ROYAL ACADEMY OF ENGINEERING

Visiting Professors

2018 Induction

Dr Rhys Morgan
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Royal Academy of Engineering

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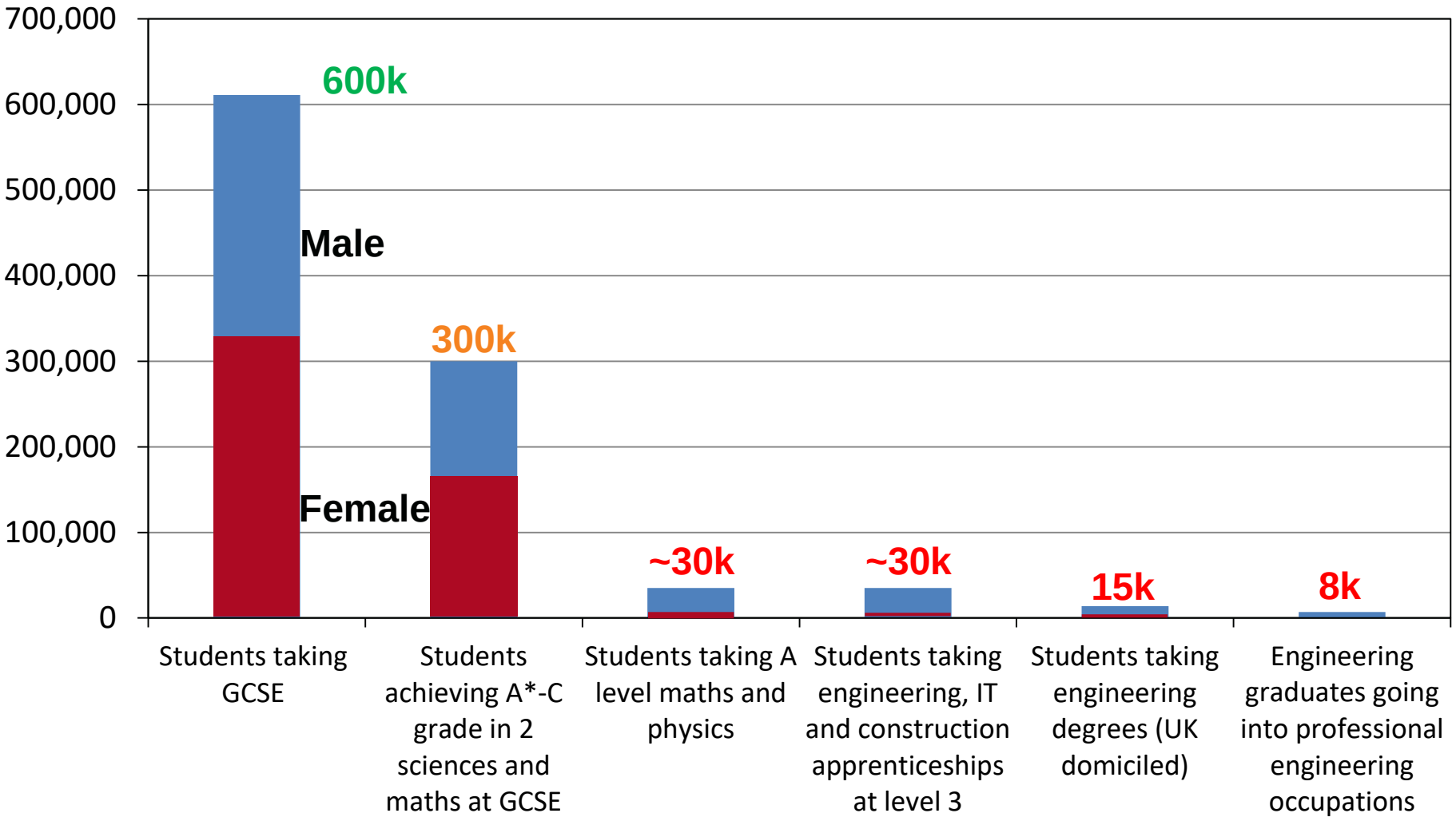
Engineering skills in the UK

Skills Supply - UK



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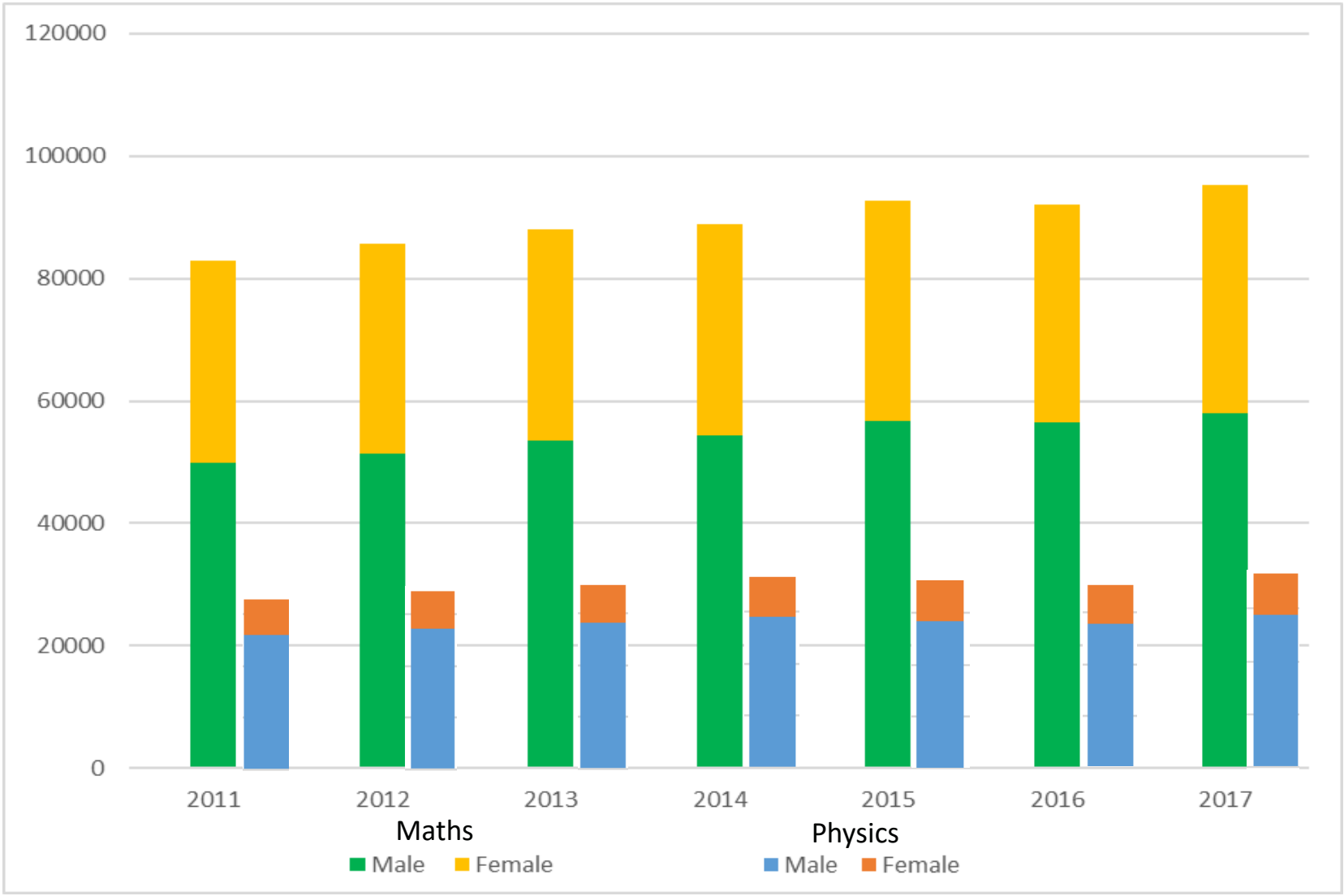
Maths and Physics A levels



