

So can you turn your Graduate into an Engineer ...?

ICE/IStructE/ACED Annual Meeting
9 May 2018

Nick Russell BSc (Hons) CEng FIMechE FICE F.ASCE MCM
2014 President of the IStructE
Chair, Joint Board of Moderators
Visiting Professor, University of Surrey

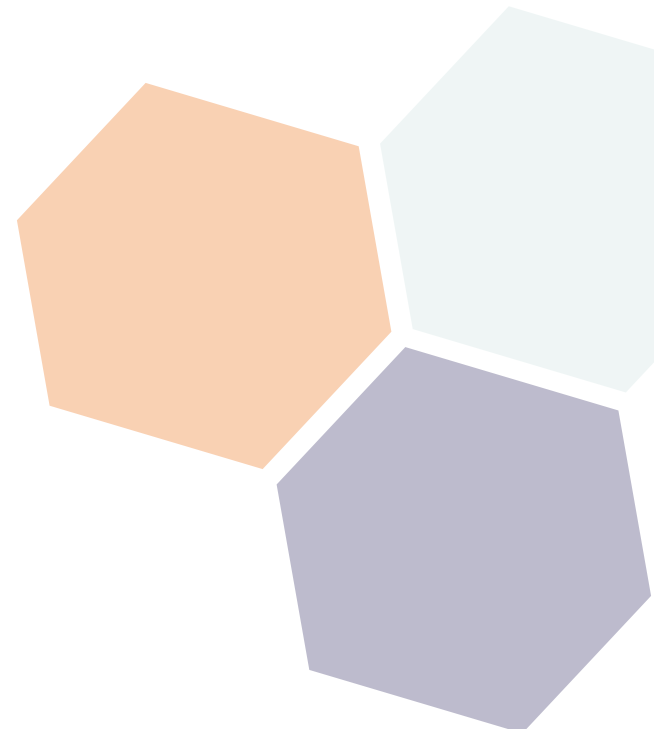


CLEAR
STRUCTURES

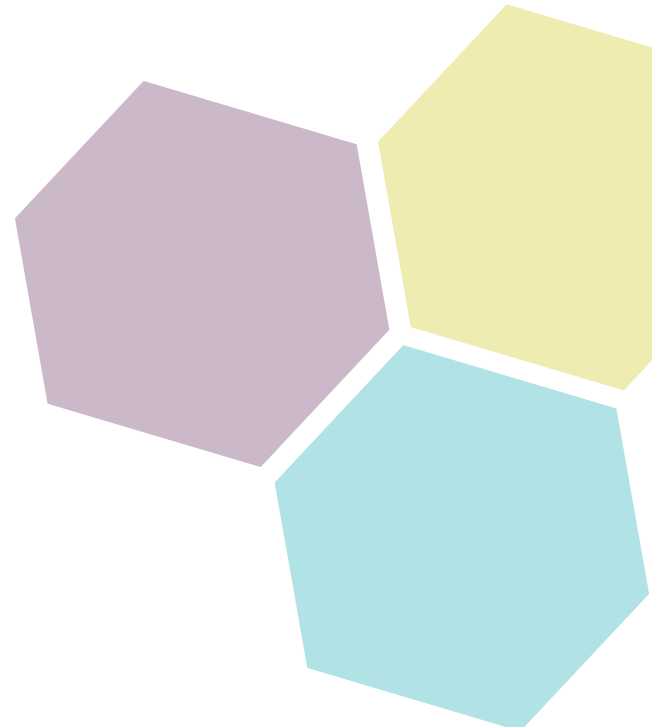


THOMASONS

So can you turn your Graduate into an Engineer ...?

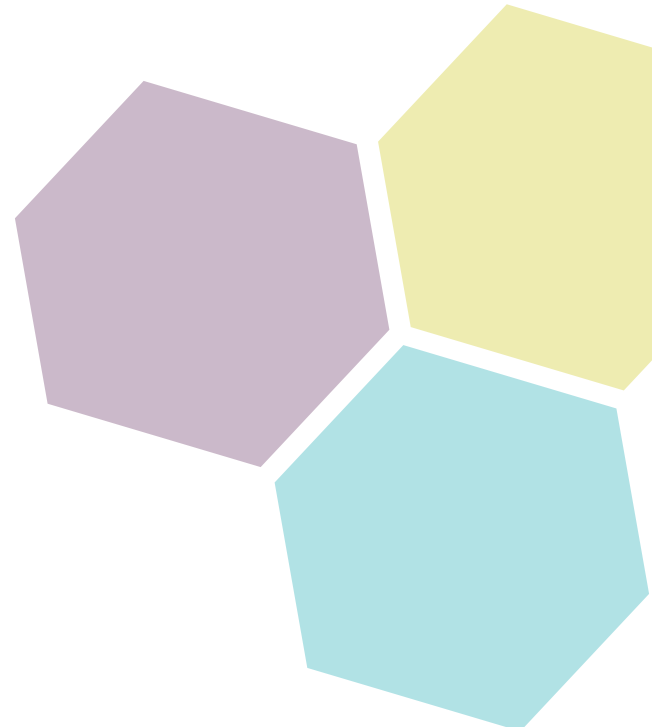


- An inspiration
- A look into the future
- The consequences of longevity
- The effect of the digital age
- Are universities adapting?
- Are employers adapting?
- Where do we go from here?

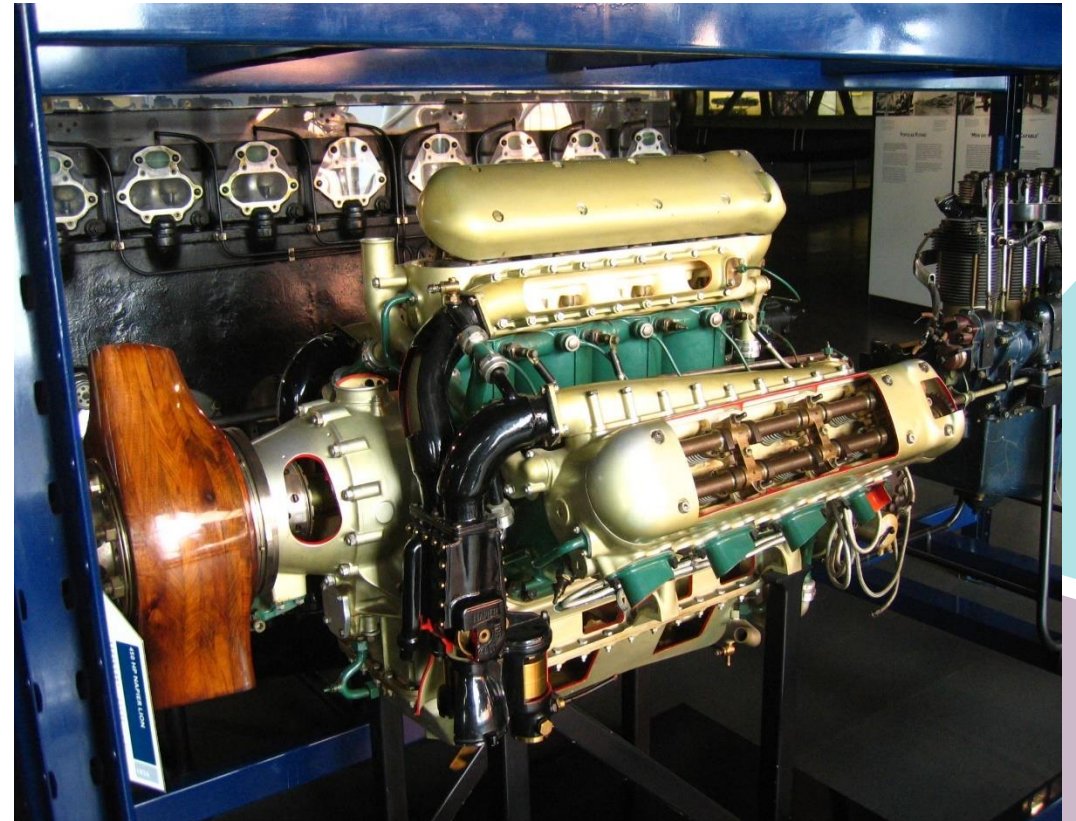
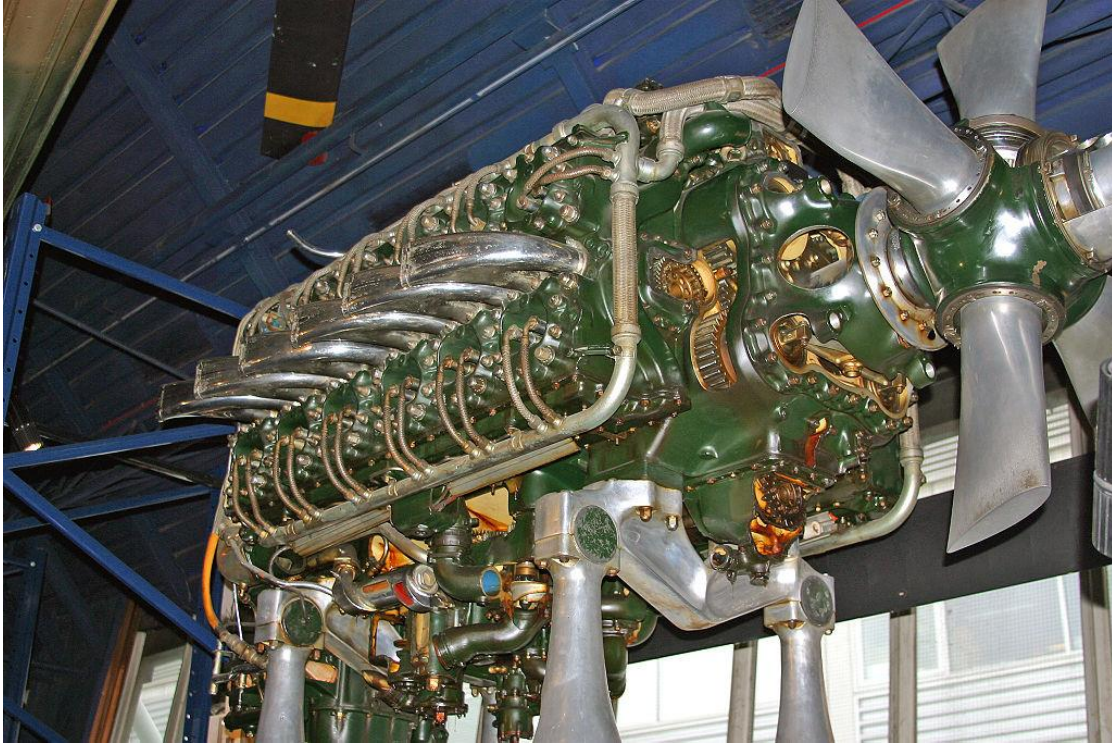


