Royal Academy of Engineering | Policy Fellowships

Engineering better policy

Insights from the Policy Fellowships programme

FROM

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January 2021

Foreword

A collaborative future for engineers and policymakers

2020 was a year of challenge and change. It has reminded us that government and civil society can achieve more when they come together to tackle the big challenges. Complex systems issues such as a public health crisis, the resilience of infrastructure, or climate change demand a wide range of skills and perspectives. The need for collaboration between policymakers and engineers has never been greater.

The Royal Academy of Engineering's Policy Fellowship programme could not be more timely with its mission to develop the ability of policy professionals to connect with leaders in engineering. We welcome the creation of a generation of high-calibre Policy Fellows across all levels of government who are championing the role of engineering approaches such as systems thinking to develop better, evidence-based policy.

We would like to thank colleagues across the policy and engineering professions who have shared their expertise so generously through the programme, and the five Policy Fellows who have authored this publication for sharing their insights and leading the way.

We hope that their experiences will inspire individuals from diverse backgrounds to apply for this scheme, and we look forward to a positive shift in the use of engineering expertise and application of systems thinking to engineer better policy. Together, we can explore more effective ways to frame difficult questions and support policy solutions that will benefit our society.

Together, we can achieve more than alone.

Sir Patrick Vallance FRS FMedSci FRCP
Government Chief Scientific Advisor

Professor Sir Jim McDonald FREng FRSE
President of the Royal Academy of Engineering

Foreword

Our call to engineers and policymakers

As policymakers in central and local government, we develop interventions that help to solve the big challenges of our times.

We aim to improve planning and delivery, decarbonise and strengthen the resilience of UK infrastructure, build and support resilient and secure systems and policies, ensure our policies support equality, diversity and inclusion, and harness the benefits of science and technology.

Policymaking takes place within a complex system. Collectively our roles cut across a broad range of policies, but we are rarely responsible for the whole system. To reconcile competing priorities, we draw on a wide range of evidence and specialist advice, which cuts across multiple fields of expertise.

As policymakers we call on engineers to advise us on systems thinking, to help policymakers think through not just the right thing to do but also how to make it happen, to understand the power of good data and to help generate it.

This report is our collective call to our colleagues in government to discover the value of engineering to policy.

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Deputy Director Innovation Policy, Department for Business, Energy and Industrial Strategy

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Head of Innovation, Aviation Security, Department for Transport

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Deputy Director Policy, Defence Science and Technology, Ministry of Defence

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About the Policy Fellowships programme

The Policy Fellowships programme is an intensive professional development programme that supports better evidence-based policymaking through building stronger connections between policymakers and the technical community.

Three times a year the Academy selects exceptional policymakers to become Policy Fellows. We welcome applications from policymakers with a variety of insights, expertise and backgrounds from across the policy community.

Access to a prestigious network of experts
As the UK's national academy for engineering and technology, the Royal Academy of Engineering brings together the most talented and successful engineers, the finest systems thinkers and the most outstanding talent in technology for the benefit of society.

The Academy's engineering network includes Academy Fellows based in the UK and internationally, and awardees from its prestigious research, enterprise and education programmes. Where appropriate, Policy Fellows have also been introduced to the specialist engineering expertise of the 40 professional engineering institutions and other partners of the National Engineering Policy Centre, as well as global experts via the international network of national academies for engineering.

The core programme
Over a four-month core programme, each Policy Fellow benefits from regular individual coaching to help make the most of the programme, plus an introduction to engineering and the Academy's Systems 101 Workshop. They then undertake up to 12 one-to-one meetings with leaders in engineering, peer-to-peer discussions about engineering and applying engineering systems approaches to policy, and further introductions to engineering networks and engineering policy work.

The alumni programme
After graduating from the core programme, Policy Fellows join our alumni programme, which brings a rich array of development opportunities including networking and alumni-led events. It also supports involvement in other Academy policy work relevant to their interests, which to date has included work on decarbonising construction, the safety of complex systems, resilience, and inclusive outcomes for engineering. Policy Fellows are expected to play an active role in this post-Fellowship experience.

This report was co-created with Policy Fellows by distilling the takeaway messages from their individual programme reports, interviews and group workshops. It also builds upon a conversation on what policymakers need from engineers, which was initiated by alumni in November 2020.

For more information about the programme, please visit **www.raeng.org.uk/policyfellowships** or contact **policyfellowships@raeng.org.uk**

> "The Policy Fellowship has supported members of my team to forge meaningful connections outside of the department and bring new and diverse ways of thinking into their work."