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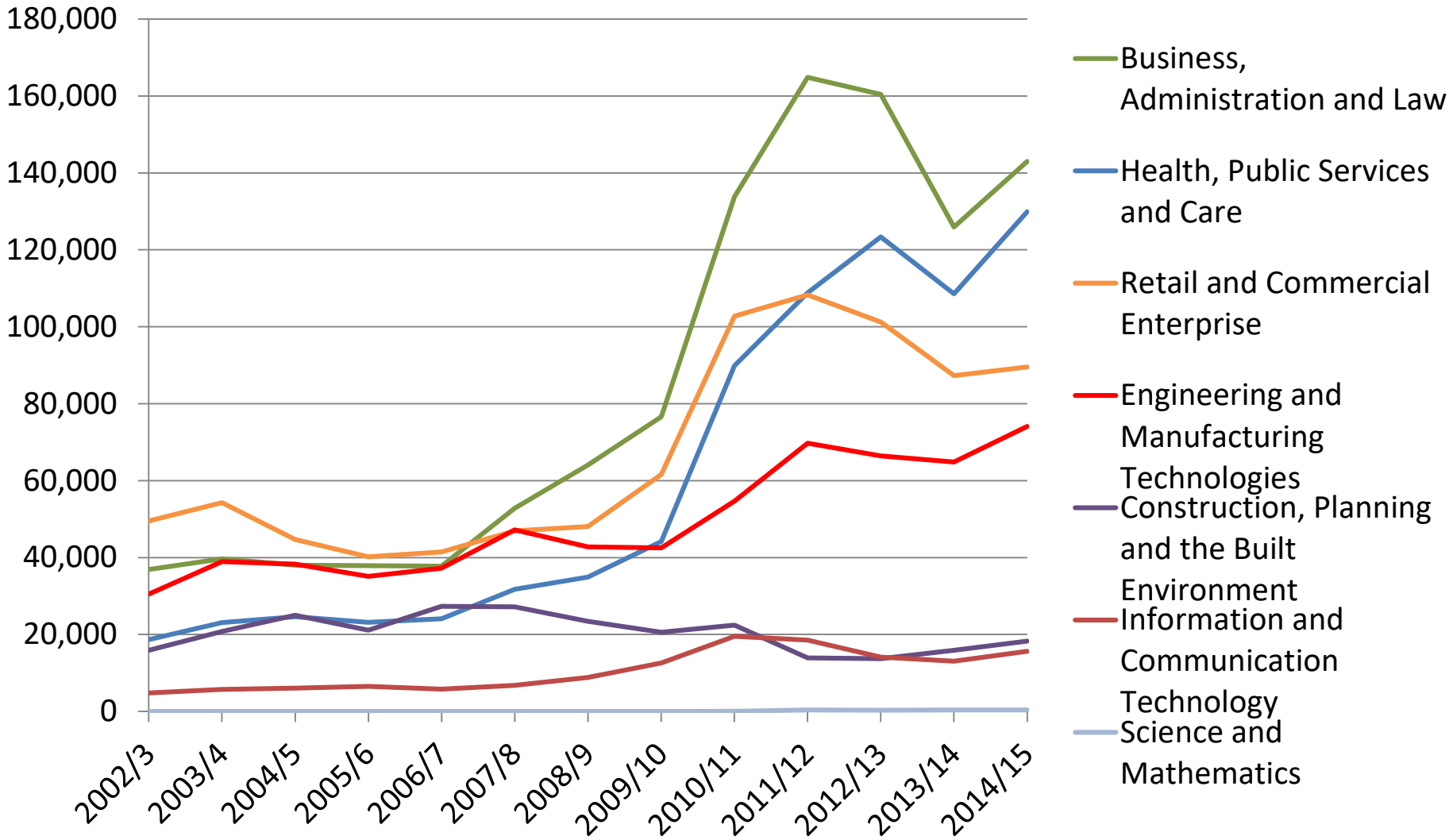
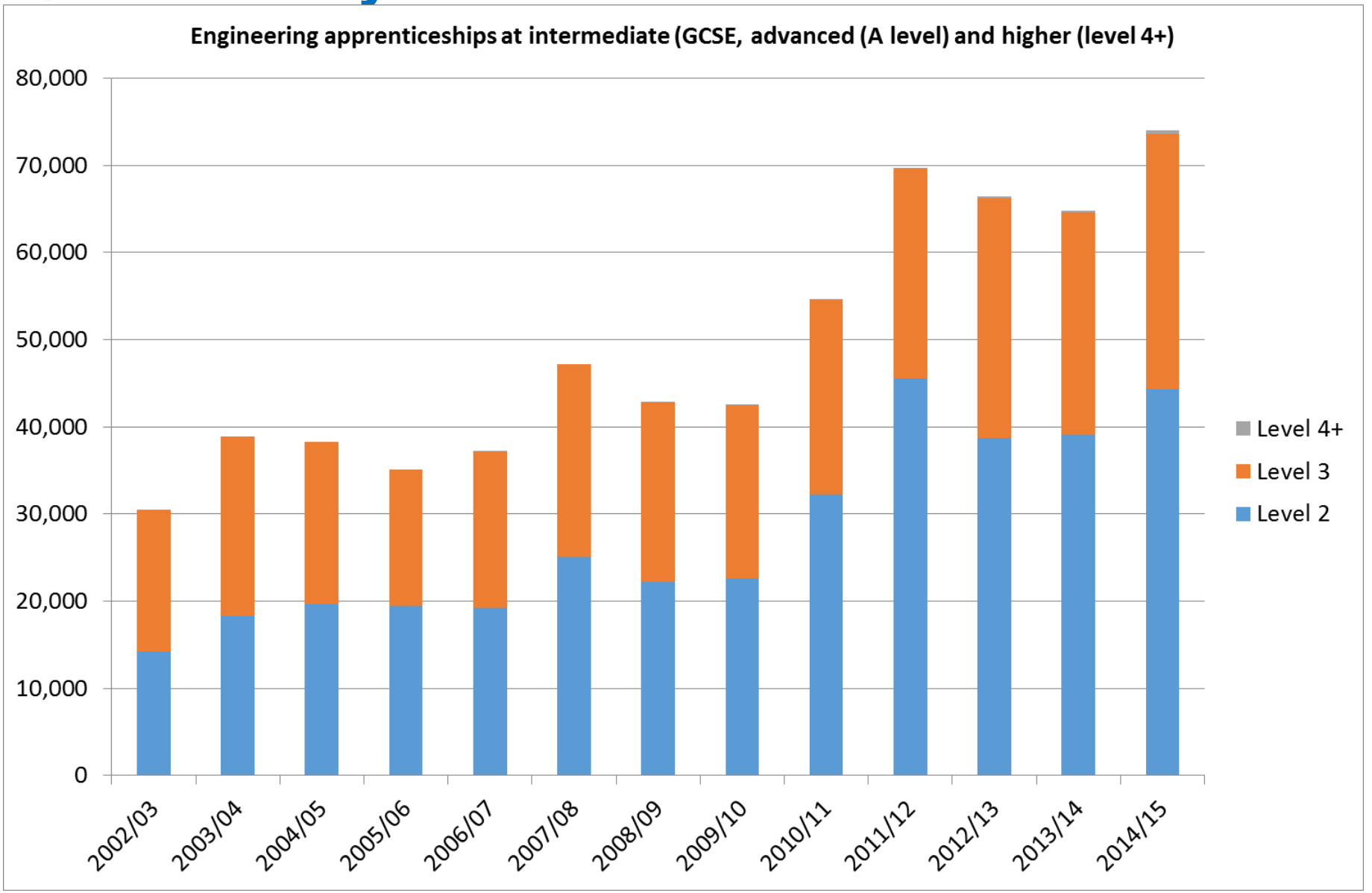
Apprenticeship starts