- **An inspiration**

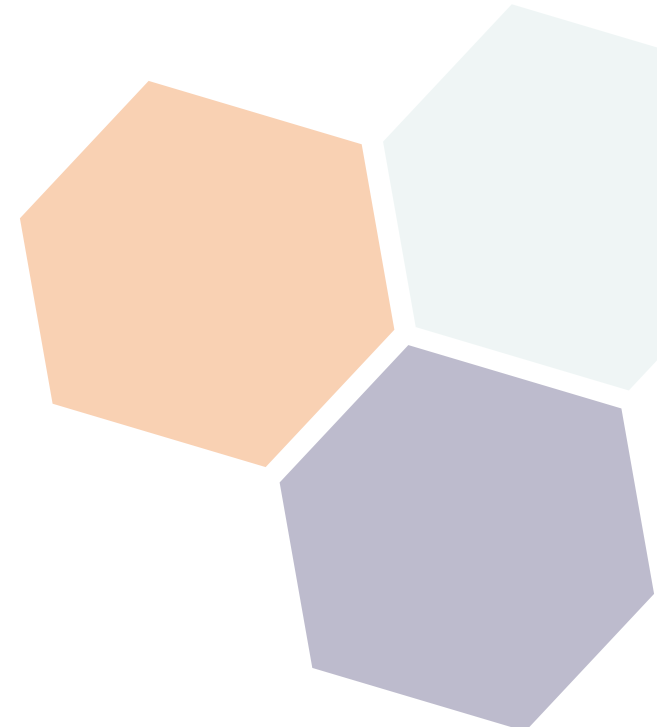
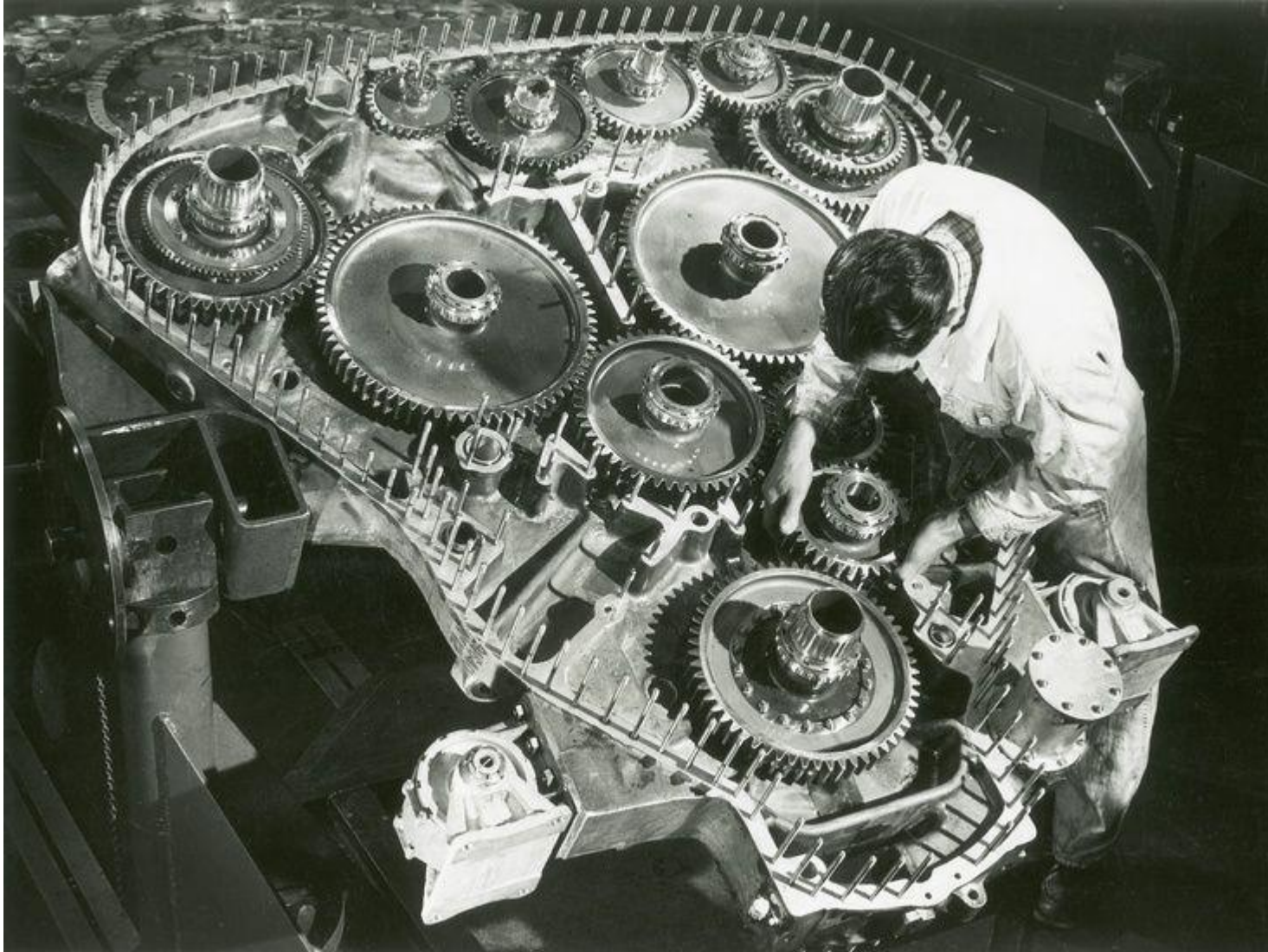
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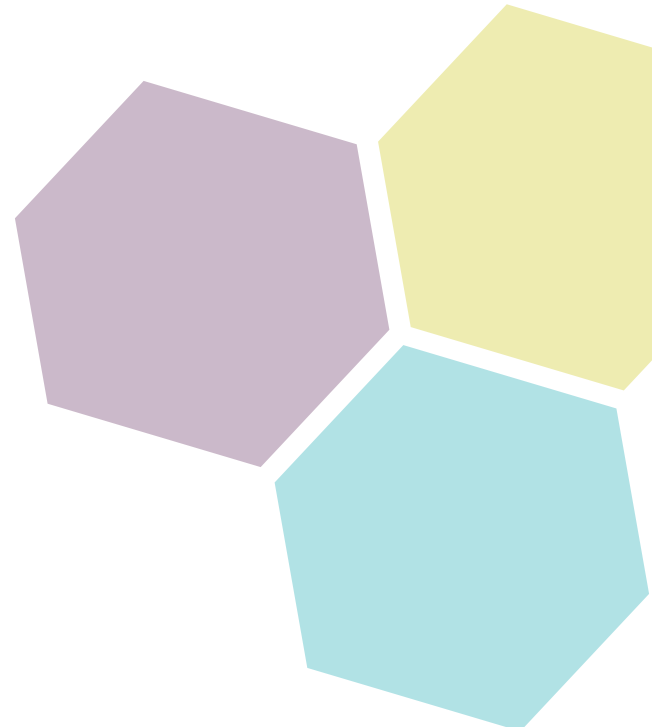
Inspiration



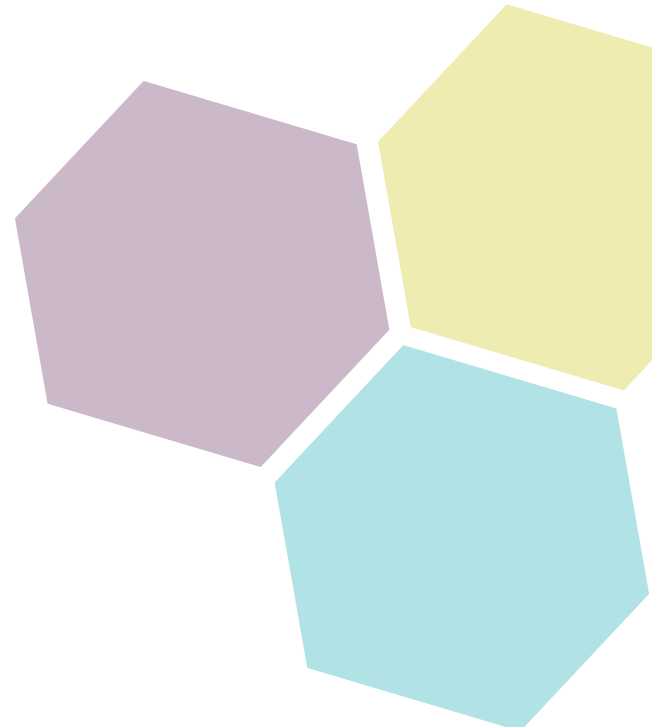
Inspiration



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It's 2030...

- An earthling leaves home for work at 8:30
- An on-line check confirms no traffic
- A tap on the mobile phone results in the driverless car arriving
- Voice command “take me to the office”
- Returns to pick up the kids for a trip into town, then takes parents for a day out
- Returns later to take the family members home and then works during the night as a taxi
- Oh – and the occupants watch an onboard screen

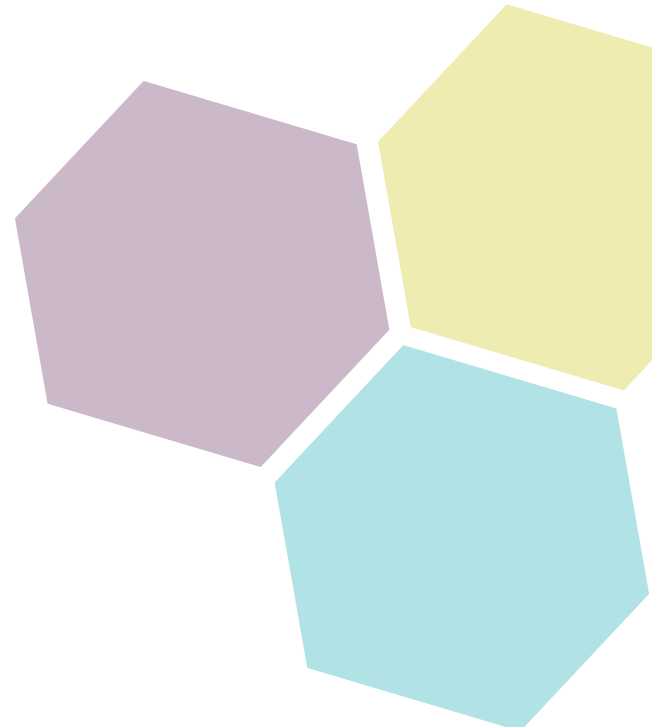


Not so far fetched...