Jo Shanmugalingam
Director General, Industrial Strategy, Science and Innovation
BEIS

Executive summary: engineering better policy

This report is an invitation to discover how engineering perspectives can transform policy practice. It is written for policymakers and engineers alike, for those interested in the study of policy and what exposure to engineering brings, for engineers wanting to know how to engage with policy more successfully, and for potential applicants and their managers wanting to understand the benefits of joining the programme.

It contains:

Five case studies that showcase the learning journeys and personal insights from Policy Fellows since commencing an intensive development programme in May 2020.

Hear from:

- **Louise,** who used expert discussions and systems-based approaches advocated by engineers to help embed the public sector equality duty (PSED) in BEIS' policymaking.
- **Ben,** who explored systems and processes in parallel industries, alternative approaches to regulation, and open architectures to better understand future trends for aviation security.
- **Chris,** whose introduction to systems thinking and its application to policy problems transformed his team leadership approach and influenced work on the UK Government's *Integrated Review.*
- **Hannah,** who improved connections between resilience and security in government and developed new connections between her team and experts in academia and industry.
- **Madalina,** whose programme insights influenced the forthcoming Mayor of London's Infrastructure Strategy and supported plans for stronger technical advice in London.

How the Policy Fellowships programme adds value to policymakers in practice, based on the shared accounts from participants.

Benefits include:

- **Harnessing engineering expertise.**
  The programme equips policymakers with engineering insights and tools and introduces them to engineering systems approaches and systems thinking, with transformational results.
- **Creating communities.**
  The programme builds a network of policymakers and engineers. It creates a space for peer-to-peer learning for policy professionals, and an ongoing dialogue that benefits both policymakers and engineers.
- **Inspiring a change in culture.**
  The programme injects fresh and practical perspectives into policy work and explores new ways of working between policymakers and engineers, creating value beyond the programme.

The Policy Fellowships programme transforms policy practice with engineering perspectives. It is becoming the forum for policymakers' and engineers' communities, inside and outside of government.

Louise Dunsby

How to embed public sector equality duty (PSED) in policy making.

Louise Dunsby is Deputy Director for Innovation Policy at BEIS. She was an engineer before joining the civil service, and has retained her chartered status while at BEIS.

Policy challenge

I wanted to embed PSED into policymaking, ensuring public authorities meet their obligations under the Equality Act 2010. I was keen to evolve from a compliance approach to a more invested and proactive level of engagement with PSED.

Learning journey

My engineering background inspired me to join the Policy Fellowship programme. Ensuring civil servants take equality and inclusivity into account while developing and implementing new policies became particularly important this year as we have had to make policy at quite an unusual pace. COVID-19 is disproportionately impacting people in specific backgrounds, and we need evidence that our policies are not doing that as well.

I held a dozen meetings with Academy Fellows. The first four focused on defining the problems of non-compliance and institutional resistance to PSED, with low levels of engagement and understanding of the Equality Act. It was an important first step as if the problem is not defined, then solutions may be solving the wrong problem. This is an area where systems thinking is particularly helpful. Subsequent meetings considered approaches to behavioural and organisational change, before concluding with practical next steps. Chosen techniques included testing general awareness of PSED, mapping stakeholder views and brainstorming causal links. The programme helped me demonstrate that PSED is not only an objective in itself, but its promotion is also an opportunity for civil servants to become better policy professionals.

Impact

Following discussions with experts, I identified 'inclusion' as offering optimal alignment with the user-centric systems-based approach advocated by engineers, since it promotes commonalities rather than differences. Since completing the Policy Fellowship, I have created a PSED Champion role within my department to offer information and tools to policy officials, helping them to consider the PSED implications of their actions. I am keen to set out a vision for policymakers regarding PSED.

"The connections you make with people in communities relevant to your work are incredible."

Harnessing engineering expertise

"I gained a lot out of the Fellowship," Madalina said of her journey, *"it surprised me by going beyond my expectations of specific answers to questions, or precise engineering advice on certain aspects of the role. The programme has helped me build a more systemic way of thinking around issues".*

Engineering insights and tools
Policy Fellows brought specific policy challenges to progress through the lens of engineering. Conversations with engineers helped to **tease out technology challenges** facing specific government departments and policy areas, allowing Policy Fellows to address them more directly. Participants were inspired to think about long-term data gathering and how that could support high level, authoritative recommendations for change.