Engineering apprenticeship starts by level



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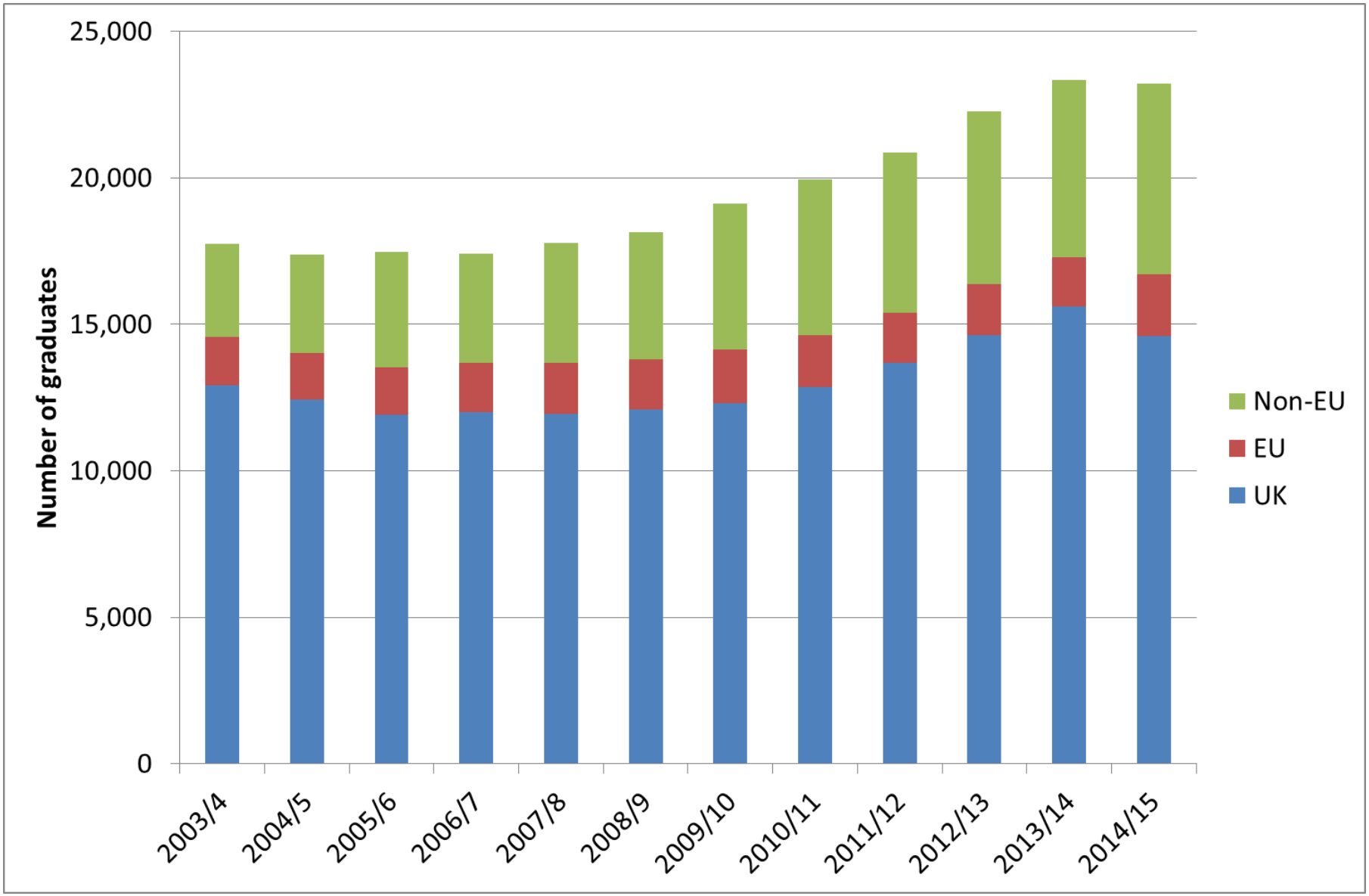
First degrees in engineering



