

ROYAL ACADEMY OF ENGINEERING

VISITING PROFESSORS IN ENGINEERING DESIGN FOR SUSTAINABLE DEVELOPMENT

VP Workshop 2003

Experiences in Teaching Sustainable Development through Case Studies

Belfast, 17th – 18th June 2003

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Appendices – The presentations

Appendix A Aston University

George Drahun

Department of

The problem

- expansion of factory making PVC windows
 - ⇒ public enquiry
 - ⇒ report

Learning objectives

- to gain experience of the behaviour required to work within multi-disciplinary team during the design of a process
- to understand the practical aspects of SD and their application during the design, manufacture, use and final disposal of the product
- to practise the summarising and presenting, in a public forum, the relevant information and the arguments used during the decision-making process

The roles

- Social
 - ⇒ media
 - ⇒ manufacturer
 - ⇒ unions
 - ⇒ local residents
 - ⇒ council / MP
 - ⇒ environmental activists
- Technical
 - ⇒ aluminium
 - ⇒ by-products
 - ⇒ PVC
 - ⇒ chlorine
 - ⇒ electricity
 - ⇒ timber

Features

- Multi-disciplinary
 - ⇒ chemical engineering
 - ⇒ mechanical engineering
- Virtual Learning Environments

- ⇒ database
- ⇒ communication
- ⇒ monitoring

Presentation and Discussion

Appendix B Loughborough University

C J Backhouse, A J Clegg and K G Snowdon

Wolfson School of Mechanical & Manufacturing Engineering

Life-cycle Assessment Case Study

- RAE Project in context
- MEng in Product Design & Manufacture
- Sustainable Product Design
- LCA Elements
- Conclusions

RAE Project Chronology

- Manufacturing for the Environment exists
- October 1999 RAE Start
- October 2000 Wolfson School formed
- 2001 IEE Accreditation (MfE compulsory for Manf.)
- October 2001 MSc module EDfSD
- October 2002
 - ⇒ SPD Module
 - ⇒ LCA software
 - ⇒ New staff involvement
- October 2003 module handovers

MEng in Product Design & Manufacture

- Programme introduced in the 1980s
- Strongest 'manufacturing' programme
- IEE Manufacturing Division accredited
- New Year 4 modules in 2003
- Includes compulsory Sustainable Product Design
- Manufacturing for Environment compulsory in Year 3

Sustainable Product Design

- Single semester module (15 weeks, 2 hours/week)
- Taught by lectures, tutorials, case studies and a group project (6 weeks for lectures etc. and 6 weeks for project)
- Examined by exam. (1.5 hours, 2 from 3) (50%) and project (50%)
- 9 students in inaugural module

LCA Element

- Taught in 2 of the 6 'lecture' sessions
- Session 1 lecture + tutorial + case study
- Session 2 software demonstration + tutorial
- Application in group projects
- Boustead LCA Model: £2250 for software and introductory training.
- LCA 'Expert': RA on EU funded project

LCA Feedback (1)

- | | | |
|--------------------------|-------------|------|
| • New knowledge gained | 4.44 | |
| • Intellectual challenge | | 3.78 |
| • Interest value | 4.56 | |
| • Enjoyment value | <u>4.00</u> | |
| • Overall average | 4.20 | |

Nortel Case Study

- Faceplate: aluminium or plastic?
- Functional unit
- Features
- Compromises

LCA Feedback (2)

- Invaluable for quantitative and objective data/decision
- Time-consuming
- Limited database
- Lacked flow chart guide
- Poor output display
- Data not transportable for 'what-if?'

Conclusions

- LCA preferably taught by 'hands-on' use of software tool
- Case study is useful
- Group project is better (live issue)
- LCA requires an 'expert'
- SPD module numbers expected to double to 18 in October 2003
- New teacher for October 2004

Appendix C Bournemouth University

George Howarth

Appendix D Liverpool University

Richard Dodds

Department of Mechanical engineering

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: 2nd semester:130 students)
- Proposed component of third year Mech Eng course (2005-2006: 80 students)
- Potential component of modules for first year civil, electrical/electronic engineers (2004-2005)
- Ensure can be continued by permanent staff

Domain

- 'Fast-moving' and other consumer goods
- Consumer attitudes
- Regulations

Unilever Case Study Slides

- Launch of Laundry Tablets.
- Launch of Laundry Capsules.

in the context of :

- Competitive position
- Business Decisions
- Sustainability Aspects

The Proposition

- All the performance of the best powder in a new, more convenient, form
- Introducing Liqui-tabs

Taking newspapers / bottles to the tip

- How many do it?
- Why?
- Does it do any good?
- How did it happen ?