Policy Fellows explored the **value of framing cross-cutting policy goals** so that such goals can be achieved alongside results in specific policy areas. The programme helped participants to create the conditions for securing buy in from colleagues, by clarifying policy development and projecting a vision of the future, and directly impacted how they articulate challenges and influence people.

The programme also led Policy Fellows in **unexpected directions and broadened their initial focus beyond progressing a specific issue,** for example considering novel approaches to regulation. It has led directly to moves to create a data association for roadworks, inspired by analogous initiatives in the oil and gas industry, and a knowledge base for critical national infrastructure networks.

This improved understanding of challenges and solutions **is already having a direct impact on policymaking.** Policy Fellows' aspiration is that the programme will make a big contribution to changing how public sector organisations operate in the coming years.

Engineering systems approaches applied
The programme also introduces Policy Fellows to engineering systems approaches and systems thinking, with transformational results.

The **value of exposure to systems thinking** was repeatedly singled out as one of the biggest benefits of the programme. Policy frameworks and engineering systems approaches are especially compatible, since change does not happen in isolation and policy challenges inevitably form part of far larger ecosystems. Being able to apply systems thinking in real time has become critical, as the COVID-19 crisis has shown.

A systems approach helps with **problem definition.** As Louise stated, "if a problem is not defined, then solutions may be solving the wrong problem". For Madalina, it also led to a better understanding of what different **stakeholders** care about, with an impact on recommendations and new policies. Hannah noted that the way engineers combine systems thinking with an understanding of detail and internal processes helps with how to frame **decision-making** and respond to evolving expectations.

It can seem hard to apply systems thinking in government, with barriers such as data and departmental siloes, blurred or multiple accountabilities, political cycles and fast pace. Identifying the existence of these issues provides a first step to resolving them. Engineers are well-placed to support and challenge government to overcome these barriers and, as Chris argues, we need to **build more proactive frameworks for such learning and development.** The Policy Fellowships programme is a welcome step in this direction and is making a big contribution to this change.

Ben Jones

What are the novel detection technologies and how will evolving security systems impact the future passenger journey context at horizon 2050?

Ben Jones is the Head of Innovation in Aviation Security Policy at the Department for Transport. His role involves identifying challenges and opportunities surrounding aviation security.

Policy challenge

I wanted to better understand how aviation security might develop between now and 2050, and how novel technologies could simplify passenger and cargo journeys through airports.

Learning journey

Airline security is being disrupted by new technology and AI, from computed tomography to threat detection algorithms. My job involves streamlining consumer and commercial security processes in response, working towards the Department for Transport's goal of making the passage of goods and cargo seamless. I wanted to explore what engineering could offer in terms of testing these evolving systems, and also what the surrounding regulatory framework might look like.

My involvement in the Policy Fellowship programme fostered a greater sense of systems thinking. Through discussions with engineering experts, I explored the larger ecosystem of parallel systems around my policy area. I am now better able to articulate the nature of industry challenges, which will help in terms of communication and getting wider policy buy-in going forward.

Impact

My actionable insights include studying the systems test and approval process in parallel industries, such as vehicle components. I am investigating alternative approaches to regulation, and how open architectures are being implemented in areas such as the military. I am also keen to explore further training in systems thinking approaches, building on the knowledge gained through the Policy Fellowship.

"The Academy did a very good job of linking me to people they thought would be relevant."

Creating communities

"The Policy Fellowships programme is a great way to meet people in the engineering and policymaking communities" said Louise. *"It's good for networking."*

Connecting with engineers and engineering networks

A real strength of the programme is the **connections** that Policy Fellows make with a rich and diverse group of leaders in engineering, who are specifically chosen to respond to and support each Policy Fellow's individual interests.

For Ben, the Royal Academy of Engineering "did a very good job of linking me to people they thought would be relevant, like people from the defence sector, where many of the challenges I face are already entrenched. Although my policy challenge is unique in transport security, it reflects issues faced by other sectors." There is immense value in building a network of engineers that can be tapped into in the future, and Policy Fellows aspire to an **ongoing dialogue which benefits all parties.**

The bespoke nature of the programme enables Policy Fellows to **follow their own interests,** through one-to-one coaching, follow-on introductions and invitations to participate in wider Academy policy activities. These activities enable Policy Fellows to create strong connections with the teams at the Royal Academy of Engineering and improve their access to engineering networks and expertise for the future.

Connections within the policy community

The Policy Fellowships programme is also about connecting Policy Fellows within a strong and proactive community of like-minded policy professionals. It creates a **space for peer-to-peer learning.** The range of connections across a diversity of departments and authorities creates a promising network as government increasingly focuses on science, engineering and technology.

