Engineers 2030: A vision of success

Report of the visioning workshops

Prepared by Waverley Consultants, February 2024

Royal Academy of Engineering

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CONTENTS

PART 1: INTRODUCTION 5

PART 2: THE VISION

- Creating the vision 6
- The vision statement 8
- Day in the life narratives 10
- Timelines 16
- Review: key steps and tasks for achieving the vision 26

PART 3: PRINCIPLES 28

PART 4: CONCLUSION 31

ANNEXES 32

Engineers 2030

Rethinking engineering and technology skills for a world in which both people and planet can thrive.

Led by the Royal Academy of Engineering on behalf of the National Engineering Policy Centre (NEPC), Engineers 2030 seeks to identify how engineering knowledge, skills and behaviours are changing in the 21st century and to develop a shared new 'vision and set of principles' for engineers in 2030 and beyond. The NEPC will work across the engineering and education communities and with UK policymakers to investigate how UK systems, frameworks, and cultures for attracting, educating, and developing engineers might be updated or transformed to deliver against our new vision.

For further information, visit:
www.raeng.org.uk/engineers-2030

PART 1: INTRODUCTION

The National Engineering Policy Centre's Engineers 2030 programme is exploring how the role of the engineer is changing and examining what foundational knowledge, core skills, and key behaviours the future engineer will consequently need.

The Royal Academy of Engineering held two workshops – in December 2023 and January 2024 – to gather the views of a range of stakeholders on these issues.

The specific aims of the workshops were:

- **to build an aspirational vision of the future engineer and their role in tackling future environmental, economic, and societal challenges**
- **to identify key changes that need to be made to achieve the vision and to establish an indicative timeline for achieving that change**
- **to scope out the principles – the values, practices and behaviours – that will underpin delivery of the vision**

The vision created from the two workshops held greatly supported the Engineers 2030 working group to build on their own draft vision which can be seen in the Engineers 2030 Vision and Principles document. This draft vision was used for wider consultation in the following months after its launch on 18 March 2024.

This report presents the outputs from those discussions. It is in four parts:

- **Part 1** introduces the report.
- **Part 2** sets out the vision, explores how it might shape individual engineers' daily experience, and presents the indicative timelines for delivering the vision.
- **Part 3** records participants' thoughts on the principles that will define future engineers.
- **Part 4** offers our concluding observations.

There are four annexes:

- **Annex 1** contains the list of workshop participants.
- **Annex 2** contains the list of visioning questions identified by groups in the first workshop.
- **Annex 3** contains the first draft of the vision.
- **Annex 4** contains schematics from the discussion on delivering change that took place in workshop 1.

The workshops were facilitated for the Academy by Waverley Management Consultants and Ogilvie Design. Waverley consult in futures-based strategy and policy development in the public, private, and higher education sectors, specialising in horizon scanning, scenario development, visioning, and strategic planning. Ogilvie Design use illustration in real time to capture the main themes, ideas, and key issues that emerge over the course of the workshop.

PART 2: THE VISION

Creating the vision

The vision was developed using a four step process:

Step 1: scope the vision

Step 2: produce the first draft of the vision

Step 3: review and adjust the first draft

Step 4: produce the final draft of the vision

Step 1: scope the vision

Step 1 took place in the first workshop. Participants worked in small groups to answer a broad visioning question:

Imagine it is 2050.[1] Engineers have been – and remain – at the heart of the global effort to mitigate and adapt to climate change. They are highly regarded and valued for their ability to anticipate problems and find innovative solutions to manage them. The profession is influential in policy development.

Now imagine you can speak to an engineer from 2050 and find out anything about her job and working life. What would you like to ask?

Each group developed a long list of questions in response to this question. These are set out in Annex 2.

Groups then developed their vision in detail by answering the questions they had identified. They were asked to make their vision:

- **ambitious**
- **aspirational**
- **transformational**
- **achievable**

1 We asked participants to look beyond 2030 to allow for more substantive change.

Step 2: produce the first draft of the vision

Following the first workshop, the outputs from these discussions were used to produce a first draft of the vision.

This is attached at Annex 3.

Step 3: review and adjust the first draft

The first draft of the vision was sent to participants before the second workshop. Participants were asked to review the draft critically and, in particular, to note:

- **what they liked about the vision**
- **what they did not like about it**
- **what they wanted to add in**
- **what they wanted to take out.**

Participants shared their thoughts with each other at the second workshop and worked in small groups to produce a refined draft of the vision. They were also encouraged to stretch the vision further.

The final vision statement, set out below, is based on the output of these discussions. The vision retains some elements from the initial draft and has substantively refined others.

The vision created from the two workshops held greatly supported the Engineers 2030 working group to build on their own draft vision which can be seen in the Engineers 2030 Vision and Principles document. This Draft Vision was used for wider consultation in the following months following its launch on 18 March 2024.

The vision statement

Engineering has a far higher public profile than it has ever had before. Partly, this is because engineering solutions are at the heart of the world's transition to a sustainable net zero economy and a more just society. Partly, it is because engineering thinking is embedded in public policy making. And partly, it is because engineering and what it contributes to society is visible and widely understood.

It is not just what engineers do, it is how they do it. The engineering mantra 'build for the future and do no harm' is more than words. It encapsulates everything that engineers believe. That social purpose and environmental purpose are as important as economic purpose. That ethical practice both creates competitive advantage and attracts the highest quality talent. That engineers are a central part of the ecosystem of professions that are creating a better world for us all.

Engineering, then, is firmly in the public eye. A new cohort of engineering communicators are constantly available to the broadcast media, helping society understand how we are solving the big challenges of the age and reassuring people that those challenges are being met. They have made engineering interesting, intriguing, and meaningful.

As levels of interest have risen in the general population, so has interest in pursuing an engineering career. Every 8-year-old knows what an engineer does. The number of children – both boys and girls – who aspire to an engineering job from an early age has increased. The greater focus in schools on industry – characterised by the increased representation on school governing boards – has proved a significant boost. The pipeline has, finally, stopped leaking and engineering graduates both reflect and represent all parts of society.

Delivering this success has been made possible by the strong partnership between government, the teaching profession, and industry. Teaching in particular has made a significant impact. Far more teachers today have engineering experience and the continued support of bodies such as the Royal Academy of Engineering, the Institution of Civil Engineers and the Institution of Mechanical Engineers means that CPD is indeed continuous and up to date.

Today's engineers come from a variety of backgrounds and have made the journey through a variety of educational pathways. They bring a wider and more diverse range of skills and experiences to the profession. Personal attributes such as collaborative working, critical thinking and problem solving, adaptability and effective communication are as important as technical skills. The boundaries that once existed between different specialisms have all but disappeared and the holistic approach – focusing on the complexity of the problem and designing cross disciplinary solutions – is the new norm.

Engineering skills and experience are not only valued within the profession. The engineer's ability to make sense of complexity and identify how to develop solutions that work is a transferable skill that is much in demand elsewhere. This is particularly noticeable in government where those analytical skills are increasingly trusted to deliver in frontline policy roles – not just engineering policy, of course, but across all aspects of government.

The Chief Government Engineer (CGE) has been highly influential in leading government policies to tackle climate change and the concomitant redesign and rebuilding of the infrastructure that is now beginning to allow the nation to live and work a net zero life. The CGE has, moreover, been instrumental in developing a more forward looking approach to regulation of the sector that marries responsibility with possibility.

UK engineering's ambition is infectious and in demand around the world. British engineers work with commercial partners across the globe to meet the big infrastructure challenges of the age – flood defences, water management, solar, wind, and/or wave power (depending on geography) – and work with educators to maintain the flow of new recruits from a wide range of backgrounds into the profession.

Day in the life narratives

Once they had scoped the vision, participants at the first workshop were divided into four working groups. Each group described what a day in the life of an engineer might be like in the future they had envisioned.

The four engineers and their stories are set out in this section.

- **Navya is a multidisciplinary team leader.**
- **John supports government policymaking.**
- **Eleftheria supports citizens and communities.**
- **Rob is an engineering student.**

The narratives have been revised slightly to take account of the changes to the vision which resulted from the second workshop.

Navya's day

Navya is a multidisciplinary team leader

Navya takes her first metaverse call of the day from home at 9.00am local time. It's a quick review of progress on the virtual walkway her team is working on and she is impressed with progress.

The simulation highlights a design detail that needs to be fixed before the client presentation in two days' time. It's 6.00pm in Tokyo and Akyo offers to get the revision done in the next three hours but Navya tells him to leave it until the next day. They arrange to meet at the same time tomorrow.

She calls the client to update him on progress. Mr Takahashi doesn't speak English so they use the interpreter filter to simultaneously translate.

Navya's next meeting is with her firm's head of PR. The virtual walkway project will feature on an upcoming episode of *Engineering Tomorrow's Solutions*, UK commercial TV's top ranked engineering news magazine, and the head of PR is acting as liaison with the programme makers. Navya provides background on work to date, highlights the unique innovations in the project and agrees to introduce the head of PR to Mr Takahashi. She also agrees to appear in the program,me as the face of the business and is surprised to find herself looking forward to the experience.

