PE1006 Professional Engineering Communication and Ethics

- Dr Michael Creed (Head of School, Civil & Environmental Engineering)
- Dr Alan Morrison (Electrical & Electronic Engineering)
- **Dr Edmond Byrne** – *this section*

  e.byrne@ucc.ie

  Room 309, Food Science Building

  (Process & Chemical Engineering)

PE1006 Professional Engineering Communication and Ethics

Module Objective: Introduce the fundamentals of effective communication and visualisation in engineering while **developing an appreciation of professional ethics through application in complex problems and case studies.**

Module Content: Engineering Communications: data interpretation, constructing and interpreting graphs and plots, modelling, choosing appropriate models, scales, error-bars, outliers; structure and types of reports, report writing, visualisation, presentation and spoken communication skills, visual aids: reading, interpreting, (A. Morrison) constructing and visualising engineering drawings, including orthogonal and isometric projections. (M. Creed) **Professional engineering ethics and ethos; philosophy of engineering, role of engineering in society, micro and macro ethical frameworks, risk and uncertainty in complex problems, wicked problems, the new engineer and post-normal science. (E. Byrne)**

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Topics this section:

- Role of engineering in society
- Philosophy of engineering
  [historical and current philosophies and trends]
- Professional engineering ethics and ethos
- Micro and macro ethical frameworks
- Complex problems; risk and uncertainty
- Wicked problems
- The new engineer and post-normal science

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Assessment: Total Marks *100 (Continuous Assessment 100 marks)*:

Graphic assignment	20 marks
Drawing assignments	20 marks
Wicked problem assignment	40 marks
Reflective report	20 marks

1. Role of engineering in society

Kick-off reflection:

What is the role of the Engineer?

TO MAKE STUFF THAT'S NEEDED BY SOCIETY
TO SOLVE PROBLEMS IN INNOVATIVE AND ECONOMICAL WAY
TO IMPROVE THE STANDARD OF LIVING OF SOCIETY
COMMUNICATIONS
CREATE NEW TECHNOLOGY AND ADVANCE CURRENT TECHNOLOGY
APPLY SCIENTIFIC PRINCIPLES AND IDEAS TO REAL LIFE
SCIENTIFIC DESIGN AND INNOVATION
MAKE SURE SOMETHING CAN BE DONE SAFELY
IMPROVE EXISTING PROCESSES TO MAKE THEM MORE EFFICIENT
WORKING WITH AS OPPOSED TO AGAINST NATURE; WITHIN ECOLOGICAL LIMITS
CREATE AND IMPLEMENT IDEAS TO MAKE THE WORLD MORE EFFICIENT
COPY NATURE'S DESIGNS; BIOMIMICRY

Role of engineering in society

Kick-off reflection (2):

What are the *most important challenges* that engineers will face over the next 50 years? (i.e. over the course of your own career)

Resource shortages e.g. water, acerbated by rising population
Global warming – combat through e.g. more efficient cars
Sustainable building
Resource demands as a result of population growth
Energy
Efficiency
Solving and implementing problems of nuclear fusion
Peak oil/new energy resources/renewables
Creating technologies to prolong life
Rising sea levels

Role of engineering in society

P.J. Rudden, Annual Presidential Address, Engineers Ireland, 14th Sept 2011:

*"[There is a] need for engineers to **integrate** their response to engineering projects by having regard **not only** to the **technical** facts and figures but to factor in **environmental, social and political** considerations. In this way we are likely to have a **constructive public conversation** on the project.*

*If our response to traffic problems is necessarily to build a new road rather than to traffic calm, or our response to water shortage is solely to seek a new source rather than fix the leaks or conserve water in the first instance or rely solely on fossil fuels to solve our energy problems then we are unlikely to develop a **sustainable future** or **communicate** well with the general public."*

Role of engineering in society

P.J. Rudden, 14th Sept 2011 (cont.):

*"Very often **technically** we may actually be **correct** in offering purely technical solutions. But there's **more to life than technical solutions**.*

*...We will not be capable of having a **real influence** on policy and we **certainly won't inspire**.*

*We have to **integrate** our great talents with the **other professions**, to have a **holistic approach** to policy drivers in terms of creating new products and services while meeting the global challenges of climate change, market volatility and competitiveness."*

Wicked Problem Assignment

Artificial, oversimplified, well defined problems and case studies often neglect what Louis L. Bucciarelli (2008) calls;

"the social complexities of engineering practice".