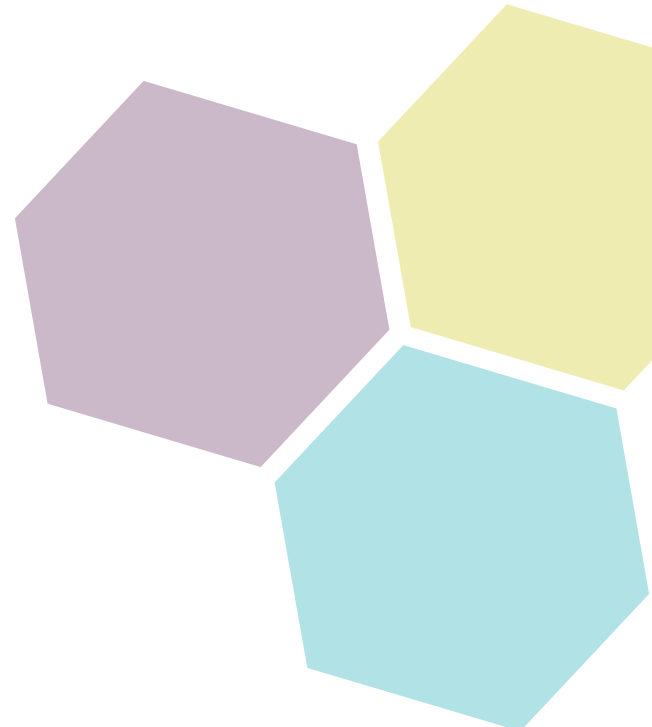
- 96% of the cars in the UK are parked at any one time
- BMW say that cars will change more in the next 5 years than in the last 100
- Toyota say 5.5million autonomous cars by 2030
- In 10 years' time it will be unusual to see someone driving a car
- In theory no accidents
- No car parks
- No car insurance
- Of course there are disadvantages – no traffic police/car salesmen/ traffic wardens/taxis



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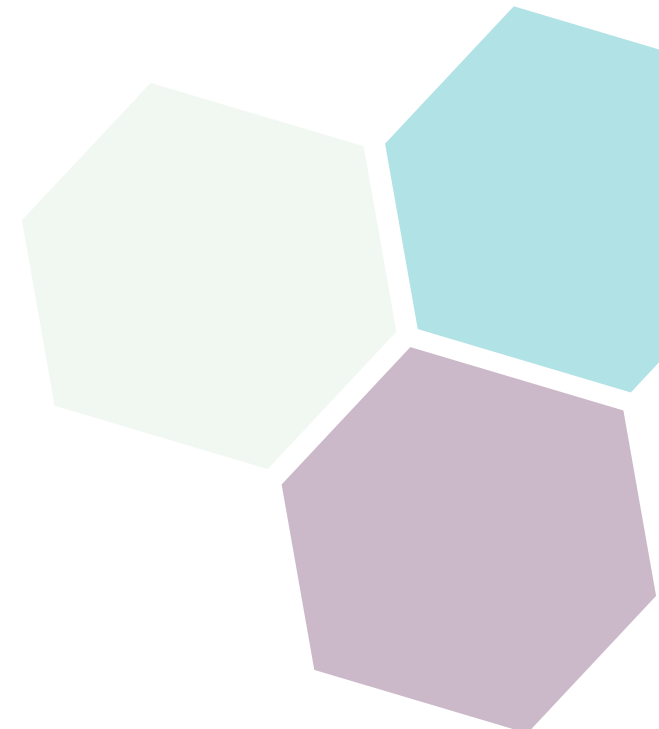


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The consequences of longevity...1

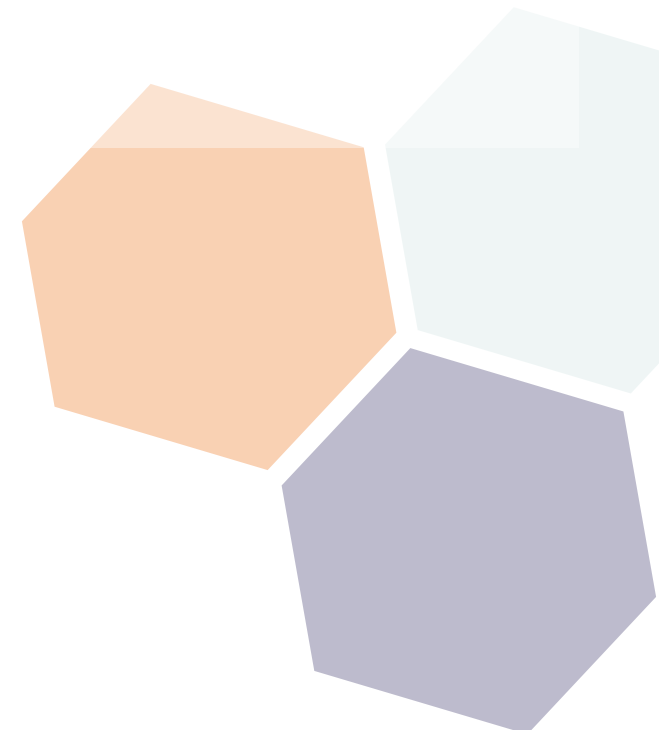
- The average life expectancy of a person born in the UK is 103
- I have a 50% chance of reaching 90
- Today's graduates will probably reach 90
- This makes the conventional notion of a three-phase life untenable
- Education, work and retirement as we know it will cease



The consequences of longevity...2

So let's look at an engineer starting work just after the Second World War

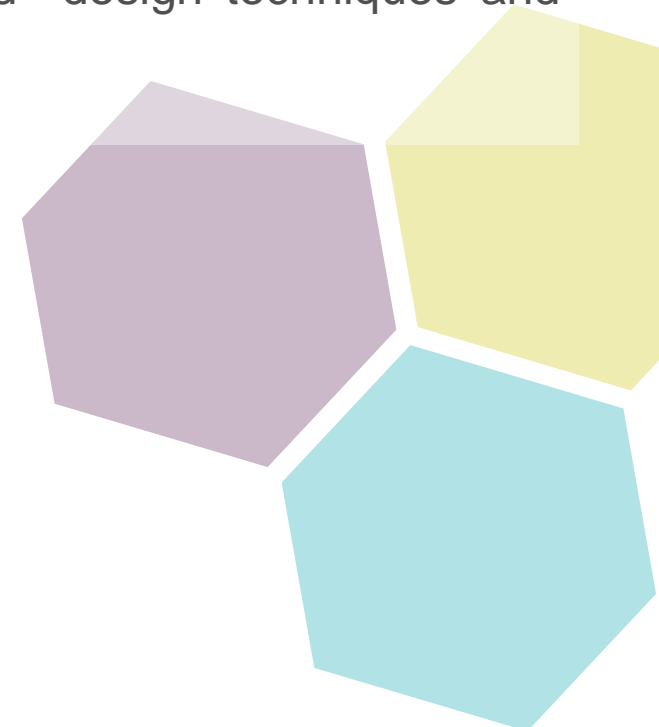
- Starts work in 1945 and retires in 1990
- Calculations always done by hand
- Drawing boards and dyeline printing
- Mainframe computers start to undertake analysis in large organisations
- Desk top computers just introduced
- No internet or any notion of the digital age
- Three to four post bags in and out every day for a 40-strong office
- University education probably lasted a whole career



The consequences of longevity...3

Someone like me ...

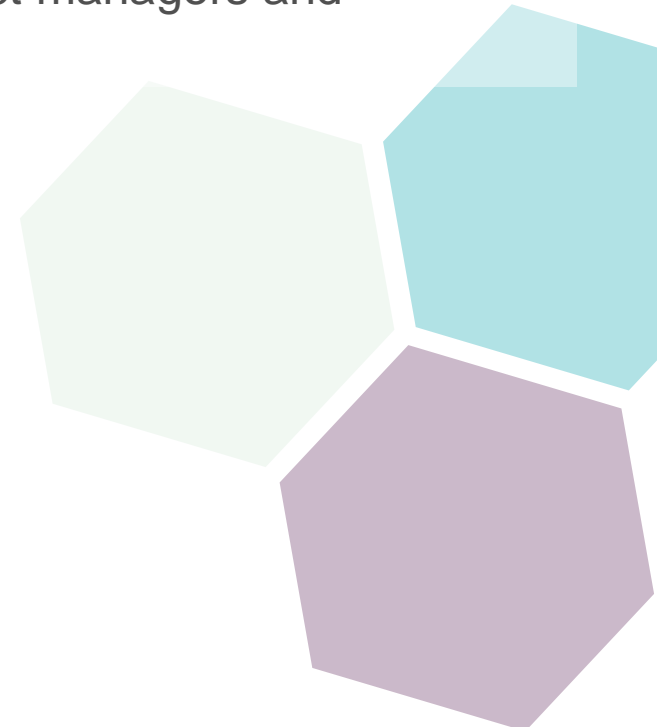
- Starts work in 1980 and retires in 2025
- Hand calculation and drawing skills
- Drawing boards and dyeline printing
- Desk top computers replaced mainframe computers
- Computing power increases exponentially
- Over-reliance on digital technology for simple design becomes the norm – rapid design techniques and approximation methods start to be lost – completely so by 2025
- University-taught skills have to be updated during a career



The consequences of longevity...4

A current undergraduate ...

