

# Covid-19 and the new normal for infrastructure systems – next steps

## A White Paper to drive the reinvention of infrastructure delivery

### Introduction

Nearly five months on from the introduction of social distancing measures to halt the spread of the coronavirus pandemic, society is emerging from lockdown. The last few months have challenged old norms and created new, sometimes better, ways of working and going about our daily lives.

The call for evidence<sup>1</sup> that fed into the development of this White Paper outlined a picture of what these new norms mean for the infrastructure system interventions we need, how we go about paying for them and how we can change to deliver these interventions more effectively.

However, from the 100 stakeholders and organisations that responded to the call for evidence, there was also a clear sense that as the UK emerges from the Covid-19 pandemic, much of our infrastructure will be required to operate in the same way it did before – and that this will be the case in the long term.

In short, this paper sets out how infrastructure provision in the UK can be improved based on what we've learnt from the lockdown, while ensuring that we have the networks in place to address the long-term challenges that were already present. These challenges include demographics (the UK's projected population growth to 75 million by 2050<sup>2</sup>) and the need to deliver infrastructure in a more efficient way and in a way that is compatible with achieving the UK's climate-change commitments.

This paper comes at a time when the infrastructure industry is primed and ready for action. The Construction Leadership Council has published Roadmap to Recovery, a strategy for the recovery and reinvention of the construction sector.<sup>3</sup> It affirms the role of the Infrastructure Client Group (ICG) in leading the reinvention of infrastructure delivery.

Several other initiatives have also commenced, including work to create a Construction Playbook similar to the Outsourcing Playbook<sup>4</sup> and announcements on the use of infrastructure investment as a stimulus to provide jobs, growth and broader social and environmental outcomes. A full Comprehensive Spending Review in the autumn will set out further detail on investment.

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<sup>1</sup> ICE (2020) [Covid-19 and the New Normal for Infrastructure Systems](#)

<sup>2</sup> ICE (2016) [National Needs Assessment](#)

<sup>3</sup> Construction Leadership Council (2020) [Roadmap to Recovery](#)

<sup>4</sup> The Construction Playbook is currently being developed by the government in partnership with industry.

The key elements are available to start the journey towards reinventing infrastructure in the UK. The recommendations we set out provide a framework to inform the actions that need to be taken as part of that journey.

## Recommendations

In the context of the short-, medium- and long-term needs of the UK's infrastructure sector, this White Paper makes the following recommendations:

- Recommendation 1: Long-term planning should still be driven by the UK's existing long-term challenges, including population growth, meeting the 2050 net-zero emissions target and the UN Sustainable Development Goals.
- Recommendation 2: To improve approaches to long-term planning, corresponding investment should be made in digitalisation of new and existing infrastructure assets alongside growing the digital skills necessary for that transition. Future infrastructure forecasting should use scenarios to navigate the current period of uncertainty.
- Recommendation 3: New infrastructure investments in the short and medium term, particularly as part of any stimulus, should focus on accelerating the roll-out of both full-fibre and 5G communications infrastructure, and greater active travel (cycling and walking) provision.
- Recommendation 4: Increased funding should be made available for the National Digital Twin Programme<sup>5</sup> and the creation of digital twins should be mandated for all major projects and programmes.
- Recommendation 5: To support increased use of more productive, enterprise-based delivery models, a standardised scorecard should be developed to prioritise, identify and weight non-financial outcomes for major projects and should-cost modelling should be encouraged to inform procurement, with the potential for this to be mandated.
- Recommendation 6: Public procurement and funding models should become more intelligent and outcomes-based, so that communities and businesses get the infrastructure that will deliver the greatest social, economic and environmental benefits.
- Recommendation 7: To support a shift towards leadership based on a systems-integration skillset, further study should be conducted to identify the strategies, structures and people needed to deliver major infrastructure systems interventions in the future, learning lessons from recent projects.

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<sup>5</sup> Centre for Digital Built Britain (2020) [National Digital Twin Programme](#)

## White Paper structure

In reaching its recommendations, this paper is structured around four key areas: what hasn't changed as a result of Covid-19, what has changed, what is the role of infrastructure as part of the recovery and what changes are needed in how we deliver infrastructure.

