Melbourne School of Engineering

THE UNIVERSITY OF MELBOURNE

Engineering Systems Design 1

Lecture EN02 – Engineering and Society

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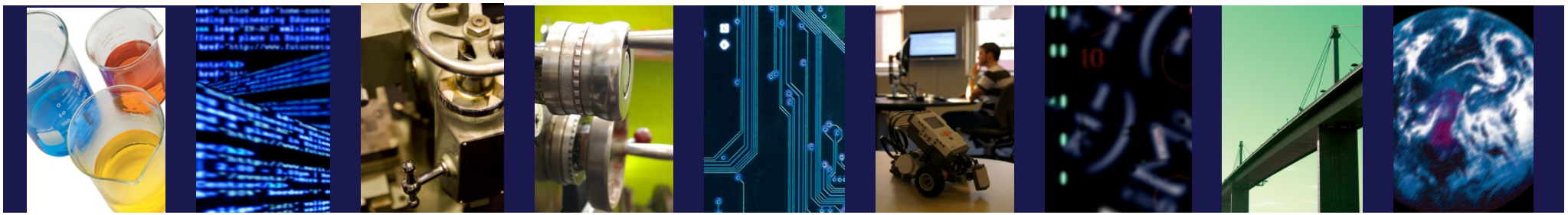


Learning Objectives

- To discuss the role of engineers in society
- To describe the types of skills an engineer requires
- To describe the different engineering disciplines

What is an Engineer?

- Word “engineer” derives from Latin *ingenium*
  - refers to one’s native genius to design or create things
- Engineers apply technology so need technical training in science and mathematics
  - This is only part of the training

Engineering: A Definition

- The profession in which knowledge of mathematical and natural sciences, gained by study, experience, and practice, is applied with judgement to develop ways to use, economically, the materials and forces of nature for the benefit of humanity.

Accreditation Board for Engineering and Technology (ABET)

Who in society can explain how this structure was formed?

A Scientist

Are scientists responsible for its design and construction?

Who in society can explain how this structure was formed?

An Engineer

Are engineers responsible for its design and construction?

Science ≠ Engineering

- Scientists explore what is, but engineers create what has never been.
  - *Theodore von Karman*

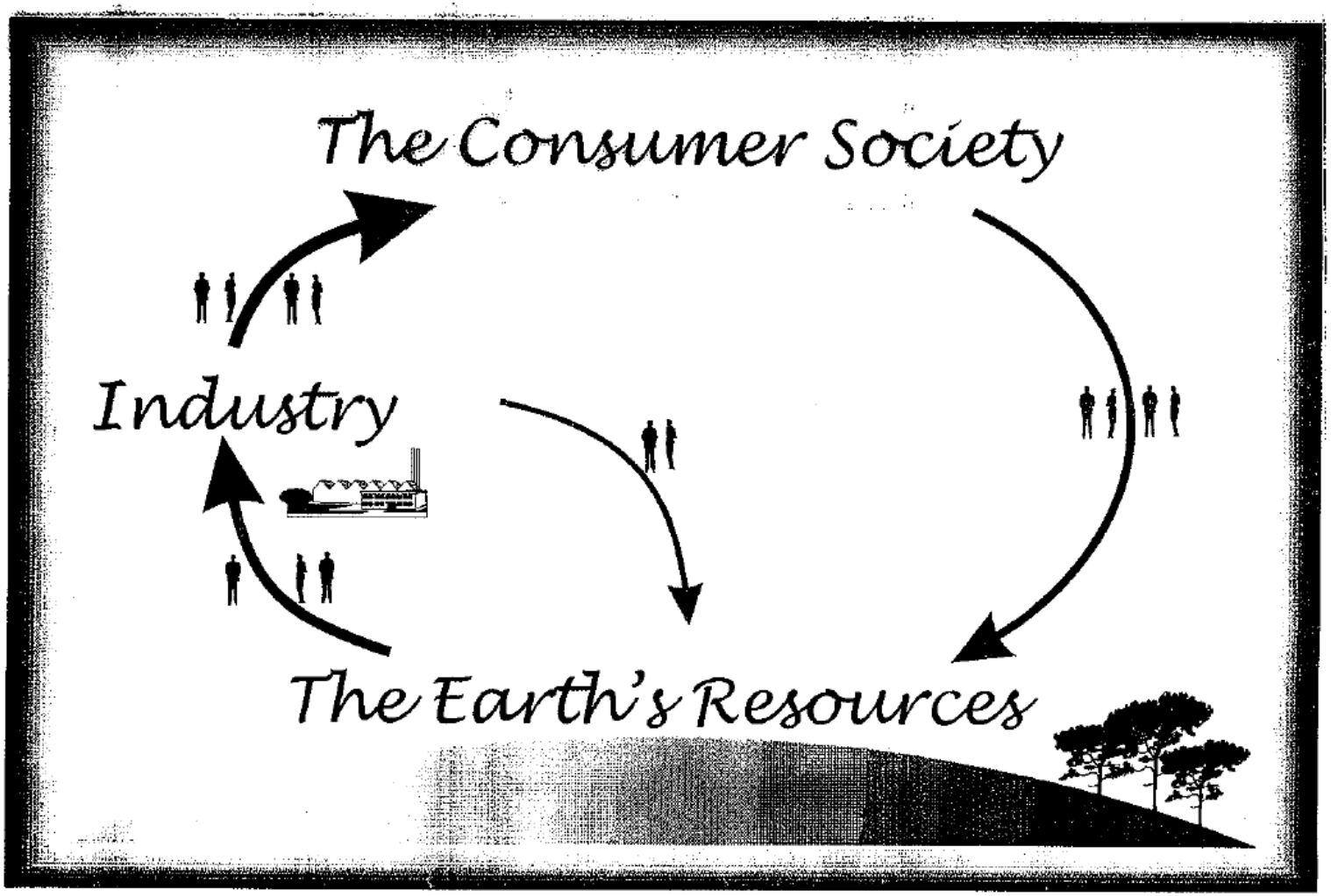
- Some [people] see things and they ask “why.” I dream of things that never were and ask “why not.”
  - *George Bernard Shaw*

