Global Engineering Education: A Personal View

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INTERNATIONAL ENGINEERING ALLIANCE

European Accreditation of Engineering Programmes EUR-ACE®

ENAEE

What is Global Engineering Education?

- A student exchange scheme: Global E3 or GE^3
- Universities offering engineering programmes in multiple countries
- A field of study on the impact of globalisation on the engineering industry
- …
- For this presentation …

Global Engineering Education is …

Engineering education in different countries/regions achieving the ***objectives***:

1. Programmes achieve globally agreed ***graduate attributes***
2. Achievement is quality assured through ***best practice accreditation systems***
3. ***Quality of programmes are recognised*** widely as achieving the graduate attributes
4. ***Benefits are accorded to graduates*** widely, for example recognition toward professional status in different countries/regions

- Note the greater degree of difficulty in achieving 4

Why Aspire to Global Engineering Education?

- In decade 2001-2011 there were
  - many papers on the global engineering graduate
  - Recognition of need for *competence beyond countries*
- We have well-established graduate attributes:
  - IEA Accords: Graduate Attributes Adopted in 2005, revised 2009, 2013
  - EUR-ACE: Programme Outcomes (2008 & 2015)
- Graduate attributes apply whether an engineer works in a country or across countries

Importance of Attitudes

Exisiting standards focus strongly on the need to take ethical, social, cultural, health, safety, regulatory, environmental and sustainability into account in engineering design and solutions.

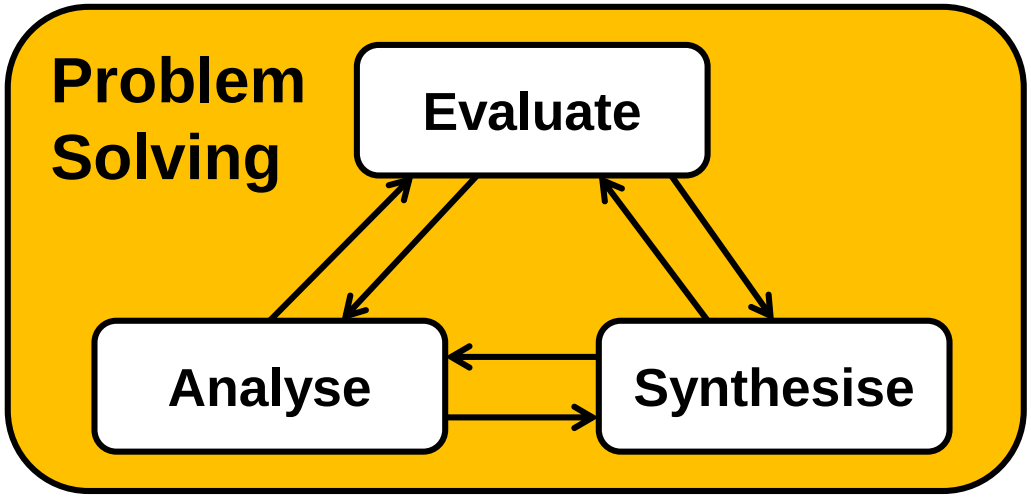
The key to appropriate application of engineering knowledge and skills lies in the attitudes of graduates

Attitudes: the goals toward which knowledge and skills will be directed

Education programmes in development of a professional engineer

- A programme that meets the agreed graduate attributes provides the educational foundation for the graduate to enter engineering practice
- Graduates have the competence to enter engineering practice as “junior engineers”
- Junior engineers can then develop the competence for independent practice

Core Competence: Problem Solving

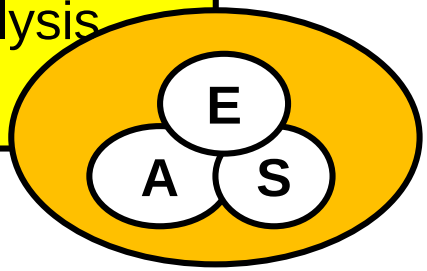


- Problem solving is a transformation from an initial state, to a final state, via a solution process carried out in a context
- Solution requires *systematic application of analysis, synthesis and evaluation*
- Problems occur on different scales and are often nested.
- Problem's difficulty depends on the nature and uncertainties of the initial state, the final state and the problem context.

… + What differentiates engineers ….

Engineers' Unique Ability

1. Apply engineering and underlying knowledge
2. Apply engineering tools, methods and processes
3. Apply economic analysis



… + What engineers do …

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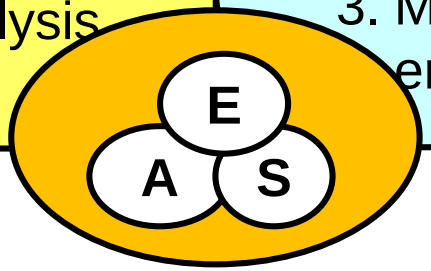
Engineers' Activities