The Challenge

- The governing impulse of the consumer is "I want."
- The governing impulse of the citizen is "We need."

- How do we change 'consumers' into 'citizens' ?
- What will trigger a change in behaviour ?

Perception of Risk

- Social psychologists have found that citizens judge the tolerability of risk on two dimensions – voluntariness and catastrophic potential.
- Where risks are entered into voluntarily then tolerance is higher than for risks that are somehow 'imposed'.

How do consumers experience product information?

- Information Providers tend to operate on the tacit assumption that people reach judgements on the strength of 'facts' - and so concentrate on what is known rather than the uncertainties.

Instruments of environmental policy

- Awards/recognition
- Public Information/Education
- Life-cycle assessment
- Environmental accounting/reporting
- Eco-audits/management
- Products Labelling
- 'Right to Know'
- Negotiated agreements
- Demand-side management
- Regulatory reform
- Liability rules
- Subsidy removal
- Marketable permits
- Eco-taxes/ tax reform
- Environmental impact assessment
- Trade restrictions
- Ambient/emissions standards
- Licensing/permitting
- Bans

In summary . . .

- Information-based strategies to correct the lack of information
- Incentive-based instruments to change behaviour
- Directive-based regulations to force specific behaviour

Four Slides to Remember - Bringing it all together

Sustainable Development

- “..development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs..” (Bruntland 1987)
- Sustainability is the principle, the destination
- Sustainable Development is the route we take to get there

Influencing the Design Process

- What worked...
 - ⇒ Level of interest
 - ⇒ Level of effort in both team and individual projects
 - ⇒ Country based projects (8 China, 1 India, 1 Indonesia, 3 Greece)
 - ⇒ Mixed-nationality teams
 - ⇒ Understanding of sustainability concept
- What didn't work well....
 - ⇒ Method of displaying trade-off's between cost, environmental impact, social and regulatory factors.

 - ⇒ Their understanding the above ?
'Design for X' preferred

First year proposals

- An introductory lecture on Sustainable Development to be reinforced by private study and working through web-based materials in preparation for..
- The second lecture which will be an 'interactive teaching' session on a particular laundry powders consumer goods industrial case study, which will lay the framework for considering sustainability aspects in ..
- The market survey and operator questionnaires of electric drills, which will be modified to include some sustainability aspects, to encompass more DIY drills in addition to industrial use, and to make students aware of the impending EU legislation on Waste Electrical and Electronic Equipment(WEEE) which fundamentally changes the manufacturers' responsibilities.
- There will then be opportunities for students to identify and propose design improvements for sustainability benefits as part of the detailed work in the second half of the module.

At the end of the module the Learning Outcomes will be

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

Appendix E Newcastle University

Department of Chemical Engineering

Professor Jeff Hulse & Professor Peter Norman

Background

- Royal Academy of Engineering
- Visiting Professors Scheme
- Newcastle University
- Jeff Hulse.....
 - ⇒ Chemical Engineer
 - ⇒ 40 years in Chemical Industry
 - ⇒ Former Head of Environment Health & Safety.....BASF.

Benchmarking

- Test student understanding
- 1st year undergraduates (Chem.Eng.)
- MSc & MEng Level
- Other subjects
- Glossary of terms
- Define priorities

Glossary of terms

Desertification

- The conversion of pastureland and crop land into desert, or the gradual enlargement and encroachment of deserts into formerly marginal arid lands; caused by climatic factors such as prolonged drought and by overgrazing and over cultivation.

QUESTIONNAIRE 1.

We need your help.....to improve in future.

First lecture.

- ⇒ 1.Key Sustainability Issues
- ⇒ 2.What are we doing about it?
- ⇒ 3.Balancing Economic, Environment and Social issues.(The Triangle Model)

QUESTIONNAIRE 2.