- Science can amuse and fascinate us all, but it is engineering that changes the world.
  - *Isaac Asimov*

Engineering is not always visible, for example:

- Penicillin – antibiotic, critical in WW II
- Discovery: Alexander Fleming, and shared a Nobel prize with Howard Florey and Ernst Chain
- Large scale production happened using deep-tank fermentation
  - Adapted from fermentation used for food additives
  - Achieved by a **Chemical Engineer**, with a background in separation process and petroleum separations
- First plant made by Pfizer by 1943
  - technology foundation of pharmaceutical production for many other drugs and chemicals
- Dr. Margret Hutchinson
  - Bachelor of Chem Eng. – Rice University
  - PhD, 1937, MIT, first women in Chem Eng
  - First female member of the American Institute of Chemical Engineers

How Do Engineers Fit in Society?



SUSTAINABILITY is part of Engineering

What Kinds of Societal Needs Do Engineers Address?

- Clean water and safe food
- Shelter
- Energy
- Transportation
- Store and communicate information
- Good health and medical care
- National defense
- Clean environment
- New knowledge
- Entertainment and art

And doing so in such a way as not to compromise these possibilities for future generations!

Major Challenges Facing Society?

- Energy
- Water
- Air
- Food





Other Challenges Facing Society

Unexpected areas? Ways for engineers to have Impact?

- **Poll Question…..open ended text, word cloud!**

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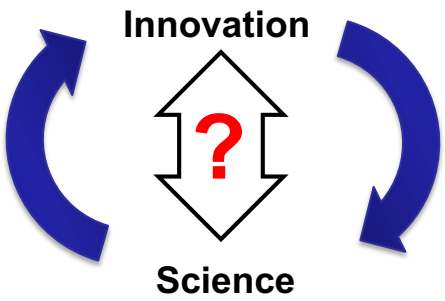
How would **YOU** as an engineer fit in society?

How would **YOU** as an engineer have impact?

Engineering Method

- Most engineering problems are *open-ended*
  - More than one possible solution
    - Doesn't necessarily make it easier to solve!
    - Often frustration that **there is no "right" answer**
- Often the problem doesn't contain enough information to apply a familiar technique
    - Assumptions may have to be made
    - Determining how reasonable the assumptions are comes with experience (and plenty of practice!)
- Sometimes engineering solutions have preceded the scientific theories that explain how and why they work



Engineering Skills

- In addition to traditional scientific skills, engineers must learn skills such as:
  - How to represent a design problem
  - How to make assumptions
  - How to generate possible ideas for designs
  - How to plan and schedule activities
  - How to make efficient use of resources
  - How to organise the components and activities of a team design project

Subsystems – Engineering Disciplines

- Study and practice of Engineering has evolved into a set of “subsystems”
  - Engineering Disciplines
- Engineers do not need to know the specifics of every discipline but understand the interfaces between them.
- Engineering is inherently *multidisciplinary*

How Many Different Engineering Disciplines Can You Name?

