Who are the Innovators now?

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1. Pushing for Change? (Where is it coming from?)
2. U Canterbury and Curriculum Challenges
3. Are Incremental Curriculum Changes Enough?
4. Next Steps?

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1. Push for change-- UK

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- the funding and ranking-driven focus on research in many universities is constraining the development of innovative learning and teaching in engineering;

If the UK is to maintain and grow its strength in designing and building systems, we have to improve both the way that engineering is taught and the way that it is applied. We must produce and employ effectively engineers who bring to the design and implementation of projects:

- ***creativity*** – to devise novel, imaginative and effective solutions to the real problem and not to force the problem to match a solution
- ***analysis*** – using the tools and methods of mathematics and science, including the human sciences, to model and predict the behaviour of the interacting parts of complex systems
- ***judgement*** – using insight, experience and wisdom to reconcile the inevitable conflicts between competing demands and to align systems with customers' needs
- ***leadership*** – focusing on the right technical challenges & motivating others to succeed.

d more effective ways of ensuring that
irements of industry and enabling
e of industry as part of their education;

tems that work:
g systems for the 21st century

Push for change: North America

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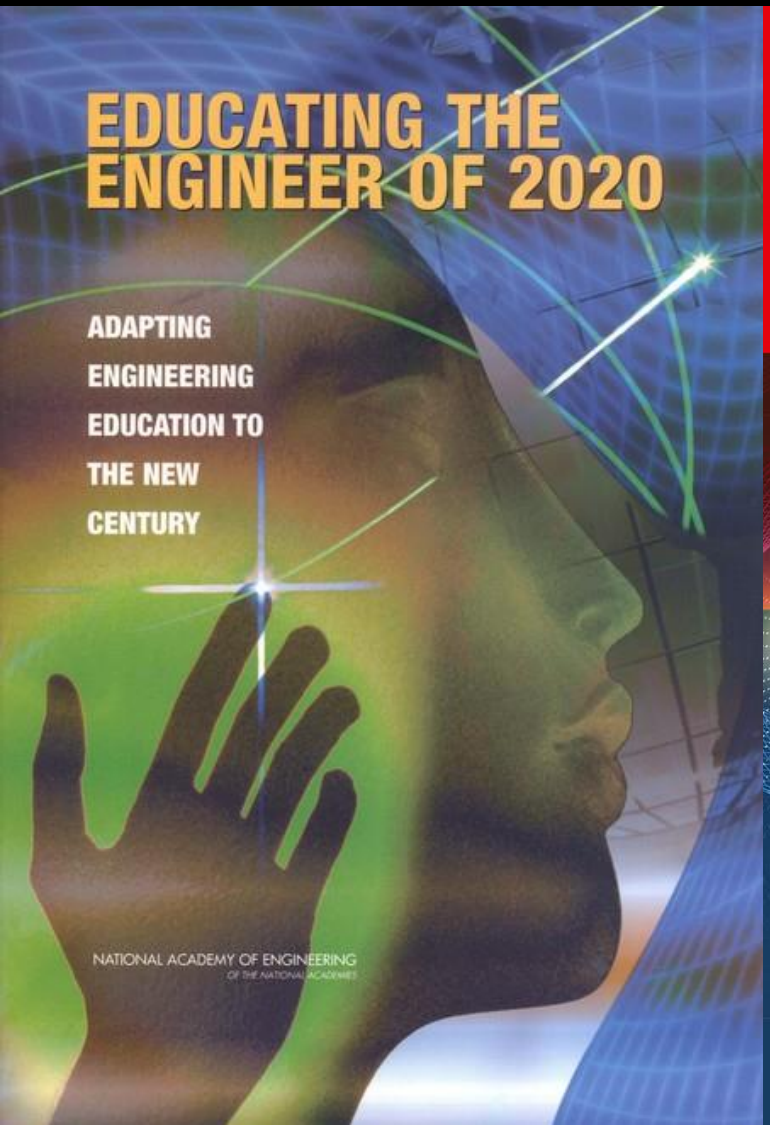

