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ICG Infrastructure Client Group

National Infrastructure & Service Transformation Authority

The Green Construction Board

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Built Environment Connective



The evidence base for systems change

Fifteen case studies informing the Infrastructure Systems Review

Introduction

The evidence base for systems change: 15 case studies informing the Infrastructure Systems Review.

The performance of the built environment shapes daily life, public services and economic activity. It is critical to long-term national outcomes including growth, resilience, climate adaptation and nature recovery.

However, while the built environment is connected, many important decisions are fragmented. This can leave value unrealised and shift costs and risks to other organisations, places or generations, and matters more as resources tighten and demands grow.

In July 2025 the Built Environment Connective published 'Connect to Change', a manifesto calling for systems thinking – to improve the decisions that determine how scarce resources are used, risks are managed and infrastructure performance is improved over time.

It argued: systems approaches make good business and economic sense. They create opportunity to plan and deliver future projects better, and also to create more value through better stewardship of the existing built and natural systems on which the UK depends. Systems approaches could improve outcomes across the built environment.

Connect to Change recommended a study, the Infrastructure Systems Review, to better understand how our built environment performs as a system of systems; address interconnected challenges; identify how to deliver improved outcomes, in particular sustainable growth; and maximise value gained from investment.

The Infrastructure Client Group, the National Infrastructure and Service Transformation Authority and the Green Construction Board recognised the need for new approaches to decision-making, planning, delivery and management of the built environment. They have co-sponsored and shaped the review.

Primary evidence

The review has highly practical foundations. These 15 case studies are its primary evidence. They span a range of places, sectors, scales and lifecycle stages.

The case studies and their interpretation were challenged through the following activities:

Expert reviews: Expert and practitioner reviews challenged assumptions, tested findings and assessed their wider relevance.

Workshops: Workshops with government, regulators, clients, investors, industry, academia and civil society tested emerging conclusions, identified common patterns and supported the interpretation of evidence.

Senior stakeholder engagement: Senior stakeholders provided a broad perspective and constructive challenge for the overall narrative and recommendations.

Success factor assessment: The assessment tested and refined the conditions that enable systems approaches to improve decisions and outcomes.

Economic analysis: The analysis assessed the mechanisms through which systems approaches can create value.

It has been a substantial voluntary undertaking, involving individuals and organisations across the whole of the Built Environment Connective. We thank everybody who has contributed their time, expertise and constructive challenge to this process.

Each case study was developed using a common structure covering scope, outcomes, systems, interventions, economic assessment, systemic assessment and recommendations. This allows evidence to be compared across different sectors and places, and helps distinguish the context, systems approach, interventions, value evidenced or anticipated, and lessons that can be generalised.

The evidence includes both cases where systems approaches contributed to improved decisions and outcomes, and cases where fragmented decision-making, weak integration or unmanaged interdependencies contributed to avoidable cost, delay, risk or lost value. The value identified in the evidence therefore includes both realised benefits and losses that could have been avoided.

The case studies differ in the maturity and strength of their evidence. Nonetheless, across them, recurring themes emerge:

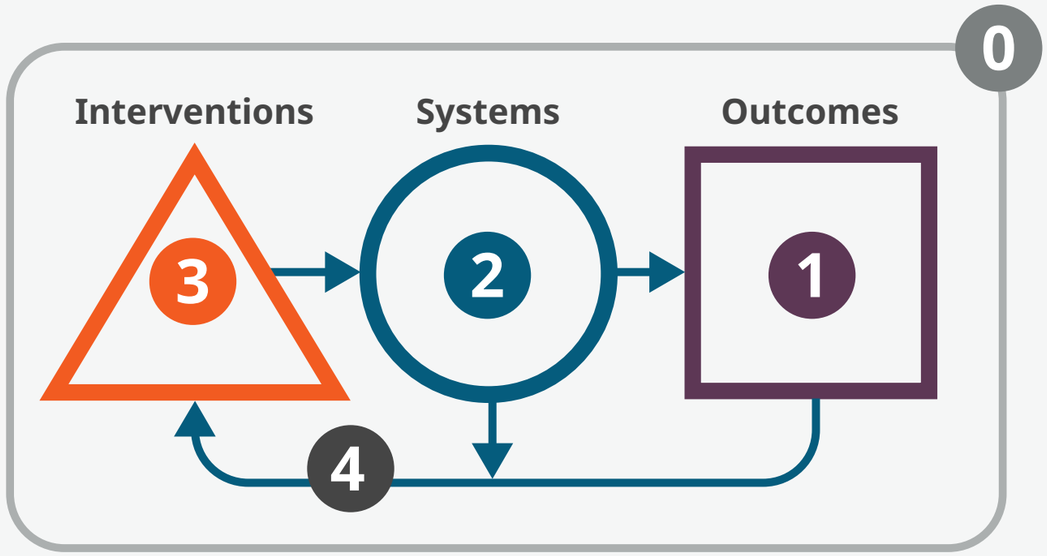
- Better system understanding can improve consequential decisions.
- Significant opportunities lie in the stewardship of existing systems.
- Realising value depends on organisations being able to act across boundaries.