The next hour is spent reviewing a new Invitation to Tender from Germany to design a series of smart playparks for under fives. Her AI assistant has highlighted a couple of significant ambiguities in the ITT and rather than second guess what the client needs, Navya asks for a call with her and only has to wait three minutes to connect.

The conversation is helpful and Navya decides who should lead delivery on the ground. She calls him to discuss the who, how, and when of the proposal.

After lunch – a 20 minute walk to her favourite café to meet a friend – Navya stays at the table to write a blog post on the social benefits of designing communities around home working. She then heads back to her home office to deliver a live stream lecture to second year conversion students on the technical and practical skills needed to turn the engineering mantra – Build for the future and do no harm – into reality. She takes questions for a further 30 minutes.

She checks with her AI after the lecture to see if she needs to deal with any emails personally. There is only one, from the community engineering advisory service she carries out pro bono work for. She spends 25 minutes on the reply and arranges a follow up call later in the week.

She finally logs out at 4.45pm. It's been a longer day than usual because her daughters have been away at friends. She'll join them at 6.00pm for dinner and there's talk of everyone heading to the cinema to see the latest movie release. Perfect.

John's day

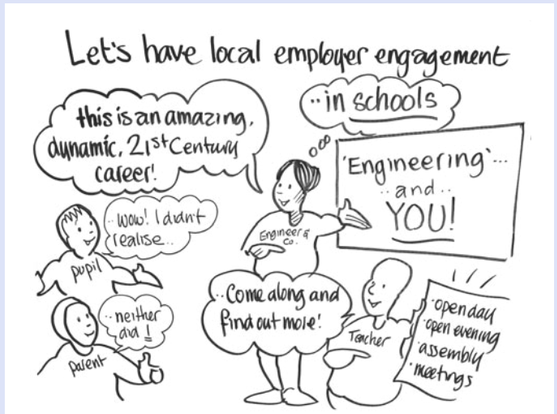
John supports government policymaking

As John looks at his schedule for the day ahead, his thoughts turn to his father – who had tried to persuade him not to take on the job. "You'll hate it," his father had said. "No-one will listen to your opinions and you'll become frustrated by everyone's inaction. Trust me. I know." John smiles wryly and shakes his head slightly. His dad was so wrong . . .

He attends his first meeting in the car on the way in to work, joining a conference call while the car joins a road train into the city. The discussion is focused on how to identify and mitigate the cybersecurity risks upstream in the supply chain to the infrastructure project he is currently assigned to. John really enjoys working with this group since he is the only engineer on the team and his skills and knowledge are in high demand at this particular stage.

It's a tricky problem – cybersecurity remains patchy at the far (and small business) end of the supply chain – and he offers to explore various options for delivery before the next team meeting in a week. He calls his boss's PA to see if she has a diary slot to discuss what those options might be and is delighted to get an hour after lunch. His boss, the Chief Engineering Adviser, is in demand and not always available at short notice – but she had a meeting cancelled that day and is keen to pick up on what's happening with this project.

John arrives at the office by 9.45am and grabs the papers for his next meeting, a two hour workshop to explore how to engineer solutions to loss of biodiversity in the marine environment. He feels a little underqualified for the discussion but after two years in the job he now realises that he's invited to some workshops because of how he thinks rather than what he knows. It took him



some time to feel comfortable in these discussions, but he now enjoys them immensely and finds that he is often able to create value by connecting ideas from different parts of the Department. Sometimes he does this from his own knowledge, but more often than not, he posts a question in the cross government engineers' network (C-GEN). He always gets some kind of useful answer. It still surprises him when colleagues are unaware of potential solutions elsewhere in government.

His meeting is interesting and he's able to connect the group to an old friend of his from university who works in environmental protection and may have some useful IP for the project.

He meets the CEA after lunch and they go through the cybersecurity issues. He enjoys speaking with any colleague with engineering habits of mind and finds them productive. They always lead to an efficient and productive conversation. The CEA picks up on this at the end of their chat and shows John the proposal she's developing to train all staff in principles of engineering. She invites John to contribute to one of the course modules.

The second half of the afternoon is spent writing up meeting notes from the days' discussions and preparing for tomorrow's event at the Royal Academy of Engineering's National Engineering Policy Centre where he is chairing a round table to canvas members' opinions on how to improve the pipeline of net zero engineering skills in the UK. Which are in decline...

He leaves at 5.30pm to head to Chatham House for a dinner to explore ways to build public understanding of STEM and why it is important for public policy making. It's a subject close to John's heart and he's looking forward to hearing some intriguing ideas that he can put into his presentation to his son's Year 5 class later in the week.

Eleftheria's day

Eleftheria supports citizens and communities

Eleftheria's day starts as usual – trying to persuade her children Nick (8) and Electra (12, Ellie for short) to get ready for school. She leaves the house with both children at 8.25am and they walk the mile to school. Ellie goes on ahead to meet her friends and Eleftheria walks with Nick who wants more detail about her job for his 'My mum's an engineer' show and tell.

She chats with some of the other parents at the gate for a bit after the bell has rung. People are always trying to catch her to ask about the latest government announcement or for advice on the best smart pump to install (and how to apply for a grant to do so). When she first started the community support role, she was always anxious to get away as quickly as possible, but now she knows this is – to all intents and purposes – her first clinic of the day.

She jumps on her bike around 9.20am and cycles to her morning community clinic which is held in a remote working hub five miles away from the school. She arrives with time to spare and is able to grab coffee for herself and cake for her clients. Today's clinic is themed around how to manage household carbon budgets. It has become quite a scary topic for some people now that government is talking about fines and the clinic is busy.

She's due at a local planning meeting in the Council offices at midday to look at community energy solutions and she leaves the hub at 11.15am to cycle back across town. She's the community representative for the south side of the city, responsible for liaising with officials on the legal obligations the project places on her constituency and for holding the planners to account if she feels they are cutting corners on any of the project specs.

Although her role on the group is primarily to listen and represent, she can't resist stepping outside her brief today to offer a technical fix for a specific problem that has caused much head scratching over the last few weeks.

She leaves the Council offices at 1.30pm and heads to a local café for a mentoring session with her replacement. Eleftheria has been seconded to this community role for the last two and a half years and will go back to her senior post in one of the large civil engineering companies in 6 months. She'll spend a significant chunk of that time helping her replacement Steven to get up to speed on the project portfolio and – perhaps more importantly – change his mindset from consulting engineer to community resource.

She reflects on how much she's enjoyed the secondment and how much she'll miss it as she cycles back to the school. She's looking forward to it, though, and believes she'll be a better engineer as a result of the secondment.

Eleftheria heads into the school for the final class of the day, the BTEC Level 2 class she teaches once a week. She's particularly enjoying this module on how to respond to an engineering brief. Today's lesson will focus on how to build community value into the commercial response to the brief.

She's amused at pick up time to find Nick's classmates treating her as a minor celebrity after today's show and tell. Nick's happy. His presentation went well and he's been basking in reflected glory all day.

After school is family time and Eleftheria helps with homework while her partner prepares dinner. He also takes over bedtime duties – Elfetheria's final task of the day is to record her weekly time sheet and expenses (light, since she walks or cycles everywhere) for her employer.

Rob's day

Rob is an engineering student

Old habits die hard. Rob wakes at 6.00am so he can write for three hours before heading into uni. His current book chronicles his adventures cycling around India last year and he has to keep hitting his daily word count if he's going to deliver on time. He's trying to get ahead of his target. The classes are getting harder and his publisher is keen to get the first draft soon to capitalise on the success of his last one.

Rob is strongly of the opinion that he wouldn't find it as easy to complete his degree if he wasn't an experienced traveller. He's used to uncertainty and to taking responsibility for choosing the path ahead. He's noticed that some of his fellow students struggle with the level of choice (Rob prefers the word flexibility) in the degree course and believes they would prefer a more ordered, more organised learning pathway through the various modules available to them.

He's also noticed that those students who struggle tend to be the younger ones with less life experience or less of an idea about where they are trying to get to.

It probably helps that this is Rob's second undergraduate degree. His first, in ethnography, established his appetite for understanding cultures and societies on the edge of change and he's excited to complete his degree and begin working to tackle some of the wicked engineering challenges that many of those communities now face. He sometimes finds that he doesn't even think of himself as 'an engineer.'

Rob has back to back lectures this morning and after lunch he heads to the faculty office for a meeting with his Facilitator of Studies. Rob's halfway through his modules and wants to explore whether he can do the sustainable aerodynamics module as a more practice-oriented placement in an engineering firm. It will take longer but it suits his preferred learning style. He finds, too, that industry placements give him a clearer sense of purpose and greater insight. His facilitator is positive and promises to look into it for him.

The rest of the afternoon is spent with his year project team. The six of them are working on the design of a self charging, lightweight electric touring bike. Rob put the project idea forward and was overwhelmed by the number of students bidding to join him. It's a fantastic experience and the team is creative and productive. Four of the members are engineers, one is a physiotherapist and one is studying psychology.

The team finish the day's tasks and then head to the pub. Rob joins them for one beer but then heads home – he needs to get an early night and he needs a clear head for the morning. He's got an open book exam starting at midday and needs to think carefully about what research he wants to access.

And, of course, he's got at least a couple of hours' work on the book in the morning before he can get to that.

