WHITEPAPER

IMPROVING THE PERFORMANCE OF BUILT ENVIRONMENT SYSTEMS
MAKING CONNECTIONS TO ACHIEVE BETTER OUTCOMES FOR EVERYONE

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EXECUTIVE SUMMARY

The built systems that underpin essential services, including transportation, energy, healthcare, water, sanitation, and communications, are the backbone of modern society.

Their complexity and interdependency have been growing for decades. Digitalisation is accelerating this process, and, in practice, we are now dealing not with stand-alone buildings and infrastructure assets, but with a complex and interconnected cyber-physical system of systems.

However, the way we develop and manage our infrastructure systems has not kept up with these changes. Government departments, regulators, and infrastructure owner-operators continue to work in the sectoral and organisational silos that might have been sufficient previously. Now, these silos not only fail to address the most pressing system-level challenges, but are also actively causing those challenges.

In short, it is simply not possible to deliver net zero, build resilience to the impact of climate change, reverse biodiversity loss, develop a circular economy, turn around social and economic inequalities, or achieve any other system level outcome without incorporating a joined-up systems-based approach.

While a project-focused approach can be very effective at delivering an infrastructure project, people operating in silos lack the information, the means, and the incentives to work holistically across networks to improve the overall performance and effectiveness of our interconnected infrastructure systems.

The way forward, particularly in the current stretched economic circumstances, must focus on becoming better joined up to deliver more from our existing infrastructure, and then to maximise the value from every new investment into the system.

In the United Kingdom, the Infrastructure and Projects Authority's (IPA) Transforming Infrastructure Performance (TIP) Roadmap is an important step in this direction. TIP is grounded in a commitment to build understanding of the whole system of built and natural assets and the services they provide, and then select the best interventions to maximise social, economic, and environmental outcomes.

However, the IPA's leadership can only take us so far. Its mandate is primarily to improve productivity in project delivery, not to increase the performance and effectiveness of our entire built environment. The National Infrastructure and Service Transformation Authority (NISTA) appears to have a similar mandate. There is no clear accountability for or shared understanding of the overall system of systems or of the outcomes it provides.

This mandate is not a party-political argument, nor is it a criticism of existing industry bodies. Rather, it is a call for longer-term, strategic systems-thinking. The built environment community needs to step up and show visionary, boundary-spanning leadership across technological, economic, and social remits, backed up with meaningful action.

Improving infrastructure development will be a long journey, and it is important to break it down into manageable steps that allow us to learn along the way. Two important enablers of this journey that should be prioritised by the infrastructure community are:

1. **Developing an improved understanding of the condition, performance, and effectiveness of our current infrastructure at an interconnected systems level.** This understanding requires creating joined-up systems, maps, and models that relate systems performance to outcomes. To achieve that goal, we need to identify how to join up existing data sets, insights, and initiatives across the infrastructure sector to create sociotechnical models and tools that will help us to drive system level improvements.

2. **Establishing a body to oversee the performance and effectiveness of the built environment systems.** This body would enable visionary, boundary-spanning leadership, and be a driving force to galvanise others to develop the sociotechnical tools and practices to make it a success. It should provide a focal point for joining up like-minded people across traditional organisational, sectoral, and disciplinary boundaries and coordinate action across government, industry, and academia.

Our next step is to champion these ideas and discuss the best ways to take them forward.

The U.K. already has a vision recognising that we need to manage the built environment as a complex and interdependent system of systems—but it needs to be implemented.