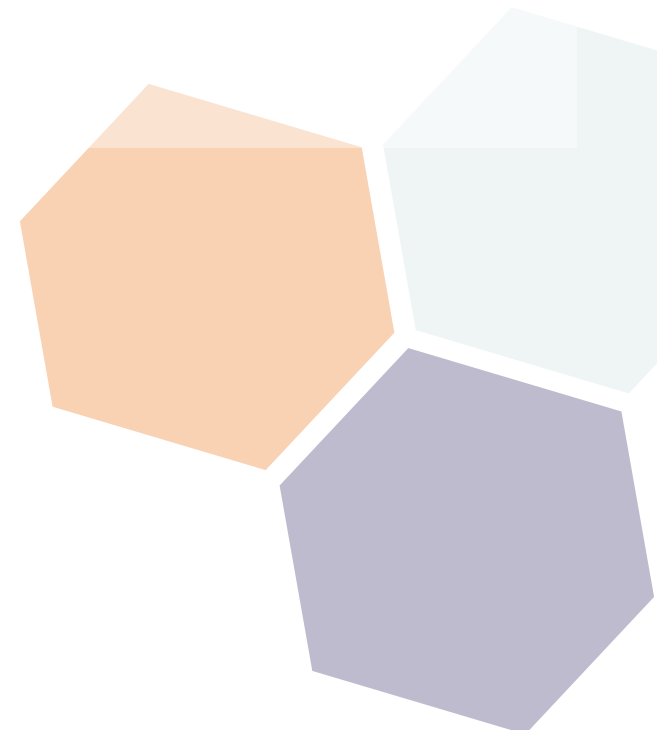
- Starts work in 2020 and retires in 2075
- Artificial intelligence becomes widespread
- BIM is widespread, universally used by 2025 and obsolete by 2030
- Virtual reality is here
- Computer modellers and programmers are not technically trained
- Consultancy – having being commoditised by 2025 – is taken over by clients, project managers and contractors by 2030



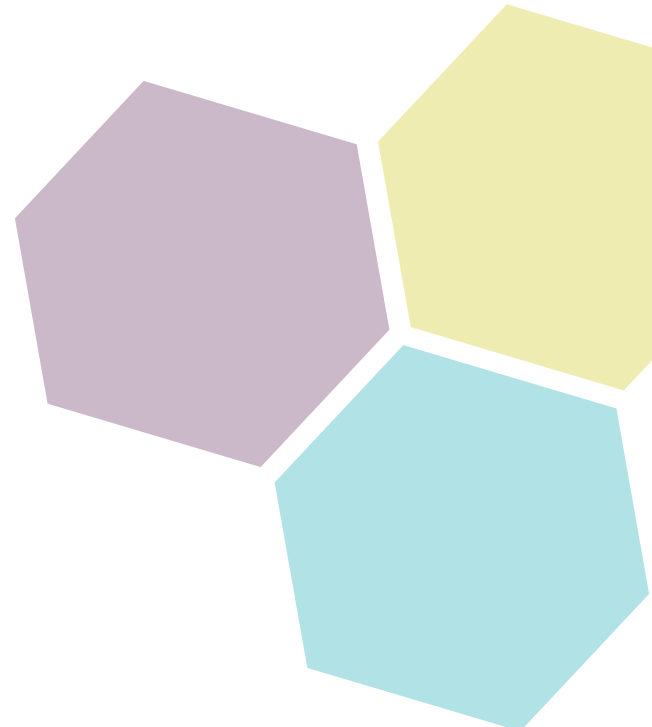
The consequences of longevity...5

A new graduate's child ...

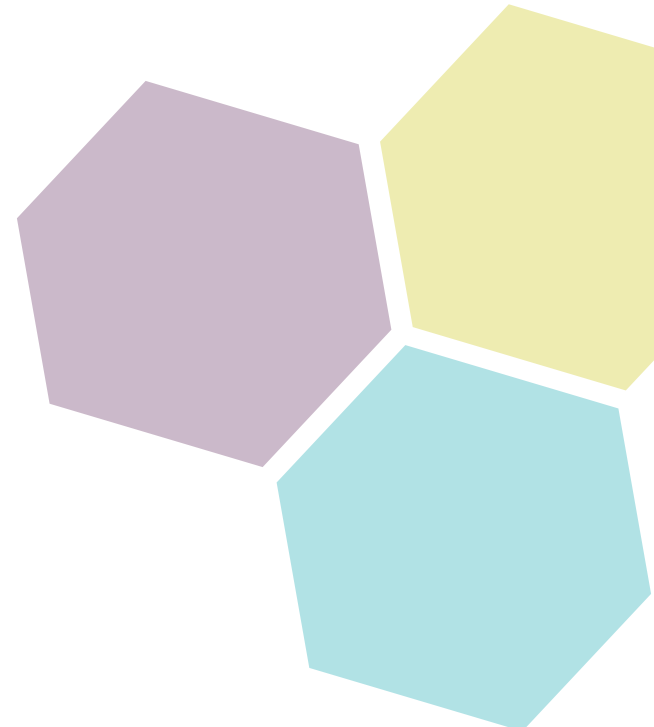
- Starts work in 2040 ...
- 60-year plus careers are the norm
- Retraining throughout career is universal to keep abreast of emerging technology
- Design and construction is fully automated
- Professional people are constantly re-inventing and staying ahead of robots
- Manual and repetitive jobs no longer exist
- Micro companies that can respond rapidly survive – large companies are history
- Leisure time is higher than ever



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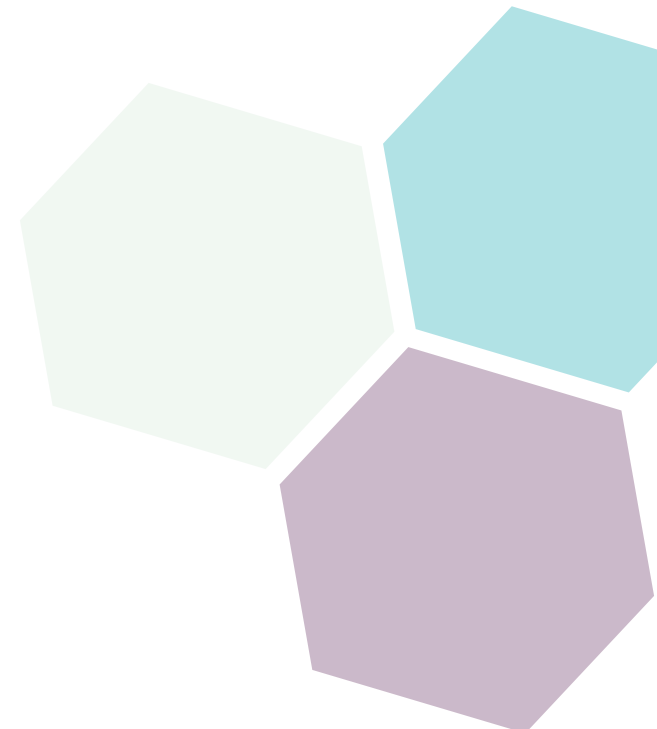
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The digital age...1

Consider the world outside construction...

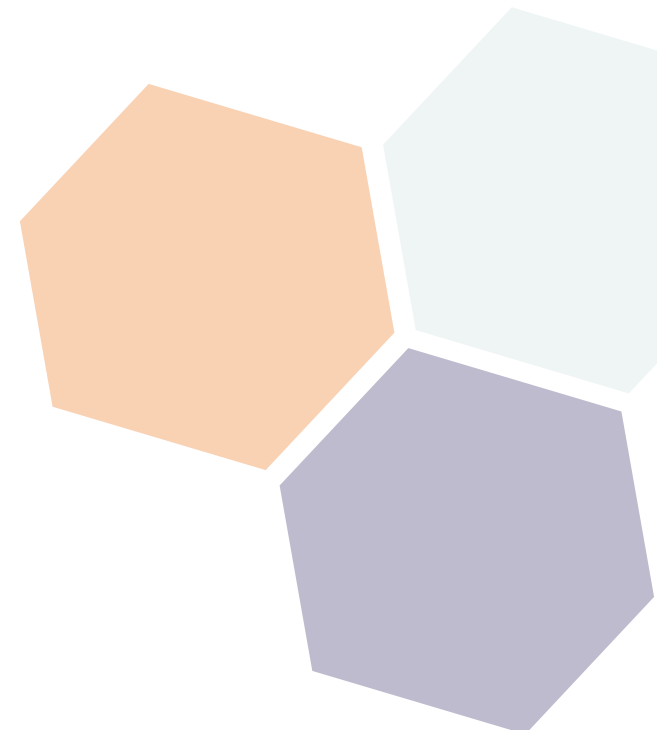
- Advances in medicine in the last 35 years have been phenomenal
- The office environment has changed – no typing pools, clerks or assistants
- The insurance industry has been transformed by the digital age
- Car manufacture has been almost wholly mechanised
- Cost of services is largely accepted



The digital age...2

And in construction...

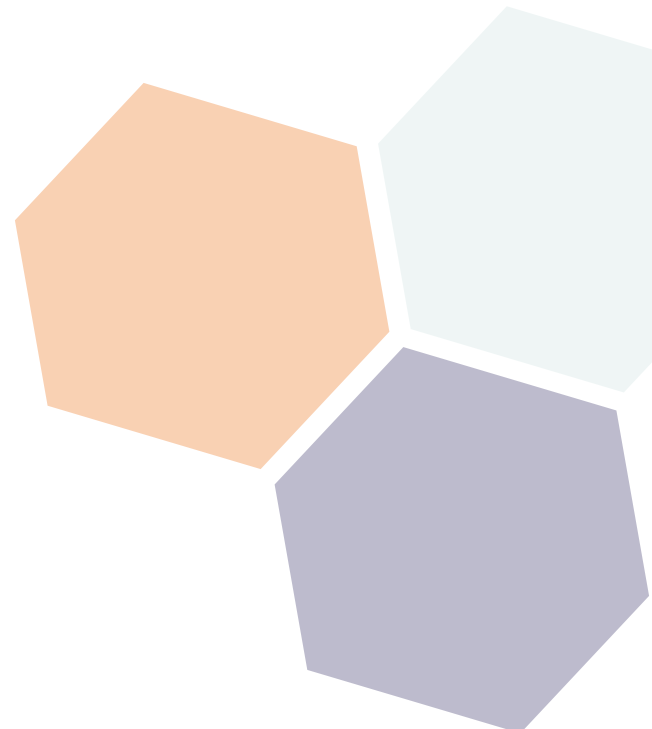
- Construction has changed little in the last 35 years – change is slow
- Construction techniques are much the same
- Professional services are becoming commoditised, novated to contractors or part of supply chains
- Lowest price is often the main driver



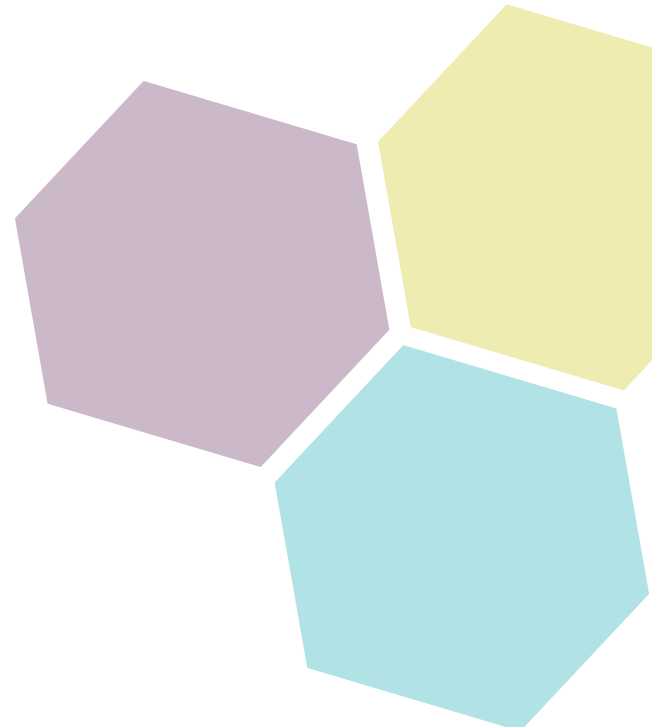
The digital age...3

Construction will change ...