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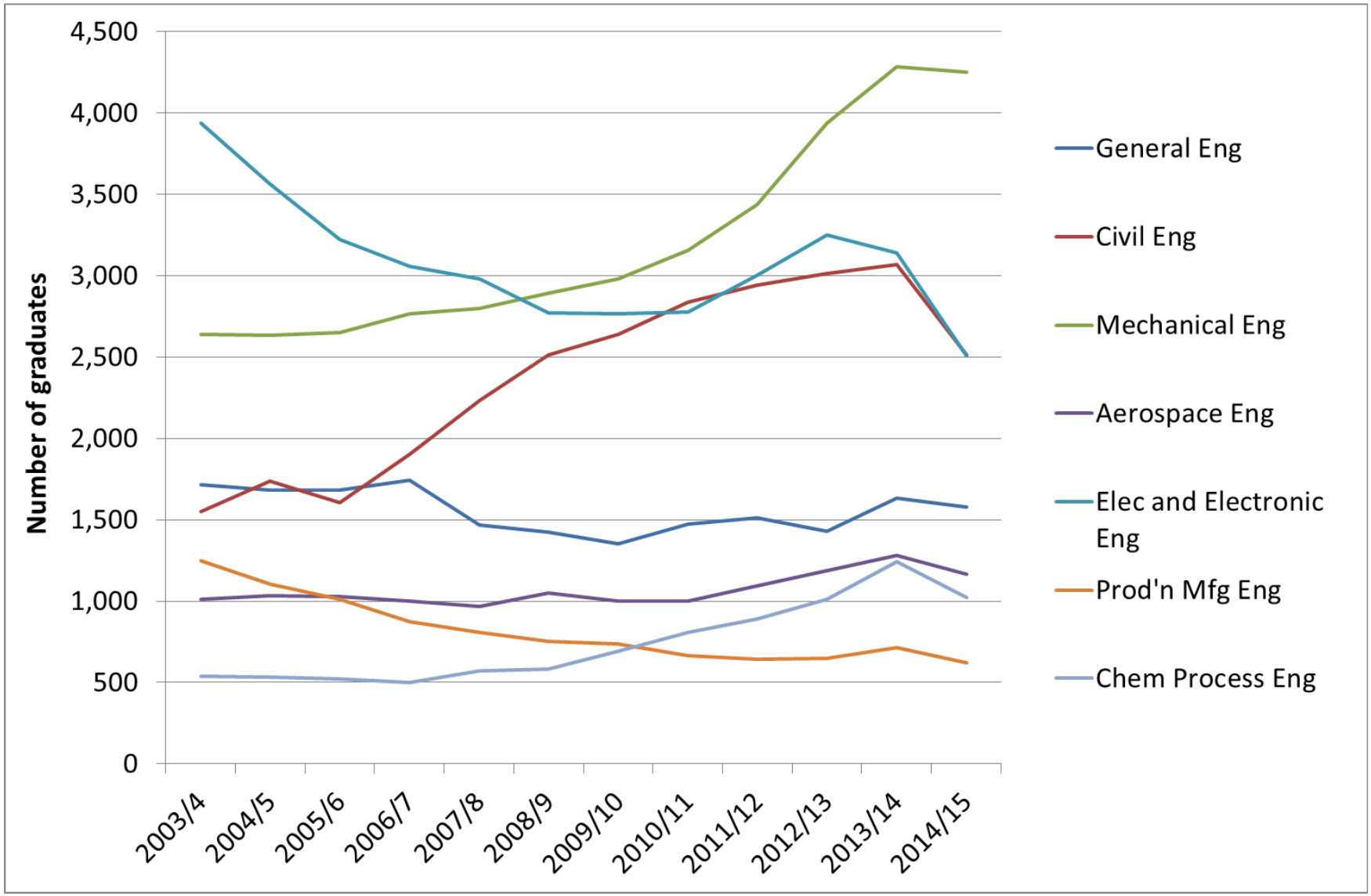
First degrees by discipline



