Data skills and knowledge in the engineering sector

Workshop summary report

Open Data Institute

Contents

About

This report was produced as part of a project funded by Lloyd's Register Foundation. It builds on research from the Open Data Institute's Sharing engineering data for the public good project funded by Lloyd's Register Foundation. The views in this report are those of the authors.

This report has been researched and produced by the Open Data Institute, and published in January 2021. Its lead authors were Deborah Yates, James Maddison and Mahad Alassow. If you want to share feedback by email or would like to get in touch, contact James Maddison at james.maddison@theodi.org.

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OPEN FOR FEEDBACK   How can it be improved? We welcome suggestions from the community in the comments.

Executive summary

This report is the result of a half-day discovery workshop facilitated by the Open Data Institute (ODI) and commissioned by Lloyd's Register Foundation. The workshop was designed to help understand the extent of support, training and guidance for data literacy and skills in the engineering sector. This is part of wider work to take forward the principle of 'building data literacy and skills' set out in the industry backed [manifesto](#) for sharing engineering data for public good. Together with a variety of stakeholders (see appendix one) from across the engineering landscape, we discussed the role that data plays in the everyday work of engineers; examined the balance of data skills needed across engineering organisations; and discussed how existing support compares to what is needed, in order to inform interventions to drive greater use and sharing of data in the sector.

While it was felt that in some areas of engineering, data skills and knowledge were fairly strong, the general consensus from participants was that the level of data skills and knowledge across the whole sector needs to be improved, and requires more investment.

In this report we make a number of recommendations on next steps to be delivered over the short (next six months) and long (beyond six months) term. These are provided in detail at the end of the report and include:

1. Producing a white paper on data skills in engineering
2. Convening a roundtable with engineering CPD providers to explore opportunities for adding data skills to existing CPD offerings
3. Working with universities, research organisations and professional bodies to increase capacity in data skills and knowledge
4. Developing an 'introduction to data in engineering' learning programme

Background

In 2019, the ODI, funded by Lloyd's Register Foundation, undertook a [short project](#) aimed to develop a movement within the engineering sector that would lead to the sharing and use of data for the public good, with a particular focus on improving safety.

We engaged with stakeholders – including the Royal Academy of Engineering, the Health and Safety Executive, The Alan Turing Institute and Cambridge University Press – to develop a shared vision around better use of data. In May 2019 we hosted a public event to help to articulate and explore our shared vision, and in October 2019, we published a [manifesto](#) and [report](#) with Lloyd's Register Foundation, which identifies ways to build a stronger engineering data infrastructure to increase safety within the sector.

The ODI and Lloyd's Register Foundation teamed up again in 2020 to take two of the manifesto principles forward:

- **Using challenges to drive innovation that solves problems** by launching a new stimulus fund to support [small projects to pilot approaches](#) on a practical level.
- **Building data literacy and skills.** Through desk and user research aiming to gather evidence and insight into the need for data literacy and existing support available in the form of training, certifications or codes of practice.

This workshop forms part of the user research to ensure we focus efforts on adding value to sharing data within the sector, and don't repeat work already done.

Approach

This half-day discovery workshop, held on 22 October 2020, brought together key stakeholders from the engineering sector to share their perspectives on data literacy and skills. Participants came from a variety of disciplines, representing research, regulation, funders and those that create data. A full list of organisations attending is included in appendix 1.

The workshop was split into three sessions:

1. How data relates to the everyday life of engineers
2. Identifying the data skills and knowledge needed to improve access, use and sharing of data in the engineering sector
3. How data skills and knowledge needs compare to what support is already available

We used the ODI Data Skills Framework to consider the balance of data skills – from the more technical to those that enable innovation – needed within organisations. We reflected on which elements of the skills framework were a priority to increase access, use and sharing of data, and considered the skills most relevant or missing for specific disciplines.

Our intention is to use these insights, combined with findings from more focused user interviews carried out by the ODI (included in appendix 3), to determine whether there is a need to revise or expand on existing codes of practice, certifications or training, and consider new initiatives to promote data understanding and use for the engineering sector.