Wicked Problems

Horst Rittel and Melvin Webber (1973):

'The problems that scientists and engineers have usually focused upon are mostly ***"tame"*** *or* ***"benign"*** *ones. As an example, consider a problem of mathematics, such as solving an equation; or the task of an organic chemist in analyzing the structure of some unknown compound ..for each the mission is clear. It is clear, in turn, whether or not the problems have been solved.*

Wicked problems*, in contrast, have neither of these clarifying traits; and they include nearly all public policy issues ..It makes* ***no sense*** *to talk about* ***"optimal solutions"*** *[and indeed] there are* ***no "solutions"*** *in the sense of* ***definitive and objective answers****.''*

Wicked Problems Characteristics

- Wicked problems are **more than just purely technical problems**; non-technical and value based approaches are required also as they involve some societal aspect or interaction with people.
- **Values and ethics** are inherent in describing and in tackling them.
- Resolutions never come from **simple answers** or **simple thinking**.

Wicked Problems Characteristics

- Tackling wicked problems requires **collaboration**, usually between **stakeholders** with different backgrounds, disciplines and experience.

- Collaboration is required to develop a **shared understanding** around given problems as well as a **shared commitment** to possible solutions.

- **Agreement** on the problem is **not required**; instead stakeholders need to understand each other's positions or **'object worldviews'** well enough to have **intelligent dialogue** about the nature of the problem, and to create **collective intelligence** which can be directed towards resolution.

Wicked Problem Assignment

1. Class divided into **26 groups** (No's. 1-26). Note your group number from attendance sheet *(available on Blackboard).*

2. **Identify** and **meet** your fellow group members.

3. Review list of **26 wicked problems** (A-Z) together and collaboratively **select 5 problems** in order of preference *(available on Blackboard).*

4. Problems will be **assigned** in (assignment) class based on preferences (max 4 groups for any problem).

Wicked Problem Assignment Execution

1. **Meet** with group during and outside of designated sessions.

2. Select a **chairperson** and **notetaker** for each meeting. **Rotate** between members.

3. Identify relevant **stakeholders** (various professionals and experts, users, community groups, etc.); assign at least one stakeholder per group member but potentially a lot more.

4. Each member **research the problem** extensively and the issues around it from the perspective of the respective stakeholder/s. Relevant **knowledge** of the problem may include both **scientific/technical** and **experiential** (knowledge based on experience).

Wicked Problem Assignment Execution

5. Draw up positions for **each of the stakeholders** in terms of:

i) **problem definition** (including scope and problem system boundaries)

ii) **possible resolutions** based on this analysis.

Try to define the **values** inherent in the position underlying each stakeholder and the **ethical issues** which arise.

6. **Each member** writes up a **short (1-2 page) report** addressing the above issues (including relevant cited references) representing each stakeholder for **discussion** with fellow group members and to **feed into group submission**.

Wicked Problem Assignment Execution

7. **Meet** (a number of times) to:
   - **present** and discuss each other's proposals.
   - **discuss** the various **object world** views and **values** inherent in each stakeholder to try to **develop an understanding** of **all stakeholders positions** among **all group participants**.
   -try to develop a **collective approach** towards resolving the problem

The proposed outcomes may take the form of a **number of possible options** which are **agreed** upon among group members and/or may offer **conflicting options** emanating from **opposing value sets**.

Wicked Problem Assignment Execution

8. **Submissions and Presentation**

- **Collate** the individual reports, inputs, meeting outputs and references.
- Draw up a **brief (3-5 page; 1500-3000 word) group report** outlining the **issues** and **possible options** as agreed by the group
- Print off **3 copies** of each report and **submit in class on the day of your presentation**. Also **email** a copy to **e.byrne@ucc.ie** **before** your presentation.
- Draw up and make a **7 minute group presentation** with your team colleagues for presentation to your classmates and lecturers.

Wicked Problem List*..

(*see handout, available on Blackboard)

A. Energy (Ireland)
B. Water (Dublin)
C. Nanotechnology and nano particles
D. Traffic
E. Sea level/flood protection
F. Electronics waste
G. Plastics
H. Hazardous Waste
I. Food Processing
J. Food Production; Ireland
K. Food Production; Global
L. Atmospheric Carbon; Global
M. Local flooding events (Ireland)
N. Atmospheric Carbon; meeting Ireland's legal and ethical obligations
O. Safety; Car design
P. Safety; Chemical plant
Q. Safety; Nuclear power
R. Safety; Road
S. Fossil Fuel Natural Resource Exploitation
T. House building standards –thermal (Ireland)
U. Computers and Artificial Intelligence
V. Abandoned industrial waste sites
W. Resource exploitation under extreme conditions; Safety and environmental issues
X. Water quality and treatment (Ireland)
Y. Electricity power transmission (Ireland)
Z. Traffic control