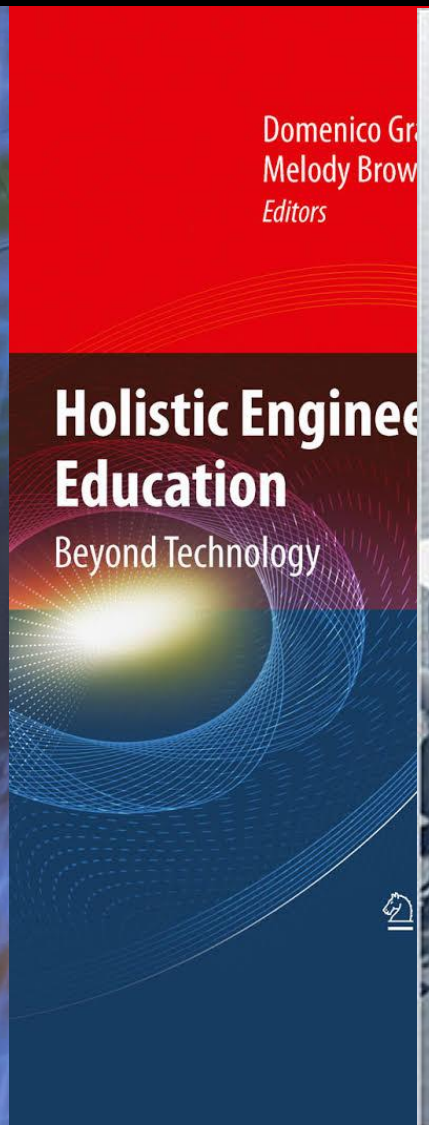

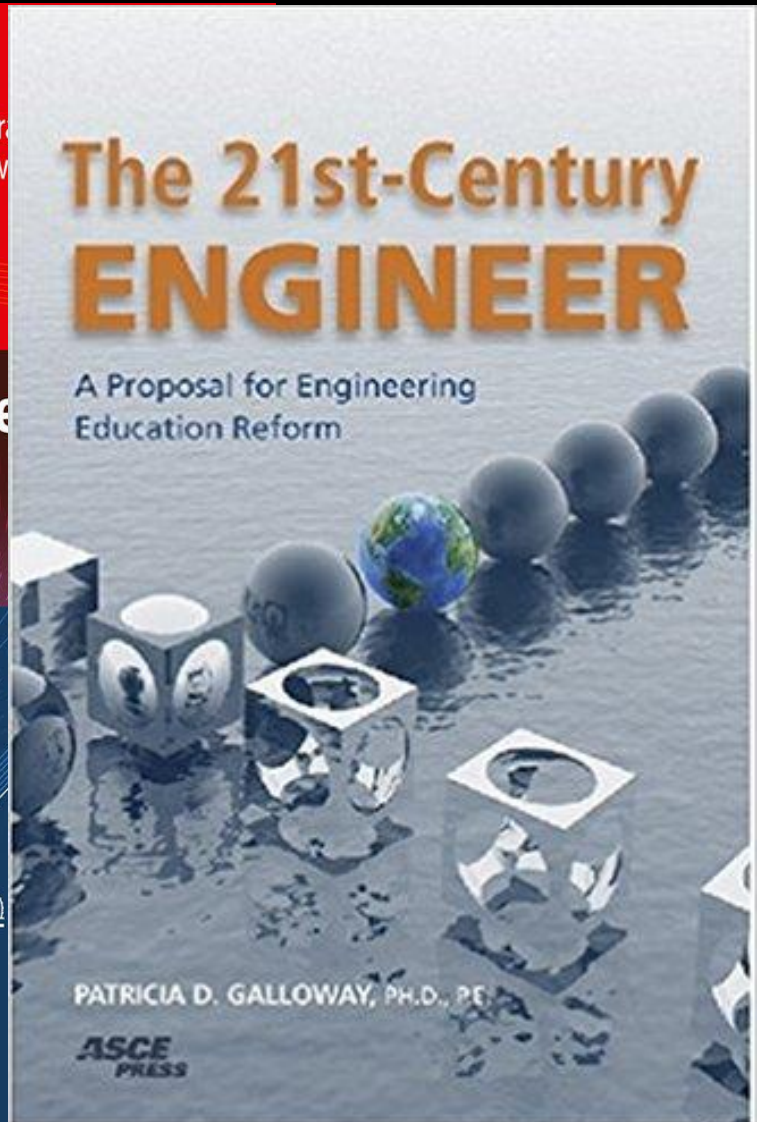

Graduates' ratings of strategies to keep higher education relevant showed that work placements; problem-based assessment rather than memorising facts; real-world case-studies; and projects that developed personal, interpersonal capabilities delivered by teaching staff with current industry experience were highly important but rated low on their extent of focus in study.

Push for change: Aust. and NZ

Overall, the report found there are a wealth of opportunities for engineers in Australia, with a pipeline of infrastructure projects creating a massive demand for civil and transport engineers in particular.

However, it also noted the growing emphasis being put on 'soft' or 'enterprise' skills such as communication, critical thinking and digital literacy.

The report found that employers in NSW are increasingly eager to hire candidates with these skills, making them more flexible in the types of candidates they consider.

"For example, we placed a British civil engineer who had no local experience but possessed strong interpersonal and communication skills and deals well with clients. Such softer skills are in short supply in the local market," the report states.

This trend is also evident in Victoria, where, according to the report, there is a shortage of what employers consider 'strong' candidates across most engineering disciplines.

"Employers typically request engineers who have a sound technical knowledge and can consult and manage clients. As in other states around the country, candidates with skills in both these areas are rare," the report states.

2. U Canterbury and Curriculum Challenges

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ABET Criteria for Accrediting Engineering Programs, 2014 - 2015
General Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as **economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability**

(d) an ability to function on **multidisciplinary teams**

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of **professional and ethical responsibility**

(g) an ability to **communicate effectively**

(h) the **broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**

(i) a recognition of the need for, and an ability to engage in **life-long learning**