Key insights

This section brings out the key insights from each session.

Session 1: How data relates to the everyday life of engineers

In this discussion we reflected on how data relates to the everyday life of engineers, considering the value of data to day-to-day work, and the level of awareness of this across disciplines. The points below bring out the main themes and insights from the discussion.

The value of data day-to-day

- There has been a slow take-up but data is being talked about a lot more, especially in the construction sector.
- There is increasing use of data within Artificial Intelligence (eg as part of research), but core skills and knowledge around data are not always prioritised.
- Private sector is often results orientated, so even with limited data it's expected that staff extrapolate.
- The Covid-19 pandemic has elevated data discussions to board level in many cases.

Knowledge

- There is a high variability of skills and knowledge depending on discipline/geography.
- Those in 'data roles' tend to have the analytics skills to do their job.
- In general there is a higher level of comfort discussing 'headlines' drawn from data, over more detailed analysis. Organisations tend to rely on high level datasets and do not understand the potential risks in terms of decision making based on these datasets only. It's an issue which results in inaccuracies.
- The engineering sector is very varied which means people need to work together – it's hard for one person to have all the expertise. Well-balanced teams are key to covering the breadth of data topics and practical experience, however the approach to skills and knowledge is currently more on an individual basis rather than thinking about the team as a whole.
- Universities are beginning to offer more data literacy courses, but uptake is slow.
- Engineering professionals need help to understand the problem of incorrect information.
- There is growing recognition that the 'data translator' is vital for organisations in making data-informed decisions and creating value from data. Visualization and creativity are vital in this.

Access and use of data

- In general, data is not curated well and this impacts access and use.
- Different people use different standards which can make it difficult to access and use data within engineering. For example, the codes will be different – how data is manually inputted makes a difference to how well computers communicate and link data.
- Building Information Modelling (BIM) is an example of best practice in access and use of data.
- Technical infrastructure, and the required understanding of it, are not always there to support use of data.
- Funders are beginning to encourage responsible data use.

Session 2: Identifying the data skills and knowledge needed to improve access, use and sharing of data in the engineering sector

In this session we used the ODI Data Skills Framework to consider the balance of data skills needed within organisations – from the more technical to those that enable innovation. We reflected on which elements of the skills framework were a priority to increase access, use and sharing of data, and considered which skills were most relevant and which were missing for specific disciplines. Images from this interactive session are included in appendix 2 and we have summarised the main points below.

Innovating with data

- Working in an ethical manner is a top priority and shouldn't be neglected in favour of other goals.
- There is a lack of knowledge about the data capabilities people hold. Promoting and developing the awareness of data capabilities could help reduce current inefficiencies.
- Skills to apply statistics, use data, analyse trends and draw insights are important to enable organisations to relate to, and achieve value from, data.

Standardising and accessing data

- Standardising data can be difficult, particularly when innovation is rapid.
- A uniform way of working to standardise data across the sector would help different systems to communicate.
- Developing an industry wide and accepted practice to manage and store data will improve and encourage collaborations.
- Improving skills to describe and inventory data will help people to find and access it more easily.
- Open platforms like Github, where people around the world start working on the code and build on the data, are important for working across countries and maximising access, use and sharing of data.

Leading change

- "Having a go-to person has been a game changer. Before it was difficult to know who had the responsibility [for the data]"
- It is important for those not in technical roles to have at least a baseline level of understanding of data and its value to a project, to foster an environment

where sharing learning – both positive and negative – about data projects is
encouraged.

- User engagement capabilities are important to encourage adoption of data
that is shared. For example, using journey maps outlining real sectoral
challenges – if a user can directly see how their practical challenges can be
addressed using data, the buy-in rate improves.

Session 3: How data skills and knowledge needs compare to what support is already available

In this discussion, we reflected on how data literacy needs compare to what support
is already available. We shared ODI desk and user research on this topic (a full
summary is included in appendix 3), and discussed whether the findings reflected the
experiences of the participants.

