NATIONAL DIGITAL TWIN PROGRAMME

The Second National Infrastructure Assessment

CDBB National Digital Twin programme response to NIC call for evidence

Feb 2022

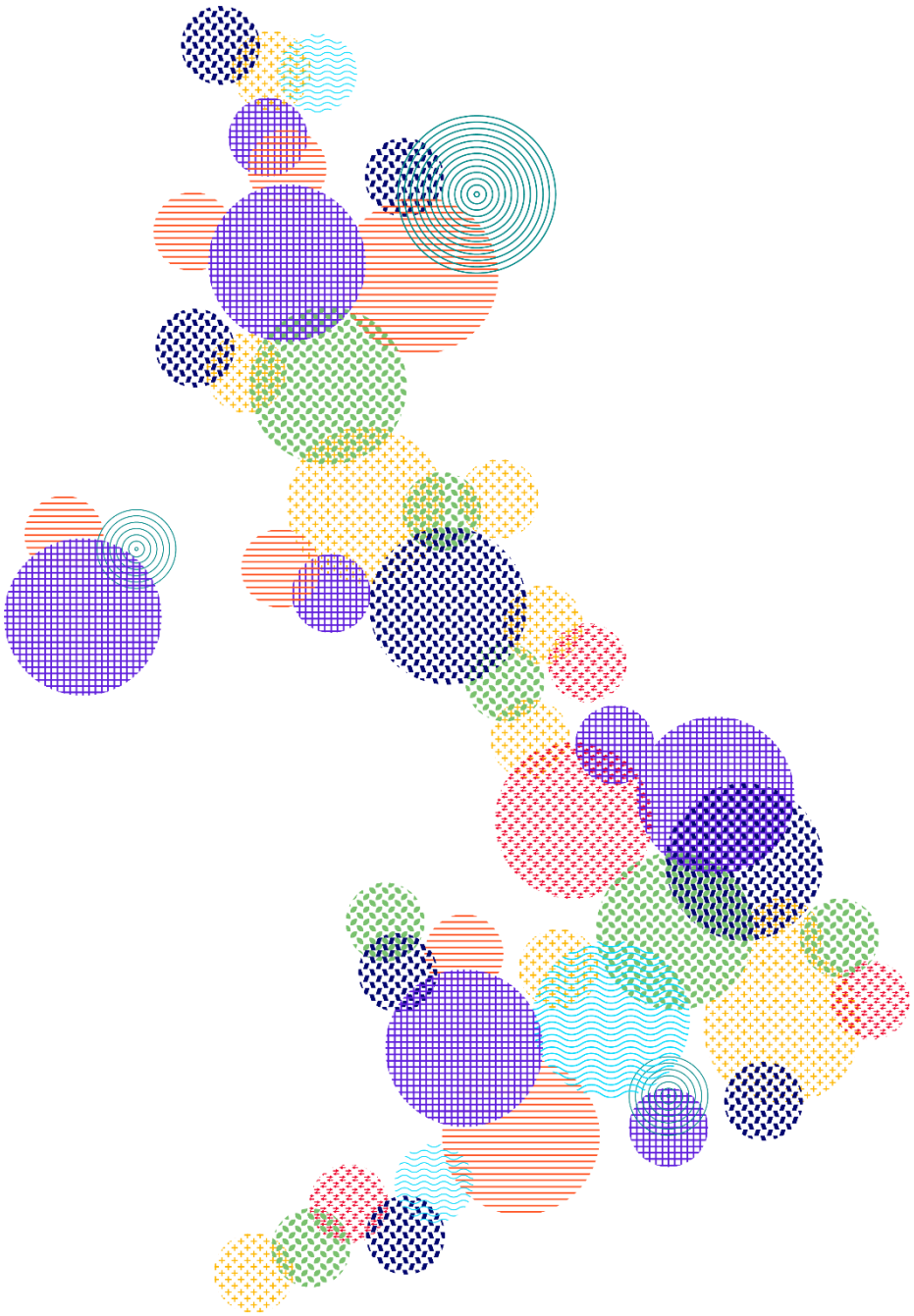

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Table of Contents

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Introduction

The National Digital Twin programme welcomes the opportunity to respond the Commission's call for evidence for the second National Infrastructure Assessment. The National Digital Twin programme came into being as a result of the Commission's report Data for the public good. In July 2018, HM Government[1] tasked the Centre for Digital Built Britain to take the National Digital Twin programme forward. The National Digital Twin programme has since set out the Information Management Framework[2] (IMF) approach to sharing data across organisations and sectors and has set up a pilot project (CReDo) to demonstrate how digitalisation and data sharing across sectors can increase climate resilience. Both the IMF and CReDo are referenced in this response.

The challenges which we think are particularly pertinent and where we have expertise and experience to share include the following:

Challenge 1: The digital transformation of infrastructure – the Commission will consider how the digital transformation of infrastructure could deliver higher quality, lower cost, infrastructure services

Challenge 5: Asset management and resilience – the Commission will consider how asset management can support resilience, barriers to investment, and the use of data and technology to improve the way assets are maintained.