Second lecture.....

- 1.Risk Communication
 - ⇒ Perception is Reality
 - ⇒ Trust and Credibility
 - ⇒ Good Communication Skills
- 2.Media and Community Relations
 - ⇒ Teesside Examples

QUESTIONNAIRE 3.

Third Lecture...

- 1.Stakeholder Analysis
- 2.Product Stewardship
- 3.Ethical Responsibilities

CASE STUDIES

- Household Detergent (Product)
- Byker Incinerator (Social)
- Sludge disposal (Process)
- Risk management (Social)
- Waste Water (Design)
- Refrigeration (Design)
- Transportation (Design)
- Bran Sands (with Surrey)

Report and Assessment

- Write a report inc....by....
- The minutes of your meetings
- A short outline of your group's position(1 side of A4). All groups except Local Newspaper that does a Press Release.
- An assessment of the role they played in the workshop viz. Methods and principles of Sustainable Development. A critical appraisal of how the group's case and proposed actions leads to a more sustainable solution.

Learning Outcomes

- Stakeholders
- Decision making
- Working in a Group
- Presentation
- Trust & Credibility
- Communication
- Balance Ec/Env/Soc issues

Phase 2 plan . . . Strand 1.

- Add value to Teaching Materials by developing a web-based SE portal to include.....
 - ⇒ Teaching materials and Case Studies
 - ⇒ Course outlines for customised syllabuses
 - ⇒ Examples of best practice
 - ⇒ Quizzes on Sustainable Engineering
 - ⇒ Self-assessment benchmarking

Phase 2 plan . . . Strand 2.

- Promotion of Sustainable Engineering thru'
 - ⇒ Engagement of other departments
 - ⇒ Use Case Study and Best Practice examples
 - ⇒ Support existing networks in VP scheme

- ⇒ Give public presentations to promote Sustainable Engineering
- ⇒ Encourage and involve young researchers

Targets for 2003

- Web-enabled Case Studies, Teaching materials and information.
- Distance learning Case Study packages.
- Additional Case Study material.
- Transfer of material to other departments.
- Network of SE practitioners
- Promotional public presentations
- Transfer of expertise.

Appendix F Birmingham University

Gary Acres

School of Engineering - Dept of Metallurgy and Materials

Case Studies

- Sustainable Materials
- Hydrogen Economy

Survey Results

- 75% of students starting level 2 in M&M
- Little or no knowledge of:
 - ⇒ Design for the environment
 - ⇒ definition of sustainable development
 - ⇒ life cycle assessment
 - ⇒ ISO14001
 - ⇒ fuel cells, etc
- Mirrored RAEng results
- Need to give background

Birmingham Case Study Research

- National Teaching Fellowship Project
- Summary – Importance of:
 - ⇒ Interactive learning
 - ⇒ Student centred activities
 - ⇒ Exposing students to real world issues
 - ⇒ Using wealth of practical examples in Engineering
 - ⇒ Case studies rather than case histories

Mini Case Studies

- Materials in a Sustainable Economy Module
- Modified Course – Level 2
- Background Lectures - Introduction to SD, Materials and Energy Resources, Cyclic Processing, Life Cycle Assessment, Materials in Ecodesign, Renewable Energy
- Mini case studies related to SD
 - ⇒ Students assess SD implications of particular industry
 - ⇒ e.g. aluminium recycling, wind power, glass recycling
 - ⇒ Assessed by individual report and presentation

Hydrogen Economy Case Study

- Real world issue facing industry

- ⇒ How do companies react to a potential HE?
- Groups of 5 students
 - ⇒ Act as consultancy for imaginary materials company
 - ⇒ VP & University colleagues act as board
- Should the idea of a Hydrogen Economy be taken seriously by industry?
- Assess SD impact on company of a particular product e.g. PVs, H-storage materials, fuel cells

HE Case Study Teaching Issues

- Background lecture and discussion with VP etc
- Group membership pre-selected
- Group skills training, role assessment
- Student progress monitored during case study
- Key skills
 - ⇒ Group learning, communication, independent study
- Assessment
 - ⇒ Group report and presentation
- Element of peer assessment marking
- Good feedback from students