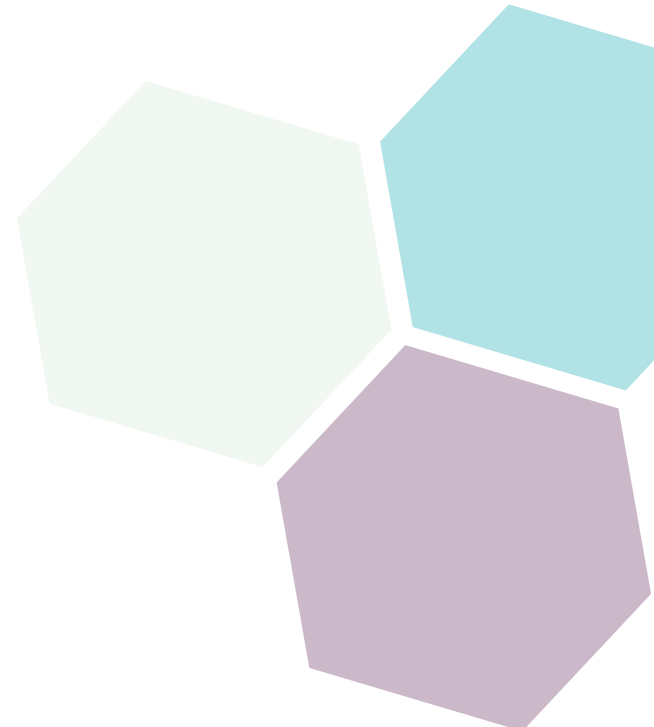
- Off-site manufacture – ready-finished components
- Robots carry out construction
- Drones deliver to construction sites
- Advanced materials such as plastic, carbon fibre, composites, reconstituted timbers



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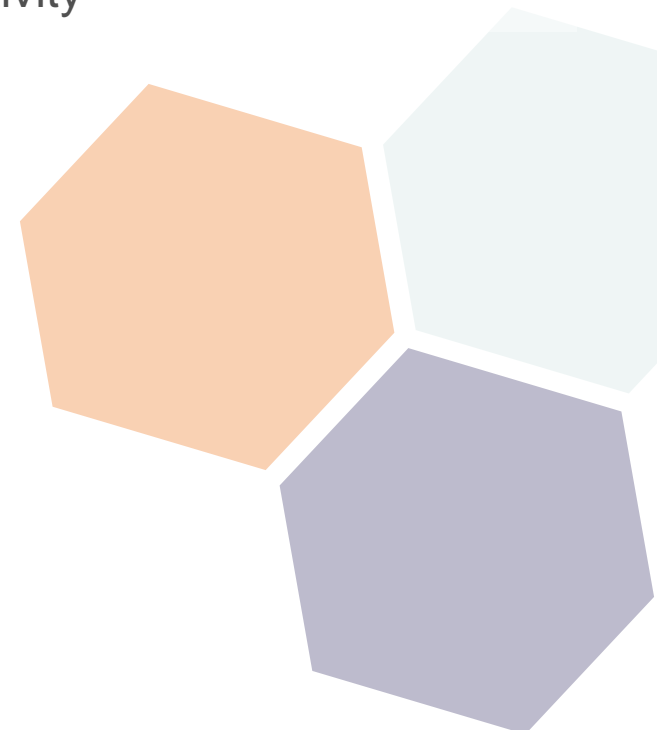


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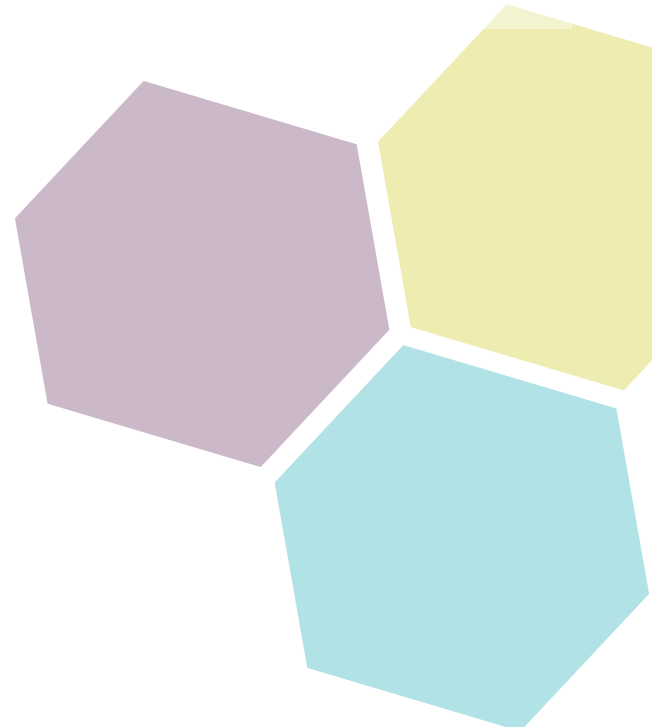
And Universities...1

- In essence the curriculum has changed little in my career...
- Structures, materials, geotechnics, and mathematics are still seen as essential (as was the case 35 years ago)
- Environmental engineering and health & safety have been introduced
- There has to be a change in university education that supports innovation and creativity



And Universities...2

- Education cannot be based on a three-phase life that is age stratified
- Longer life and artificial intelligence will put pressure on the interface between education and work
- Whereas employers looked for life commitment and a kit-bag of skills and capabilities that were ready to be deployed...
- They are now looking for graduates that have life skills, are imaginative and creative, have had experiential learning and recognise that failure is an essential part of learning and not something to be feared
- Oh, and we would like some of those basic skills back – like the ability to sketch, to approximate, and have a feel for physical and architectural form



Structural engineering

**As children we
were all interested
in everything**

At school we learnt that things were in 'subjects', which we had to 'learn' and be 'examined' in.

And then we had to stop being interested in lots of things, and concentrate only on the things that we were good at in exams.

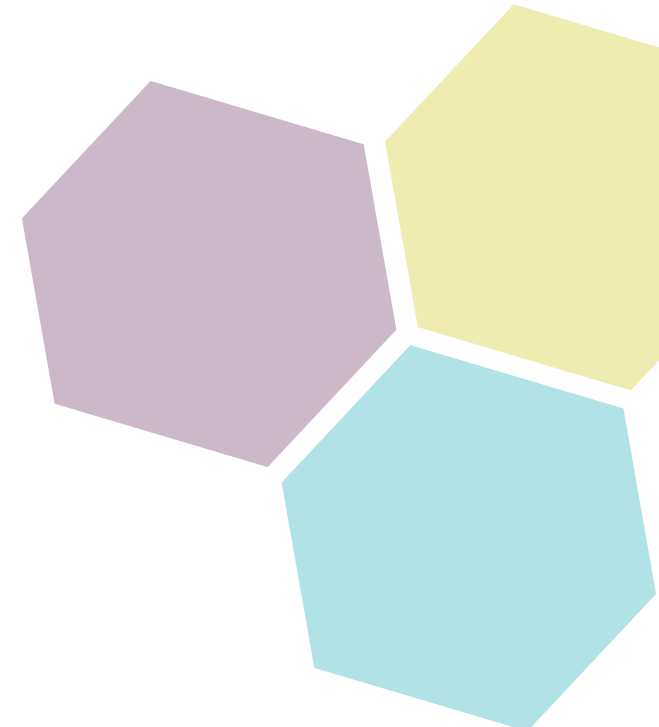
Structural engineering



Education should be broad, creative and fun.



This
leads to
deep
learning.