(j) a knowledge of **contemporary issues**

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

http://www.abet.org/eac-criteria-2014-2015/

2. Curriculum Challenge: a. More conceptual design

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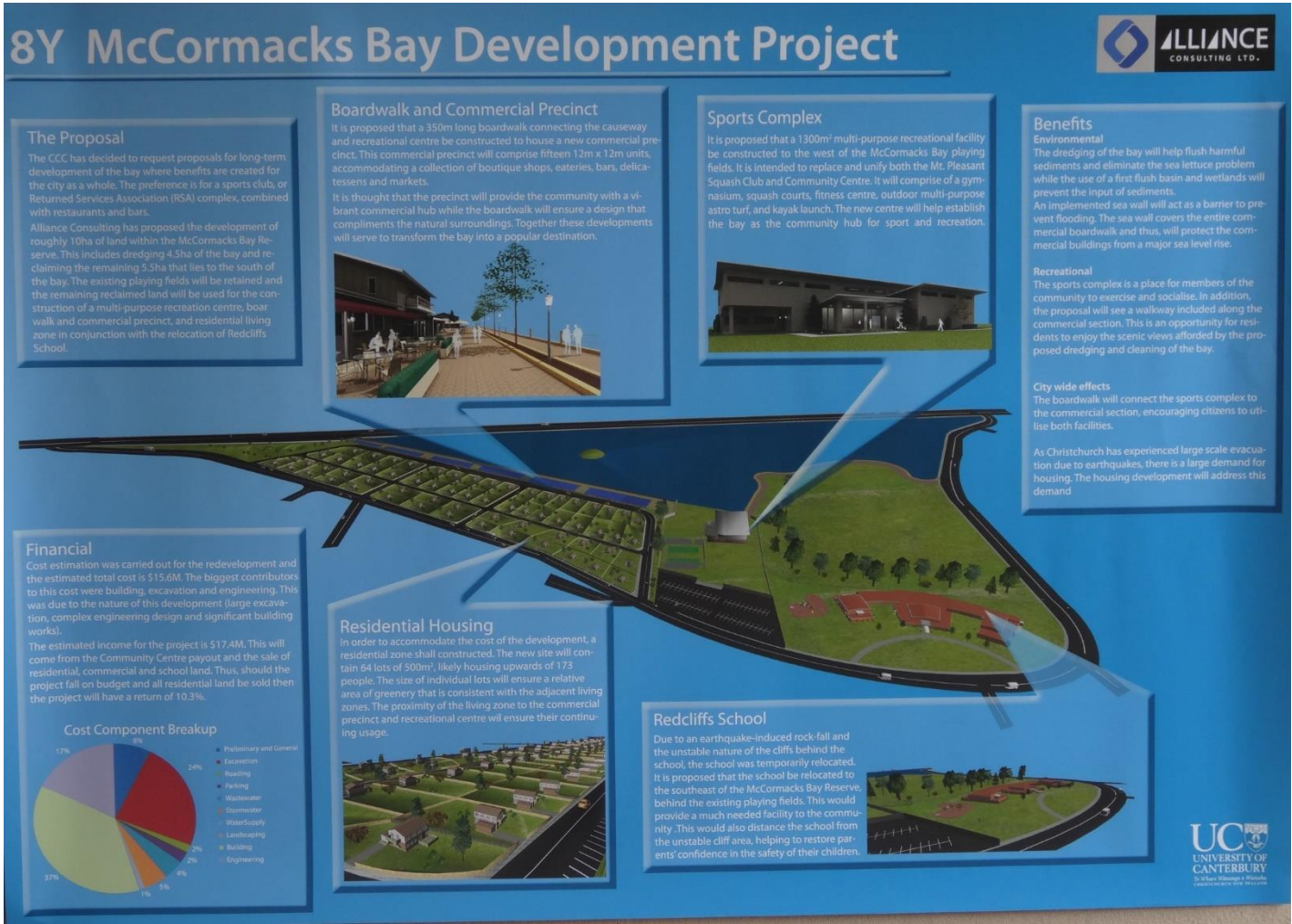
- Few lectures
- Engineers run tutorials as mentors



2. Curriculum Challenge: b. reports and writing

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Typical Year 4 Student before changes:

→ Disadvantages ↳ reference?

However, despite the advantages mentioned above, infiltration galleries comprise of several drawbacks such as pipe leakage, pipe protection, clogging of gallery and require skilled engineering labour for maintenance. Infiltration galleries can also be costly as pumps are required to extract the groundwater, occurrence of pipe leakages and if special equipment is required to support the tunnel sides.

Further investigation is still required to show an in-depth analysis of the infiltration gallery technology such as; its efficiency, affordability, design, impacts on human health, possible construction materials used, costs involved, equipments required, its operational life and some statistical values which support the findings.

→ give some examples that will be researched

There are also non-technical issues which need to be explored, such as economical, social, ethical, philosophical, cultural and political issues. These issues will be examined according to how they shape the implementation of the technology within the developing communities.