Timelines

Working in four groups, participants built a series of timelines setting out the key changes required to make the transition from where engineering is today to where it is in the vision statement.

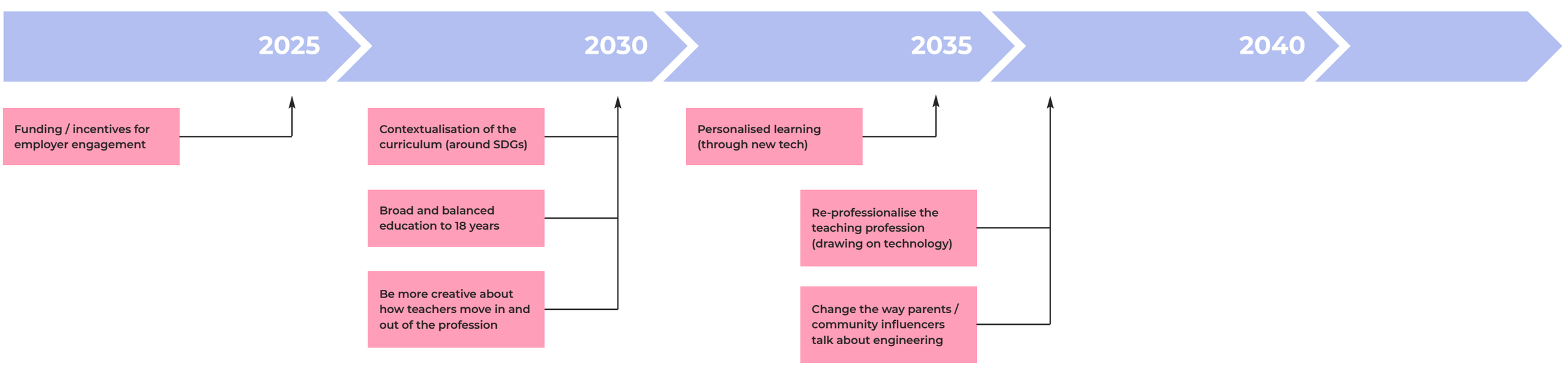
In the first part of this exercise, each group built a timeline for one part of the education and training infrastructure:

- **Schools**
- **Further education**
- **Higher education**
- **Workplace training**

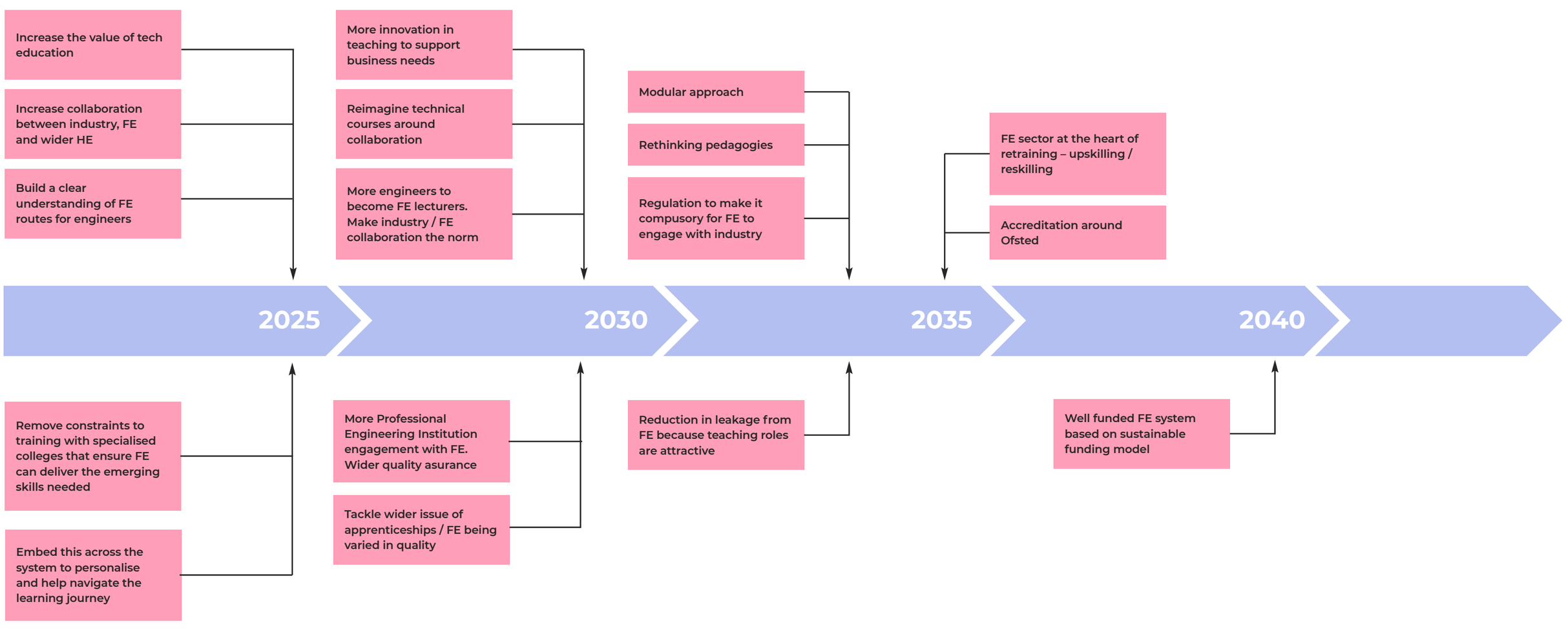
The timelines are shown schematically below.

In the second part of the exercise, each group identified the four key things that need to be done to connect their part of the infrastructure to other parts. We asked participants to identify two 'no brainers', one creative idea and one game changing idea. These ideas are set out in the table on page 24.