Development into Engineering

- STP (Special Technology Programme)
 - ⇒ Group report for University environmental coordinator on University response to SD
- Core Level 1 – design for the environment
- Mech Eng Level 3
 - ⇒ Industry response to SD
- Postgraduate courses
 - ⇒ MRes, EngD

Conclusions

- Emphasis on student interactive case studies
- Importance of embedding SD case studies in existing courses
 - ⇒ Need person in place with knowledge of University teaching practices and courses
- Importance of awareness of outside activities
 - ⇒ Corus, AWM, B'ham City Council etc

References

- International Survey: Environment and SD
 - ⇒ Universities of Surrey and Melbourne
- Case Study Research
 - ⇒ 'Case Studies in Materials Science', LTSN Booklet

- HE case study
⇒ <http://www.cases.bham.ac.uk/metmat/hydrogen.htm>

Appendix G Surrey University

Dr Adisa Azapagic

Department of Chemical Engineering

- Started in 1999
- Theme of Sustainable Energy
- Consistent with University's teaching practices
- Find suitable spaces in heavily loaded curriculum
 - ⇒ Year 2 Engineering & Society
 - ⇒ Year 2 Course Work Modules
 - ⇒ Year 3 Design Project
 - ⇒ Year 4 Chemical Processes
- Given by Visiting Professor
- Not classical (Harvard type) case studies
- Now fully embedded in undergraduate teaching

Appendix H Oxford University

Roger Booth

Engineering Science at Oxford

- One of the UK's largest unified departments
- 600-plus undergraduates (> 20% women), 200 researchers
- Close links with industry – 9 spin-off companies
- Four courses (accredited by Institutions):
 - ⇒ Engineering Science
 - ⇒ Engineering & Computing Science
 - ⇒ Engineering, Economics & Management
 - ⇒ Engineering & Materials
- All are members of a college, with tutor.
- Academic Committee & Sub Faculty approve curriculum

Year 2 Engineering & Society

- Both optional & core elements
- Initially Sustainable Energy optional (~60 students)
- Academic Committee approval as core from 2001
- Increased from four to eight lectures
- Supported by College tutorials
- Examination question

Engineering & society lectures

- Engineering & Sustainability (Prof Darton) Engineering & the Environment
 - ⇒ Regulation & Compliance
 - ⇒ Introduction to Sustainable Development
 - ⇒ Can We Assess Sustainability?
- Sustainable Energy (Dr Julia Stegemann) Energy & the Environment (Introduces LCA)
 - ⇒ Scope for Renewable Energy
 - ⇒ Clean Cars & Renewable Fuels
 - ⇒ A Sustainable Energy Future?
- Tutorial - 8 numerical questions:
 - ⇒ Global warming, GHG emissions, global energy use, BIPV,
 - ⇒ nuclear waste, car emissions, multi-criteria decision making.

Yr 2 coursework module

- Five days – 25 students
- Builds on Engineering & Society Lectures

- ⇒ Sustainable development
- ⇒ Energy supply & use
- ⇒ Climate change
- ⇒ Scenario development
- Opportunity for team work, role-play & presenting
- Flexible half or one day modules (mix & match)
- Outside speakers – Jeff Hulse’s 1-day Byker very popular
- Site visits

Year 3 Design Project

2000 - Professor Rankin developed a project for:

- ⇒ Hydrogen plant for a fleet of fuel cell buses
- ⇒ IChemE approval

2002 - All project teams to assess sustainability:

- ⇒ Brief (2 page max) section of the report
- ⇒ Supported by quantification (e.g. ratios)
- ⇒ Lecture: ‘Assessing the sustainability of projects – A Guide for Design Teams’

Consultancy service

- Positive & negative sustainability impacts:
 - ⇒ Social development
 - ⇒ Economic development
 - ⇒ Resource efficiency
 - ⇒ Environmental protection
- +ve, -ve or neutral impact on future generations?
- Modifications made
- Improvements for next iteration
- Comment on methods used
- Who are the stakeholders? Consultation required?
- Proceed without further modification? (Go/no go)