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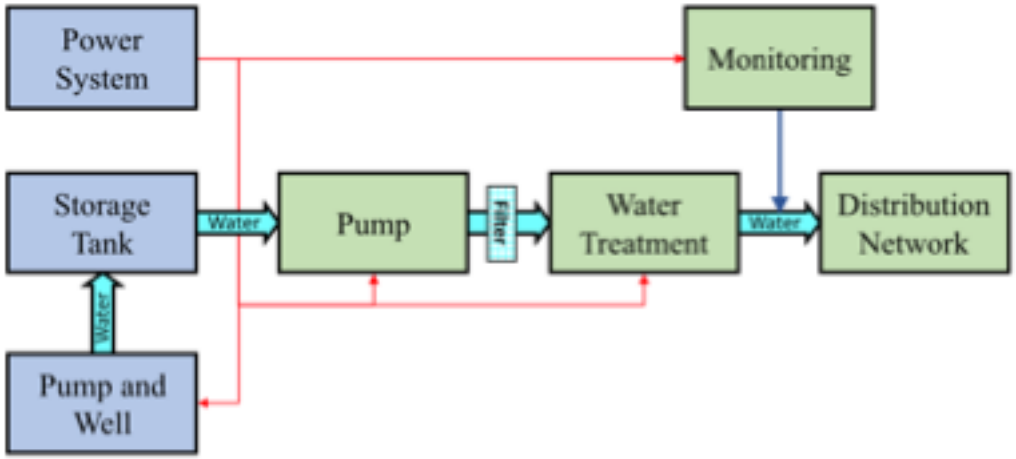
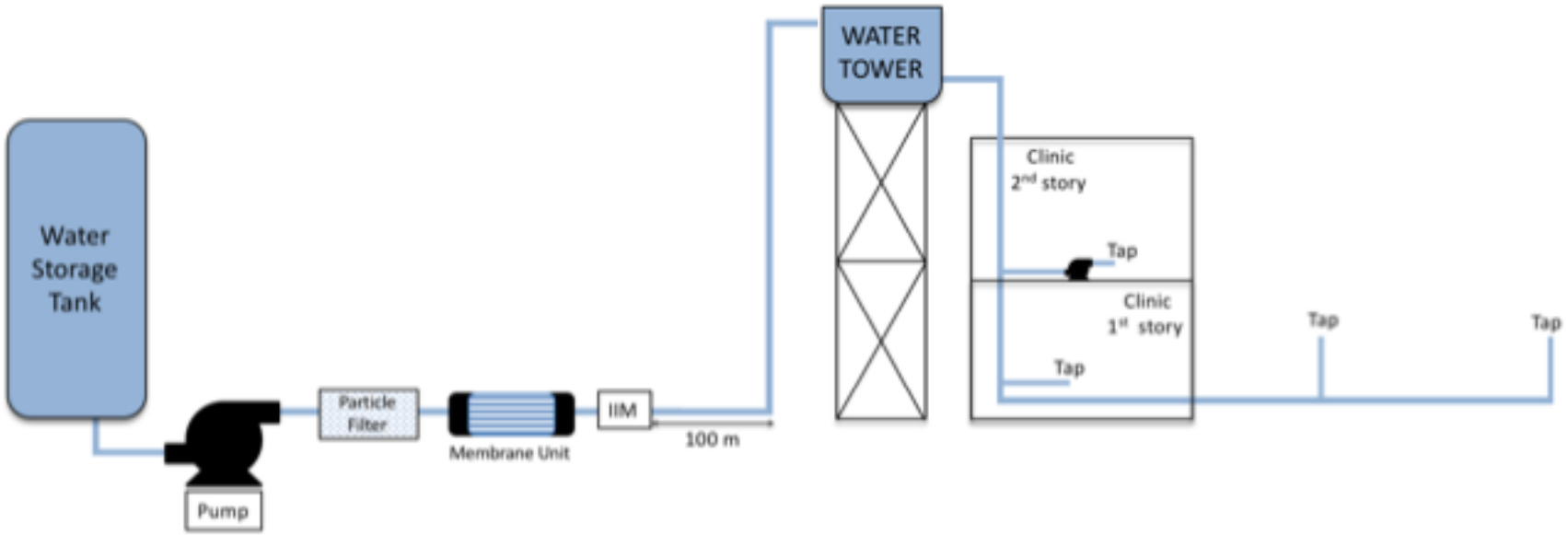
Civil Engineering
Mechanical Engineering
Electrical Engineering
Chemical Engineering
Aeronautical Engineering
Bioprocess Engineering
Earthquake Engineering
Geomatic Engineering
Marine Engineering
Naval Engineering
Petroleum Engineering
Software Engineering
Space Engineering
Telecommunication Engineering
Biomedical Engineering