1. Design: create what does not yet exist
2. Investigate Understand what exists
3. Manage: to attain engineering results



… + Responsibilities of Engineers

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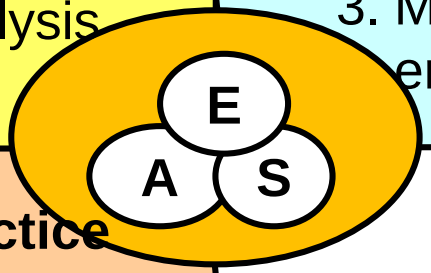
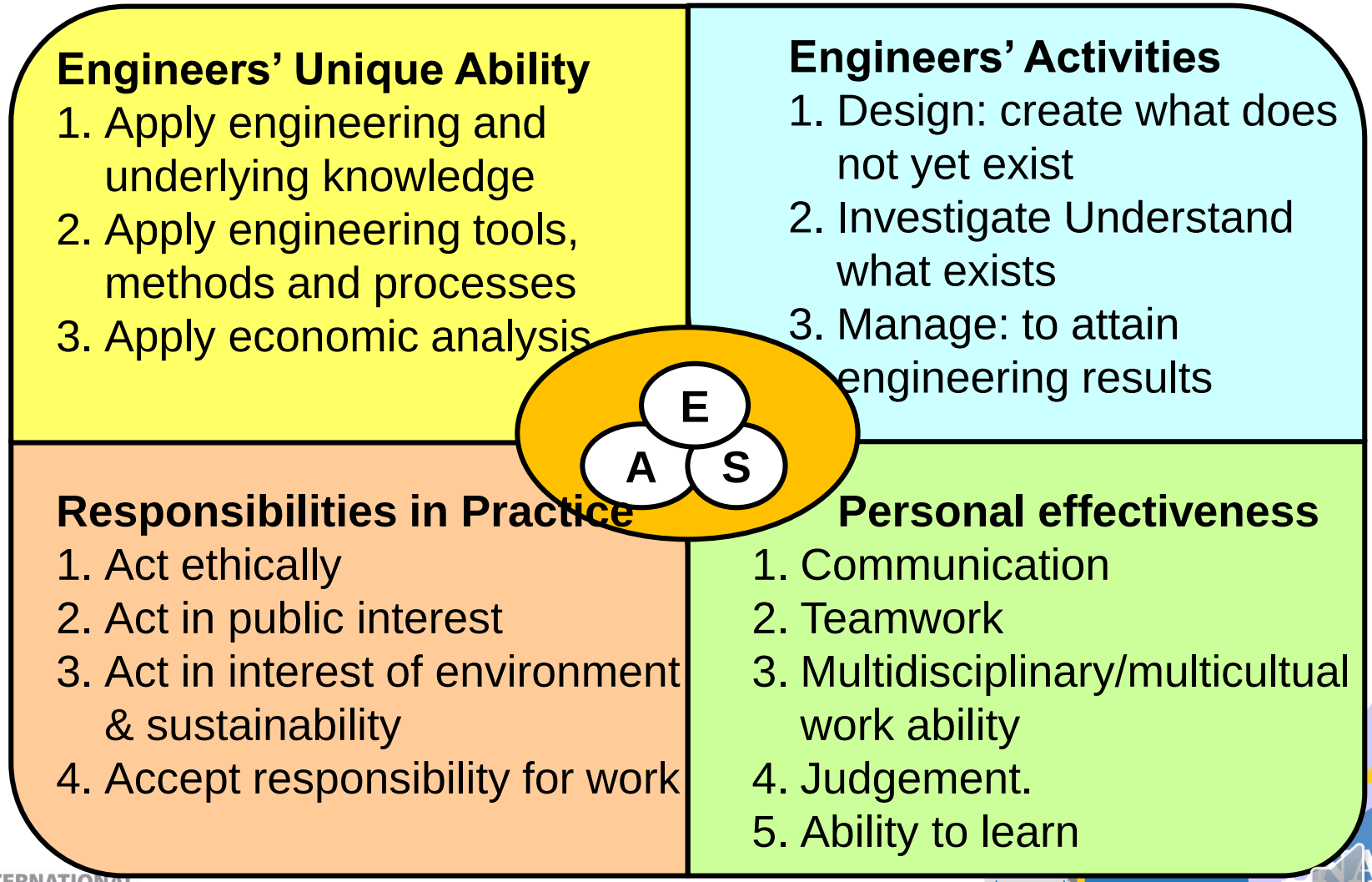


Responsibility of Practice

1. Act ethically
2. Act in public interest
3. Act in interest of environment & sustainability
4. Accept responsibility for work

… + Personal Effectiveness Attributes …



Programme Outcomes: a Foundation for Developing Professional Competency

1. Create a knowledge base: Engineering sciences based on natural science and mathematics, plus engineering specialised topics
2. Develop ability to solve complex engineering problems
3. In the simulated engineering context develop:
   a) Ability in design, investigation and principles of management
   b) Critical awareness of responsibilities of engineering practice, impact analysis and mitigation principles
   c) Essential personal attributes

How to work toward evolved outcomes

- ***A personal view:*** significant commonality between WA Graduate Attributes and EUR-ACE Master programme outcomes is a basis for evolution of a set of outcomes
- To attain this goal we should
  - Follow the high level design – the five groups
  - Build logically from simplest to most general
  - Use economy of expression
    - Use a consistent syntax
    - Use common definitions of key elements that can be referred to as required

Example of possible outcomes: 1

Solve problems by systematically

Analysing materials, components, systems, processes, impacts, situations and information;

synthesising information and solutions; and

evaluating inputs to and outcomes of analysis and synthesis

at various scales and levels including *complex engineering problems*

Level of demand …

The ***complexity of an engineering problem*** can be quantified by the complexity of some or all of

1: The ***final or goal state***

2: The ***initial state***

3: The ***problem context***

4: The ***solution process***

Example of possible outcomes: 2

Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering specialization as specified in the knowledge profile to aid in the solution of *complex engineering problems*

Relies on definitions:

- Knowledge profile
- Complex engineering problem

Example of possible outcomes: 3

Design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations where the design problem constitutes a *complex* engineering problem.

Conclusions

My personal belief is that it is both possible and desirable to work toward globally applicable outcomes for programmes that define requirements described as

- the competence to enter engineering practice by ENAEE; and
- the educational foundation for a professional engineer by the Washington Accord

which are substantially equivalent