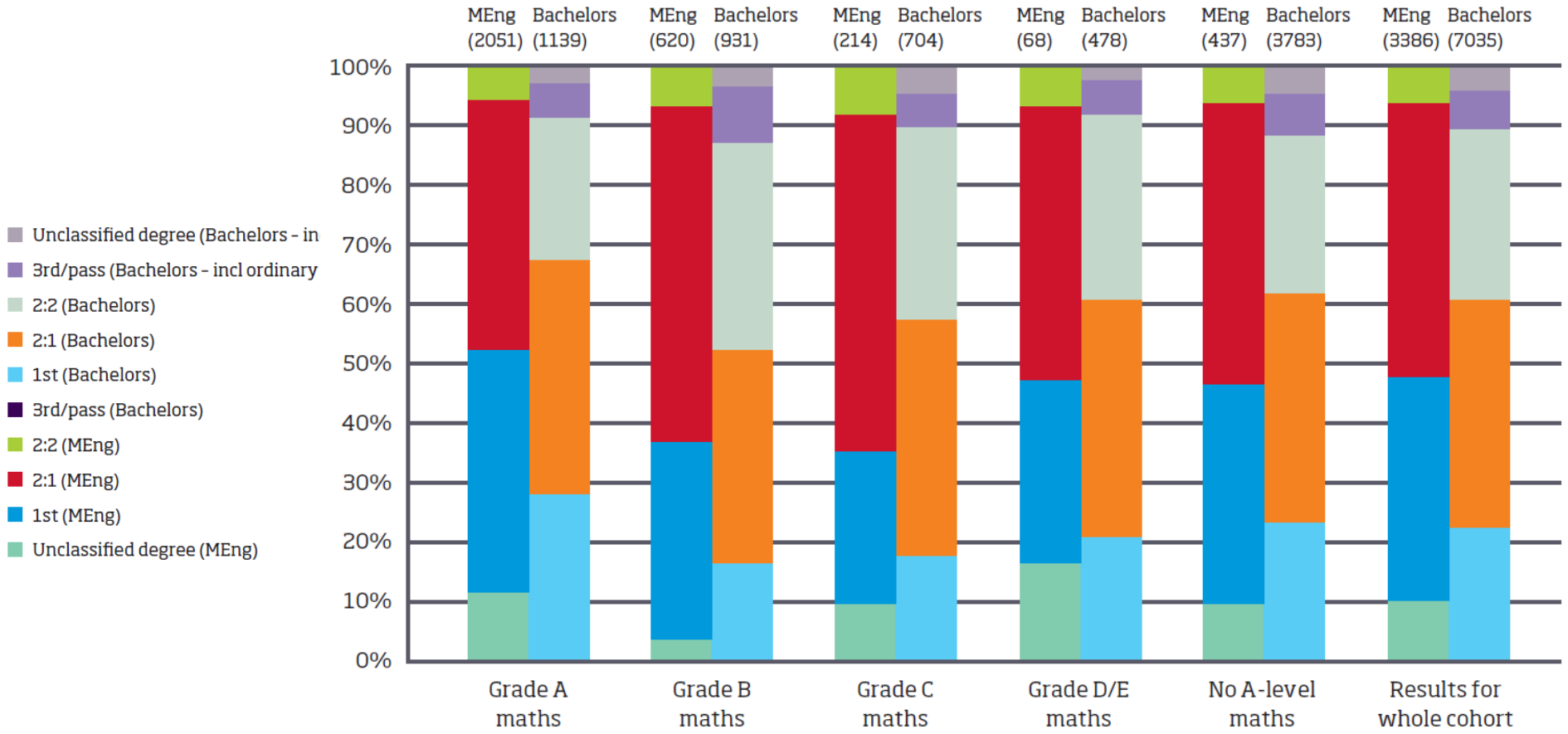
The importance of maths and physics

Qualification	Pre-1992 University	Post-1992 University	Total
A level Maths	70.0%	22.1%	51.6%
A level Physics	59.8%	18.8%	44.1%
A level Chemistry	26.6%	5.5%	18.5%
A level General Studies	14.0%	7.3%	11.4%
A level Further Maths	13.0%	0.7%	8.3%
A level Biology	10.6%	4.3%	8.2%
A level Design and Technology	7.8%	7.3%	7.6%
A level Computing	3.2%	3.0%	3.1%

from "Pathways to success…" report. Royal Academy of Engineering 2015

The importance of maths and physics

- No statistical correlation between degree classification and A level maths results (or lack of maths) for MEng or BEng



from "Pathways to success…" report. Royal Academy of Engineering 2015

Employment outcomes from engineering are strong

Destination	Full-time work only	Part-time work only	Work & further study	Further study only	Unemployed	Other	Engineering occupation
Engineering graduates							
First destination (total)	60.0%	6.7%	7.6%	13.0%	9.8%	2.9%	54.5%
Long destination (total)	83.7%	2.2%	3.3%	6.9%	2.5%	1.3%	68.9%
All graduates							
First destination (total)	47.9%	14.8%	10.3%	15.1%	8.8%	3.2%	
Long destination (total)	73.4%	6.9%	5.3%	9.0%	2.5%	2.9%	

Table 1. 'Long' (40 month) and first destinations of 2010/11 graduates. First destinations based only on those responding to both surveys

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Table 1. 'Long' (40 month) and first destinations of 2010/11 graduates. First destinations based only on those responding to both surveys

Employment outcome within engineering occupations are very strong

Destination	Full-time work only	Part-time work only	Work and further study	Further study only	Unemployed	Other	Engineering occupation
Engineering graduates							
First destination (total)	60.0%	6.7%	7.6%	13.0%	9.8%	2.9%	54.5%
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Table 1. 'Long' (40 month) and first destinations of 2010/11 graduates. First destinations based only on those responding to both surveys

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Gender

Destination	Full-time work only	Part-time work only	Work and further study	Further study only	Unemployed	Other	Engineering occupation
2013/14 – Engineering graduates							
Male	66.0%	7.2%	3.4%	11.3%	7.9%	4.2%	56.1%
Female	65.3%	5.4%	5.0%	12.7%	6.1%	5.6%	52.4%
Total	**65.9%**	**7.0%**	**3.6%**	**11.5%**	**7.7%**	**4.4%**	**55.6%**

Table 2. First destinations of graduates, by gender

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Ethnicity

Destination	Full-time work only	Part-time work only	Work & further study	Further study only	Unemployed	Other	Engineering occupation
2013/14 - Engineering graduates							
Black	45.9%	12.8%	4.5%	17.9%	14.3%	4.6%	36.7%
Asian	52.0%	10.4%	3.0%	17.0%	13.0%	4.8%	40.9%
Mixed/Other	52.3%	8.2%	2.9%	18.1%	13.8%	4.7%	43.4%
All BME	*50.6%*	*10.5%*	*3.4%*	*17.5%*	*13.5%*	*4.7%*	*40.4%*
White	70.8%	5.9%	3.7%	9.5%	5.8%	4.3%	60.4%
Total	**65.9%**	**7.0%**	**3.6%**	**11.5%**	**7.7%**	**4.4%**	**55.6%**

Table 3. First destinations of graduates, by ethnicity

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Degree classification

Destination	Full-time work only	Part-time work only	Work and further study	Further study only	Un-employed	Other	Engineering occupation
2013/14 – Engineering graduates							
1st & 2:1	69.10%	5.20%	3.50%	11.50%	6.20%	4.40%	59.70%
2:2 & below	53.40%	13.70%	3.50%	11.80%	13.00%	4.50%	40.40%
Total	**65.90%**	**7.00%**	**3.60%**	**11.50%**	**7.70%**	**4.40%**	**55.60%**

Table 4. First destinations of graduates, with degree classification (where known)