## What hasn't Covid-19 changed?

The UK has some long-term social, economic and environmental goals that remain, despite Covid-19, such as achieving the 2050 net-zero emissions target or the 2030 UN Sustainable Development Goals (SDGs). These long-term desirable outcomes can be used to supplement the existing forecasting models, which are driven by economic metrics and slow observable changes to patterns of social behaviour, both of which will be disrupted in the medium term by Covid-19.

Focusing on extant goals will allow decision-makers to cut through the current period of uncertainty and invest in the right infrastructure systems to achieve these long-term objectives. The SDGs all link to recognised challenges in the UK, including regional economic inequalities, poor productivity and a workforce lacking the right skills.

There is a clear opportunity to refocus and act, particularly through infrastructure investment, recognising that 72% of the SDG indicators are linked to investment in networked infrastructure and the UK currently has gaps in policy or is performing inadequately across 57% of the domestic targets.<sup>6</sup>

In addition to the desirable long-term outcomes, there is also a range of long-term challenges that can't be ignored in determining future infrastructure provision as the UK's economy emerges from the pandemic. Chief among these is that the UK's population is projected to reach 75 million by 2050.<sup>7</sup> Even if some public life activities – including both working and socialising – are carried out in a more remote way in the future as a result of enhanced full-fibre and 5G connectivity, the underlying demand growth on conventional transport networks will remain significant.

Whether this demand is met by building new capacity or by using existing capacity in a more intelligent way, including through the implementation of measures to smooth peaks, meeting this demand remains a long-term and complex challenge. This will require continued digitalisation of infrastructure networks.

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<sup>6</sup> ICE (2020) [Covid-19 and the UK's Sustainability Challenges – Lessons for the New Normal](#)

<sup>7</sup> ICE (2016) [National Needs Assessment](#)

## Digitalisation of infrastructure networks

The digitalisation of several of the UK's infrastructure networks was in train prior to the outbreak of Covid-19. This includes the Digital Railway<sup>8</sup> and Smart Motorway<sup>9</sup> programmes, while work to create a National Digital Twin is underway.<sup>10</sup>

Broadly speaking, the purpose of each of these activities was to improve performance and resilience across our infrastructure networks – railways, roads and utilities – by allowing a better understanding of assets in use. Before Covid-19, capacity, connectivity and reliability improvements were all key outcomes in this context.

The successful delivery of these activities has taken on added importance in the wake of the pandemic. Besides 'in operation' improvements, the digitalisation of infrastructure networks will enable the more effective collection, analysis and use of data to enhance infrastructure performance in different economic scenarios that may occur following the end of the pandemic. This could, for example, include a return to pre-pandemic economic conditions or alternatively a scenario in which the UK's workforce is deployed in a much more flexible way, as discussed below.

This data can also be used to develop new approaches to resilience and allow operators to deploy temporary solutions with greater agility as more is learnt about the ability of different networks to operate in and respond to external impacts, be that the indirect consequences of any future viral outbreak or other external factors that can cause stress to infrastructure networks, such as significant weather events.

There is an additional benefit from digitalisation, in that it will provide data on assets in use to inform future design. The ability to test design standards and tolerances in the real world will provide the opportunity to adapt design codes to address potential over-design of assets. This will bring additional benefits, including advances in cost and carbon savings by designing to real-world specifications and use.

## What has Covid-19 changed?

Going forward, there will be an appetite among certain segments of the workforce for continued remote working and living. Investments geared at accelerating the roll-out of both full-fibre and 5G communications infrastructure will be fundamental to this. The benefits of active travel were laid bare during the lockdown and hence respondents to the call for evidence identified the need to improve infrastructure provision for cycling, walking and running.