Portfolio Writing Programme

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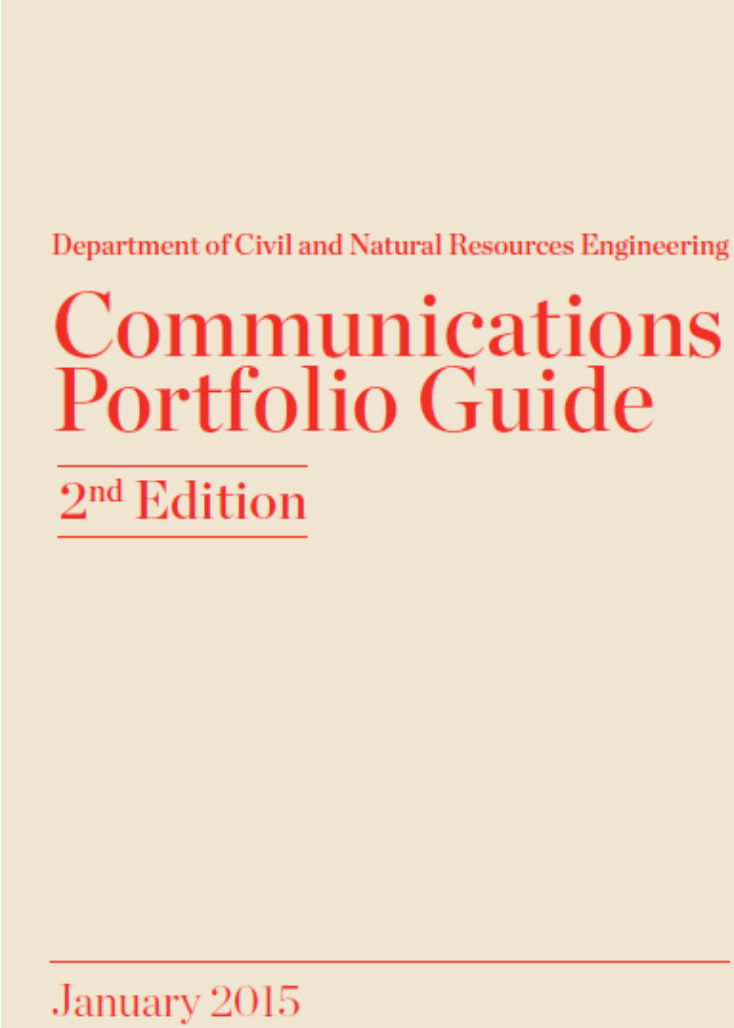
- **Students must reach professional standard on 6 items over Years 2 and 3**
- **Tutorial support provided**
- **Style guide and advice provided**
- **Peer review sessions**
- **Week-long courses for some**
- **$50 fee for each resubmission**


Department of Civil and Natural Resources Engineering

Communications Portfolio Guide

2nd Edition

January 2015

Current focus of Engineering/Engineering Education?

STEM?

Science, Technology, Engineering Mathematics

– all left-hand side of the brain thinking

But need to some right-hand side of the brain thinking – Add some **"A"**

Awareness, **A**ttitude,

Aptitude, **A**pplication

Aspiration, **A**rt!

From STEM to STEAM!

Who are we seeking to attract?

STEM nerds (and make them super nerds?) or STEM plus?

"STEAM!"

Need to provide separate learning pathways

(Test-based? Project-based?)

Need to find and use students' motivators

Principle Based/Value Driven or Personality Based/Image Driven?

Red: Leaders; Driven; Forceful; Dominant

Green: Cautious; Precise; Disciplined; Guarded

Blue: Considerate; Caring; Supportive; Consistent

Yellow: Outgoing; Enthusiastic; Passionate; Persuasive

Which type do we tend to attract?

Are we missing out?

Colourful personalities at work

Engineering Education:

Teaching and Learning Process?