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STEM

VS

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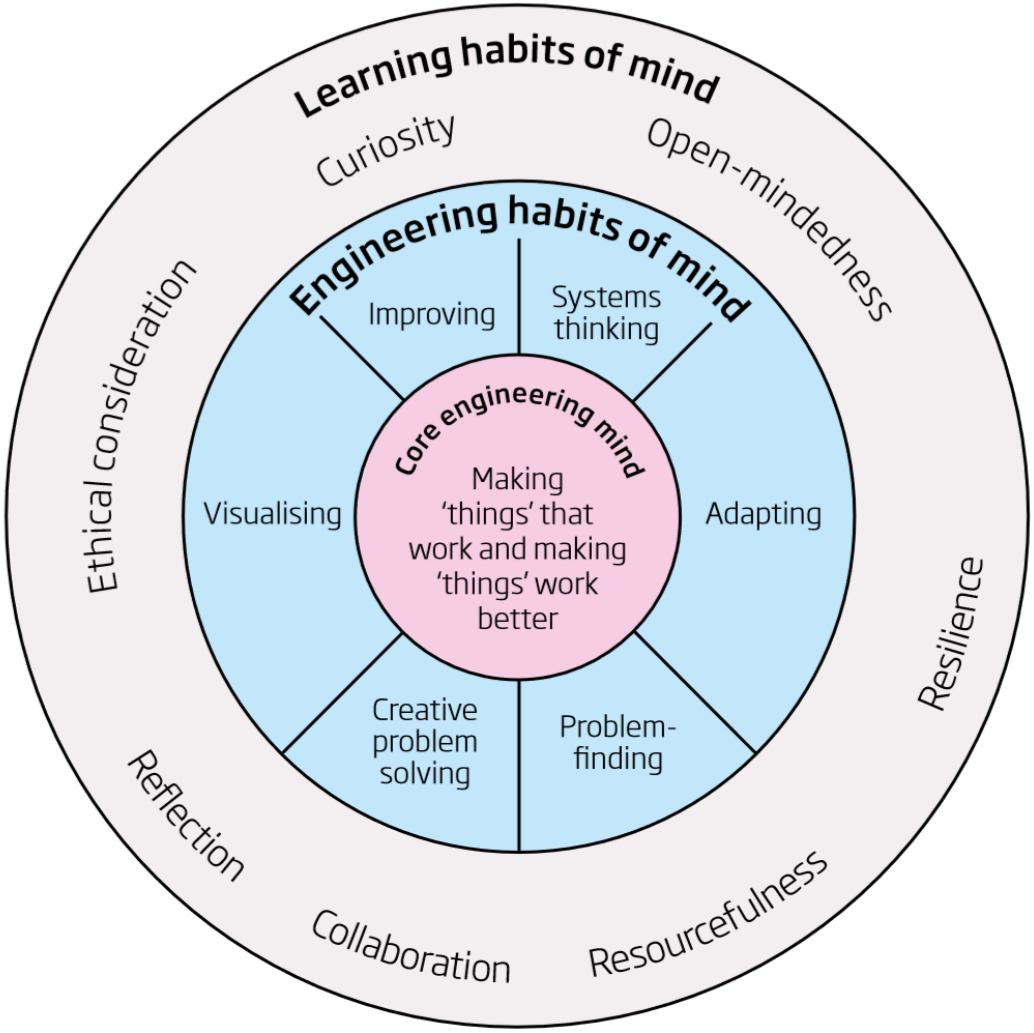
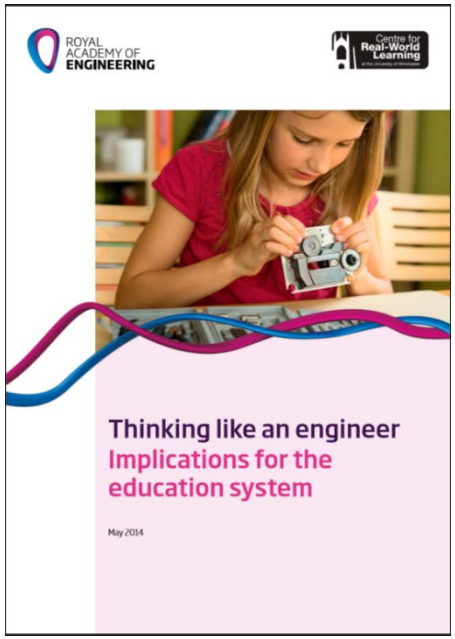
But what is the ‘E’?

Engineering Habits of Mind





Thinking like an engineer, Royal Academy of Engineering and University of Winchester, 2015

Professional practice

There are three dimensions to professional work

- To think, to act, to perform with integrity

Professional education is not education for understanding alone

- It is the preparation for accomplished and responsible practice in the service of others
- It is the preparation for ‘ good work’

Signature Pedagogies

Signature pedagogies – characteristic forms of teaching and learning for the professions; law, medicine, engineering etc.

Signature pedagogies have three dimensions:

- surface structure: concrete, operational acts of teaching and learning:
- deep structure: reflect a set of assumptions about how best to impart a certain body of knowledge and know-how
- Implicit structure: includes a moral dimension that comprises a set of beliefs about professional attitudes, values, and dispositions

Schulman, L. S. (2005). Signature Pedagogies in the Professions. Daedalus, 134 (3),