We have provided responses to questions 5, 6, 7 and 13.

[1] Government response to Data for the Public Good - GOV.UK (www.gov.uk)

[2] IMF - DT Hub Community (digitaltwinhub.co.uk)

Response to Question 5

Question 5: What are the main opportunities in terms of governance, policy, regulation and market mechanisms that may help solve any of the Commission's nine challenges for the Next Assessment? What are the main barriers? Your response can cover any number of the Commission's challenges

The Commission faces a key challenge of siloed thinking in addressing the nine challenges for the next assessment. Government is structured into departments which can make it difficult to solve problems which span sectors such as net zero and resilience. A systems-thinking approach to governance, policy and regulation can help to tackle these large-scale problems which are not sector specific and can unlock innovation.

Government requirements for integrated national infrastructure design and resilience planning will require data sharing between national infrastructure operators and across government departments. Adopting a common approach to data sharing across industry, government and academia as envisaged in Data for the public good will facilitate this. The Information Management Framework as referenced in the National Infrastructure Strategy[3] and Transforming Infrastructure Performance[4] is in evolving, nascent form to enable this common approach. Adopting the common approach may require mandatary levels of data quality and data sharing through regulation in particular across the regulated sectors; energy, water and wastewater, digital and transport.

Response to Question 6 (Challenge 1)

Question 6: In which of the Commission's sectors (outside of digital) can digital services and technologies enabled by fixed and wireless communications networks deliver the biggest benefits and what how much would this cost?

The digital transformation of infrastructure involves the strategic adoption of digital technologies to improve processes, productivity and to deliver better net zero outcomes from infrastructure. Digital transformation enables people to use information to make better decisions. It is not just about new technologies improving processes but how the human factor is a key part of the change. Digital transformation therefore involves socio-technical change across organisations across infrastructure sectors.

Whilst net zero is a challenge for all infrastructure sectors, energy is at the centre of the net zero challenge and it would be reasonable to expect energy to gain the most and equally to lose the most from failing to adopt digital technologies.

Digital services and technologies can deliver benefits across energy, water, flood resilience, waste, transport. Whilst there are many examples to show how digital can deliver benefits, evidence to quantify these benefits in the future is limited and it is recommended that the Commission undertake further research in this area. The Climate Resilience Demonstrator project (CReDo) is currently undertaking a study on the benefits of using digital technologies to share data across organisations to improve resilience. Results will be available and will be shared with the Commission in March 2022.

[3] National Infrastructure Strategy - GOV.UK (www.gov.uk)

[4] Transforming Infrastructure Performance: Roadmap to 2030 - GOV.UK (www.gov.uk)

Response to Question 7 (Challenge 1)

Question 7: What barriers exist that are preventing the widescale adoption and application of these new digital services and technologies to deliver better infrastructure services? And how might they be addressed? Your response can cover any number of the Commission's sectors outside digital (energy, water, flood resilience, waste, transport).

The main barrier to adoption and application of new digital services and technologies is social not technical. The National Digital Twin programme has hosted a number of webinars and hosts a weekly call for practitioners in the Digital Twin Hub community and the same theme constantly re-emerges that it is human factors rather than technological factors that restrict adoption and application. The root cause is a lack of digital skills across the workforce. The National Digital Twin programme published the Skills & Competency Framework - Public Resources - DT Hub Community (digitaltwinhub.co.uk) in 2021 which sets out the skills required to develop and adopt a common framework for sharing data and managing information, the Information Management Framework. This report found that there is a lack of key digital skills, particularly with regard to what are described as data fundamentals and lifecycle assurance and quality management. The report also draws attention to a lack of transformational leadership skills to encourage the use of digital technologies in a way that contributes to human flourishing. A shortage of understanding about the benefits of using and adopting digital technologies at the top of an organisation filters down to every level of that organisation and embeds cultural resistance to change and the embracing of new technologies to do things in a better way, or more simply to make less mistakes.

Hence the main barrier to adoption and application is cultural. If organisations are resistant to finding better ways of doing the same thing or to solving problems then it will not be possible to deliver better infrastructure services.

Once the cultural factor is overcome as people understand and recognise the benefits of digital transformation, the next key barrier is overcoming decades of poor information management which was originally caused by a lack of transformational leadership. Adopting and applying new digital services and technologies relies upon better use of information. If that information is of a low quality then the end result from applying the technology will not achieve the desired result. Models that run on low quality data are not reliable as per the adage, garbage in garbage out. The capability of artificial intelligence is currently limited by the availability of high-quality data. Therefore improving information quality management is key to achieving the true potential of digital technologies. The Information Management Framework, under development in the National Digital Twin programme, sets out an approach to improving information quality management. See IMF - DT Hub Community (digitaltwinhub.co.uk) for existing and forthcoming documents.