Policy Fellows were inspired to **disseminate their learning journeys** within their teams. "I got the team that ran the Policy Fellowship to come and deliver the Academy's Systems 101 Workshop to my colleagues," said Louise, "because it's hard to articulate what the value of the Fellowship is without going through it."

Nine of her colleagues have so far harnessed the expertise of engineers, bringing alternative viewpoints into their own jobs and working relationships. Louise also created a new role within her department, charged with providing tools and information to policymaking officials to encourage data sharing. This will lead to new ways of thinking and networking opportunities.

> "Through this fellowship, Madalina has been able to integrate the Greater London Authority's infrastructure work further with the wider engineering community. This has already proven beneficial in the projects we do and will bear fruits long into the future, supporting and improving our policymaking."
>
> **Tim Steer**
> Assistant Director – Transport, Infrastructure and Connectivity, Greater London Authority

Chris Moore-Bick

What sort of technology policy framework should the Ministry of Defence develop in response to accelerating and profound technological change and its various implications?

Chris Moore-Bick is Deputy Director, Policy Defence Science and Technology at the Ministry of Defence (MoD). He has been with the MoD since 2005.

Policy challenge

While other Policy Fellows were attempting to solve a specific policy problem, I wanted to apply policy to science and technology within the MoD. My Policy Fellowship focused on issues such as the importance of different technologies and their policy implications.

Learning journey

I wanted to build a proactive (rather than reactive) framework for learning and development, pulling together the best thinking from different disciplines to create a distinct subset of government policymaking. If you are doing policy work right, you are integrating different perspectives and considerations. A policy person might not understand that they could produce a better piece of work if they approached it as an engineer would, or reached out to engineers for help.

I had 10 sessions with Academy Fellows. Some were working on specific technologies, while others had more experience of engaging with government departments. I noted that the engineering mindset and the policy mindset are intrinsically compatible, and found it valuable to explore different ways of bridging the gap between the scientific/engineering mindsets and the policy approach. This remains a significant barrier, as the engineers with experience of working inside or alongside government acknowledged during the programme.

Impact

The Policy Fellowship gave me a valuable introduction to systems thinking and its application to policy problems. It helped to clarify the technology challenges facing the MoD. I now have a greater insight into how implementing complex systems involves recognising the intersections between new technologies and wider sociological and geostrategic factors. This has informed both my team leadership and my work on the UK Government's *Integrated Review.*

" It's been a pleasure and a privilege to participate, and to benefit from the workshops and my discussions with Academy Fellows."

Hannah Tooze

How can the owners and operators of infrastructure be influenced to assess, own and mitigate high-consequence, low-likelihood risks such as terrorist attacks or very extreme weather events?

Until recently, Hannah Tooze was the Head of Land Transport Security at the Department for Transport. Inspired by her Policy Fellowship experience to move her career towards resilience, she has just become Deputy Director, COVID-19 Policy in the Department for Environment, Food and Rural Affairs.

Policy challenge

In my previous role at the Department for Transport, I had to prepare for high consequence but low likelihood security threats to the UK's land transport infrastructure. I wanted to gain an understanding of engineering perspective on risk and behaviour change.

Learning journey

My Policy Fellowship involved 10 meetings with Academy Fellows, from people working on cyberthreats to chemical engineering experts. This diversity was particularly useful given the variety of challenges involved in counter-terrorism security for land transport. Structural silos, information sharing failures and nervousness about blurred accountabilities can inhibit and disincentivize cross-sectoral collaboration and systems thinking in government. How engineers combine systems thinking with an understanding of detail and internal processes has helped me with how to frame decision-making and respond to evolving expectations.

By speaking to experts in a wide range of sectors, I gained insights into multiple approaches to risk mitigation and ownership. It opened up new avenues for more comparative work, and the identification of best practice in the analysis and management of risk. I spoke to engineers who had led major post-incident reviews of regulatory systems, and people engaged in cutting-edge research into new risks and vulnerabilities in emerging technologies. The importance of systems thinking was cited by many of the engineers, who encouraged creative thinking regarding the consequences of potential scenarios and wider systemic risks.

Impact

I completed the programme with a focus on improving the connections between safety and security regulation and design, as well as between resilience and security in government. I initiated the development of a knowledge base of critical national infrastructure networks. I also explored approaches to resilience outlined by the engineers, bringing colleagues into the discussion and connecting them with academics and other experts in organisations with overlapping interests and concerns.