The Infrastructure Systems Review will examine these patterns, assess their wider relevance and translate them into recommendations for national policy and practice.

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Systems to outcomes

The framework set out in 'Connect to Change' illustrates a way of applying systems approaches to improve decisions and outcomes. It informed the analytical approach across all of the case studies, and recurring patterns across them confirm its relevance to different contexts.



0 Know your scope
Define the scope of the decision, the system you are seeking to influence, the boundaries that matter and the stakeholders who need to be involved.

1 Focus on the outcomes
Clarify the outcomes sought, understand the gap between current and desired performance, and use those outcomes to compare options, make trade-offs and guide decisions.

2 Understand the systems
Understand how outcomes depend on the relevant physical, organisational and digital systems, including the interdependencies and external influences that shape their performance.

3 Drive effective interventions
Use the interventions most likely to improve outcomes, including physical, operational, digital, behavioural, governance and nature-based interventions. Focus effort where it can make the greatest difference.

4 Observe, learn and adapt
Monitor outcomes and system performance, test assumptions, learn from experience and adapt interventions as conditions and evidence change.

Foreword

Achieving better outcomes requires different ways of thinking and working. These case studies signal how.



Jason Tucker
Chair, Infrastructure Client Group

Never in recent times has infrastructure been so much in the public and political eye.

It is better recognised now than at any point in my lifetime that infrastructure enables and underpins social and economic growth; that it is inseparable from the environmental, biodiversity and climate emergencies; and that its effectiveness, security and reliability are fundamental to national resilience.

Sustaining the country's existing infrastructure inventory and investing in its future – with £725 billion of planned public and private funding over the coming decade – presents complex questions and requires complex trade-offs. We ignore them at our peril.

Our critical infrastructure is systemically interconnected. We must better understand how – both to avoid unintended consequences, and to realise co-benefits where we can. We require systems awareness and skills to improve performance, productivity, outcomes and value despite resource constraints and the challenges presented by an increasingly turbulent, uncertain, novel and ambiguous world.

This is the nettle that the Infrastructure Client Group has grasped in co-sponsoring the Infrastructure Systems Review with NISTA and the Green Construction Board. Between us, we have the ability to set the direction for the infrastructure value chain, and create the conditions for it to work differently, to achieve better results.

We have done this before. The ICG was founded in 2010 to implement the recommendations of the 'Infrastructure Cost Review', published by HM Treasury, to reduce waste and cost, and improve efficiency and value. The ICG commissioned the 'Infrastructure Carbon Review', which HM Treasury published in 2013 – showing the correlation between carbon and cost, and setting out a clear hierarchy of actions to reduce them both.

Looking back over the last decade and a half, it is clear what impact the cost and carbon reviews, and the workstreams they unleashed, have had on the way the whole value chain thinks and behaves. It is also clear that change has come about as a result of leadership. Clients have rallied behind specific recommendations, developing standards, specifications and guidance, adjusting commercial arrangements, embracing technology, reporting progress and sharing best practice. Government has set policy and shaped regulation.

Infrastructure cost and carbon are ongoing journeys – but they have become embedded in business as usual throughout the infrastructure industry.