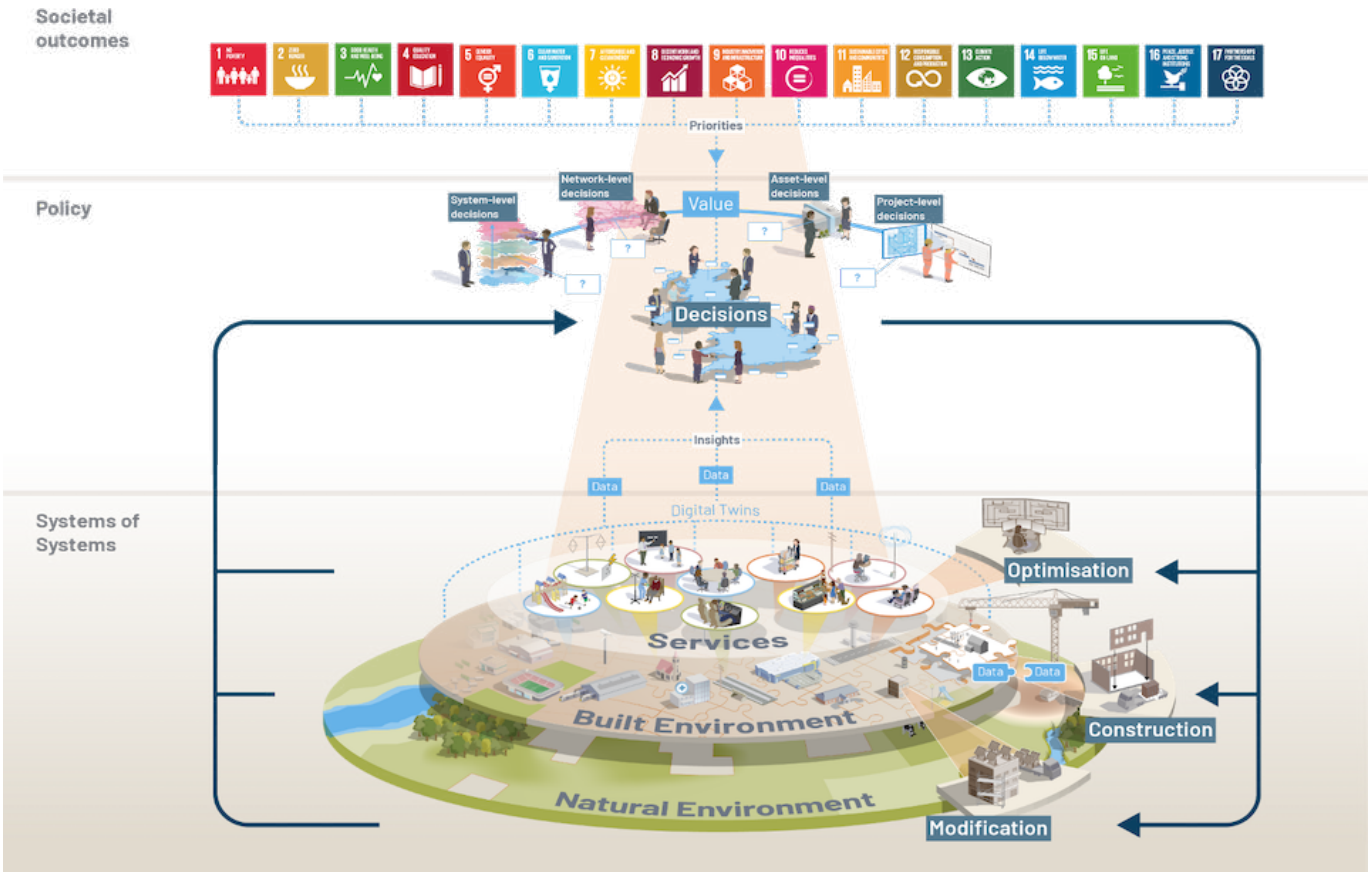
Papers like this one often begin by pointing the finger at the government, criticising it for lack of ambition and vision. That is not our argument.

The U.K. Government has a vision that recognises the ever-increasing interdependency and complexity of our built environment, and how it interacts with digital and human systems to provide the services on which we all rely. Importantly, it shares this vision with the owners of many of the assets that make up the system, and with the supply chain businesses that service it. Even more importantly, it recognises that our planet is the ultimate system of systems upon which everything else depends.