Structural engineering

Modern languages

Art and Design

Mathematics

Geography

Physics

Sociology

Politics

Engineering Science

Economics

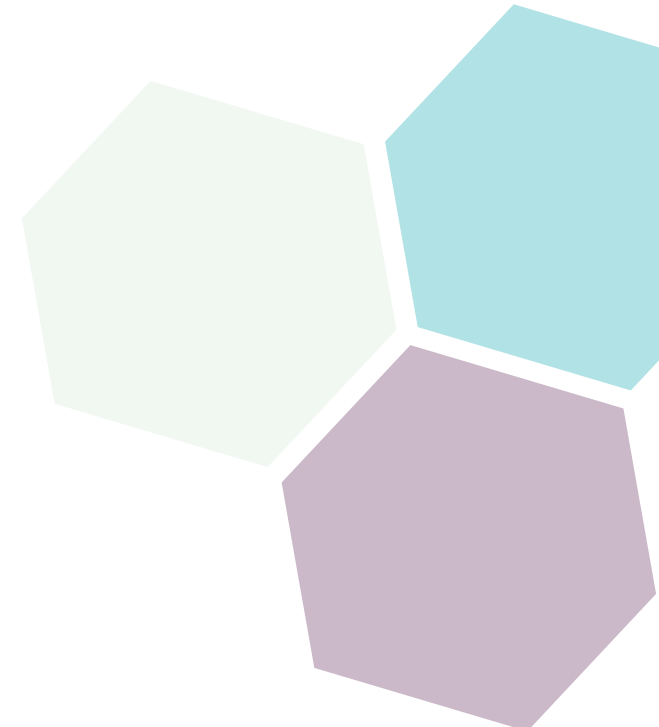
Chemistry

Architecture

Further maths

History

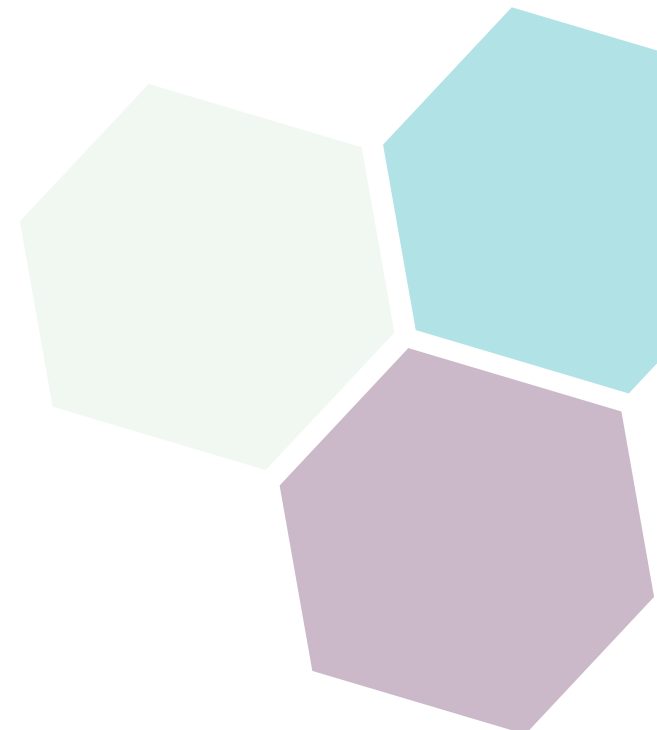
Psychology





The issues

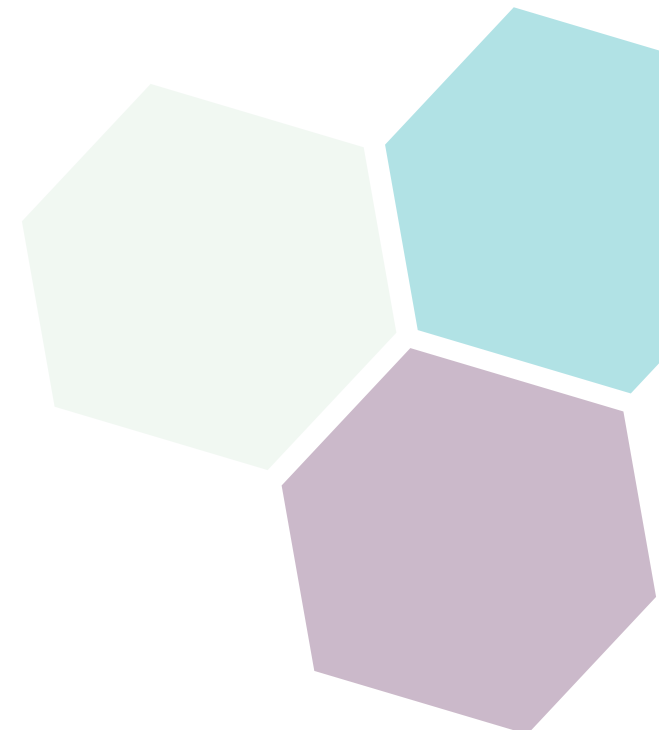
- The students?
- The educators?
- The curriculum?
- The setting?
- The outcome?





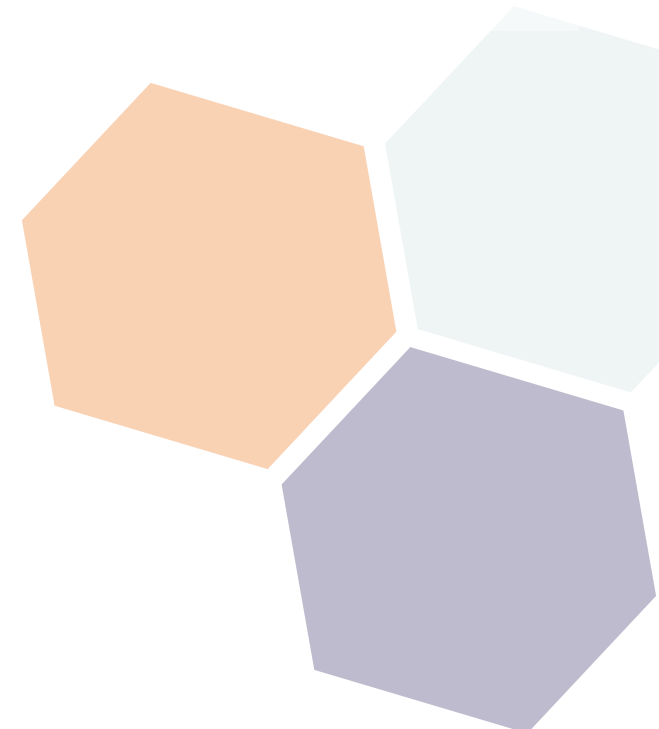
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The students?

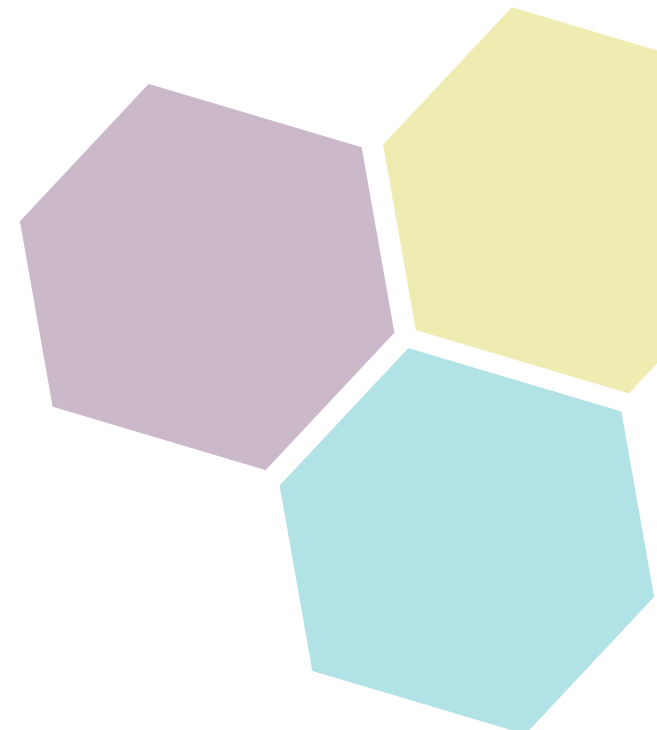
- Civil engineering degrees have in the main been undertaken by school leavers with A-level maths, quite often A-level physics and in many cases a further technically-biased subject
- Is it really appropriate, given the diversity of a civil engineering career, that universities effectively select our engineering population from a pool of 30,000 rather than 650,000?
- Surely we need creative types of people in our profession rather than just those who are technically minded at school?





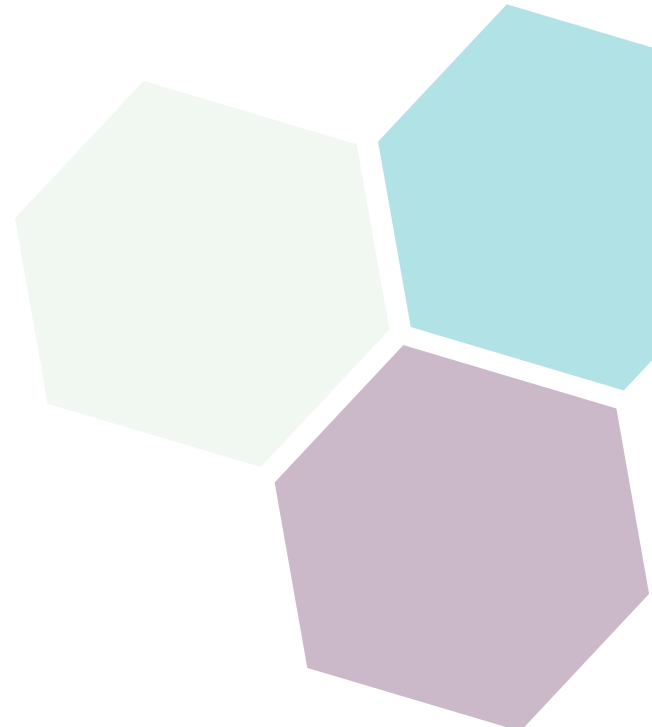
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The educators?

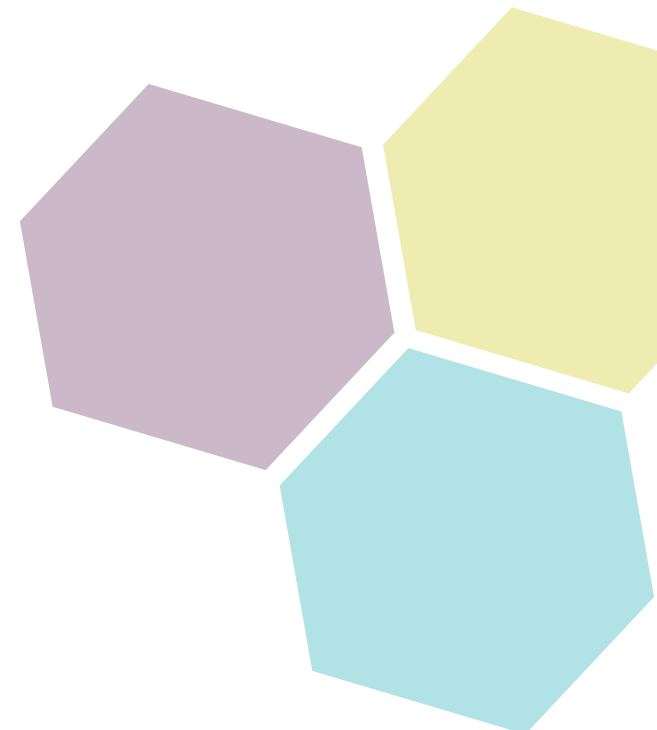
- How do we ensure degree courses meet the needs of industry – IABs/JBM/institutions/employers?
- We need a partnership with industry
- Seamless edges between graduation and working





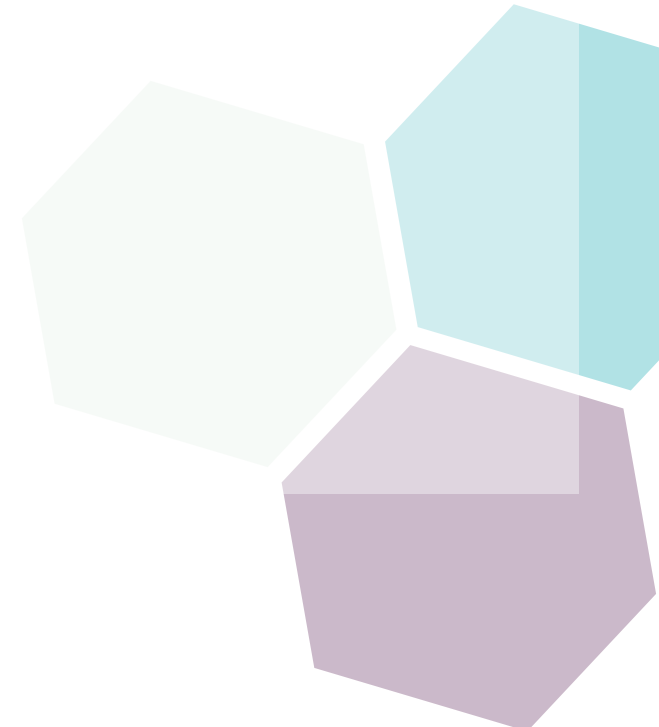
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The curriculum?