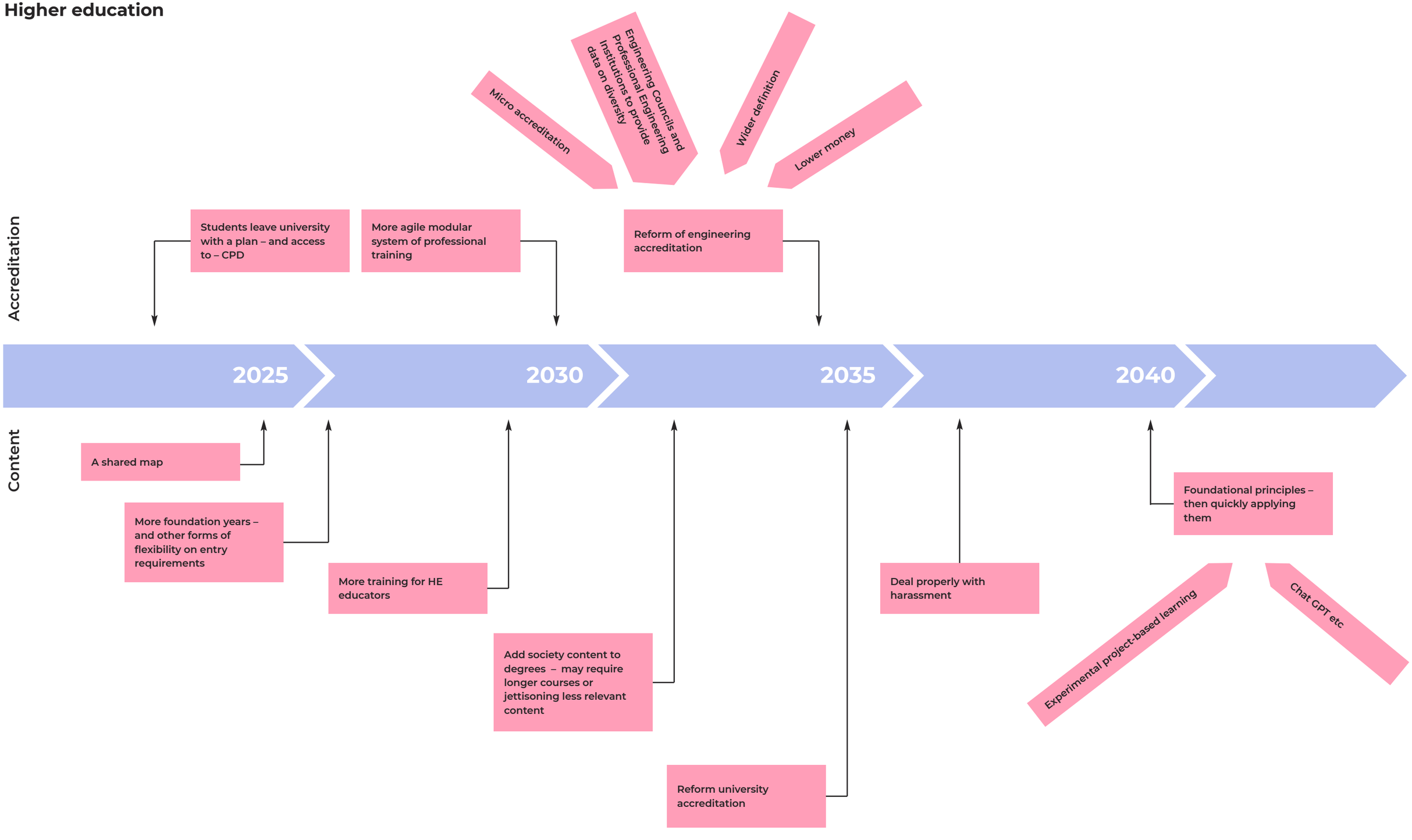
Schools



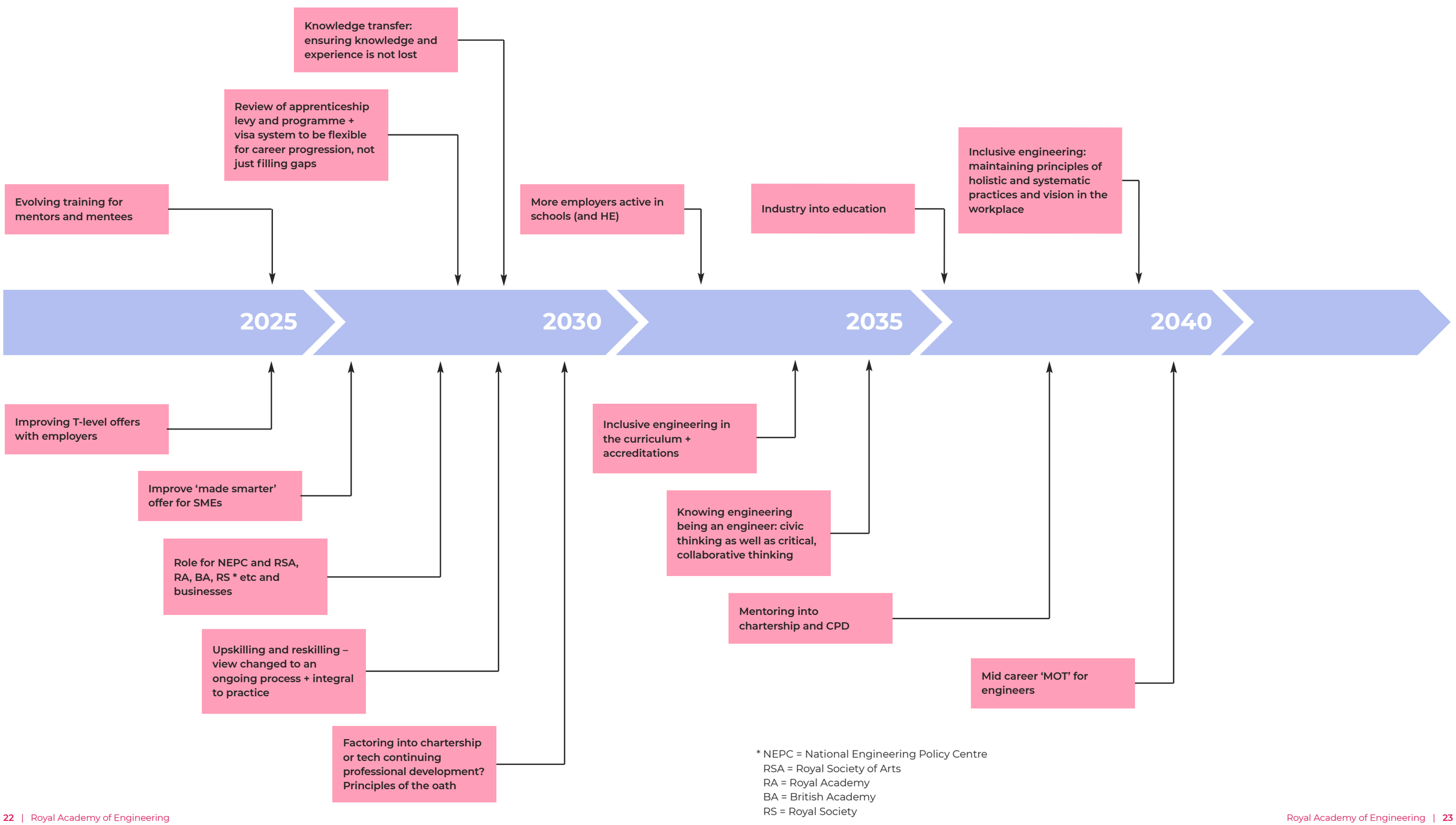
Further education



Higher education



Workplace training



* NEPC = National Engineering Policy Centre
RSA = Royal Society of Arts
RA = Royal Academy
BA = British Academy
RS = Royal Society

Key things that need to be done to connect the different parts of the education system together

	Connecting **SCHOOLS** to the other parts of the education system	Connecting **FE** to the other parts of the education system	Connecting **HE** to the other parts of the education system	Connecting **WORKPLACE TRAINING** to the other parts of the education system
No brainers	• Agree one strategic vision for engineering education • Reform assessment across the whole system	• Provide passion-finding careers guidance to inspire a diverse pool of would be engineers • Embed it across the system to help individuals navigate and personalise their learning journeys • Use language in schools to increase confidence in using the word engineering	• Establish 'Engineers in residence' in schools to create a long term relationship • Create a shared map of the engineering education ecosystem and how to navigate it	• A strategic vision for embedding CPD and mentoring into engineering
Creative ideas	• Embed systems thinking throughout education	• Establish a cross functional role in industry/ academia to make the relationship the norm • Marketing to raise public understanding of engineers at a national level	• Reform – simplify – university accreditation	• National long term engineering strategy to grow depth and capability
Game changers	• Double teaching salaries across the system • Depoliticise education – set up a Royal Commission	• Create a regionally-focused agile system that translates national objectives	• Change the markers of success in academia away from the narrow view that it comes from papers and spin outs	• Business models reflecting true costs – the 'quadruple bottom line'

Review: key steps and tasks for achieving the vision

The timelines set out some of the key changes to the education and training infrastructure that workshop participants believe are essential for making the transition from where engineering is today to where it is in the vision statement.

Each timeline looks at changes in one part of the system – schools, FE, HE, the workplace – but change will not happen unless all parts of the system move together.

Recognising this, participants highlighted several things that need to be done to connect the different parts of the system together (set out in the table on page 24). These and other linkages will be essential if the education system is to make the holistic changes that the vision calls for.

Four things are, perhaps, of particular importance:

- **Agree one strategic vision for education.**
- **Create a shared map of the engineering education ecosystem and how to navigate it.**
- **Embed CPD and mentoring into engineering.**
- **Embed systems thinking throughout education.**

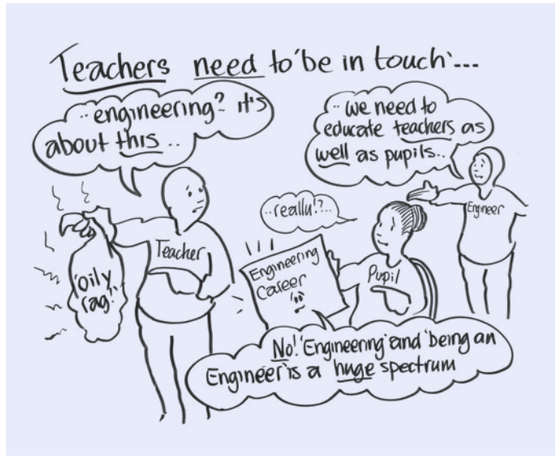
Each one of these will require the sector to work closely together and to work with all parts of the education system. Neither of these will be straightforward, but working with the education sector – and particularly schools – to make the fundamental systemic changes highlighted in the discussions is likely to be particularly challenging given the scale of the task and the range of demands on education.

It is likely that change to the educational system will not happen at the pace and scale required to deliver the vision without significant political influence. This makes engagement with government and policymakers a critically important task for this project.

Nor will it happen if the sector as a whole is unable to coordinate its activities and speak with one voice. This, too, feels critically important for success moving forwards.

A review of the timelines shows that – as well as these points of connection between the different parts of the education and skills system – there are several common issues across the different parts. These include:

- **accreditation**
- **collaboration**
- **building a more agile modular system of education and training**
- **strengthening the skills and relationship between mentors and mentees.**



One interesting idea that appears on the timelines is making the boundary between industry and education much more porous so that engineers can move between the two sectors. While there are undoubtedly high barriers to achieving this, it could be a transformative development.

Encouraging more engineers into teaching will address the lack of skills and knowledge of engineering among the teaching profession in schools. This is not a pejorative view; there is a considerable body of evidence which highlights that teachers and career advisers have limited knowledge about engineering; and that (particularly preschool and early years) teachers do not always have sufficient familiarity with the concepts, principles, and techniques to be comfortable bringing engineering activity into the classroom.

All this highlights the importance of moving forwards quickly. The strategy for change needs to be emergent; it should not plan every step for delivering its vision before it begins. It should mobilise the sector quickly, begin moving forwards where it can, and adapt the strategy as it goes.

PART 3: PRINCIPLES

Defining the principles

Having established the vision, workshop participants discussed what the underlying principles of Engineers 2030 should be.

For the purposes of the discussion, principles were broadly defined as the values, practices, and behaviours that will underpin delivery of the vision.

Participants discussed four areas:

- **Principles for the education and skills system**
- **Principles for individual engineering organisations**
- **Principles for the individual engineer**
- **Principles for government**

The output from these discussions is set out in the tables below. Groups 1 and 2 provided answers in a text format. Group 3 built a mind map.