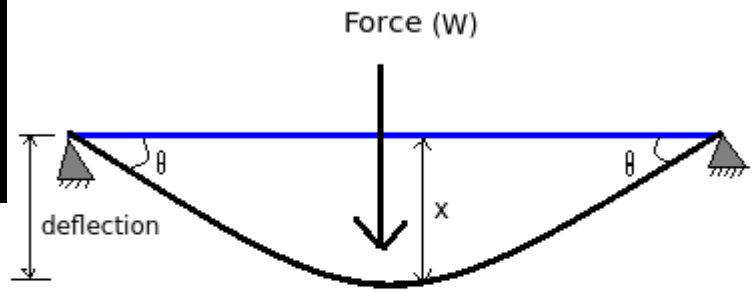
❖ **Process**:

- Use of Case Studies
- Studio Based
- Issue Driven
- Process Based
- Team Based
- Design/Delivery Focussed

Pulling relevant material into the curriculum,

not shoving more material into it…

How do we balance Rigour and Vigour?



Simply supported beam

Yes, our students need to be able "to do the sums". But there has to be life before and after $WL^3/48EI$ …

Remember the Telephone Directory entry!

"Boring – see Civil Engineering"

Options exist:

- **create open-ended laboratories**
- **stop "hand-holding" on fundamentals– challenge students**
- **bring creative dimension into the fundamentals courses too**

How much should we worry about accreditation?

JBM
JOINT BOARD OF MODERATORS

versus

Who are the real bogeymen?
The JBM? or our inner demons?

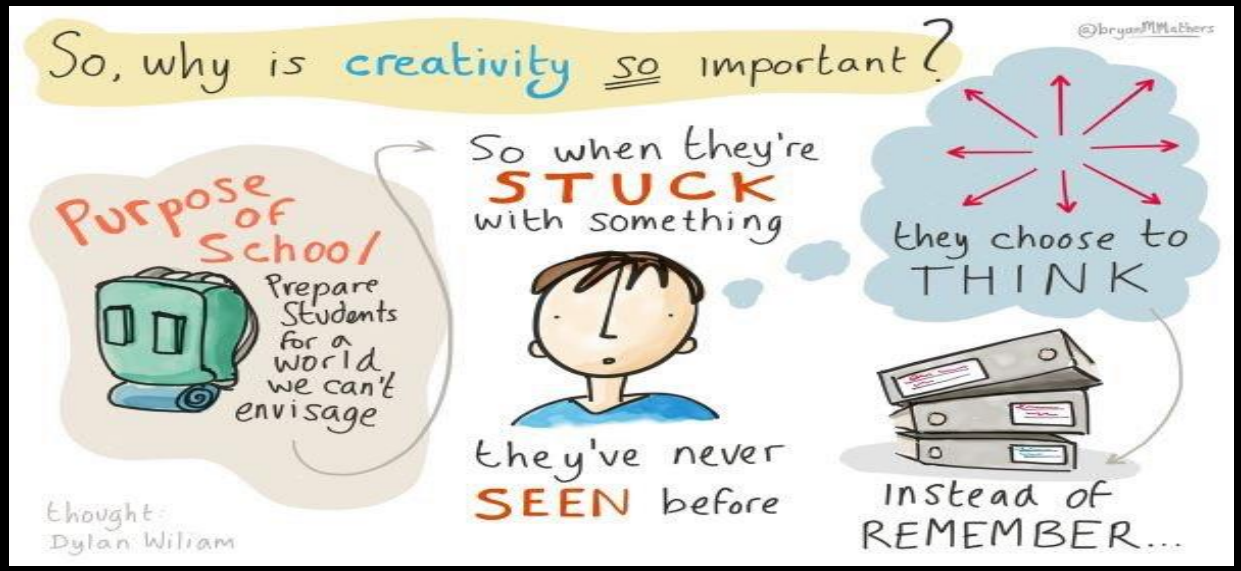
"Slaying the dragon!"