This vision is articulated in the Infrastructure and Projects Authority's Transforming Infrastructure Performance Roadmap to 2030, which commits to:

> *" A new approach to decision-making that is founded on an understanding of the interlinked nature of our infrastructure systems (in which) we focus on the outcomes that we need for people and nature when we are choosing where and how to intervene in this complex system."*

These ideas are codified in the built environment model (figure 1 below), created by a wide coalition of the infrastructure community. At a conceptual level, the model draws a direct line between the performance of the system of systems and societal outcomes in the form of the United Nations' Sustainable Development Goals.



If we are serious about implementing the vision, then we need to recognise that construction projects are only a part of the route to improving the performance and effectiveness of the whole system.

In our conversations with colleagues from across the infrastructure community, we have encountered widespread frustration at the slow progress towards putting the vision into practice.

This is not a criticism of the excellent work of the IPA; we recognise that its mandate is primarily to improve project delivery, not to improve the performance of the whole system. There is, however, no clear leadership elsewhere in government of the overall system, of a process for understanding or modelling that system, or of the outcomes that the system provides. In practice, this situation has contributed to the infrastructure community remaining focused on improving the productivity and efficiency of construction projects. While this is very important work, it will never be sufficient on its own to deliver a higher performing and more effective built environment system that largely consists of existing assets.

The built environment model itself shows why. Mature economies like the U.K.'s have been building infrastructure for centuries. Any new-build project, however large, will only ever be a relatively small intervention into our enormous, existing stock of interconnected buildings and infrastructure.

Similarly, a construction project is only one possible intervention amongst many—and often will only play a small part in achieving the outcomes we need from the system. Furthermore, before we set out on costly, carbon-intensive, and risky construction projects, we need to be convinced that we have exhausted all the credible no-build options that would allow us to achieve our outcomes through more effective use of existing assets.

These insights are not new. In recent years, countless voices in government and industry have taken the TIP vision on board and stressed the need for a greater focus on the performance of existing systems. Taking just one example, National Highways put ***"making the most of our network at the heart of its plans for Roads Investment Strategy 3 and stressed that it sees its network forming just one part of "a seamlessly integrated transport system that meets our customers' needs by connecting the country safely and reliably, delivering economic prosperity, social value, and a thriving environment."***

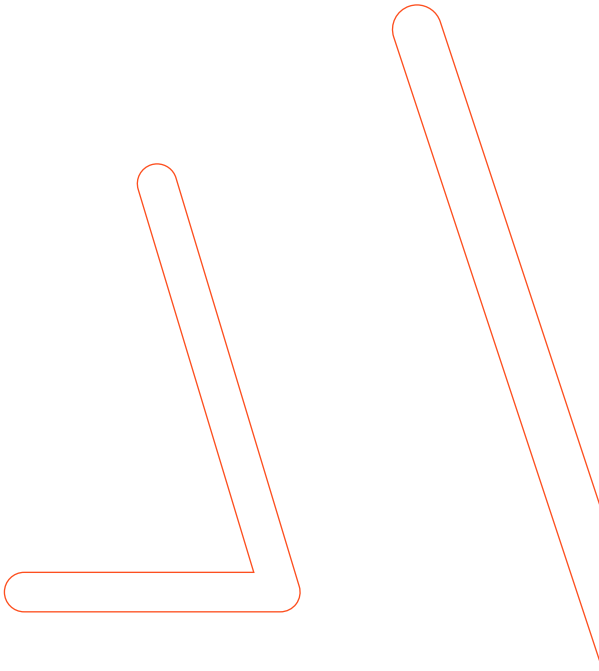
Unconnected silos are not an effective way to manage a connected system—we need visionary, boundary-spanning leadership from across the infrastructure community to join them up.

We have already noted that, despite the government's embrace of the built environment model, there is no clear leadership of the whole system or the outcomes that society needs from it.

This is not a political point. The attempt to enable a connected system of systems via unconnected silos extends beyond government and is shared by private sector asset owners and their industry partners. Without action, this situation is unlikely to change irrespective of the party in power.

If we want to make progress, the infrastructure community—people working in the built environment across government, owner-operators, supply chain, investors, and academia—needs to work across our silos and deliver the necessary outcomes, at a price that the country can afford. We need visionary, boundary-spanning leadership that is backed up with meaningful action.