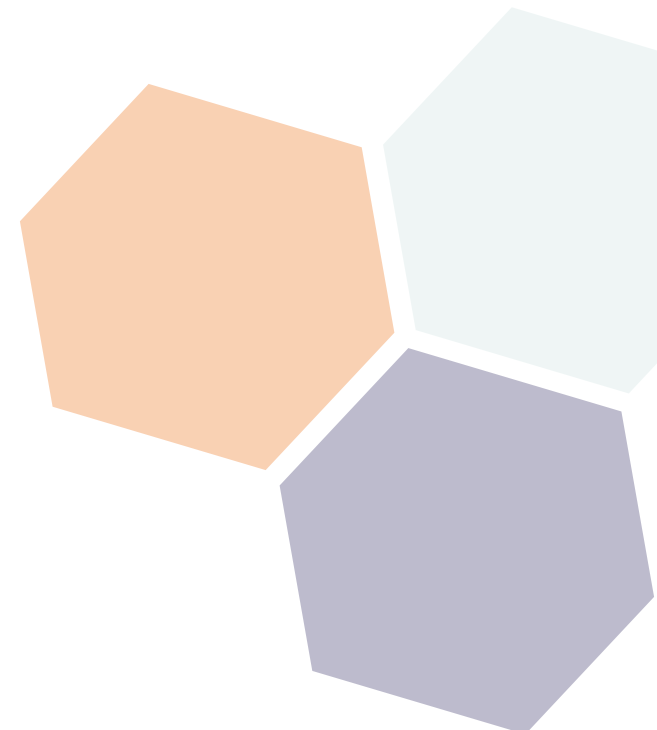
- Creativity at core of the degree
- Asking 'why?'
- Making mistakes
- Design thread which controls everything
- Embedding technology
- Understanding the process of design and how others fit in
- Moving from teaching to learning
- Having ideas
- Dropping things (bravery)
- Collaboration with other disciplines
- Intuition
- Approximation
- Sketching
- Making things
- Understanding the profession
- Having FUN!





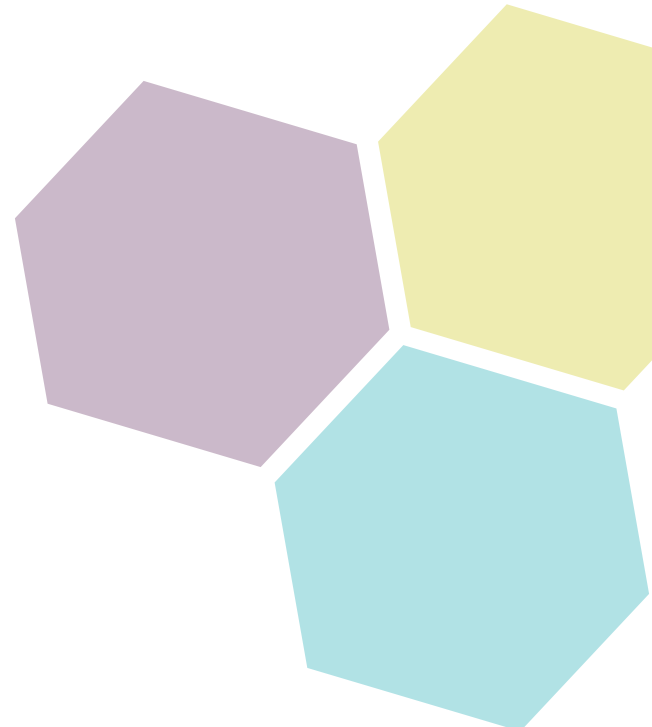
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The setting?

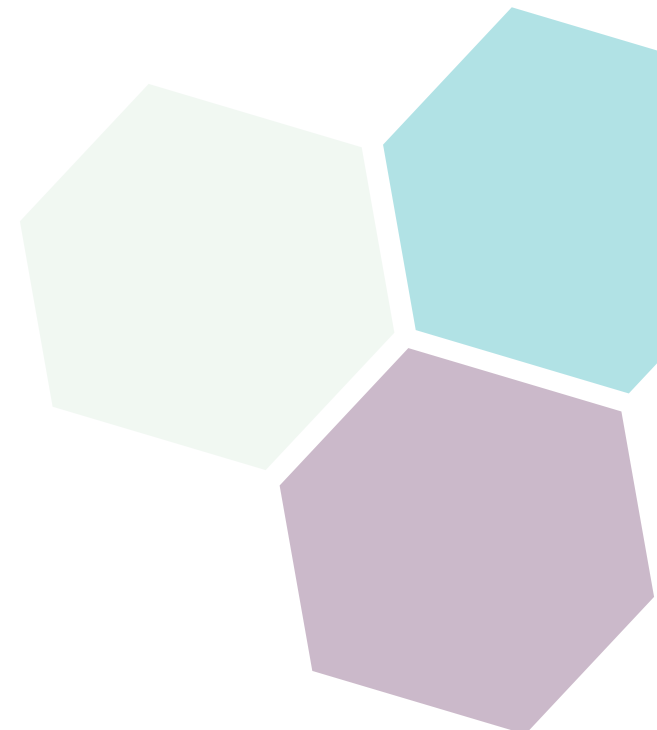
- Engineering in the built environment is at least as much about people as about numbers
- Collaboration is key
- If architects and engineers are to work together, they should be educated together





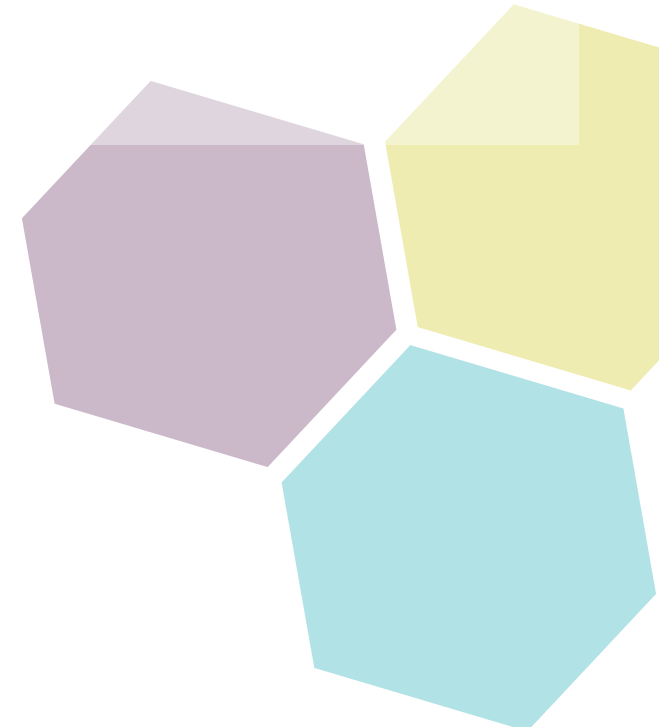
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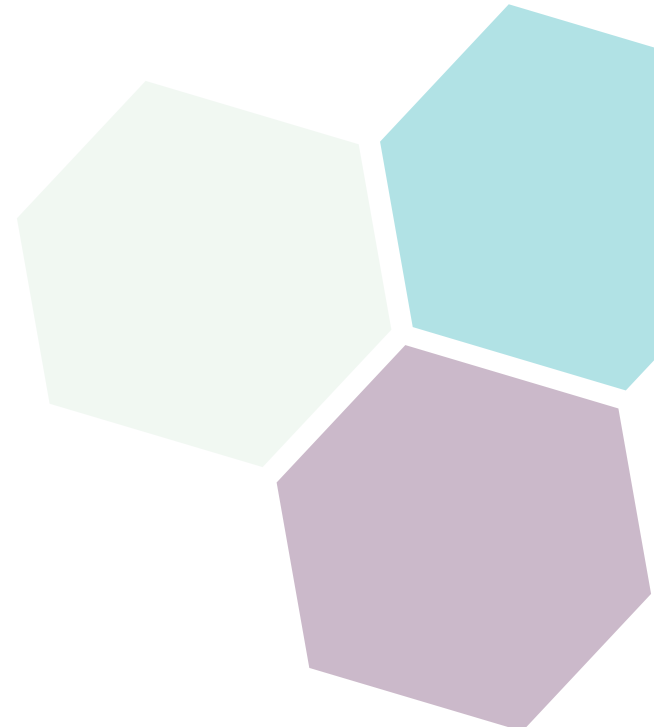


The outcome - some possible head start attributes

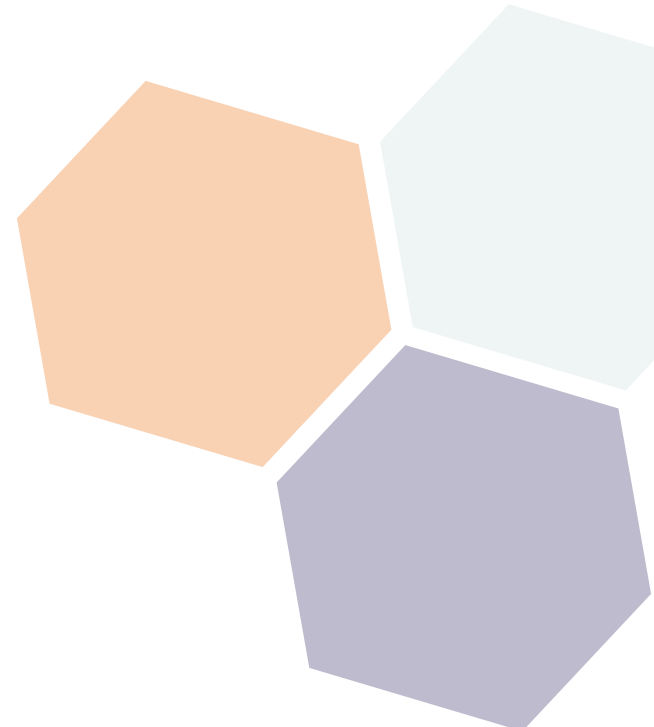
- Creativity
- Mindset of asking 'Why?' – not just 'What?' and 'How?'
- Deep learning from being able to make mistakes
- Mindset of innovation
- Intuition
- Approximation
- Sketching
- Making things
- Mindset to explore beyond the immediate needs
- Ability to see the much bigger picture rather than just the day-to-day