Next slide…

… a recent communication from Perry Shard (Balfour Beatty and Chair, University of Liverpool ILC)

All "left field"…

… but very "right-hand side" of the brain



from Perry Shard

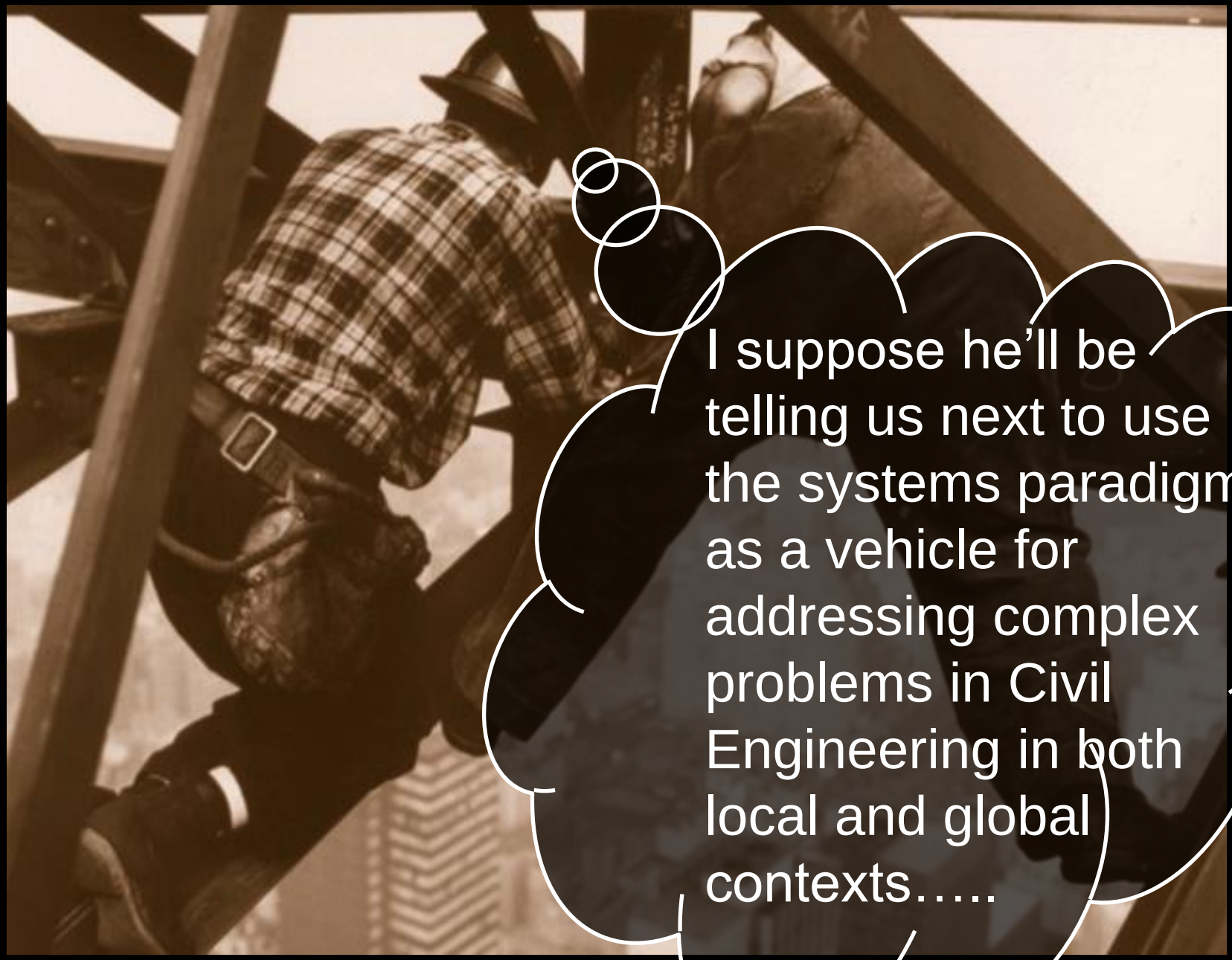
ADVOCACY	**CHALLENGE**	**CONFIDENCE**	**CONTEXT**	**DELIVERY**
EXPERIENCE	**FRAMEWORK**	**FREEDOM**	**INSPIRING**	**MENTORING**
MESSAGING	**NETWORKING**	**PLAY**	**REALITY**	**REWARDING**
SIGNPOSTING	**SKETCHING**	**SPACE**	**STATUS**	**STIMULUS**

And what was JBM response?