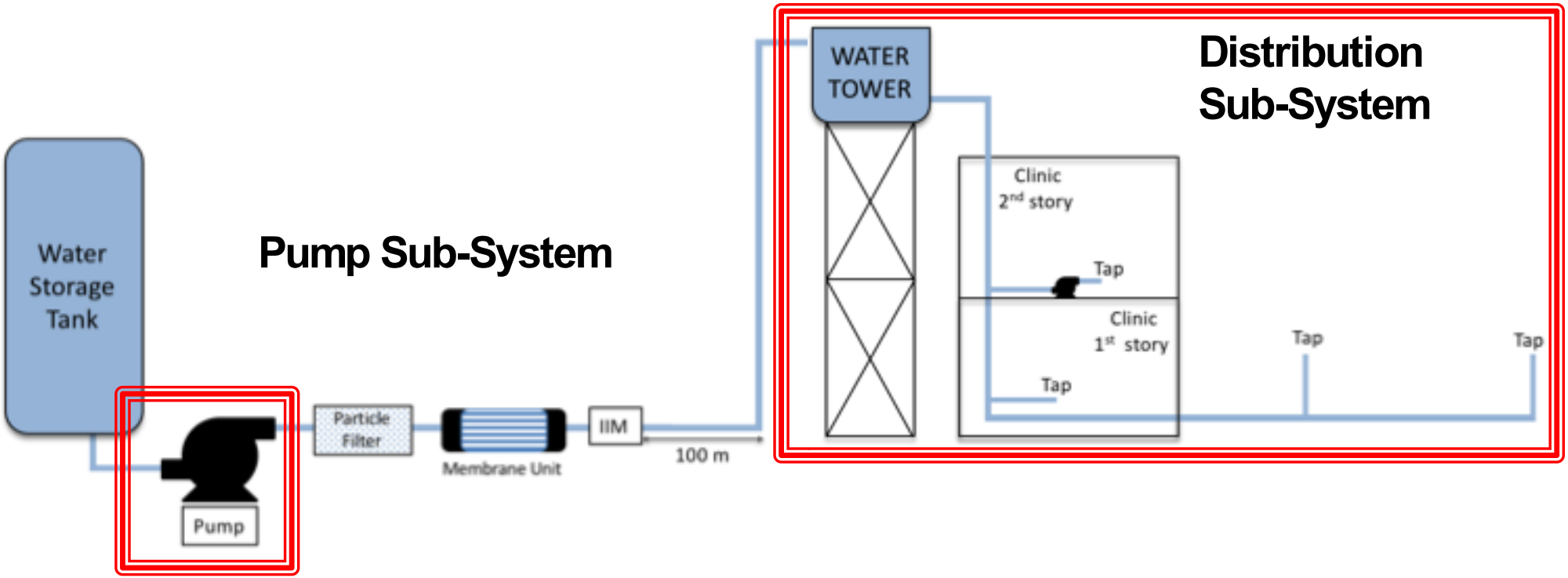
How do the disciplines relate to the Design Project?



What types of engineers work with each sub-system?