Principles for the education and skills system

Group 1	Group 2
• Value excellence in communications and outreach equally as much as we value technical skills • Value a broker-based education system up to 18 • Value the international interoperability of standards and accreditation • Don't blame those that 'don't like' engineering; foster valuing engineering • Acknowledge the impact of the challenges that engineering has left the world with • Equip engineers to see the bigger picture • Ensure the education and skill system reflects what engineers care about	• Foster an engineering mindset and leadership mindset. Help engineers be prepared to put their head above the parapet • Encourage inclusivity • Be extremely ambitious for engineers • Provide skills in adaptability • Make engineering a superpower – emphasise the E in STEM and remind everyone success is not just building science and technology capabilities. • Use the coalition to develop and embed the principles for success • Promote the vision properly. Be accountable for ensuring it happens

Principles for individual engineering organisations

Group 1	Group 2
• Embed systems thinking in the professional development pathway and provide structured mentoring • Approach increasing diversity with the seriousness and quantitative attitude that we approach engineering problems • Embed sustainability and digitalisation from the start of all projects • Draw best practice from around the world	• Build a coalition across the engineering ecosystem – education, industry, and government – to collaborate on delivering the vision. Make delivery a whole team effort of all actors, led by the Royal Academy of Engineering • Use the coalition to develop and embed the principles for success • Communicate the vision widely through different formats – text, audiovisual, workbooks for schools • Put posters in schools and workplaces to build commitment to engineering and engineering issues and to encourage people to embody good engineering practice • Raise public awareness and appreciation of engineering. Use programme formats such as Planet Earth to focus on engineering solutions and capture people's hearts and minds • Don't let the perfect be the enemy of the good

Principles for the individual engineer

Group 1	Group 2
• Be aware of and value international best practice; and draw on it more broadly than from the usual developed countries • Show leadership. Ensure every person in the system has agency and is empowered to act for change • All engineers and technicians to appreciate their role and responsibilities • Commit to lifelong learning	• Be ethical. Agree and work to a statement of ethical principles and practice such as the Global Responsibility Competence Compass • Adapt to change. Be agile and responsive

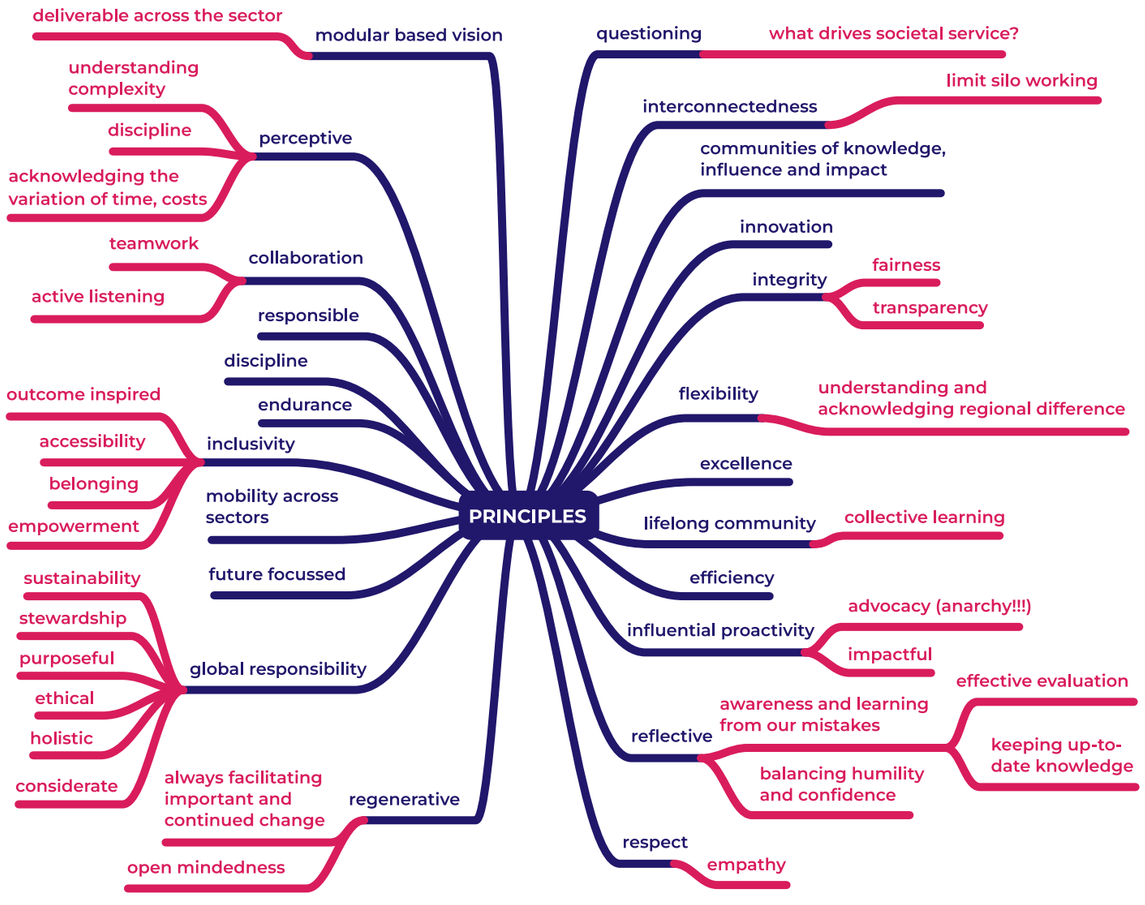
Principles for government

Group 1

- See engineering as a high value sector and as a lever and catalyst for other sectors of value creation
- Agree an apolitical education strategy across all parties and departments
- Agree a long term industrial strategy that is delivered consistently across multiple parliamentary terms
- Debate systems engineering for government

Group 2

- Accept shared ownership of the collective vision. Collaborate with others to build and sustain continuity in delivering it
- Promote the vision properly. Be accountable for ensuring it happens



PART 4: CONCLUSION

The discussion of principles underlined many of the earlier points in the workshops but it also did something more – it highlighted a confidence among participants that changing the perceptions and practice of the engineering profession is possible.

The final plenary conversation that followed focused on how to change this possibility into reality. Participants noted that achieving the ambition set out in the vision will require:

- collaboration across the sector to deliver a change of pace
- as part of that collaboration, a strategic and managed action plan that is implemented
- … and, so, agreement among key actors about who plays what role in that implementation process.

Collaboration will be essential to building the link between visioning and action that is critical if the profession is to change.

Participants emphasised that the vision is an aspirational document, not a roadmap for change and that it does not need to be overly detailed, consulted on, and refined. There is no need to seek permission from external stakeholders such as government for beginning the journey.

Participants also agreed that the profession has control of its own destiny and that it should exercise that control.

Communicating this intent widely across the profession – and beyond – will be key. One output from Engineers 2030 should therefore be a clear statement of strategic intent and a few clear focused messages that will focus the profession on the path ahead.

ANNEXES

Annex 1: Workshop participants registered

Temi Afolabi	Nichols Group
Professor Bashir M. Al-Hashimi CBE FREng FRS	King's College London
Zayeed Alam FREng	Procter & Gamble
Lydia Amarquaye	Institution of Mechanical Engineers
Will Arnold	Institution of Structural Engineers
Professor Erkko Autio FBA	Imperial College London
Richard Barnes	King's College London
Simon Benfield	Ramboll
Husain Bensaud	Institution of Structural Engineers + HBL Ltd
Martina Capecchi	SheCan Engineer
Jamie Cater	Make UK
Professor Peter Childs FREng	Imperial
Andrew Churchill OBE FREng	JJ Churchill Ltd
Professor Joan Cordiner FREng	University of Sheffield
Pippa Cox	Royal Academy of Engineering
Emma Crichton	Engineer without Borders UK
Ann Davies	BP
Alice Delahunty FREng	National Grid
Amanda Dickens	STEM Learning
Mark Enzer OBE FREng	Mott MacDonald
Professor Elena Rodríguez Falcón FREng	University of Wales Trinity Saint David
Professor James Flint	Loughborough University
Professor Ollie Folayan	University of Dundee and Optimus Pro
Dr Matthew Forshaw	The Alan Turing Institute
Andrew Foster	Institution of Chemical Engineers
Professor Jarka Glassey FREng	University of Newcastle
Elliot Gillings	Royal Academy of Engineering
Tony Harper FREng	Industrial Advisory Group
Simon Harrison FREng	Mott Macdonald
Sarah Hitt	NMITE
Shaun Holmes	Royal Academy of Engineering
Andy Hughes	AGH Engineering Ltd
Dr Anne-Marie Imafidon	Stemettes and The British Science Association
Professor Helen James OBE	Institution of Mechanical Engineers
Laura Justham	Loughborough University
Giles Lane	Royal Academy of Engineering
Dr Hilary Leevers	EngineeringUK
Professor Paola Lettieri FREng	UCL

