silo/files/towards-a-european-approach.pdf>

# Designing the Curriculum

Learning About Implementing Change  
Towards Sustainable Development



# RAEng Vision

- A new type of engineer/scientist needed for 21<sup>st</sup> century's wicked/complex problems
- Current university graduates:
  - think "in box"; experts in own subjects
  - do not have interdisciplinary/inter-professional learning
  - do not learn about ethical/societal dilemmas
  - do not have skills/abilities to initiate/manage change
  - need education in Sustainable Development



# Education for Sustainable Development

- RAEng funding of pilot scheme in EPS faculty (TSDU) for a course unit on SD in 2006
- Aid of RAEng Visiting Professor Charles Engel
- A teaching innovation action research project
- SD for Engineers & Scientists / Interdisciplinary SD
- No lectures, no taught theory, no set text, no exam
- Active, contextual, integrated, collaborative, interdisciplinary, cumulative learning
- Student-centered group learning, enquiry-based, reflective learning

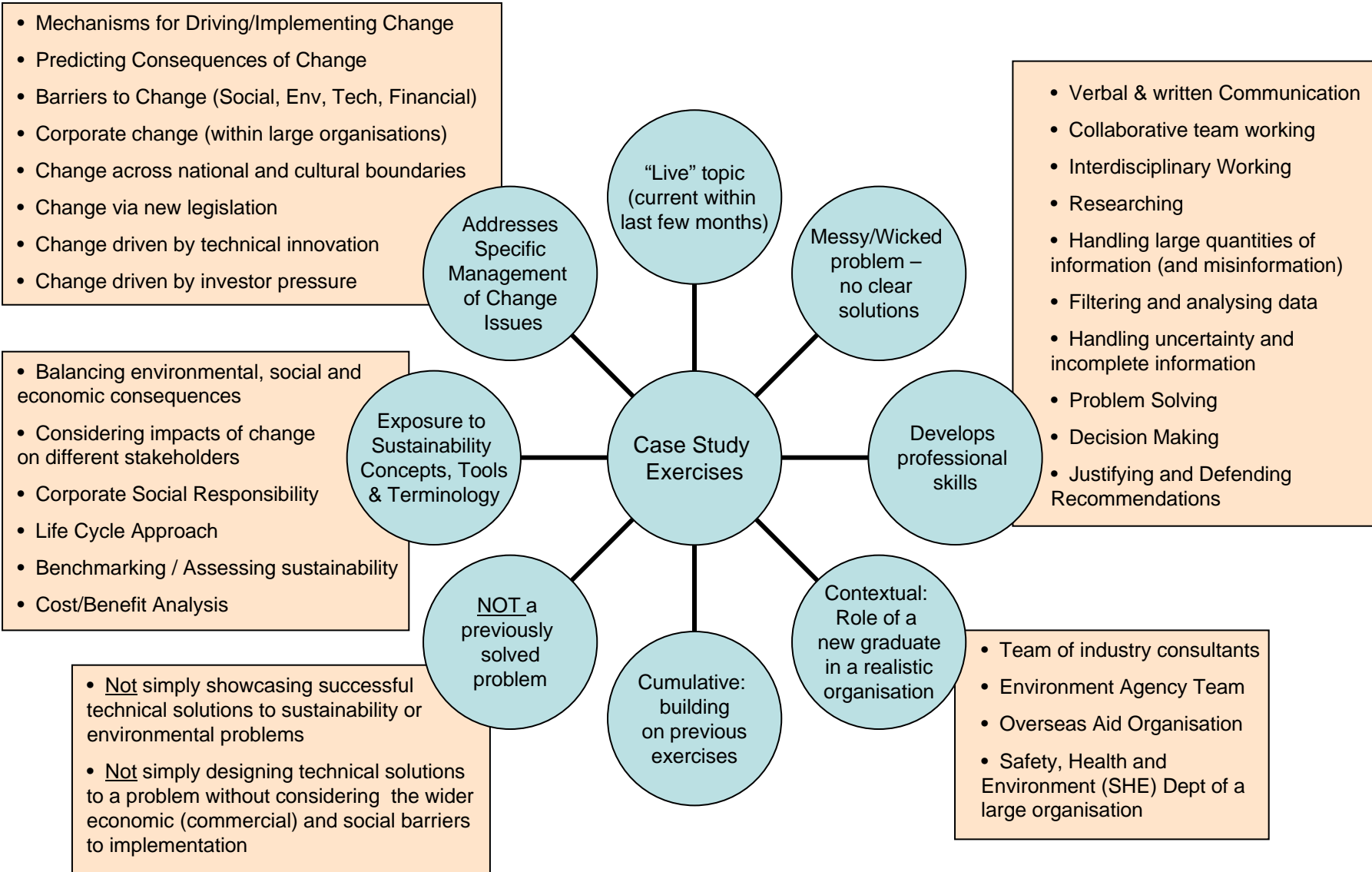


# Unit Description

- 10 credit unit, 12 weeks, 24 hours in-class group work, online (Blackboard) and other meetings
- 96 final year students from 8 disciplines
- 12 groups of mixed disciplines, culture, gender, nationality
- Electrical/Civil/Mechanical Engineering, Earth/Atmospheric/Environmental Sciences, Maths, Chemistry, Physics
- 5 case studies to familiarise with aspects of SD
- Live/real world unsolved “wicked” problems
- Authors: academic staff, visiting experts e.g. lawyer, architect, mechanical engineer, CSR consultant
- Students act as consultants employed by an organisation
- Critically analyse problems, share knowledge & research, develop new ideas, produce professional reports
- Assessment: formative, reflective, summative
- Valuation/monitoring: questionnaires, nominal group process



# Case Study Exercise Development



# Summary of Some Case Study Exercises

- **Wheels** - recommend sustainability models and initiatives for a tyre manufacturing company
- **Shelter** - develop a strategy for transitional accommodation after a natural disaster
- **Energy** - assess the positive and negative social, financial and environmental impacts of renewable energy sources