Year 4 Chemical Processes lectures

Part of the Chemical Engineering option

- LCA – A Tool for Sustainable Development
Two lectures taken over by Dr Julia Stegemann
 - ⇒ Refresher on sustainable development
 - ⇒ Methodology & examples of LCA
- Fuel cells – a process engineering challenge?
Two lectures: Taken over by Dr Richard Stone
 - ⇒ History, theory & status of fuel cells

Core Knowledge

- Engineers make things!
- Turn raw materials to products
- Use energy & create waste
- Need to understand their responsibilities to:
 - ⇒ The Environment
 - ⇒ Society
 - ⇒ The Economy.
- Includes an understanding of:
 - ⇒ Background to Sustainable Development
 - ⇒ Resource depletion
 - ⇒ Carrying capacity of the environment
 - ⇒ Climate change (IPCC & UNFCCC)
 - ⇒ Inter- & intra-generational equity
 - ⇒ Legislation & compliance (EMAS & ISO 14,000)
 - ⇒ Role of the engineer
 - ⇒ Stakeholder analysis
 - ⇒ Triple bottom line
 - ⇒ Material & energy efficiency
 - ⇒ Sustainability indicators

Skill sets

- SD a holistic property - potential conflicts.
- Familiar engineering dilemma! (*High flexibility / low cost*)
- Go / no go decision point – similarity to safety
 - ⇒ Modelling & design skills
 - ⇒ Arts of analysis & synthesis
 - ⇒ Deal with defined & open ended problems
 - ⇒ Application of judgement
 - ⇒ Basic LCA
 - ⇒ Multi-criteria decision making
 - ⇒ Effective team working (multi-disciplinary)
 - ⇒ Communications skills (written & oral)

Teaching approach

Some see SD as ‘soft’, non-quantitative with poor fit to engineering; Oxford approach follows the approach to all engineering:

- Provide theory or information
- Give a practical
 - ⇒ calculations, essays, laboratory work,
 - ⇒ project work, role-play, presentations

- Test
 - ⇒ Tutorials and year 2 Course work - opportunity to assess

Integrates transferable skills - multi-criteria decision making, team working, role-play, and communications....

Conclusions

- Teaching SD now fully embedded at Oxford
- Taken over by academic staff - will continue!
- New material must be consistent with teaching practices
- Initial delivery by VP essential
 - ⇒ Understand students
 - ⇒ Significant changes years 1 to 5
- Close co-operation and support of mentor et al essential
- Students responded positively
- New entrants have greater awareness than 5 years ago
- Outside world moved on in 5 years
 - ⇒ Rate of change far higher than typical u/g material
 - ⇒ Still a demand – must be well planned and up to date

Appendix I Ulster University

Professor Alan Strong

Department of the Built Environment

STAGE 1: ROAMEF Statement for each Case Study

- **Rationale** - Triple Bottom Line, LA21, Pedagogy, multi-use
- **Objectives** - Account of: Before & After, SD appraisal, pedagogy, future development
- **Appraisal** - Data capture, synthesis & analysis leading to delivery of each Objective (?)
- **Monitoring** - Engage Staff, SPAT + Stakeholders
- **Evaluation** - Stakeholders + SVP
- **Feedback** - Inform future CS work; see below

STAGE 2: Audit Built Environment Modules

Explicit & Implicit reference to SD in Learning Outcomes

- (8% + 14%) = 22% SD reference (from 192 modules, in 2001)
- Highlight - Environmental Engineering - 45%
- Lowlight - Quantity Surveying - 5%
- Identify possible modules for Case Studies
- Review Course Learning Outcomes re SD & influence change

STAGE 3: Selecting key modules for CS

- Apply Module SD Evaluation
- Use Staff Champions + SPAT
- Match disciplines & themes in CS with Module Learning Outcomes

STAGE 4: Negotiate CS Stakeholder support/ownership

- Stakeholders: Client, Architect, Engineer, Experts
- Staff: Academic [flyer, info. Drip-feed]
- Students: awareness, interest, action
- Community: local, workshops, relationships!