Gaps in support for data skills and knowledge

- Practical guidance on working in an ethical manner when sharing and using
data.
- Peer learning approaches. For example, across supply chains, for those
working on digital twins, or via implementation of the UK National Data
Strategy.
- Sharing where things went wrong, as well as where things went well –
balancing sharing the learning with managing reputation is often a challenge.
- Data literacy for those not in formal 'data roles' – often there is a big gap in
knowledge here.
- Cultural change – people and organisations often go on a journey to become
comfortable sharing data, particularly if they are worried about reputation or
competitive advantage. There isn't much available to support this process.
- Curating, documenting and inventorying data – it can be hard to find what's
needed and then access it. There is a need for help to structure what already
exists. For example, data about building stock and construction.
- Clarity on roles and governance of key national data assets such as building
stock (eg currently this is being collated by the Colouring Cities project).

There was broad agreement that no one organisation is in an obvious place to drive
change and lead skills development, and that it should be a private/public
partnership.

Summary and next steps

This half-day workshop generated some useful insights into the levels of data literacy and skills required to access, use and share data in engineering. The group was enthusiastic and engaged throughout and each participant had the opportunity to input and be heard. Workshop participants agreed there is value in bringing cross-discipline groups like this together as they all learnt something from each other.

There are some clear areas to consider in terms of next steps. Taking into account what we heard during the workshop, and building on our earlier work with Lloyd's Register Foundation, we have identified some short-term activities for the ODI to undertake as part of our ongoing project with Lloyd's Register Foundation. We have also identified potential future activities that would require additional funding. Together, these should begin to increase data literacy and skills to support increased access, use and sharing in the engineering sector.

Short term (January – March 2020) – next steps for the ODI

This set of short-term activities will be delivered by the ODI under our existing grant from Lloyd's Register Foundation.

1. **Produce a white paper on data skills in engineering.** This joint paper will be a collaboration between Lloyd's Register Foundation, ODI and industry leaders such as the Alan Turing Institute and the Royal Academy of Engineering. The paper will consider the skills and any specific types of training needed to implement the principles set out in the manifesto to increase access to data and drive innovation in the engineering sector.

2. **Convene a roundtable to explore opportunities for adding data skills to existing CPD offerings.** Engaging universities and engineering organisations which provide education services to explore the value of working together to include data skills and literacy in their training programme. This would include data, digital and education staff from continuing professional development (CPD) providers and support the longer term aim of sector change.

Longer term (April 2020 onwards) – considerations for funders

These activities could help to improve data skills and knowledge across the sector. Funders are asked to consider:

1. **Work with universities, research organisations and professional bodies to increase capacity in data skills and knowledge.** Develop a programme of training that would enable universities to communicate, teach and engage students in the practical application of data within specific disciplines of

engineering, and add any new courses or content focused in this area to their existing CPD offering.

2. **Develop an 'introduction to data in engineering' learning programme.** Building on feedback from the ODI's trial of learning programmes (above), this piece of work would engage and align with existing initiatives, such as [Engineering X](#) and [Data-Centric Engineering](#) to improve data literacy for those not in formal 'data roles'.
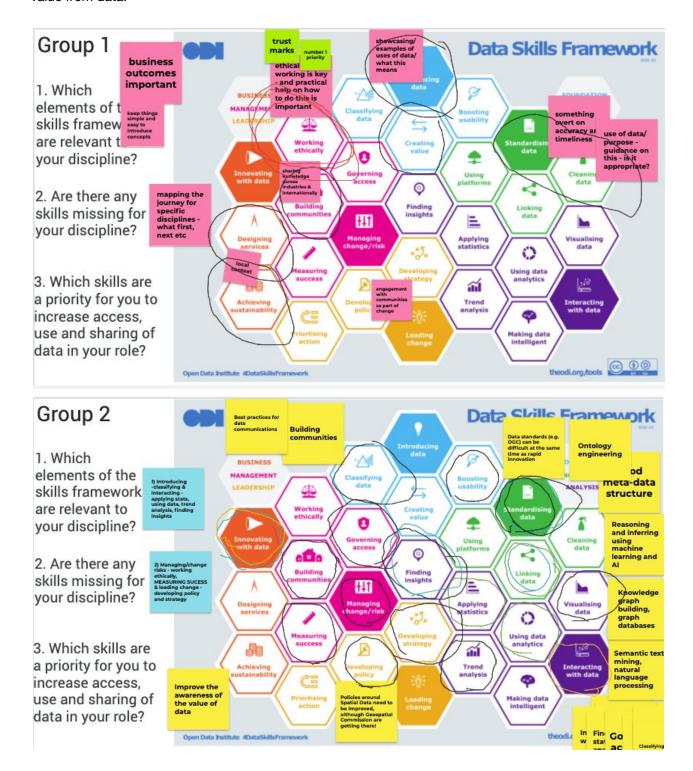
Appendix 1: Workshop attendance