- **Food** - outline financial models that would support an agri-corporation to introduce a novel, real-time tracking service to the food and perishable crops supply chain
- **Planes** identify the main mechanisms by which key regional organisations can assist in the delivery of emission reductions from aviation in the North West



# 13 Project Stages

**(1) Trigger/Briefing on New Task**

**(2) Analysis/Discussion of Problem**

**(3) Choose individual questions and a common question to research**

**(4) Individual Research  
Follow-up meetings/emails**

**(5) Verbal presentation by two students: common question**

**(6) All students feed back results of individual research**

**(7) Discuss, debate and reach consensus on proposals**

**(8) Plan writing of the report or other deliverable(s)**

**(9) Follow-up meetings/emails  
Produce Report / Deliverable**

**(10) Hand in deliverable and submit electronically**

**(11) Team Process Review - Self-evaluation discussion**

**(12) Receive and discuss Academic feedback on the task**

**(13) Record your Individual Reflections and Ongoing Action Plan**

WEEK 1

WEEK 2

WEEK 3

WEEK 4



# The Facilitator

- Is a member of University staff (PDRA), selected and trained to support collaborative teamwork
- Is not a specialist in Sustainable Development
- Does not have the answers to the tasks
- Acts as a resource broker
- Is not assessing anyone or their team, though can be asked for informal feedback
- Will intervene less as the team becomes more independent



# Modes of Assessment

- **Formative**
  - Four 'training' group exercises/case studies
  - Written feedback provided throughout the course unit
- **Reflective (40%)**
  - Individual report to reflect on learning about sustainability, managing change and team-working
- **Summative (60%)**
  - Final assessed group project
  - Peer-feedback to assess individual contributions



# Reflective Writing Portfolio

- Reflective practice and action planning:  
Continuous Improvement
- Comprehension of learning points:  
Sustainability and Change
- Self-directed learning and critical analysis:  
Information Literacy
- Team dynamics:  
Improvement
- Team processes and organisation:  
Project Management