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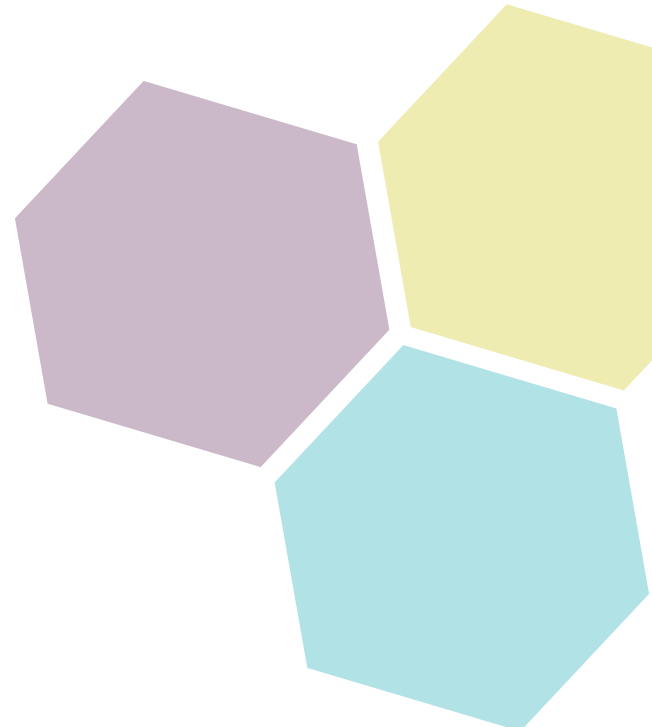


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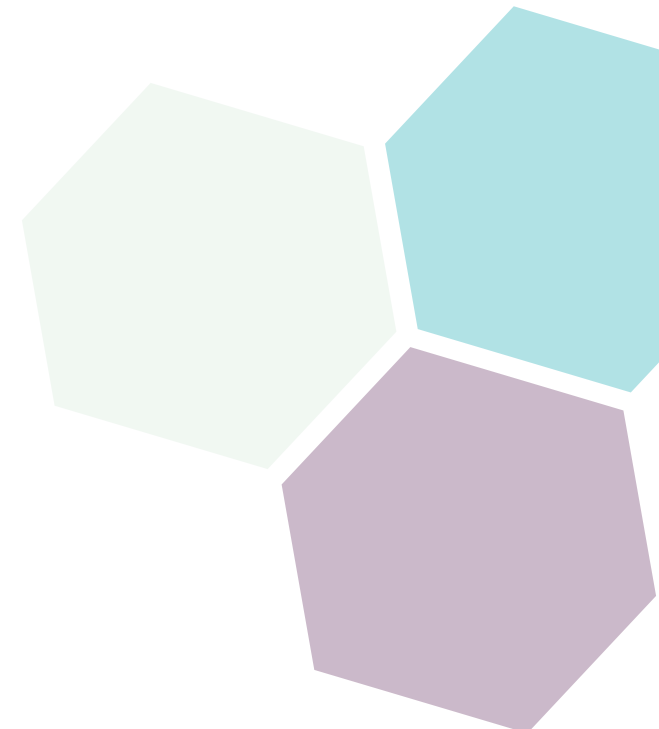
How can employers help?...1

- Are employers aware of the undergraduate curriculum?
- Do they know the difference between a BSc/BEng/MEng?
- Do they know what level of skills they can expect from a graduate?
- How do they provide structured training?
- Do they simply bypass the process and employ trained graduates?



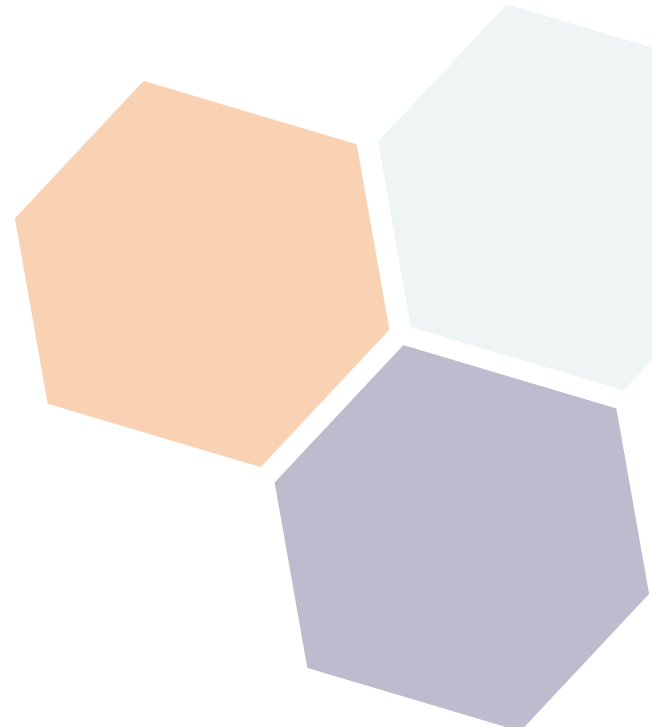
How can employers help?...2


- Graduates are the same people that they were 35 years ago!
- Professional practice has changed considerably
- Digitalisation is widespread
- Have opportunities for basic skills learning diminished?
- The cost of training opportunities has increased

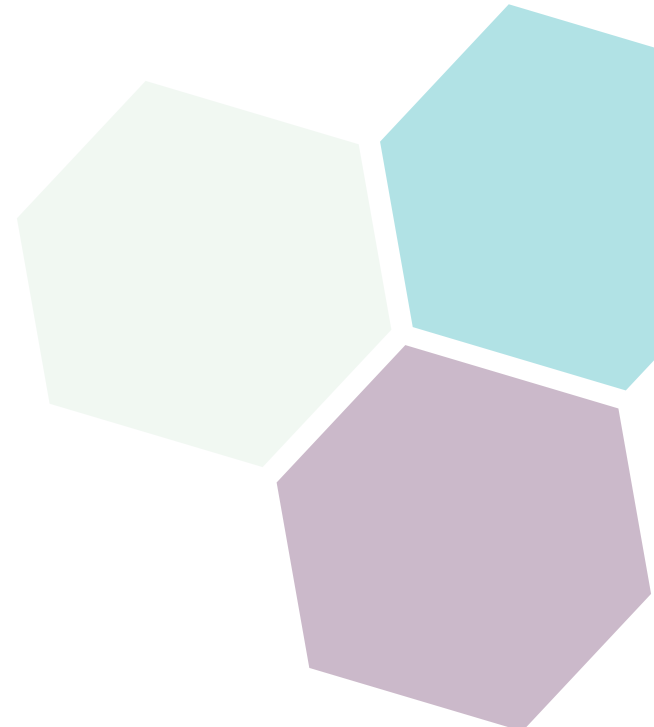


How can employers help?...3

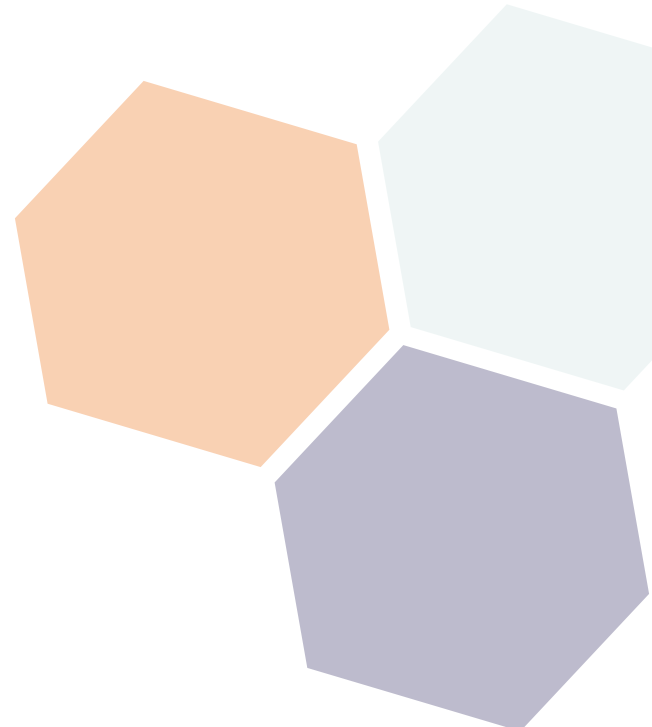
- Employer awareness of the undergraduate development process is key
- Industrial participation in undergraduate courses is essential
- External help in facilitating degree courses is essential
- Academic staff spending time in industry is beneficial
- There are no magic bullets



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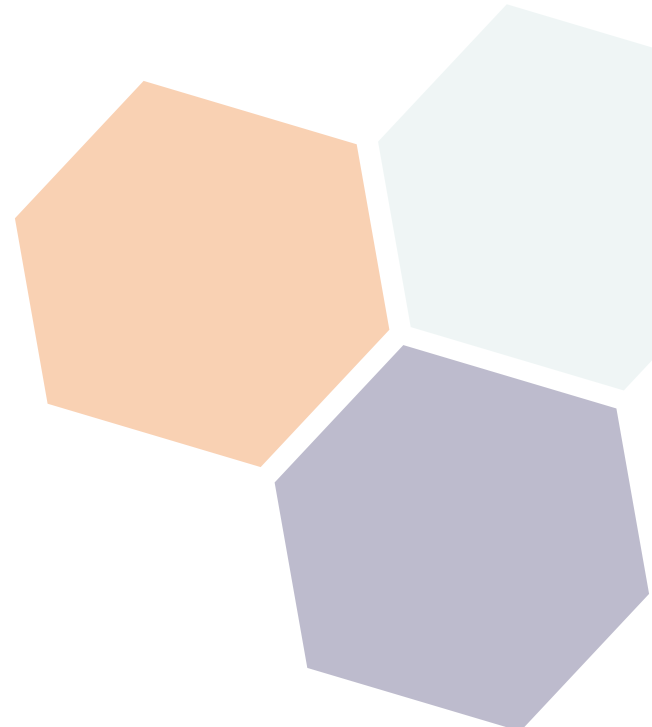


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Where do we go from here

- Student A and student B are identical twins
- Student A joins an engineering company at age 18
- Student B goes to university
- Four years later, what head start on A should B have?
- And 20 years later?
- We need to articulate this and then deliver this



Thank you for listening



Thank you for listening

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2014 President of the IStructE
Chair, Joint Board of Moderators
Visiting Professor, University of Surrey



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