STAGE 5: Building Data Sheets

STAGE 6: Fact Sheet Development

- Category [Transport, Biodiversity, Waste etc]
- Capital [Natural, Human, etc]
- Legislation/Policy [National, EC, International]
- Relevant Indicators and/or Benchmarks
- Data Sets

- Support documents
- Further Reading
- Comments

STAGE 7: Select Auditing Tools

- Options:
 - ⇒ Triple Bottom Line
 - ⇒ Indicators - Headline, National, LA21, KPI's, EPI's
 - ⇒ Life Cycle Analysis + Mass Balance/Ecological Footprint
 - ⇒ Balance Score Cards; SPEAR
 - ⇒ 5 Capitals (Forum for the Future):
 - * Natural * Human * Social * Manufactured * Financial

STAGE 8: 5 Capitals / 12 Features Scoring System:

- 6 represents SD 'actual performance' achieved
- 4 represents a realistic SD goal, expressed as 'As Sustainable as Reasonably Practicable' (ASARP)
- ASARP describes 'sustainable enough'
- ASARP should be regularly assessed in light of political, economic & social constraints & changes
- Gap between Actual & ASARP becomes 'realistic target' for improvement - 'DEFERRED OUTCOME'

DELIVERY MECHANISMS:

- Liaise with Staff & SD Champions
- Facilitate 'Teaching the Teachers' Workshops
 - ⇒ Staff Groups, Lunchtime Seminars, Engage Staff
- Construct 'Introduction to Case Study' (ppt)
- Prepare Overview of Case study for Marketing: Flyer, Brochure
- Deliver underpinning knowledge [Auditing tools, policies & protocols, etc]
- Review of Awareness Teaching
 - ⇒ Use of Guest Lecturers
 - ⇒ Content: Generic & discipline-related
 - ⇒ Evaluation: e.g.

- SD & what it means	65% v good or excellent
- Need for Indicators	64% v good or excellent
- Importance of addressing SD	58% adequate
- Pilot Student Group
 - ⇒ Feedback, Evaluation, Discussion
 - ⇒ Exam Question!!
- Assessment Mechanisms
- Summative, Formative & Diagnostic balance

- Range of tools & delivery mechanisms:
 - ⇒ Workshops : ‘What if scenarios’
 - ⇒ Tutorials: ‘Discipline specific assignments’
 - ⇒ Class Test: ‘Open Book assessment & analysis of data’
 - ⇒ Exam Questions: ‘Awareness + analysis’ issues
 - ⇒ Site visits - discussions, observations, reporting, role play
- Assignments & Assessments to be primarily open-ended, challenging, seeking correlations, relationships, context
- Reference ROAMEF Statement

Feedback Mechanisms:

- Student Questionnaire [Meets QAA requirements]
- Module Evaluation [QAA + T & L Issues]
- Performance Assessment [Module Summative Scores]
- Performance Assessment [Specific measurable responses]
- Staff Feedback [Case study content, need for further teaching]
- Internal Feedback [by SPAT]
- External Feedback [CS Client, to SVP]

Range of Issues - positive and deferred outcomes!

- 6 SD not fully embedded in University systems - procurement, biodiversity, policy, Course Learning Outcomes
- 4 SD has place in University systems - Energy Management, Waste recycling, Staff awareness, CPD courses
- 6 Staff buy-in & ownership limited
- 4 Student response- positive & open-minded
- 4 Strong network of external support

Summary

- Case Studies are time-consuming AND valuable
- SD is complex and needs multi-discipline approach
- SD must be introduced bottom-up
- Holistic approach is rewarding, but need champions
- SD is excellent vehicle for:
 - ⇒ Meeting need of Professional Bodies in providing conceptual framework
 - ⇒ Addressing broad & deep areas of study & understanding
 - ⇒ Developing strong repertoire of pedagogic activities

Appendix J De Montfort University

Greig Mill

Department of the built environment

Case studies

- The Queens building
- Urban climate change strategy
- Renewable energy in the city

Case study users

- MSc Climate Change and Sustainable Development
 - ⇒ energy in buildings
 - ⇒ renewable energy
 - ⇒ energy analysis techniques
- MSc Energy and Sustainable Building
 - ⇒ daylight and lighting modelling
 - ⇒ heat transfer and dynamic thermal modelling
 - ⇒ natural ventilation and airflow modelling
 - ⇒ design project