# Activity Sessions

- Activity sessions provide the opportunity to step back and reflect, outside of the tasks
- Activities also develop understanding of useful team-working skills, including:
  - Setting Ground Rules for Teamwork
  - Dealing with Conflict
  - Decision-making
  - Creativity
  - Influencing and Leading

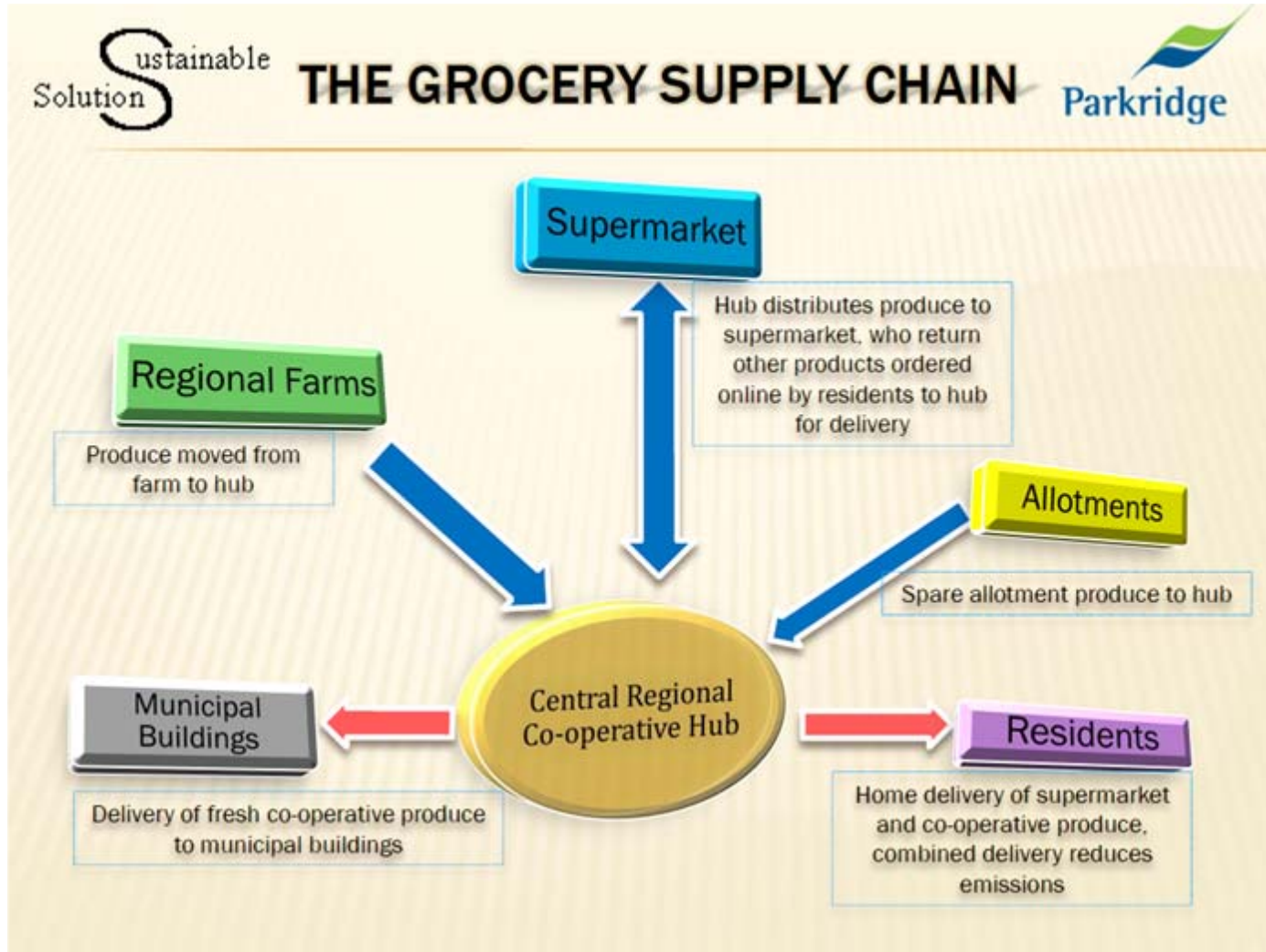


# Assessed Project: Ecotown

- Teams were tasked with developing a strategy for sustainable grocery supply to one of the UK's proposed ecotowns, Western Otmoor
- Strategy must consider issues associated with:
  - Local food production
  - Transportation
  - Consumer choice
- Teams required to present proposal in a written report and executive summary presentation






# Assessed Project: Ecotown



# Assessed Project: Ecotown



# Assessed Project: Ecotown

Sustainable Solution		BENEFITS		Parkridge	
		Strategic Outcomes			
<b>Environmental Sustainability</b> 	<ul style="list-style-type: none"> <li>✓ Using local produce reduces food miles</li> <li>✓ Better use of natural resources with seasonal local produce</li> <li>✓ Electric floats reduce carbon footprint</li> <li>✓ Waste minimised by composting scheme</li> <li>✓ Environmentally friendly packaging</li> </ul>				
<b>Economic Sustainability</b> 	<ul style="list-style-type: none"> <li>✓ Profits within the supply chain remain in the business so the co-operative can expand and develop further</li> <li>✓ A successful scheme can be extended through the local region</li> <li>✓ Similar systems can be initiated in other eco-towns</li> <li>✓ Enhance the incomes of participant farms</li> <li>✓ Self-Sustaining supply chain reduces burden on taxpayers and the rest of the economy</li> </ul>				