Both the lack of skills and low levels of information quality management stem from a lack of investment in digital technologies in both the technologies and the people required to use them. Low levels of investment occur where organisations and leaders cannot see the benefits of investment and recognise a clear return on investment. Yet again this itself stems from a lack of skills in understanding the benefits of being about to work with better quality information and digital technologies and the lack of transformational leadership in promoting the need for those skills.

People need to see a clear demonstration of the benefits of using digital technologies to understand why it is necessary to invest in them and the people to use them. The

National Digital Twin programme's climate resilience demonstrator project is providing a demonstration of these benefits.

Climate Resilience Demonstrator project – CReDo

What is CReDo? - DT Hub Community (digitaltwinhub.co.uk)

CReDo is a climate adaptation digital twin and is the pilot project for the National Digital Twin programme. CReDo's purpose is two-fold:

1. To demonstrate the benefits of using connected digital twins to increase resilience and enable climate change adaptation and mitigation
2. To demonstrate how principled information management enables digital twins and datasets to be connected in a scalable way as part of the development of the information management framework

Data about assets is brought together across three infrastructure asset owners, Anglian Water, BT and UK Power Networks into one digital twin of the infrastructure system network. Combining data sets from three separate organisations into one system model is not straightforward and principled information management techniques such as using the appropriate ontologies and striving for semantic precision is essential to bringing the data together to present the clearest picture of the infrastructure system without inaccuracies. Coastal and fluvial flood data has been sourced from the Environment Agency and the HiPIMS[5] (**Hi**gh-**P**erformance **I**ntegrated hydrodynamic **M**odelling **S**ystem) model has been used to generate surface water flooding data that could be expected under a range of future climate change scenarios. Expert elicitation techniques have been employed to understand the impact of the flood scenarios on asset failure within the infrastructure networks. Operational research techniques have been employed to better understand the infrastructure interdependencies and to identify the propagation of asset failure across the infrastructure system resulting from the flood scenarios. This builds a picture of system impact from flooding scenarios which would not otherwise be available to the individual networks or regulators who would only see the impact of flooding on their own networks.

This cross-sector picture of impact of extreme weather events on the infrastructure system can enable asset owners and regulators to better understand infrastructure interdependencies and identify the most effective, least cost and lowest carbon impact interventions to increase resilience.

A project like CReDo brings benefits in terms of improved information management and increased system resilience to extreme weather events and it is necessary to demonstrate and evidence these benefits to encourage investment in information management and climate resilience digital twins, both the people and the technology.

The CReDo app CReDo Film - DT Hub Community (digitaltwinhub.co.uk) presents the concept of a resilience score to measure the resilience of an infrastructure system. The CReDo film presents a fictional scenario to demonstrate why infrastructure asset owners need to collaborate and share data to increase resilience.

[5] GitHub - HEMLab/hipims: High-Performance Integrated Modelling System

Response to Question 13 (Challenge 5)

Question 13: In what ways will current asset management practice need to improve to support better infrastructure resilience? Your response can cover any number of the Commission's sectors.

Infrastructure resilience is only rarely concerned with a single infrastructure system in isolation. Power, water and drainage, transport and communications systems are all inter-related, so an extreme event that affects one can have a knock-on effect on others. The simulation of extreme events will require access to asset data from multiple infrastructure systems. To carry out such simulations routinely, requires a standard external view of the data about each infrastructure system and interoperability between data sets which would be provided by the Foundation Data Model under development in the National Digital Twin programme's Information Management Framework.

Recent reports from the Committee of Climate Change[6] and HM Government[7] note a poor level of understanding of infrastructure interdependencies. Improving infrastructure resilience is contingent upon a better understanding of infrastructure interdependencies. Infrastructure asset owners across digital, energy, transport and water and wastewater consider the maintenance of assets within their sectors rather than the dependencies on assets in other sectors. The increased incidence of extreme weather events caused by climate change will increase the likelihood of assets failing.

Infrastructure asset owners will need to have an understanding of how their own assets and networks will respond to extreme weather events (heat, flooding, storm damage etc) and also of how assets from other networks they are dependent on will be affected by extreme weather events. In this way, asset owners need to understand infrastructure interdependencies and how those interdependencies will be affected by climate change.

The CReDo digital twin as described in the answer to question 7 pulls together data across energy, water and communications networks to present a picture of the interdependencies across these networks. Flood data can be run through the CReDo digital twin to show the impact of flooding on these interdependencies to understand which assets would fail and how asset failure can propagate through the infrastructure system causing system wide outages. Such a picture can then inform the appropriate interventions, such as increasing the level of flood defence, relocating the asset or increase back-up power capability to protect assets in advance of such extreme weather events happening and to prioritise maintenance at certain critical sites.
The operational real time response to extreme events requires access to real-time, or near real-time, data about the state of assets across multiple infrastructure systems. The CReDo digital twin currently works with static asset data but could be developed further in the future to work with live data to inform a real time response to extreme weather events caused by climate change.

[6] 2021 Progress Report to Parliament - Climate Change Committee (theccc.org.uk)
[7] UK Climate Change Risk Assesment 2022 (publishing.service.gov.uk)

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