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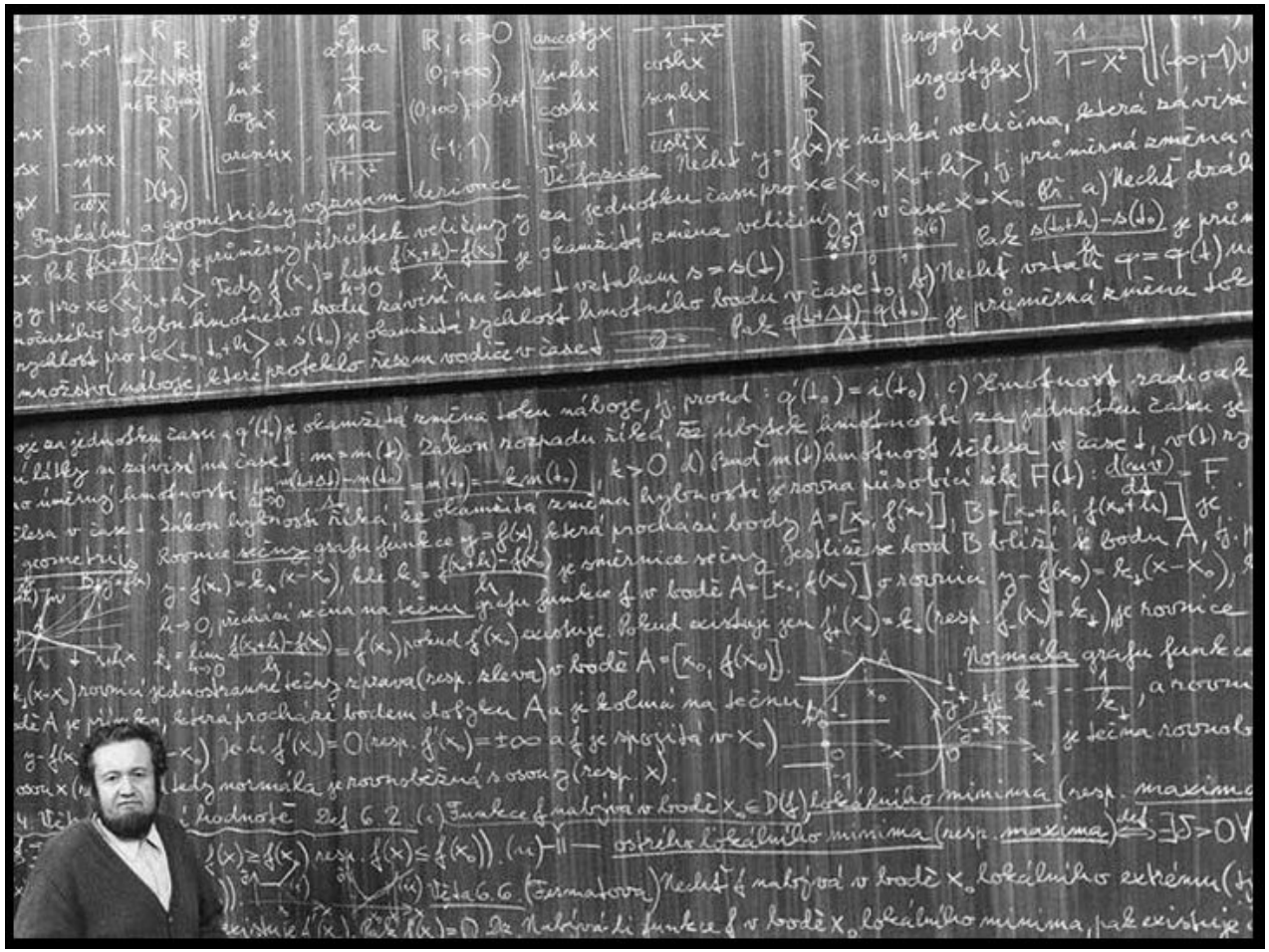
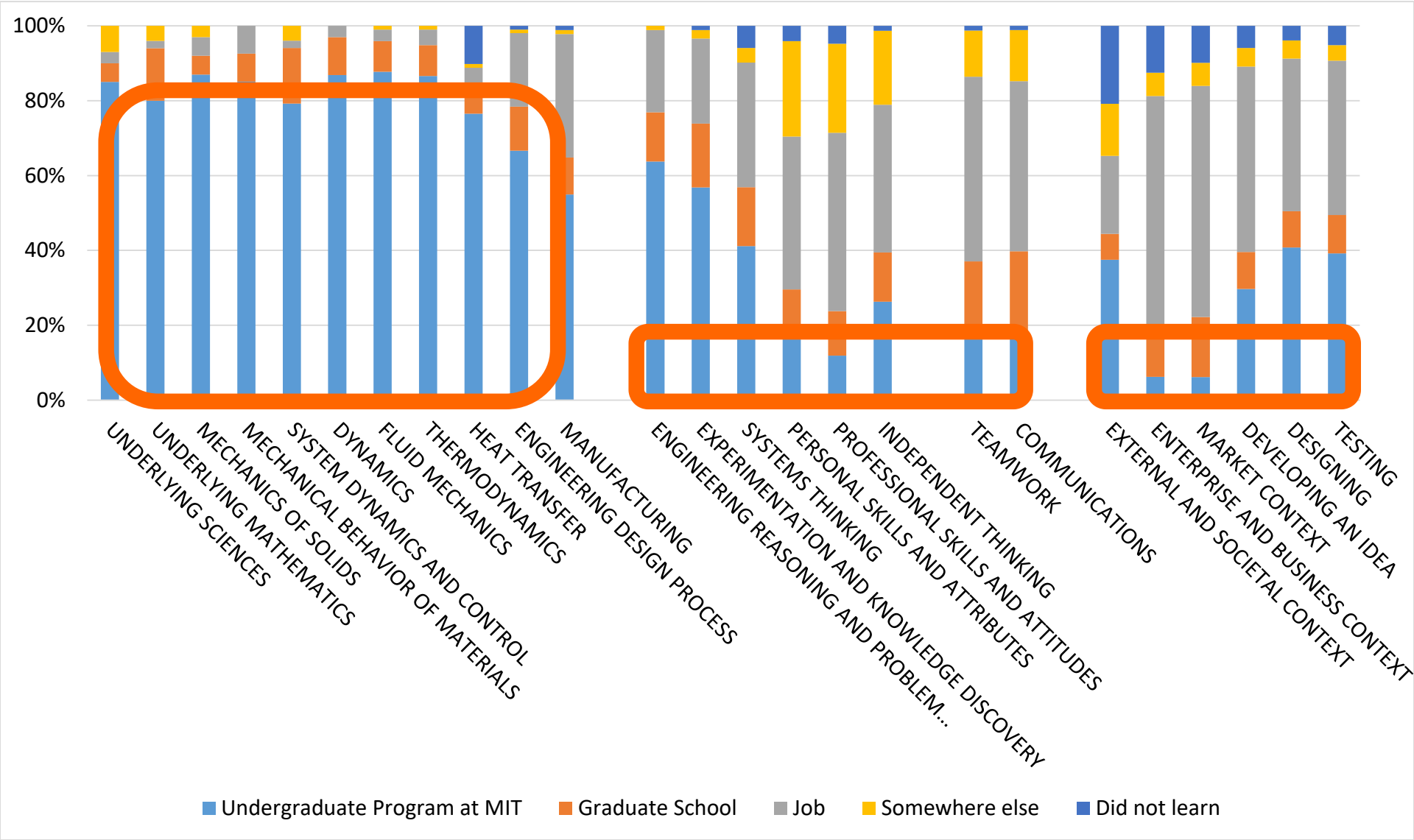
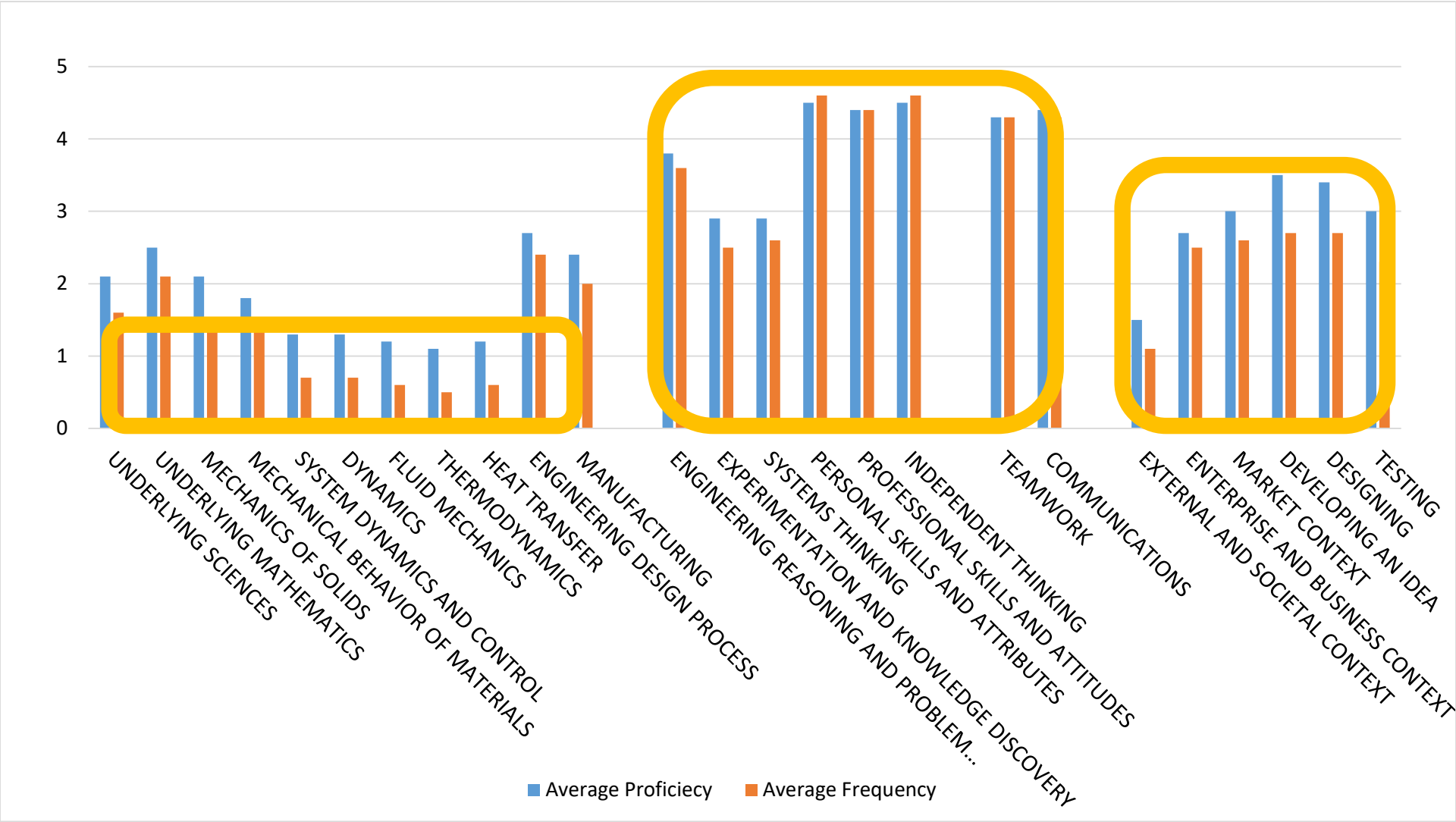
Signature Pedagogies…NOT!