<b>Social Sustainability</b> 	<ul style="list-style-type: none"> <li>✓ Public awareness of sustainability, appreciation of healthy eating and sense of community are enhanced by the cooking classes and gardening programmes.</li> <li>✓ Local services such as school and hospitals are supplied with seasonal local food</li> <li>✓ More coherent and productive rural communities.</li> <li>✓ Innovative nature of the supply chain may improve the chances of Weston Otmoor being selected as an eco-town</li> </ul>				

# Benefits to Students

- **Active learning** – students are consultants, part of a “think-tank” working on open-ended, real-world challenges
- **Sustainability and change** – develop solutions to challenges, learn how to overcome barriers to change and apply principles of CSR, life cycle thinking and stakeholder engagement
- **Teamwork** – discover how to work with those from different backgrounds
- **Employability** – develop and demonstrate the professional skills that employers are looking for in graduates



# Student Views

- “This has been the most enjoyable course I have ever done over the last three years. Love the concept of continual group work and assessment, and think the teaching staff to student ratio is superb.”
- “Working with students of diverse degree disciplines, cultures and backgrounds has taught me a huge amount both about myself and how I interact with others.”
- “The use of real-time issues as a basis for each assignment not only provided a sense of urgency, but also provided for a more realistic process for envisioning aspects of sustainable development in the real world.”

