DATA-DRIVEN INNOVATION: INNOVATING PRODUCTS, SERVICES AND SYSTEMS WITH BIG DATA

Overview

With the increase in data available, from for example IoT, there has been growing interest in data-driven design and innovation over the last decade. Data-driven design implies methods, approaches and processes using data to assist the development of products and services (Lee and Ahmed-Kristensen, 2023). Yet businesses face challenges in using data as a resource for value creation and to understand how to innovate with new products, services, and user experiences that consider the needs of their stakeholders.

Based on a review of a decade of research, we developed a data-driven design framework highlighting the types of innovation that are possible with big data. We have developed and tested both the framework and data-driven innovation process through a series of workshops with a number of industry partners to test and refine our approach and explore innovation opportunities, utilising data with design approaches. These include, respectively, a partnership with See. Sense (a manufacturer of smart bike lights); collaboration with the Advanced Manufacturing ResearchCentre (AMRC) – a High Value manufacturing catapult – to test our approach with 30 UK manufacturers, and correspondingly, with 37 Companies from the Foundation Industry via Innovate UK.

This case study focuses on our work with See.Sense, a UK and Australia-based manufacturer of smart bike lights and smart bike accessories, specialising in products and data for the cycling and micromobility market. See.Sense gathers data from sensors attached to bicycles with information on traffic flow, road surface quality, and potential safety hazards. With over 120,000 sensors deployed around the world and AI-fusion technology, their mission is to make cycling safer and collectively smarter. In this context, we facilitated several workshops, leveraging data from See.Sense and beyond, to generate value for internal and external stakeholders involved in their data ecosystem.

Our initial workshop with See.Sense utilised a data-driven design framework, to map all their data, before facilitating a data-driven idea generation process. A number of ideas that were generated, including innovative ideas that were new to the company, two ideas were selected to build upon further. These were: 1) encouraging people to cycle, and 2) designing and maintaining the planning infrastructure.

We invited external stakeholders and experts to attend three additional workshops, with the aim of developing detailed product and service ideas that considered both the positive and negative impacts for each stakeholder.

The first of these external-facing workshops focused upon design for behaviour change, bringing together local authorities, cycling experts, data scientists, transport and infrastructure managers, transport innovation managers, health psychologists, designers, and civil servants to understand how data can be used to promote healthy behaviours and encourage cycling. Thus, the expertise of designers, data scientists, and health psychologists were combined with insights from stakeholders.

The second and third workshops focused upon using data from bike lights to inform the planning and maintenance of cycling infrastructure, and brought together cyclists, transport and infrastructure managers, transport innovation managers, and local authorities. The third workshop in the series, is focusing upon reducing emissions, working with Dublin local authorities and businesses. Participants were able to explore how data could be utilised within their business context and gain inspiration for innovative design ideas, such as the design of data dashboards for individual users.

This case study demonstrates how real-time sensor technology can be combined with other datasets to create value and innovate across multiple business sectors, driving digital innovation.

Data-Driven framework (Lee & Ahmed-Kristensen,2025)

Challenges

The research challenge is to understand how data can be used to drive innovation by identifying the appropriate design and innovation methods to facilitate this. Industry challenges with how to create value and adopt digital technologies include:

- Identification of relevant data.
- How and when to collect and use the data.

Outcomes

- A data-driven design framework outlining key activities to drive innovation of products and services using big data.
- Data-driven process: A data-driven canvas and tools to facilitate creating value with stakeholders, which was developed, tested and evaluated as "D³IKIT', a data-driven design process and toolkit.'

Key benefits

'D³IKIT' enables practitioners and researchers to generate data-driven innovation.

Collaboration with See.Sense has provided the research team with a valuable opportunity to test D³IKIT in a real-world design setting, distilling insights that will enable practitioners in different design and business contexts to realise the potential value from the data they generate. From a See.Sense perspective, the collaboration has led to novel ideas that integrate data and interest from multiple stakeholders. Two of these concepts were selected for further development, demonstrating value to the company and stakeholders, leading to a subsequent EU project, entitled SPINNOVATE, with input from Dublin City Council informing the design of data dashboards.

Key publications

Lee, B., & Ahmed-Kristensen, S. (2023). 'Four patterns of data-driven design activities in new product development.' *Proceedings of the Design Society*, 3, 1925 – 1934. https://doi.org/10.1017/pds.2023.193

Lee, B., & Ahmed-Kristensen, S. (2024). 'D³IKIT: data-driven design innovation kit.' *Proceedings of the Design Society*, 4, 2109–2118. https://doi.org/10.1017/pds.2024.213

Lee, B., & Ahmed-Kristensen, S. (2025). 'D3 framework: An evidence-based data-driven design framework for new product service development.' *Computers in Industry*, 164, 104206. https://doi.org/10.1016/j.compind.2024.104206

Jiang, P., Han, J., & Ahmed-Kristensen, S. (2025). 'Opportunities and challenges of AI in design: A practical study from the manufacturing industry.' *Proceedings of the Design Society: International Conference on Engineering Design:* (ICED '25), Dallas, USA. https://iced.designsociety.org/

Johnson, K., & Ahmed-Kristensen, S. (2025). 'Exploring the role of human data in data-driven design.' *Proceedings of the Design Society: International Conference on Engineering Design* (ICED '25), Dallas, USA. https://iced.designsociety.org/

Han, J., & Ahmed-Kristensen, S. (2026). *Design thinking in the digital age*, Cambridge University Press.

Professor Saeema Ahmed-Kristensen
University of Exeter

Dr Karl Johnson
University of Exeter

Boyeun Lee
Former Post-Doctoral Research Associate

" We have co-created and tested the data-driven design with several companies and public sector organisation "

Partners:
See.Sense, Irene Mclesse, Philip Mclesse, AMRC High Value Manufacturing Catapult, KTP

For further information please contact:
Professor Saeema Ahmed-Kristensen
s.ahmed-kristensen@exeter.ac.uk