<u>Entirely positive, Exemplary, "Best Practice"</u>

Are we doing the best we can to develop civil engineers to solve tomorrow's problems?

1. **Large Scale/Systems Scale Problems**
   - Basin Scale Water Resources Management
   - Large Scale Urban Regeneration
   - Asset Management/Infrastructure Integrity
   - International Development/UN SDGs
   - Climate Change/Energy
2. **The Whole of the Construction Process**
3. **Risk/Safety/Health**
4. **Waste Min/Resource Management**
5. **<u>Sustainable Development</u>**
6. **<u>Resilience</u>**


I suppose he'll be telling us next to use the systems paradigm as a vehicle for addressing complex problems in Civil Engineering in both local and global contexts…..

3. Are incremental curriculum changes enough?

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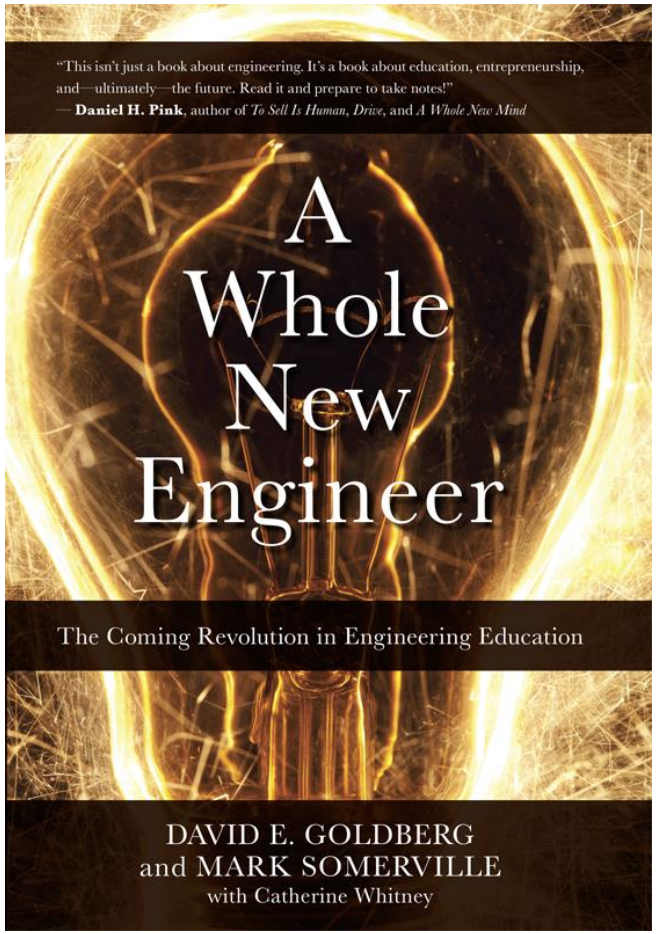
- http://nmite.org.uk/

NMiTE and Olin designed for software, electrical, mechanical engineering education.

What about Civil?



http://wholenewengineer.org/

3. Will the Civil Engineering Education Revolution be different?

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- How to have students build something at full scale?
- How to teach an equivalent of **C**onceive-**D**esign-**I**mplement-**O**perate?
- How to get more value from work placements?
- How to cover "extra" breadth employers want?
- How to develop civil-specific interdisciplinary studies?
- How to prepare students in civil engineering systems and complexity?
- How to avoid an education budget blowout?

For more: see ***Civil Eng. and Env. Systems***, v. 34, p. 78-87, 2017.
http://dx.doi.org/10.1080/10286608.2017.1313246

4. Next Steps

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International Evaluation of Civil Engineering education revolution

Survey of today's methods and attitudes using Google Forms

Potential contributors to joint report or edited book