David Lodge	David Lodge Lighting
Katherine Mathieson	The Royal Institution
Professor Mark Miodownik MBE FREng	UCL
Professor John Mitchell	UCL
Tasneem Najmudin	
Sam Nicholas	Royal Academy of Engineering
Graham Ogilvie	Ogilvie Design
Professor Rachel Oliver FREng	University of Cambridge
James Partington	Institution of Mechanical Engineers
Andrew Pemberton	INCOSE UK
Robert Quarshie	The Knowledge Transfer Network [Innovate UK]
Professor Shahin Rahimifard	Loughborough University
Alex Reeve	Frazer-Nash Consultancy
Sam Rhodes	WSP
Angela Ringguth	Chartered Institution of Building Services Engineers
Matthew Rooney	Institution of Mechanical Engineers
Dr Luisa Freitas dos Santos FREng	Global Clinical Supply Chain (R&D), GSK
Robin Saaristo	Martin-Baker Aircraft Co Ltd
Rose Sargent	Make UK
Marine Shah	Royal Academy of Engineering
Professor Nilay Shah OBE FREng	Imperial College London
Peter Sheppard	IMAREST
Dave Short FREng	BAE Systems Plc
Mr Ian Shott CBE FREng	Enterprise Hub founder
Siobhan Silas	Royal Academy of Engineering
Matthew Sinclair	Enterprise Committee
Rachel Skinner FREng	WSP
Phil Smith CBE FREng	IQE PLC
Andrew Stanley	ICE
Kate Thornton	SES Water
Professor Emanuela Tilley	UCL
Katy Turff	Engineering Council
Professor Nick Tyler FREng	UCL Centre for Transport Studies, PEARL
Juliet Upton	Royal Academy of Engineering
Konstantinos Vlamis	Flexitricity
Rebecca Weston FREng	Sellafield Ltd
Alister Wilson	Waverley Consultants

Annex 2: Visioning questions

Participants in the first workshop identified a range of questions they would ask if they could speak to an engineer from 2050. These questions informed development of the vision.

Group A

What is your house like? Where is it?

How are people working together?

What do you actually do as an engineer?

How are your freedoms and rights affected?

What is your sense of purpose? How do you see your role in society?

What is engineering and corporate governance structure?

What influence does engineering have in politics?

How important is digital?

How easy has it been to repurpose engineering of the past?

How much engineering is about decommissioning as opposed to new materials?

Who do engineers working for? The wealthy or society?

Has there been a change in gender balance in engineering? What about the ethnic mix?

How do you see your role society?

How is the prestige of the engineer in society?

What is the balance of regulation versus ethical conscience?

How much does social responsibility affect your work? What makes you think about that?

Group B

What kind of engineer are you?

Where did you train to be an engineer?

What inspired you to go into engineering?

What software/computer are you using to do your job?

Who do you work for – government, institutes, companies?

What are the disciplines you have?

How well did school prepare you – and what is missing?

How do you and your colleagues communicate and collaborate?

What is the relationship between humans and robots?

Who regulates engineers? Who steps in when engineers go bad?

How does public culture depict engineers?

What products / processes are you working on?

What materials do you work with?

How are you clearing up the issues from the early 2000s?

What are the big challenges for the future?

What fuel does your vehicle use?

Can you be an engineer all over the world? Do you have a digital twin?

Who else do you collaborate with who isn't an engineer?

Why are you an engineer rather than anything else?

Group C

Are you still working in silos?

Who do you work with?

Does IMEngE still exist?

How did we replace oil?

Are you well-paid? Is there equality?

Are the robots unionised?

Who owns AI?

How did it happen that there are so many engineers in Parliament?

Is fusion still 30 years away?

How did society move away from GDP as a measure of progress?

What was the radical magical technological solution that allowed us to tackle climate change?

Is the world a more equal place as a result of engineers?

Group D Do you like your job?

How do you manage to influence policy?

Why were you interested in doing engineering?

What gets you out of bed?

How do you describe your discipline?

How much of your job is your life? What is your work–life balance?

How many of your colleagues trained as traditional engineers?

How do you define success? Is it social or cultural?

Who do you like working with and why?

When is the last time you physically met someone?

What is asked of you in a project proposal?

What's the greatest challenge now?

Is the Earth a stakeholder in your job?

What is the dominant system of work?

How has technology changed your life?

What's top of corporate agendas? What behaviours are encouraged / discouraged?

Do you value privacy?

What's the line between work and personal?

How connected to the creative side are you?

Is the constant drive towards perfection seen as more or less human? Is more weight given to new ideas?

Annex 3: First draft vision

In the future

More children want to be engineers when they grow up than want to be doctors.

No wonder. Engineers are very much in the public eye, using their skills to address the range of current and future challenges the world faces. They are doing so efficiently and effectively and the role they play in society is widely recognised and highly appreciated.

Meeting society's need is the core purpose that drives engineering today. The old business model that put profit first is out of step with what the world needs and out of step with the ethics and values of today's engineers. Those values are perfectly encapsulated in the Archimedean Oath all engineers take when they qualify: Build for the future and do no harm.

The majority of engineers in the private sector today work in companies that put social purpose before profitability.

Engineers are well rewarded for their work but those rewards are not solely financial. For many, time – working a four day week, for example – is more valuable to than money.

Employees can negotiate personalised wellbeing packages that give them significant scope to design the hours they work each week and the balance of commercial vs community-based projects in their portfolio.

The approach works well – even in those smaller specialised companies that have a little less flexibility than their larger cousins – primarily because it is the embodiment of the profession's values; but also because new engineers will not join businesses that do not apply the Archimedean Oath to their own workforce. Authenticity, ethics, and social purpose are the only elements of the engineer's job contract that are non-negotiable.

Today's engineers, who come from a variety of backgrounds and have made the journey through a variety of educational pathways, bring a wider and more diverse range of skills and experiences to the profession. Personal attributes such as collaborative working, critical thinking and problem solving, adaptability, and effective communication are as important as technical skills. The boundaries that once existed between different specialisms have all but disappeared and the holistic approach – focusing on the complexity of the problem and designing cross-disciplinary solutions – is the new norm.

Engineering skills and experience are not only valued within the profession. The engineer's ability to make sense of complexity and to identify how to develop solutions that work is a transferable skill that is much in demand elsewhere. This is particularly so in government where engineers' analytical skills are increasingly trusted to deliver in frontline policy roles – and not just engineering policy, but across all aspects of government.

The Chief Government Engineer (CGE) has been highly influential in leading development of government policies to tackle climate change, and the simultaneous redesign and rebuilding of the infrastructure that is now beginning to allow the nation to live and work a net zero life. The CGE has, moreover, been instrumental in developing a more forward-looking approach to regulation of the sector that marries responsibility with possibility.

UK engineering's ambition is infectious and in demand around the world. British engineers work with commercial partners across the globe to meet the big infrastructure challenges of the age – flood defences, water management, solar, wind, and/or wave power (depending on geography) – and work with educators to maintain the flow of new recruits from a wide range of backgrounds into the profession.

Annex 4: Schematics from workshop 1

Groups defined the transformational changes required in the education system to provide engineers with the skills they need to achieve their vision.

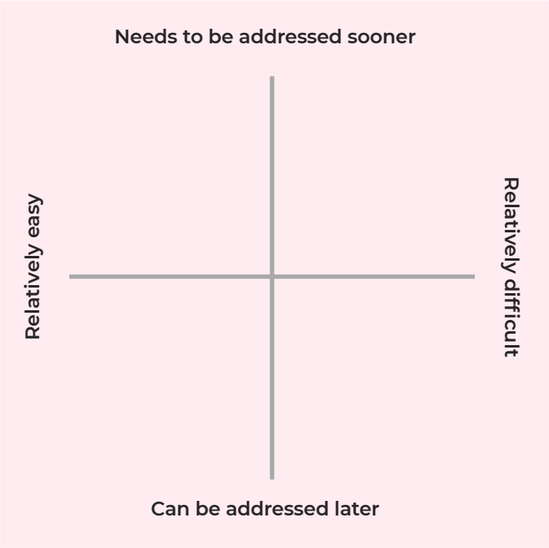
Each group brainstormed key changes – including 'taboo' changes[2] – onto post-it notes and then mapped them onto a 2 x 2 matrix according to whether:

- they need to be delivered sooner or can wait until later
- they will be relatively easy to deliver or relatively hard.

Once each map was built, groups identified the most strategically important changes – up to three – in each quadrant by marking them with a red dot.