Sustainable Development module

- Studied first by all students
- Evolution of SD concept and policy
- Student-led workshops
- Ecological sustainability
 - ⇒ biodiversity, resilience, ecosystem function
- Economic sustainability
 - ⇒ economic growth, resource management, capital accumulation

Social sustainability

- ⇒ equity, vision, adequacy of institutions, human capital, social capital

Student feedback

- Sustainable development module is well received
 - ⇒ “...exceeding expectations...”
 - ⇒ “gives insights and challenges to the fundamental question: how should we live?”
 - ⇒ “no-one was left in any doubt about the need to think and be active...”
 - ⇒ “effective in provoking thought and appreciation of the breadth of sustainable development...”
- ... *but practical implementation?*

Case studies provide

- Illustration of human factors and trade-offs
 - ⇒ building occupant behaviour (Queens building)
 - ⇒ concern regarding energy from waste (London)
- Resources for informal group work
- Documentary resources
 - ⇒ Queens building CD ROM 160+ documents at ‘one click’
- Support for assessed work:
 - ⇒ “how to do better?”
 - ⇒ “lessons for future designers?”
- Support for technical design projects
 - ⇒ e.g. School of Slavonic and East European Studies

Wider audiences

- One-day CPD courses
 - ⇒ climate change policy and greenhouse gas emissions
- British Council seminars
 - ⇒ local solutions to climate change
- Leeds Metropolitan University
 - ⇒ Centre for the Built Environment
- Brunel University
 - ⇒ Modelling Sustainable Architecture
- Wider use?

Case-study-led low energy building design

- School of Slavonic and East European Studies, UCL
- 30,000ft² library and office space
- Natural ventilation
 - ⇒ night-time purging
 - ⇒ exposed thermal mass
- Natural lighting
 - ⇒ light penetration
 - ⇒ glare and solar gain protection
- Demanding brief
 - ⇒ urban ‘heat island’
 - ⇒ CIBSE design guide temperatures

Design options

- Four design options
- Students consider

- ⇒ dynamic thermal modelling
- ⇒ CFD airflow modelling
- ⇒ physical water modelling

Student work

- Produce a list of questions
 - ⇒ Where could money or effort be saved?
 - ⇒ Specification and location of BEMS sensors?
 - ⇒ How regulate airflow, under what conditions?
 - ⇒ Feasibility of large naturally ventilated non-domestic buildings in city centres?

Conclusions

- Electronic case studies developed and in use
 - ⇒ Under- and post-graduate, short CPD courses
- Case studies provide
 - ⇒ real examples to complement theory
 - ⇒ general teaching resource
 - ⇒ documentary resource
 - ⇒ support for design project work
- Future potential
 - ⇒ closer links with potential users
 - ⇒ explore electronic medium further
 - ⇒ greater dissemination

Appendix K Cambridge University

Peter Guthrie

Department of Engineering

Performance Against Goals

- Delivery of material based on case studies for the teaching of design for Sustainable Development

Performance Against Schedule

- Case studies to form the base of material to be handed on
- Visiting Professor to be no longer required after 5 years – the exit strategy

Performance Against Budget

- Budget: £20,000 per year for five years

Teaching and delivery - What worked well?

- Definitions of Sustainable Development
- Evaluative techniques for Sustainable Development
- Case studies from the lecturer's experience
- Coursework based on well doctored case histories
- Some external speakers

Teaching and delivery - What did not work?

- Opinion-based statements
- Any indication of dogma or cant
- Classes of more than 40
- Some external speakers

Mechanics of delivery

- 2000/1, 2001/2: separate modules available to third and fourth year students (F14, G13)
- 2002/3: shared third and fourth year modules (4M14)
- 2001/2, 2002/3: first year lectures

Modules in years 3 & 4

- 16 hours delivered as eight two-hour sessions
- Coursework: three pieces each designed to take eight hours of work
- Three themes covered taking three from
 - ⇒ Water
 - ⇒ Waste
 - ⇒ Energy
 - ⇒ Environmental Impact Assessment