It will be a long journey, and it will be important to break it down into practical steps that deliver real benefits to the community as we go along, allowing us to learn by doing. To make a start, we have identified two important early priorities.



Priority 1: Building new tools to improve our understanding of the condition, performance, and effectiveness of our infrastructure at the system level.

Our work to date suggests that we don't know enough about how the existing built environment is performing at the system level. Data on the condition of assets is patchy, and while the built environment model makes a conceptual link between the built system and the UN Sustainable Development Goals, we have an immature understanding of how the performance of individual elements of the system combine to deliver against them (or any other strategic goal).

Therefore, decision-makers—whether investors, owners, policy makers, or supply chain businesses—lack the information to judge where attention and resources are needed to improve system performance and effectiveness to deliver the best possible outcomes.

An important first step must then be to create joined-up systems maps and models that describe existing systems behaviours and relate system performance to outcomes. To achieve that goal, we need to identify how to join up existing data sets, insights, and initiatives across the infrastructure sector to create the models and tools that will help us to drive system level improvements.

A concrete example of why this action is so important is captured in an April 2023 joint letter from the Climate Change Committee and National Infrastructure Commission to the then Deputy Prime Minister, which warned:

> ***" Interdependencies between infrastructure systems mean that climate impacts in one system cascade and interact with others. The U.K. requires better mechanisms to identify and track these cascading risks, with clearer accountability for key institutions to mitigate them."***

Our work to date has already identified significant foundational information. For example, the National Infrastructure Commission's 2020 study, **Systems Mapping of U.K. Infrastructure for Resilience**, is a useful exercise in clarifying which national-level decisions (such as policies, incentives, markets, and other factors) can influence the level of service provided by the U.K. infrastructure system. Similarly, we believe that it will be possible to draw on government guidance, **systems thinking for civil servants**, to drive improved outcomes in complex situations.

We have also begun looking at the information being collated on infrastructure performance. The National Infrastructure Commission has again done useful work on **infrastructure performance data**, and we know that pools of information are held by economic regulators, HM Treasury, IPA, sponsor departments, such as the Department for Energy Security and Net Zero, and public sector infrastructure owners, such as National Highways and the Environment Agency.

Other cross-cutting professional bodies have also been collating information about infrastructure performance, such as the ICE Systems Approach to Infrastructure Delivery report, or the Public Sector Benefits Management Forum, which is looking at benefits measures being used across the public sector, and how these could align with the UN SDGs.

In the private sector, we also know that asset condition data and performance metrics of various types are collated by owners, investors, strategic advisors, engineering consultants, and contractors to support a range of activities, including due diligence and asset management systems.

Priority 2: Creating a body to champion the performance and effectiveness of the built system.

The performance and effectiveness agenda needs a focus and a champion to be a driving force for creating these tools and ways of working and then putting them into practice across the system. A body should join up like-minded people across traditional organisational, sectoral, and disciplinary boundaries, and then coordinate action across government, industry, and academia.

There will be a lot of learning by doing on this journey, and whatever form this group takes, it must be sufficiently agile to respond quickly to what works and discard what doesn't.

Conclusions and next steps

The evolution of the U.K.'s built environment into a complex, interconnected systems of systems is a fact, not a theory. An interconnected system managed through unconnected silos will never perform as effectively as we need it to in the face of our enormous economic, environmental, and social challenges.

Improving the productivity of construction projects that add to the system is necessary, but it is only one of many interventions that will be needed to improve the performance and effectiveness of the whole to deliver the transformative change our people and planet sorely need.

Shifting the focus of the built environment community to the system of systems level will be a long journey, which means that visionary and boundary-spanning leadership will be vital.

The first step on this journey is to create the tools to help us understand the condition and performance of the built environment at the system level—and how this journey relates to big strategic outcomes like net zero and U.N. SDG goals. It needs a group of like-minded, committed professionals to drive the creation of these tools and the wider task of implementing them across the system. It needs a body that has some ownership of the overall performance of the built environment, making connections to achieve better system-level outcomes for everyone.

Our next step is to explore the best way to move forward with the ideas in this paper.

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