However, there was also broad agreement that human interaction, be that in the workplace or in a social environment such as a café or restaurant, is an innate need. While remote living and working has been made possible by videoconferencing and other technologies, a number of consultees regarded this as a second-best option to communication and interaction in person and we need to recognise that not everyone has the space

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<sup>8</sup> Network Rail (2020) [Digital Railway](#)

<sup>9</sup> Highways England (2020) [Smart Motorways](#)

<sup>10</sup> Centre for Digital Built Britain (2020) [National Digital Twin Programme](#)

or the facilities to be able to work remotely. Further still, there are many jobs across the economy which are either impossible or particularly difficult to perform remotely, for example in the healthcare, manufacturing, construction and hospitality sectors.

Overall, this paints a picture of mixed future infrastructure requirements, with continued investment in key public transport networks and improvements to the UK's digital infrastructure capability (both full-fibre and 5G) required. Several organisations also spoke of a large appetite that exists among younger people working in professional roles for mobility, both in a UK and international context, which too is compatible with the concept of flexibility.

In view of the new transport capacity and improved connectivity that was required before Covid-19, continuing with planned works is likely to be important as passenger numbers recover – if a vaccine becomes available, we would anticipate that the current reluctance to travel on public transport will wane. But the pandemic also provides an opportunity to reset some of the ways in which public transport operates, including restructuring of timetables and fares to accommodate more flexible working and new social habits. Likewise, and where appropriate, the prioritisation of active travel provision is needed to maintain the positive shift to healthier forms of travel that has been witnessed during the Covid-19 lockdown.

## What is the role of infrastructure as part of the recovery?

The Office for Budget Responsibility (OBR) has forecast that unemployment in the UK will peak at 12%, with a 12% fall in GDP, in 2020.<sup>11</sup> Investment in infrastructure can play a significant role in stimulating economic recovery.

Within advanced economies, research undertaken by the IMF has shown that increasing investment in infrastructure by a single percentage point of GDP increases the level of output by 0.4% in the same year and by 1.5% four years after.<sup>12</sup>

### Multiplier effects

Infrastructure is a key enabler for achieving a range of economic, social and environmental goals. In addition, infrastructure investment can act as a stimulus for economic recovery in both the short and medium term, while it can also help governments achieve their longer-term aims. The stimulus effect applies to all stages of an asset's life cycle, from planning all the way through to operation, creating a range of demand multiplier effects.

First, there is a multiplier on spending associated with the planning, procurement and design of the infrastructure. Second is the multiplier associated with building the infrastructure. Finally, once the

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<sup>11</sup> Office for Budget Responsibility (July 2020) [Coronavirus Analysis](#)

<sup>12</sup> IMF (2014) [World Economic Outlook: Legacies, Clouds, Uncertainties](#)

infrastructure is built, the asset then facilitates the demand for infrastructure services to be met and for the asset to be maintained.

Analysis conducted by Oxera on behalf of ICE found that the Office for National Statistics (ONS) estimates of multipliers by infrastructure sector range between 1.5 and 2.7. Therefore, for each £1 spent on infrastructure, there would be an additional £1.50–£2.70 of demand due to multiplier effects.<sup>13</sup>

Tangible examples include the following:

- Investment in faster digital connectivity can result in an increase of between 0.4% and 3.2% in the number of businesses operating in an area.<sup>14</sup>
- Projects funded under the first Road Investment Strategy were estimated to generate £22 billion of economic benefits over their lifetimes, at a cost of £5 billion.<sup>15</sup>
- In 2014 the Environment Agency estimated that every £1 of capital spending in flood management schemes resulted in £8 of benefits from prevented flood damage.<sup>16</sup>

### Job creation

One of the most notable multiplier effects is related to employment. Investing in infrastructure creates income opportunities and generates jobs, both directly through construction and maintenance, and indirectly through wider supply-chain benefits that support economic activity across the country in the short to medium term.<sup>17</sup>

Past studies on the impact of infrastructure investment have found that for every 1,000 jobs which the construction sector gains directly through increased infrastructure spending, a further 2,053 jobs are added to the rest of the economy as indirect or induced effects.<sup>18</sup>

### Delivering action on broader social and environmental expectations

Within the context of recovering from Covid-19, expectations around social and environmental norms may change as a result of the experiences and realities brought to light during the lockdown period.