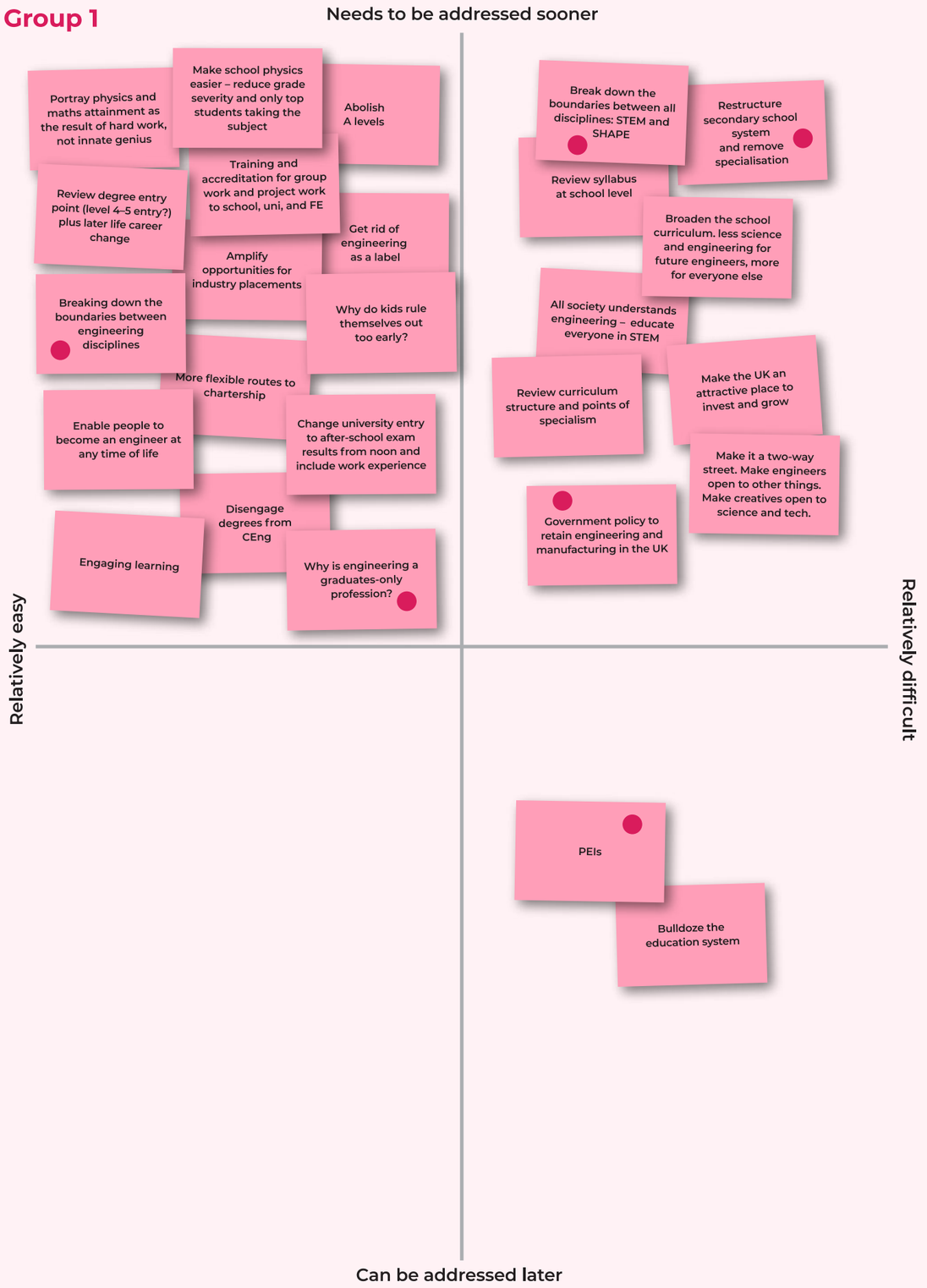
The maps are shown schematically on the following pages.

The main themes that emerged from the discussion are introduced on page 44 and set out in the tables on pages 45–50.



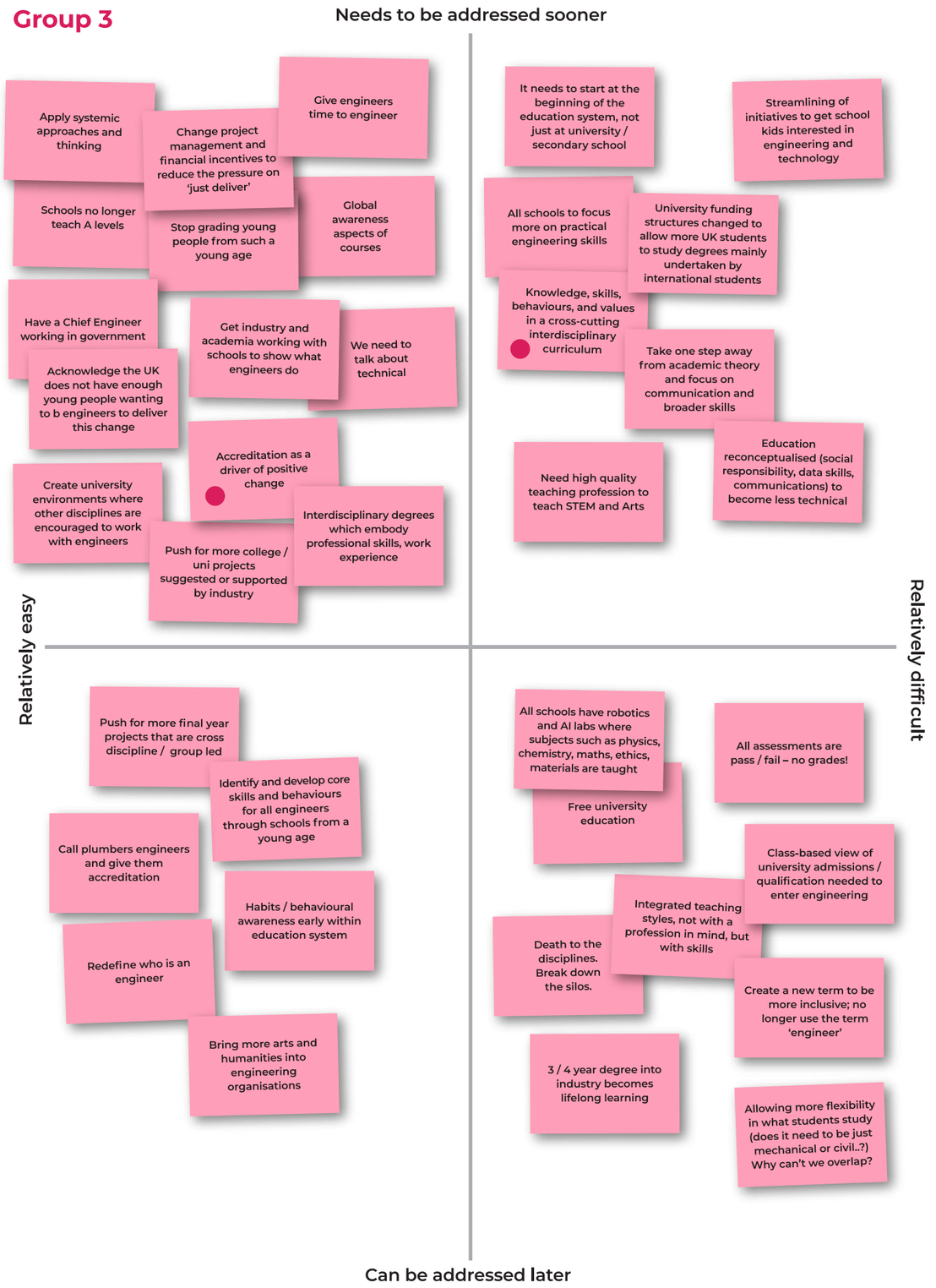
2 A taboo change is one that is necessary but is rarely talked about; either because (for example) it is deeply and culturally challenging to powerful stakeholders or because it is likely to create significant disruptive change.

