



ENGINEERING ACADEMY OF THE CZECH REPUBLIC

Thinking like an Engineer

Some Ideas from Britain and Germany

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GENERAL CONCLUSIONS

- *The most important finding is that teachers of engineering must be really engaged with the question: 'how do engineers think?'*
- *Understanding more about how engineers think could help teachers of engineering when they are constructing curricula, selecting teaching and learning methods and assessing learner progress on a course.*
- *Understanding more about how engineers think may also offer some clues as to how engineering careers can be more effectively presented to young people.*



CONCLUSION 1 – What it is to Think Like an Engineer

- ***How do engineers think and act ?***



SIX ENGINEERING HABITS OF MIND (EHoM)

1. Systems thinking
2. Adapting
3. Problem-finding
4. Creative problem-solving
5. Visualising
6. Improving.

16 Habits of Mind

- ***1 Persisting***
- ***2 Thinking and communicating with clarity and precision***
- ***3 Managing impulsivity***
- ***4 Gathering data through all senses***
- ***5 Listening with understanding and empathy***
- ***6 Creating, imagining, innovating***
- ***7 Thinking flexibly***
- ***8 Responding with wonderment and awe***
- ***9 Thinking about thinking meta-cognition***
- ***10 Taking responsible risks***
- ***11 Striving for accuracy***
- ***12 Finding humour***
- ***13 Questioning and posing problems***
- ***14 Thinking interdependently***
- ***15 Applying past knowledge to new situations***
- ***16 Remaining open to continuous learning***

CONCLUSION 2

A NEED TO REDESIGN THE EDUCATION SYSTEM

‘How best can the education system develop learners who think and act like engineers?’

Although there is considerable innovation at HE where there is more of a tradition of experimentation and exploration in pedagogy, there is :

- ***Virtually no engineering at primary level, except some highly innovative engineering education initiatives***
- ***Very limited delivery of engineering opportunities at secondary level although with a few strong examples in UTCs and specialist schools***

CONCLUSION 2 (cont.)

A NEED TO REDESIGN THE EDUCATION SYSTEM

Methods identified most likely to cultivate the engineering design process :

- ***Some signature pedagogies, in the main related to the engineering design process, which are centrally important***
- ***A number of core learning methods relevant to specific EHoM***
- ***A range of proven and underused vocational teaching and learning methods***
- ***If such a clarity of pedagogy was achieved, it would be easier to consider development issues for creating a workforce skilled in teaching engineering to younger students***

CONCLUSION 3

THINKING ABOUT ENGINEERS AND ENGINEERING MORE GENERALLY

Some more general messages on this issue which may have relevance both for the engineering and learning community and for use with the general public (some are positive and some critical of the status quo):

- ***Some aspects of thinking and acting like an engineer – making and fixing stuff – are core to what makes us ‘homo practicus’***
- ***Too many primary and secondary schools almost managed to extinguish the prototype engineers latent in young children***
- ***The value of thinking and acting like an engineer for work and for the rest of life***
- ***The close relationship between engineering habits of mind and wider employability skills***

CONCLUSION 3 (cont.)

THINKING ABOUT ENGINEERS AND ENGINEERING MORE GENERALLY

- ***Participation in well-designed project-based learning is an excellent preparation for the kinds of wider life skills that we all need in order to be able to thrive***
- ***The advisability of having better methods of helping young people to think like engineers at school, college and at university,***
- ***The model of engineering habits of mind may provide a framework for developing a better understanding of engineering among the general public.***

RECOMMENDATIONS – For the Engineering and Learning Community

- **Dissemination of core messages**

- **Signature pedagogies for engineering**

In terms of teaching and learning, approaches such as project-based and problem-based learning are actively promoted as methods for building the engineering habits of mind that will enable them – or indeed anyone – to be successful in the complex real world

- **Developing teacher capacities**

- **Improving transitions**

Supporting transitions between education sectors for student engineers

RECOMMENDATIONS – Changing Mindsets in Schools and Colleges

The invisibility of engineering in primary and secondary schools requires a radical change of attitude among teachers and, most importantly, among headteachers.

- ***Taking opportunities to extend teaching and learning***

Increasing numbers of schools are providing extended teaching time – whole days, whole weeks – rather than a diet of short lessons and engineering projects are ideal for this approach.

- ***Making school a foundation for lifelong learning***

Given the widely accepted view that schools have a key role in developing wider skills – for example, problem-solving, thinking, creativity – engineering is ideally placed as a means of doing this.

- ***Taking stock of innovations that work***

This might be a good time to take stock of their approaches to the teaching and learning of engineering and share these more widely across the sector.

RECOMMENDATIONS – Employers and the Wider Public

- **Building a political consensus**

Thinking like an engineer might contribute to a national conversation about the value of engineering in society.

- **Engaging employers**

Employers are recommended to engage in a conversation about the usefulness of focusing on 'how engineers think'; and to encourage their staff to share their knowledge with schools, colleges and universities to develop EHoM.

- **Collaborating with providers of family and extra-curricular learning**

There are many including the U3A, after-school clubs and many local bodies offering opportunities to experience engineering at first hand.



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Making Design Engineering Fascinating (1)

- ***Present design engineers act as developers, drivers and originators in the process of creating new products and thus have direct influence on the the success of manufacturing companies***
- ***Future design engineers will also be managers capable of planning, managing and supervising projects both as part of a team or on their own. **They will have to keep the whole picture in mind all the time – product, system, environment, new approaches, competition, economy and society.*****

Making Design Engineering Fascinating (2)

- *Tasks performed by a design engineer depend on the company they work for. **The job profile of a design engineer is consequently by no means clearly and precisely defined.***
- *In Germany there is currently a wide variety of educational pathways to becoming a design engineer, including vocational training combined with in-house apprenticeship, continuing professional development or studying at a university.*

Making Design Engineering Fascinating (3)

Public Perception

- *There is little awareness of the wide variety of skills a design engineer must possess taking into consideration the not quite clear understanding of the difference between a design engineer and a mechanical engineer.*
- *Consequently it is not surprising that young people and their parents have an unsatisfactory image about what involves being a design engineer and are unlikely to choose it as a profession they wish to pursue.*

Making Design Engineering Fascinating (4)

What should be done

- ***The profile of a “design engineer“ should more clearly defined and vigorously promoted***
- ***The relevant study courses should be better, both in terms of their content and teaching methods, at preparing students to work as design engineers***
- ***Companies should take the opportunity to tackle the shortage of design engineers by offering jobs with realistic terms of employment, status and career development.***
- ***New continuing professional development programmes for design engineers should be introduced***

Thank you for your kind attention