There is strong agreement that the economic recovery from Covid-19 should be a green one and as such projects, programmes and investments across the infrastructure sector should be evaluated and prioritised on this basis. The urgency of putting in place suitable policy and investment mechanisms to ensure the successful delivery of the UK's 2050 net-zero emissions target was the most consistent theme across all the responses to the consultation. This chimes with public expectations: the majority of Britons believe that, in the

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<sup>13</sup> Analysis conducted by Oxera on behalf of ICE (2020)

<sup>14</sup> Hasbi, M. (2017) [Impact of Very High-Speed Broadband on Local Economic Growth: Empirical Evidence](#)

<sup>15</sup> Department for Transport (2015) [Road Investment Strategy: Economic Analysis of the Investment Plan](#)

<sup>16</sup> National Audit Office (2014) [Strategic Flood Risk Management](#)

<sup>17</sup> International Labour Organization (2010) [Infrastructure, Poverty Reduction and Jobs](#)

<sup>18</sup> Centre for Economics and Business Research and Civil Engineering Contractors Association (2013) [Securing our Economy: The Case for Infrastructure](#)

long term, climate change is as serious a crisis as Covid-19, and that the economic recovery from the pandemic should prioritise climate action.<sup>19</sup> There is a clear role for infrastructure as part of this prioritisation.

## What changes are required in how we deliver infrastructure?

Improving approaches to delivery will ensure that investment across different infrastructure networks is made efficiently and effectively. There is a need to move from conception to delivery more quickly (i.e. to improve productivity) and for a systems-thinking approach to be adopted for better infrastructure performance and outcomes.<sup>20</sup>

More specifically, the business models for delivering infrastructure will need to change and the principle of infrastructure as a system of systems to support human prosperity<sup>21</sup> will continue to be fundamental to how infrastructure is designed and delivered.

Through the call for evidence, these assumptions and the evidence underpinning them were tested with expert stakeholders and organisations from both within and outside the infrastructure sector.

Alongside broad support for these initial outcomes and suggestions on how to actualise them, a range of other views and observations were made in terms of the endemic need to reshape infrastructure delivery.

### Tools and approaches to drive a step change in delivery

Further interviews conducted following the close of the call for evidence reinforced the view that many of the tools and approaches needed to deliver at the pace and scale required exist, are widely known and are being used. The Construction Sector Deal outlined how these can be and are being used.<sup>22</sup>

One example in the Construction Sector Deal is off-site manufacturing for construction and modular construction, adoption of which would strengthen local supply chains and local economics across the UK.<sup>23</sup> Off-site facilities also have the potential to replace carbon-intensive and declining industries, with targeted policies incentivising the industry to adopt new processes.

The Design for Manufacture and Assembly (DfMA) approach redefines the traditional phases of project delivery, agreeing and locking down the design phase much earlier to allow the manufacturing, assembly, testing and commissioning phases to be compressed and run in parallel, rather than in one long, linear sequence, driving greater efficiencies in how resources are mobilised.

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<sup>19</sup> ICE (2020) [State of the Nation 2020: Infrastructure and the 2050 Net-Zero Target](#)

<sup>20</sup> ICE (2020) [Covid-19 and the New Normal for Infrastructure Systems](#)

<sup>21</sup> Centre for Digital Built Britain (2020) [Flourishing Systems - Re-envisioning infrastructure as a platform for human flourishing](#)

<sup>22</sup> Department for Business, Energy and Industrial Strategy (2019) [Construction Sector Deal: One Year On](#)

<sup>23</sup> Department for Business, Energy and Industrial Strategy (2018) [Construction Sector Deal](#)

The benefits of DfMA include cost savings, increased productivity, better quality control, reduced waste and carbon emissions, health and safety improvements and greater collaboration between clients, contractors and suppliers.<sup>24</sup> Despite this, the industry has failed to adopt changes that will deliver the benefits DfMA provides.