Breakdown by Sub-systems



Pump Sub-System

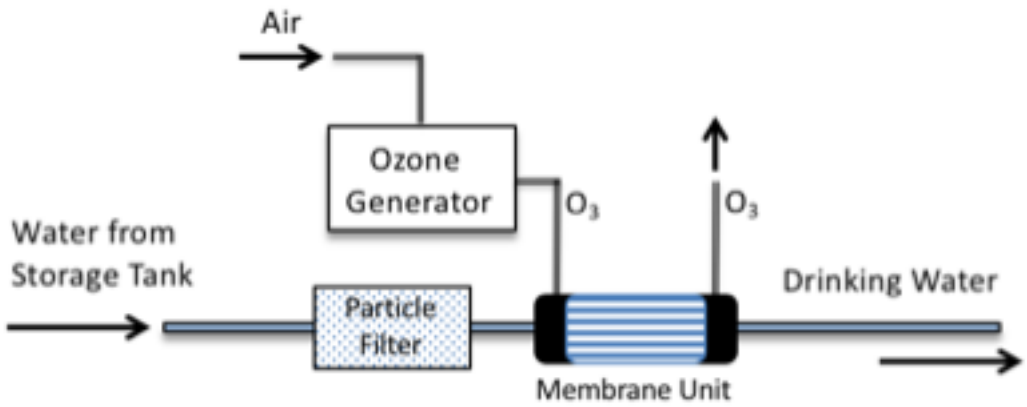
- Chemical Engineering
- Mechanical Engineering
- Civil Engineering
- Petroleum Engineering

Distribution Sub-System

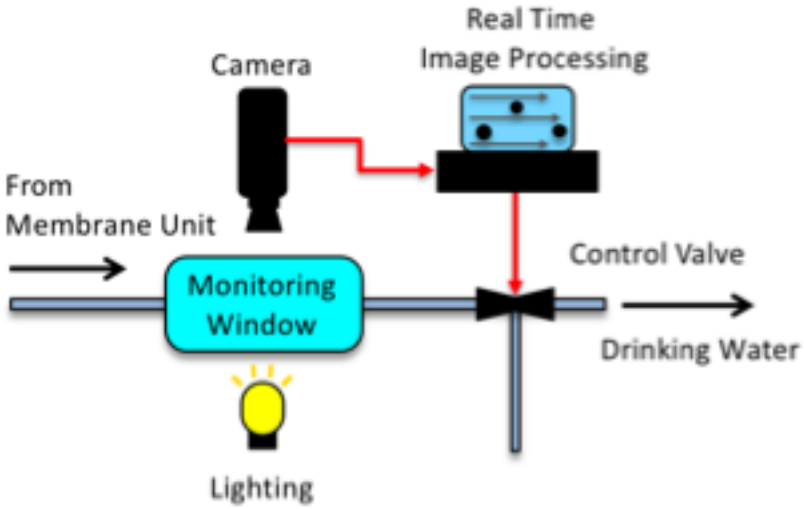
- Civil Engineering
- Construction Engineering
- Architect
- Chemical Engineering
- Mechanical Engineering

Breakdown by Sub-systems

Water Treatment Sub-System



Monitoring Sub-System



Water Treatment

- Chemical Engineering
- Civil Engineering

Membrane Units

- Biomedical Engineering
- Chemical Engineering
- Bioprocess Engineering

Monitoring Sub-System

- Biomedical Engineering
- Electrical Engineering
- Chemical Engineering
- Computer Science
- Software Engineering
- Control Engineering

Certification of Competence

- Accreditation: Engineers Australia
  - and discipline specific bodies (*e.g.* IChemE, ABET)

- Professional licensing:
  - Chartered Engineer (AU, Europe)
  - Professional Engineer (CA & US)

Industry survey of skills important in an engineer

Source : S. Male, M. Bush, E. Chapman, (2009) *Identification of competencies required by engineers graduating in Australia*, Proceedings of AAEE 2009 conference, Adelaide.

1. Business and management
2. Computer literacy
3. Ethical and professional behaviour
4. Motivation to continue learning
5. Open mind
6. Problem solving
7. Proficiency in maths and science
8. Teamwork and communication
9. Technical skills
10. Understanding world affairs

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Job Classifications

- Research and Development
- Design
- Analysis
- Testing
- Manufacturing/ Construction

- Sales
- Operations/ Maintenance/ Technical Support
- Management
- Law/Patents
- Education
- **Politician???!!!!**

Famous Engineers

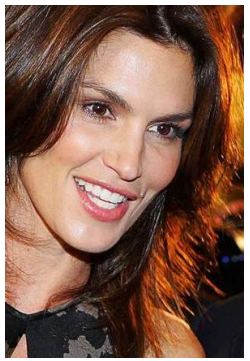
Can you name these famous engineers?












http://students.egfi-k12.org/famous-engineers/

Some Good Resources on the Web

- Engineers Australia
  - http://www.engineersaustralia.org.au/
- *TryEngineering*
  - http://www.tryengineering.org/
- *Sloan Career Cornerstone Center*
  - http://www.careercornerstone.org/