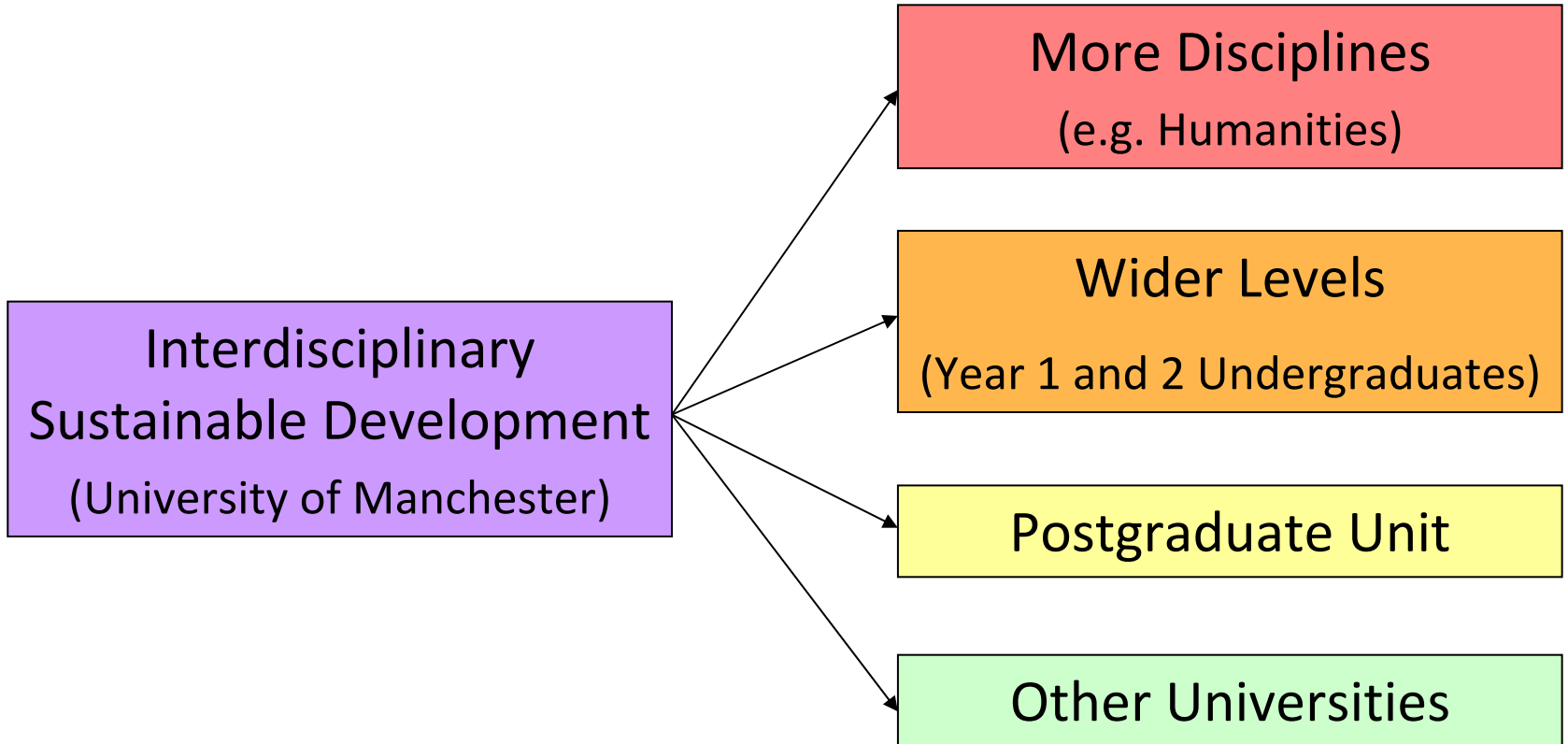


# Benefits to Facilitators

- Teaching experience at University level
  - Invaluable experience in using PBL
  - Enhance group facilitation skills
  - Learning about pedagogic development
- Engaging topics relating to sustainable development
- Enhance transferable skills and CV



# Future Scope



# Awards and Acknowledgments

- In 2008 the unit was awarded Highly Commended in the **National “Green Gown” Awards** in the courses category
- A representative from the **Higher Education Academy** stated that this course unit is at the forefront of what University Engineering Departments should be aiming to achieve
- A representative from the **Royal Academy of Engineering** stated that the quality of student interactions observed at the end of the unit was equivalent to those of graduates applying for chartered status several years into their career



# Acknowledgements – Project Team

- **Charles Engel** RAEng Visiting Professor
- **Bland Tomkinson** University Adviser on Pedagogic Development
- **Rosemary Tomkinson** Head of Teaching and Support, EPS
- **Helen Dobson** Teaching and Support, EPS (Project Officer)
- **PDRA Facilitators**
- **Case Study Authors**

The project team would like to acknowledge the RAEng for financial support