### From tactical solutions to strategic shift

The key problem is that these tools and approaches are not being used with the level of consistency needed to make a tangible and sustained impact. If we are to achieve true reinvention, that needs to change. What is needed is a move away from tactical solutions towards a strategic system-level shift in infrastructure performance.

Responses to the call for evidence highlighted four strategic enablers to drive that shift: investing in digitalisation, embedding client-led, enterprise-based delivery models, shifting to intelligent and outcome-based procurement models and fostering new leadership in delivery based on a systems-integration skillset.

## 1. Investing in digitalisation

It is impossible to expect a transformation of the infrastructure and construction industries to occur without widespread and coherent adoption of digital technologies and data. This will enable the industry to become more productive through measuring performance and improving on it. This requires progress on a number of fronts, such as the development of information management frameworks, for digital delivery and operation of infrastructure to be a procurement requirement, reskilling of the workforce, and for research outputs to be put into practice more quickly.

The rise of digital technologies has led to the concept of the digital twin, a representation of a physical infrastructure asset in a digital format which can aid the modelling and understanding of that asset. The concept of a National Digital Twin – an ecosystem of digital twins connected via securely shared data – and an information management framework, which would enable effective information sharing, is an extension of this idea.<sup>25</sup>

The National Digital Twin sets out a structured approach to managing data about infrastructure within the infrastructure system as a whole and promotes the Gemini Principles to ensure this data is used for the public good.<sup>26</sup> This allows new investments to be assessed in the context of how that new asset or system fits in with the existing infrastructure system and what the interdependencies and cross-sector impacts are.

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<sup>24</sup> RIBA (2016) [RIBA Plan of Work 2013: Designing for Manufacture and Assembly](#); Bryden Wood (2018) [Platforms: Bridging the Gap between Construction and Manufacturing](#)

<sup>25</sup> University of Cambridge (2019) [Gemini Principles](#)

<sup>26</sup> Ibid

## 2. Client-led enterprise-based delivery models

The Infrastructure Client Group's Project 13, which ICE has been supporting, is an industry-wide change programme to shift the industry from a transactional business model to an enterprise model, which could also play a part in enabling greater use of off-site manufacture and enhancing industry productivity.<sup>27</sup>

Enterprise-based delivery models provide an example of the type of initiative that could gain traction and define the way in which major infrastructure projects are delivered in the future as construction companies learn lessons from the pandemic.

The main differences between an enterprise-based delivery model and a more traditional construction delivery model are as follows:

- Reward/profit in the enterprise is based on value added to the overall outcomes, not time spent. The relationships between organisations last over a longer period, incentivising investment in skills and tailoring of supply-chain business models.
- There is greater understanding of cost drivers and risk across all organisations in the enterprise, with commercial incentives for collaboration to jointly mitigate risk, not transfer it.
- Establishing a high-performing enterprise requires fundamentally different leadership, governance, behaviours and skills to succeed.

Project 13 looks to shape the delivery of major projects into an enterprise model with a 'capable owner' at its helm. Rather than the adversarial culture associated with traditional one-off transactional relationships, the idea is that the 'capable owner' invests in selecting the right partners based on capabilities and behaviours, and develops appropriate value-based incentive mechanisms that focus on outcomes and the performance of infrastructure assets over the entirety of the life of those assets.

This approach requires investment in a governance framework that enables effective and collective decision-making, with high levels of transparency and layers of assurance built into the process, ensuring that quality of outcome remains at the core of the enterprise's objectives. Wider adoption requires progress on many fronts, including better understanding of assets through should-cost modelling,<sup>28</sup> a culture of all parties being held to account through strategic stakeholder engagement and a focus on outcomes as part of the investment programme. A standardised scorecard should be made available to facilitate this shift, with that scorecard emphasising the value and importance placed on working together to drive up productivity and drive down carbon footprint.

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<sup>27</sup> Infrastructure Client Group (2020) [Project 13](#); ICE (2019) [ICE Response to IPA Call for Evidence: Proposal for a New Approach to Building](#)

<sup>28</sup> For an overview see: Government Commercial Function (2020) [Should-Cost Modelling – Guidance Note](#)

### 3. Intelligent and outcome-based procurement models

The uncertainty brought on by Covid-19 has demonstrated the need for resilient commercial models in construction and infrastructure. There is an expectation that businesses in the sector will look towards increased collaboration as a means of innovating and sharing risks once the immediate crisis has subsided.