Naming of the Infrastructure Systems Review is deliberate. We are placing it in that lineage. But we think it will have a materially greater impact on the infrastructure industry than its predecessors.

The cost and carbon reviews generated unified approaches for tackling issues that were to a large extent known. The systems review is equipping us to address unknowns associated with infrastructure's biggest and most pressing challenges. It recognises the necessity of connecting and coordinating

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"Sustaining the country's existing infrastructure inventory and investing in its future presents complex questions and requires complex trade-offs. We ignore them at our peril."

organisations, sectors and information. It will provide the insights, strategy and recommendations to do so.

The Infrastructure Systems Review has been shaped through colossal cross-industry collaboration and consultation, with literally hundreds of contributors and reviewers. But at its core are 15 detailed case studies – real experience on existing systems, delivery programmes and strategic propositions that reveals strengths and successes, weaknesses and shortfalls in applying systems thinking and systemic approaches to infrastructure. Academics and system specialists have been involved alongside practitioners in a process of rigorously examining each case study and capturing its lessons.

A critical strength of the review is that it is not theoretical. The case studies root it in reality.

They represent diversity of sectors, geographies, scales and lifecycle stages. Yet out of that diversity, 10 clear insights have emerged. We have tested them on members of the ICG executive board, representing 20 of the UK's largest infrastructure clients. There is unanimous agreement: the insights are practical and valuable:

1. Better system understanding leads to better decisions.
2. Clear outcomes help decisionmakers make better choices.
3. Better decisions require the right boundaries.
4. Effective interventions address underlying causes, not just symptoms.
5. Some of the greatest opportunities lie in the stewardship of existing systems.
6. Natural systems can function as productive infrastructure.
7. Shared understanding enables coordinated decisions and action.
8. Systems approaches require collaboration, trust and adaptive learning.
9. System integration must be managed throughout delivery, not left to the end.
10. Authority, governance and incentives determine whether value is realised.

There are few areas in which applying the insights and principles of the Infrastructure Systems Review won't unlock better outcomes – from carrying out everyday operational, asset management and capital delivery activities, to addressing wicked problems.

I encourage everyone to read these case studies for themselves. Individually, each is instructive and offers immediately useful lessons.

I urge you next to read the Infrastructure Systems Review when it is published at the start of 2027. Initiating and driving systems change across UK infrastructure is itself a systemic challenge, needing coordination, collaboration and concerted effort. The ICG will provide leadership and exert influence where we have jurisdiction, and support those beyond.

The future performance of our built environment, and the outcomes it delivers for society, nature and the economy – for all of us – requires systemic coordination and trade-offs. A decision to ignore this is, paradoxically, still a decision – but one likely to produce outcomes we won't like.

These case studies show how we can decide to take better control, and achieve the outcomes we want.

Case studies

01

A17 Cross Keys Bridge

System: An historic bridge within the regional transport network.
Systems contribution and value: Broadened framing from bridge condition to service availability, reliability and recovery. Potential to reduce disruption costs, improve network resilience, and support freight, economic and community connectivity.

02

Anglian Water Reservoirs Programme

System: Fens Reservoir and regional water resources.
Systems contribution and value: Introduced a requirements hierarchy, common database, ownership and change control as a basis for scope and programme decisions. Improved requirements clarity and traceability, reducing scope creep, rework and investment risk.

03

Connecting the Culm

System: River Culm catchment.
Systems contribution and value: Reframed flood risk and environmental challenges at whole catchment scale, co-creating a coordinated 25-year intervention portfolio. Potential to reduce flood risk and transport disruption, with wider environmental and social co-benefits.

04

CReDO

System: Cross-sector infrastructure resilience.
Systems contribution and value: Shared data and cascade-risk modelling improved visibility of interdependencies and supported early resilience planning. Modelled potential benefits include better-targeted investment, reduced losses and improved continuity of critical services.

05

Crossrail integration

System: The transition from delivery to operation of a new metropolitan railway.
Systems contribution and value: A client-led programme 'reset' was initiated to overcome integration challenges, employing best-for-programme triage and commercial innovations. It supported programme recovery and strengthened operational readiness.