⇒ Organisational Change

Coursework

- Three topics taken from
 - ⇒ Super quarry development
 - ⇒ Energy strategy design
 - ⇒ Airport development design
 - ⇒ Construction waste strategy
 - ⇒ Organisational Change exercise
- All case-study based
- Most popular with students
 - ⇒ Coursework with calculations
 - ⇒ Readily defined problems
 - ⇒ Projects of modest scale
 - ⇒ Evidently real projects/case studies
- Least popular with students
 - ⇒ Being asked to produce written material where prose was assessed
 - ⇒ Problems where there was no right answer
 - ⇒ Mega projects where the issues were seen as too big to cope with

Fourth Year Research Project

- Year on year increase in take up
- Wide range of topics
- Students compete for places
- Quality of output very high
- Roof tile design for West Bengal (waste only)
- Energy policy for Nepal
- Energy performance of high tech buildings
- Design strategy for community swimming pool, Norfolk
- Iron removal from drinking water Uganda
- Design of virtual quarries for aggregate
- Contractor's guidance for recycling vs. landfill
- Water supply strategy for slums in Lima, Peru
- Sustainability indicators for building design
- Cold shelter design for refugees
- Arsenic removal from drinking water

The wider picture

Assessment of delivery of Sustainable Development at Cambridge reveals

- There is a great deal of activity

- There is only a little scepticism
- It has taken three years to become respectable
- Time for more radical approaches

Appendix L Heriot-Watt University

Gordon Baker and Paul Jowitt

Civil Engineering / School of Engineering

Year 1.....a flying start !!

- Framework Document
- Case Study Target Matrix
- Research Assistant appointed
- Sowing the seeds with academic staff
- Began developing case studies

Years 2 and 3.....a strong headwind !!

- External contacts (e.g. LA s) yields poor response
- Course Module content developed; rejected by Engineering dept
- Case Study development continues
- Student contact experience good; academic staff slow to respond
- Reorganisation of University departments

Years 4 and 5.....turning the tide !!

- Research assistant resigns; 6 months before suitable replacement can be found
- University re-appraising material for inclusion in courses following reorganisation
- New module being developed; three introductory lectures so far
- Work on case studies continues; led by HWU Master Plan and Green Travel Plan
- VP commits for further 2 years (to end 2005)

Overview of the Journey.....bumpy !!

- Student contact; enjoyable and rewarding
- Student successes; “closing the loop”
- Academic staff; “words speak louder than actions”
- VP experience; frustration, time constraints within a sadly failing transport industry. (Policy and legislative vacuum where apathy abounds, priorities continually change, and limited resources are misdirected.)

Outputs and Resource Materials

- One Course Module (failed!!) of ten lectures
- A second course module of ten lectures (three completed so far; failure this time is unacceptable)
- 12 case studies en route to 25-30 total; most with opportunities for re-visiting and updating.
- A framework within which much could progress; assuming willingness, “buy-in” and commitment.

The Journey Ahead.....

- Optimistic about “success”
- Work with those who will commit (seek them out carefully first !!)
- Case Studies; interesting, relevant and capable of being updated.
- The Challenge; delivery and acceptance of relevance

Heriot-Watt University Master Plan

- Travel Planning for a Sustainable Future

HWU Master Plan; some statistics

- University currently: 5500 students
- Master Plan: increase to 9000 Students
- Research Park currently: 1500 employees
- Master Plan: increase to 2866 employees

HWU Master Plan; consequences

- Current (network and traffic)
- Future traffic (no network change)
- Predict and Provide (based on current travel patterns)
- Demand Management - based on Green Travel Plan (GTP)

Can we visualise the outcomes in terms of the possible impact on road network ?

GTP Delivery; Data Inputs

- Traffic flows; university and research park
- Travel Surveys for car-parking permit applicants (charges in future ??)
- Public Transport surveys (bus)

GTP Delivery; target groups

GTP Delivery; target locations

GTP Delivery; why ? “Buy-In”

GTP Delivery; why ?

- Statutory obligation through the planning system
- Alternative outcomes unpalatable; unattractive to students, unattractive to business locating in research park
- A Sustainable Model for others?

GTP Delivery; Student Involvement

- Improving data sources (to assist targeting of new measures)
- Improving operational design aspects; for example, bus routing or new access

- Assist with monitoring effects (and therefore enforcement and marketing)
- Longevity as Case Study

Appendix M Edinburgh University