The workshop included nine participants from nine organisations:

Organisation	Organisation role	Attendee Role
Health & Safety Executive	Regulator	Senior Scientist
Colouring London/Alan Turing Institute	Researcher	Programme Director
EPSRC	Funder	Senior Portfolio Manager
Geodata	Creator	Enterprise Fellow
Atkins	Steward/Creator	Data Scientist
Mission Drive/ODI	Data skills consultant	Data Skills Consultant
Lloyd's Register Foundation	Funder	Programme Manager
RAENG – Engineering X	Researcher	Senior Manager
Tideway	Steward	Engineering Information Manager

Appendix 2: Workshop images

In this appendix we share screenshots of the 'Jamboard' activity used in session 2, asking participants to consider what skills are required to improve access, use and sharing of data in engineering. We used the ODI's Data Skills Framework to help structure our thoughts around the common skills and capabilities required to create value from data.

Appendix 3: Summary of ODI desk and user research

Approach

The ODI conducted research using a combined approach: desk research, followed by a number of expert interviews. Insights from both elements informed the structure and focus of the workshop.

The desk research focused on two key questions:

- What codes of practice or guidance are available to organisations in the engineering space around accessing, using and sharing data?
- What training courses or certification are available to organisations in the engineering space around accessing, using and sharing data?

The desk research uncovered a number of gaps which were used to create more specific questions for seven expert interviews, with a focus on current best practice and existing gaps, in guidance, training and skills. We engaged with a range of stakeholders, in different roles, from organisations working in the sector. Stakeholders were selected based on their experience working on or with data enabled projects, and to cover a range of typical roles within the engineering ecosystem.

Organisation	Organisation role
Health & Safety Executive (x2)	Regulator
Arup	Advisor
Engineering and Physical Sciences Research Council	Funder
Royal Academy of Engineering	Researcher
Tideway	Steward
Centre for Digital Built Britain	Decision maker

Key Insights

There is not much generic guidance or training around data in the engineering sector. Most organisations follow the rules outlined in GDPR, and may have their internal guidelines to follow around accessing, using and sharing data as well. Some organisations have their own training programmes around data, but it's not always mandatory to attend them. There are a small number of organisations which offer external guidance, like Royal Academy of Engineering's 'Towards Trusted Data Sharing' work, but these are rare.

Data guidance needs to be embedded into everyday engineering practices, and people working in the sector need to be able to see the value of data for their role, and for their organisation, in order for it to make sense to them. If organisations are to invest in upskilling staff in data knowledge and skills, that upskilling needs to be aimed at addressing specific business or organisational problems or opportunities. Practical guidance around accessing, using and sharing data for the engineering sector, guidance about the value of data and case studies would be really useful here.

There are some more general problems to be solved as well. Often, data isn't something that is well understood across the organisation, from top to bottom, which means that culture change around data and digital is driven by a few individuals, usually from the bottom up. There is sometimes a disconnect in understanding between departments or roles, which can cause miscommunication and a misinterpretation of each other's needs. Guidance around the fundamentals of data, such as key terms and concepts would be useful for bringing people across organisations onto the same page. Similarly, examples of how other sectors are demonstrating value with data, as well as tools that organisations can use to have conversations about data would be valuable.