06

Electricity Transmission Partnership

System: Transmission delivery ecosystem.
Systems contribution and value: Employed long-term portfolio partnering, performance-linked future work and multi-level governance, with the aim of reducing delivery fragmentation and bottleneck risk, and supporting investment in delivery capacity, capability and resilience.

07

Hastings Landslide

System: Coupled cliff stability, property and risk-financing.
Systems contribution and value: Reframed risk in terms of the cliff system, rather than individual properties, integrating geotechnics, monitoring, planning, finance and community action. Developed lower-cost intervention options with the potential to restore property value.

08

Integrated Catchment Systems

System: Integrated river catchments.
Systems contribution and value: Participatory mapping, integrated modelling and shared data improved understanding of boundaries, stakeholders, cause-effect relationships and trade-offs. Identified opportunities for coordination and co-funding.

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09

London's Thames Crossings

System: Cross-river transport.
Systems contribution and value: Proposes development from existing investment approaches, in which repairs and maintenance are coordinated between boroughs, to a fuller system approach that supports them in protecting cross-river connectivity, efficiency and resilience.

10

Oxford-Cambridge Growth Corridor

System: Cross-sector regional development.
Systems contribution and value: Outcome-led framing and systems mapping made cross-sector dependencies, sequencing needs, gaps and trade-offs visible before major choices. Identified opportunities to reduce coordination failure and de-risk cross-sector investment.

11

River Intervention and Systems Model

System: Great Ouse catchment and water resource.
Systems contribution and value: Modelled interventions considering water, land and ecology, to find balance between different user needs. Illustrated potential impacts on water security, water quality, reservoir and treatment costs, carbon, flood risk and biodiversity.

12

Strategic Nature Network

System: UK natural infrastructure
Systems contribution and value: Reframes nature as productive infrastructure and proposes a connected Strategic Nature Network, with the potential to improve ecological resilience, reduce climate and environmental risks, and increase value from existing public and private investment.

13

Thames Estuary 2100

System: Thames Estuary tidal flood-risk management system.
Systems contribution and value: Shift to adaptive pathways, estuary-wide management and system-level intervention timing. Reported examples include deferred high-cost interventions, improved maintenance timing, reduced whole-life flood-risk cost and supported co-funding..

14

Transpennine Route Upgrade

System: Transpennine rail delivery.
Systems contribution and value: Established enterprise governance, requirements architecture, and whole-railway integration for scope, interface and readiness decisions. Potential to reduce integration risk, late change and rework.

15

Wye-Usk Transition Lab

System: Wye-Usk – socio-ecological and economic.
Systems contribution and value: Shared diagnosis, convening and trust-building developed common priorities for project, finance and governance development. Strengthened collaboration and developed a pipeline of potentially investable landscape-scale interventions.

Co-sponsored by

The Infrastructure Client Group brings together UK economic infrastructure clients in partnership with government and industry. The ICG's key purpose is to lead the acceleration of improvement and alignment in the delivery and development of UK infrastructure, for the benefit of society, the economy and the environment. It is sponsored by the Institution of Civil Engineers.
bit.ly/ICG_01

The National Infrastructure and Service Transformation Authority unites long-term strategy with best practice project delivery, to transform the performance of UK major projects and programmes. It gives ministers the levers they need to drive growth. NISTA is a joint unit at the heart of government, reporting to both HM Treasury and Cabinet Office.
bit.ly/NISTA_01

The Green Construction Board is the sustainability arm of the Construction Leadership Council. It brings together government and industry to drive net zero, biodiversity enhancement and resource efficiency across the built environment, helping shape policy and industry practice.
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The Built Environment Connective is a public good organisation that brings people together to turn systems thinking into coordinated, lasting change. It connects system thinkers across government, industry, academia and civil society.
be-connective.com

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The Institution of Civil Engineers (ICE) is the home of infrastructure. It is a professional institution with 95,000 members and over 200 years of history. It qualifies civil and infrastructure engineers, promotes lifelong learning, and provides trusted, impartial, expert advice to decision makers. Its vision is a world where infrastructure enables people and planet to thrive. Its global membership designs, builds, and maintains trustworthy and sustainable infrastructure.
ice.org.uk