As outlined in the Construction Sector Deal from 2018, there is a need to diversify and improve delivery models and labour models, strengthen supply chains, as well as enact behavioural change in businesses and individuals.<sup>29</sup>

The journey towards adopting Project 13 principles will require intermediate steps for some, particularly clients or delivery bodies set up to deliver an infrastructure intervention based on new capital works, or public-sector bodies where public procurement rules inhibit innovation due to perceived levels of increased risk. Yet, without attempts to adopt an enterprise-based approach, barriers will not be identified and overcome.

One such intermediate step would be to ensure that contracts and supply arrangements are put in place with organisations who can demonstrate their commitment – either by direct investment or collaboration with specialists – to strive for the real objectives of the client body, thus rewarding those who have made the investment to strategically transform their organisations.

Alternative models, such as alliancing and collaborative contracts, are used across construction to drive change within the infrastructure delivery ecosystem. Looking to other sectors, whole supply chain continuous improvement transformation programmes, such as the Aerospace Sharing in Growth programme,<sup>30</sup> have delivered a step change in productivity and competitiveness.

Sharing in Growth UK was set up in 2013 and is delivering a programme of intensive aerospace business transformation to around 60 UK aerospace suppliers. By focusing on leadership, strategy, culture, skills and operational excellence, the aim is to improve the global competitiveness of the UK aerospace supply chain.

To enable this, public procurement should move from project-by-project bespoke procurement to programmes based on delivery outcomes, as this will drive a reduction in cost through continuous improvement – lessons learnt from early assets can be embedded directly in future works. Funding should also be made available for a supply chain transformation pilot, based on similar principles to Sharing in Growth, to be used on a major capital investment programme, improving strategic relationship management and driving up productivity through a focused business transformation programme.

Owners with a regulated asset base or public-sector clients should be required to give a detailed explanation of the barriers stopping a shift to an enterprise-based delivery model, if one is not being used for capital works.

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<sup>29</sup> Department for Business, Energy and Industrial Strategy (2018) [Construction Sector Deal](#)

<sup>30</sup> Sharing in Growth (2020) [Our Product](#)

#### 4. New leadership in delivery based on a systems-integration skillset

It was widely recognised as part of the call for evidence, and additional interviews conducted, that leadership will be a crucial driver of change towards infrastructure being seen as a system and infrastructure investment programmes as interventions in that system, not just as construction projects.

There were many examples given of major projects which have run into challenges at the point of handover following the completion of capital works. A shift in mindset is needed to view the primary skillset required for leadership of major programmes as being closer to a systems engineer. This skillset needs to be prevalent in the senior leadership team delivering the infrastructure intervention.

### Next steps

The recommendations outlined in this paper will be taken forward by the ICG and ICE through relevant workstreams. Action on delivery will primarily be driven through the CLC Infrastructure Working Group, and other actions, particularly on infrastructure investment priorities, will form the basis of work in the run-up to the Spending Review. The wider responses to the call for evidence will continue to be used to inform future work.

### About us

The Infrastructure Client Group exists to drive improvement in the development and delivery of the UK's economic infrastructure for the benefit of end users – society. The work programmes of the ICG focus on areas where clients can have the biggest impact: delivery models, digital transformation, zero carbon and people development.

The Institution of Civil Engineers exists to ensure society gets the infrastructure it needs using the knowledge and insights of our global membership of 95,000 civil engineers. As far back as 2016, our UK National Needs Assessment highlighted the need for policy decisions on infrastructure to focus on driving the economic growth necessary to enhance the UK's position in the global economy, support a high quality of life and realise a low-carbon future.

Both the ICG and ICE work collaboratively with other organisations such as the Construction Leadership Council, and the government, to ensure a long-term focus on societal need sits at the heart of decisions on infrastructure.