Group 1

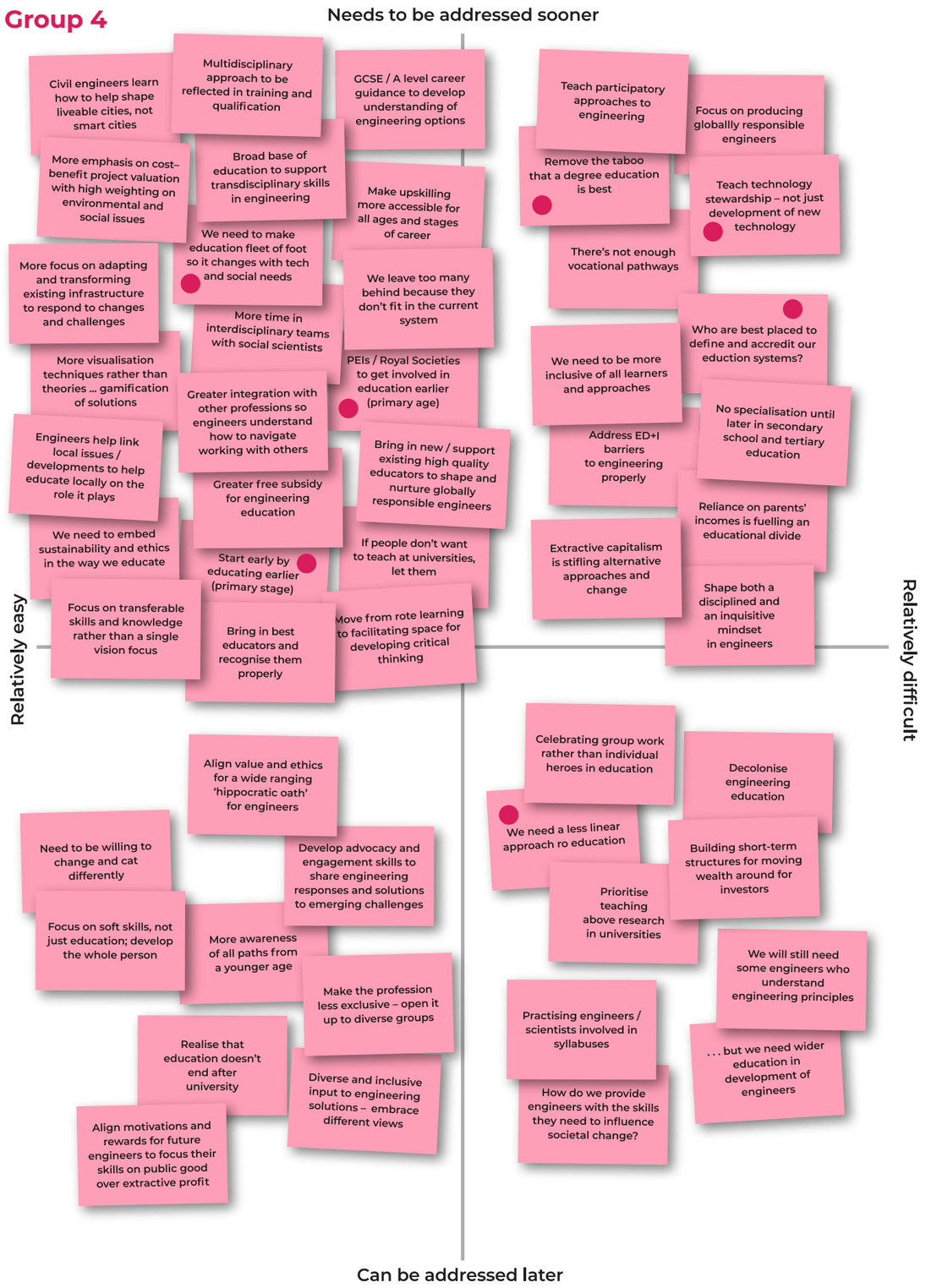


Group 2

Group 3



Group 4



The main themes

We have reviewed the full list of changes captured in the mapping exercise and identified 10 main themes which participants believe need to be addressed:

- Transform education
- Start the learning journey much earlier
- Broaden the school curriculum
- Encourage closer working between industry and all levels of education
- Break down the boundaries
- Increase interdisciplinary learning
- Focus more on personal attributes and soft skills
- Qualifications and accreditation
- Continuous development
- Working with and for government

These themes are set out in the following tables.

Transform education

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
• We need to make education fleet of foot so it changes with technology and societal needs • Education is no longer a business model – or one geared towards outcomes • We need to embed sustainability and ethics in the way we educate • Portray physics and maths attainment as the result of hard work, not innate genius • Bring in best educators and recognise them properly • Bring in new / support existing high quality educators to shape and nurture globally responsible engineers • Stop grading young people from such a young age • Apply systemic approaches and thinking • Enable people to become an engineer at any time of life • Review degree entry point (Level 4–5 entry?) Plus later life career change • Make school physics, easier – reduce grade severity and only top students taking the subject • Introduce a degree module on unintended consequences • Acknowledge the UK does not have enough young people wanting to be engineers to deliver this change • Understand why kids rule themselves out too early [and correct]	• Teach technology stewardship – not just development of new technology • We need to be more inclusive of all learners and approaches • Reconceptualise education to bring in social responsibility, data skills, communications, and to become less technical • Teach participatory approaches to engineering • No specialisation until later in secondary and tertiary • Change university funding structures to allow more UK students to study degrees mainly undertaken by international students	• Introduce more diversity of experience, culture, inclusion • Align value and ethics for a wide ranging 'hippocratic oath' for engineers	• We need a less linear approach to education • [Develop a] new system of thinking • We will still need some engineers who understand engineering principles – but we need wider education in development of engineers • How do we provide engineers with the skills they need to influence societal change? • Define alternative pathways and their flexibility • Prioritise teaching above research in universities • Integrated teaching styles, not with a profession in mind, but with skills • [Remove] subjects in education – [teach] by skillsets

Start the learning journey much earlier

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
• Start early by educating earlier (primary stage) • Make practical learning the dominant form of teaching	• The journey towards becoming and engineer needs to start at the beginning of the education system, not just at university / secondary school • Introduce engineering concepts earlier in education • All schools to focus more on practical engineering skills • Streamline initiatives to get school kids interested in engineering and technology	• Identify and develop core skills and behaviours for all engineers through schools from a young age • Establish habits / behavioural awareness early within the education system • Raise awareness of all paths from a younger age	• Create a new term to be more inclusive; no longer use the term 'engineer'

Broaden the school curriculum

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
	• Restructure the secondary school system and remove specialisation • Review the syllabus at school level • Review curriculum structures and points of specialism • Broaden the school curriculum. Do less science and engineering for future engineers, more for everyone else • Educate everyone in STEM so that all society understands engineering		• Ensure All schools have robotics and AI labs where subjects such as physics, chemistry, maths, ethics, materials are taught

Encourage closer working between industry and all levels of education

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
• All manufacturers to be fiscally encouraged to engage with their local schools • PEIs / Royal Societies to get involved in education earlier (primary school) • Get industry and academia working with schools to show what engineers do. Break the stigma and help teachers • Push for more college / uni projects suggested or supported by industry • Amplify opportunities for industry placements • Engineers [to] help link local issues / developments to help educate locally on the role engineering plays	• Streamline initiatives to get school kids interested in engineering and technology • Make liaison and work placement with industrial partners mandatory • Bring more practising engineers into the classroom	• 3/4 year degree into industry becomes lifelong learning	• Get practising engineers / scientists involved in [developing] syllabuses

Break down the boundaries

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
• Break down the boundaries between engineering disciplines • Get rid of engineering as a label • Broad base of education to support transdisciplinary skills in engineering	• Break down the boundaries between all disciplines: STEM and SHAPE • We need a high quality, trusted teaching profession to teach STEM and Arts	• Make the profession less exclusive – open it to diverse groups • Bring more arts and humanities into engineering organisations • Redefine who is an engineer • Call plumbers engineers and give them accreditation	• Death to the disciplines. Break down the silos • Allow more flexibility in what students study (does it need to be just mechanical or civil...?). Why can't we overlap?

Increase interdisciplinary learning

Sooner/Easy

- Create university environments, where other disciplines are encouraged to work with engineers
- Establish interdisciplinary degrees which embody professional skills, work experience
- More time in inter-disciplinary teams with social scientists
- Multidisciplinary approach to be reflected in training and qualification
- Greater integration with other professions so engineers understand how to navigate working with others
- Have a planet and human centric curriculum

Sooner/Difficult

- Build knowledge, skills, behaviours, and values in a cross cutting interdisciplinary curriculum
- Require engineering students to spend study time in other disciplines
- Engineering degrees to have content that shows social sciences are valued
- Have a broad 'generalist engineer' education, linking with non engineering disciplines
- Bring disciplines together more often in higher education
- Make it a two way street. Make engineers open to other things. Make creatives open to science and tech
- Stop narrowing so early

Later/Easy

- Push for more final year project that are cross discipline/group led
- iverse and inclusive input to engineering solutions – embrace different views

Later/Difficult

- Celebrate group work rather than individual heroes in education

Focus more on personal attributes and soft skills

Sooner/Easy

- Focus on soft skills – team working, communication, decision-making
- Move from rote learning to facilitating space for developing critical thinking

Sooner/Difficult

- Take one step away from academic theory and focus on communication and broader skills
- Greater focus on communication and collaboration skills in the education of engineers
- Value skills, values and behaviours as highly as content

Later/Easy

- Develop advocacy and engagement skills to share engineering responses and solutions to emerging challenges
- Focus on soft skills, not just education; develop the whole person

Later/Difficult

Qualifications and accreditation

Sooner/Easy

- Remove the taboo that a degree education is best
- Use accreditation to drive positive change
- Why is engineering a graduate only profession?
- Create more flexible routes to chartership
- Schools to no longer teach A-levels
- Abolish A-levels
- Change university entry [applications] to after exam results and include work experience
- Training and accreditation for group work and project work at school, uni and FE

Sooner/Difficult

- Who are best placed to define and accredit our education systems?

Later/Easy

Later/Difficult

- Change the way we measure education
- Remove maths / physics from the base requirement to study engineering
- Make all assessments pass / fail – no grades!
- Define alternative pathways and their flexibility

Continuous development

Sooner/Easy

- Make upskilling more accessible for all ages and stages of career
- Enable people to become an engineer at any time of life

Sooner/Difficult

- Require periodic update of education to update knowledge

Later/Easy

- Realise that education doesn't end after university
- [Provide] education for those in mid career
- Make it easier to get back into learning after leaving
- Put more emphasis on continuing education to keep up with new technology development … and new paradigm shifts in other disciplines and society

Later/Difficult

Working with and for government

Sooner/Easy	Sooner/Difficult	Later/Easy	Later/Difficult
• Teach engineers about how engineers can work in and with government • Teach non-engineers about how engineers can work in and with government • Have a Chief Engineer working with government • Chief Engineer in government and in DfE, DBT, and Treasury to influence education policy and strategy		• Align motivations and rewards for future engineers to focus their skills on public good over extractive profit	

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March 2024