"The Fellowship is a great programme, it has transformed my view of engineering."

Inspiring a change in culture

"It is about injecting the policy model into the engineering world and the engineering model into the policymaking world" says Chris, *"We need to take deliberate action to bring the two communities together."*

New perspectives
Completing a Policy Fellowship injects **fresh perspective into the day-to-day work of policymakers.** Meeting people from diverse backgrounds and experiences that work across several sectors, industries and policy areas will lead to perceptions and traditional ways of working being challenged.

Policy Fellows give credit to **the care and thought** the Academy puts into the design, development and delivery of the programme, from its essential onboarding stage, to the taught (workshop) elements, the bespoke programmes of meetings with engineers, and the individual and collective development opportunities as part of the alumni programme.

A new forum for change
The one-to-one meetings were experienced by both sides as meetings of equals. Beyond the programme, Policy Fellows **call for greater reciprocity** than simply experts handing down learned wisdom.

Policy and engineering both involve complex systems and a flexible approach to possible outcomes where historic evidence is not readily available.

Policymakers can learn from engineers and their systemic approaches and solutions-focused mindset, while engineers can learn from policymakers' need to anticipate issues created by technologies and challenges associated with their exploitation. It was suggested that programmes like the Policy Fellowships should be integrated into **future qualifications for science and technology policy professionals.**

The need to develop more open dialogue between those in and out of government was a key takeaway for the Policy Fellows, to learn how and why the private sector often accomplishes outcomes more quickly than the public sector. The expectation that 'things happen slowly' was singled out as a roadblock to action and innovation, and one that requires challenging by engineers and policymakers alike. It was suggested that a **compendium of best-practice examples of joint working methods** would be useful, though acknowledging that everyone will face different challenges requiring unique approaches and resolutions.

The Policy Fellowships programme is becoming **a forum for policymakers and engineers** to engage in two-way exchanges **to explore ways of working** between both communities, inside and outside of government.

> If we are to respond effectively to the challenges of profound and accelerating technological change, it is essential that we develop effective joint working and shared understanding between policy, science and technology and engineering professionals. Through Chris's participation, the Policy Fellowship programme has already helped inform the Integrated Review; it is an important initiative that I am sure will bring significant benefit to Whitehall and the engineering community in the coming years."
>
> **Dr Nick Joad**
> Director Science and Technology, Ministry of Defence

Madalina Ursu

How to deliver joint streetworks through collaboration, and future-proof infrastructure against trends such as rising demand, changes in use and climate change?

Having joined the Greater London Authority in 2013, Madalina Ursu is now the Head of Infrastructure at City Hall.

Policy challenge
I wanted to develop better evidence-based policymaking for implementing a 'dig once' policy for roads throughout London, working with infrastructure providers and highways authorities while future-proofing this policy against climate change and evolving demand.

Learning journey
Although roadworks are inevitable, there are many steps that can mitigate and minimise their impact. Existing policy was not having much effect, so my Policy Fellowship explored how engineers can contribute to streamlining infrastructure and public realm works. I was specifically trying to understand the needs and priorities of stakeholders, from reputation and PR to cost and carbon reductions.

I haven't resolved all of my questions with the Policy Fellowships programme, but I feel better rounded to tackle tasks that come from an engineering direction, and I now have access to this technical community, which I can reach out to with any question. Exposure to systems thinking encouraged my entire team to better understand what different stakeholders care about.

Academy Fellows recommended that I speak to providers, regulators and other stakeholders like the British Standards Institution (BSI) and UK Collaboratorium for Research on Infrastructure and Cities (UKCRIC). This could help to improve asset registers, change the existing paradigm so that streets are viewed as assets rather than burdens requiring maintenance, and to study international best practice. I am now investigating the creation of a data association for infrastructure, inspired by existing initiatives in the oil and gas industry. I am planning a 50-year audit of the powers and limitations of highways authorities to develop a cross-government paper outlining recommendations for change.

Impact
Systems thinking is already shaping Greater London Authority policies when thinking about infrastructure resilience or mandating data sharing, and evidence from the Fellowship Programme will support the forthcoming Mayor of London's Infrastructure Strategy. The Policy Fellowships programme has also had a positive influence beyond my initial policy challenge. For example, we are now close to getting a Chief Scientific Advisor for London and this very much came on the back of the programme.

" Everyone provided valuable contributions that reinforced our hypotheses or made me consider whether we'd been asking the right questions."

Royal Academy of Engineering | Policy Fellowships

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

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