MIT analysis – alumni skills

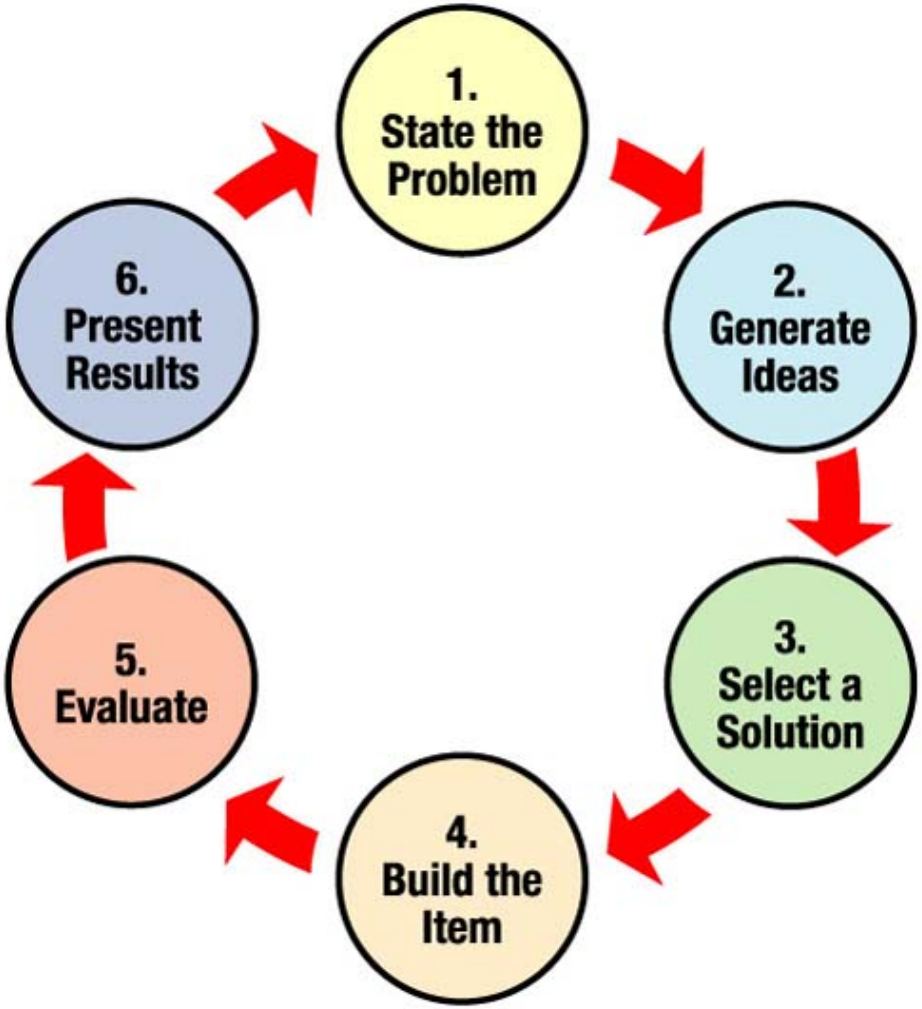


MIT analysis: proficiency and frequency of use



Signature Pedagogies for engineering

The Engineering Design Cycle itself is a candidate signature pedagogy for teaching engineering



Signature Pedagogies for engineering

tinkering FOR learning

The Academy is also exploring 'tinkering' and purposeful play as an alternative signature pedagogy for teaching engineering in primary (elementary) schools

7 Principles of Primary Engineering Education

1. Pupils are engaged in purposeful practical problem solving
2. Pupils take ownership of the design and make process
3. Pupils embrace and learn from failure
4. Pupils' curiosity and creativity is responded to
5. Pupils demonstrate mastery from other curriculum areas
6. Pupils draw on a range of thinking skills and personal capabilities
7. Pupils' learning experiences are guided by a whole-school approach

Tinkering for Learning, Royal Academy of Engineering and University of Manchester – Publication Summer 2018

Engendering self-efficacy

The purpose of signature pedagogies is to increase engineering 'self-efficacy' in students

Self efficacy - one's belief in one's ability to succeed in specific situations. Bandura

- *Moving from 'fragile' Self concept*
- *Active learning approaches*
- *Situated learning contexts*
- *Multiple tasks – accomplishments*
- *Reflection – why competitions don't work!*
- *Supportive role models*

Engendering self-efficacy

- Providing learners with authentic, practical challenges builds confidence and a strong 'belief' that they can *do* engineering
- For example, the 'relatively' simple process of taking apart and re-building a bicycle is very empowering and gives learners confidence to take on bigger challenges
- All 1st year undergraduates should be made to do it!!

Author's 7 year old daughter helping to fix bike!

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Thank you

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