



Infrastructure
and Projects
Authority

Transforming Infrastructure Performance

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Ministerial Foreword

Lifting productivity growth by even one quarter of one per cent a year, on a sustained basis over 10 years would add £56 billion to GDP. Infrastructure investment can help increase our national productivity, which is why we have made it a cornerstone of our national economic plan and one of the five foundations of our *Industrial Strategy*.

We are making substantial increases in infrastructure investment, including a 50% increase in transport investment between 2015 and 2020. We have extended the £23 billion National Productivity Investment Fund to £31 billion and appointed the National Infrastructure Commission to provide independent advice on the country's long-term strategic infrastructure needs.



The Infrastructure and Projects Authority will publish the National Infrastructure and Construction Pipeline, which sets out around £600 billion of public and private infrastructure investment over the next 10 years and the country's infrastructure delivery record since 2010 including the delivery of more than 4,500 projects.

The construction sector faces issues such as low profit margins and lagging productivity compared to other sectors of the economy. It is vital that we address these issues if we are to deliver this investment as efficiently as possible.

Our ambitious investment plans must be met with ambitious plans to modernise the way we manage and deliver major projects. *Transforming Infrastructure Performance* is the government's long-term plan to change the way infrastructure is planned, procured, delivered and operated so we can make the most out of our increased investment.

Through interventions including benchmarking projects and accelerating the use of modern methods of construction like offsite manufacturing, our programme will help us to support economic growth and exploit a £15 billion productivity opportunity in construction every year.

We will only achieve this, however, if we work in collaboration with the construction industry, which we recognise is already making strides in improving its delivery and performance. You will see that we showcase best practice and are putting measures in place to drive a greater pace and scale of change.

This government is seeking to transform the way we both deliver and use our infrastructure so we can extract the maximum possible value from our investment and so bring about real change for people, communities and our economy. As we begin to implement our programme over the coming months, I hope you will join us on our journey for higher performance.

Andrew Jones MP

Exchequer Secretary to the Treasury

Chief Executive Foreword

The government has ambitious plans for infrastructure over the next decade. The IPA, at the centre of government, has a unique role to play in helping to realise them.

We estimate there will be around £600 billion of public and private infrastructure investment over the next 10 years and we have a delivery record to be proud of.

Successful delivery builds confidence. This enables us to develop future networks that meet our needs and support increasing investment. Looking to the future, changes in technology, the impact of digitalisation and growth of city regions will transform the way we plan and deliver infrastructure. We must protect this confidence by delivering our future pipeline as efficiently as possible and maintain our excellent track record. Then we will ensure investment will continue to flow.



Transforming Infrastructure Performance is our long-term programme to improve the delivery and performance of infrastructure. We examine how the government and industry can work together to benchmark performance and select the right projects; improve integrated planning across sectors; support effective commercial relationships; and increase uptake of technologies and innovations – both for new and existing infrastructure.

We have also set ourselves some bold ambitions for the short-term, identifying key areas we want to prioritise over the next two years. This includes improving our capability as the country's biggest construction client. We will leverage our buying power and champion the wealth of good practice that is already occurring.

It has become increasingly clear that the government, working with industry, can play a significant role in helping to create a more productive and innovative sector. Our programme has, therefore, been designed in tandem with our Industrial Strategy. We will work with major initiatives already taking place such as the Department for Transport's Transport Infrastructure Efficiency Strategy, the Construction Sector Deal, and the National Infrastructure Commission's studies.

I see our programme as a direct response to the many calls for the IPA to play a leading role in helping to make the government an enabler of change. While we do not claim that we will solve every problem, this is a significant step in the right direction. We are sending a clear signal for how the government wants to select, procure and deliver infrastructure going forward.

The scale of ambition is great but it is not unrealistic. I have seen productivity leaps in the oil sector and we have all witnessed the transformation of the UK automotive sector in more recent times. By government and industry working together and aligning our work through this programme, I believe we can future-proof our investment and drive the transformation in this sector that we all want to see.

Tony Meggs

Chief Executive, Infrastructure and Projects Authority

Executive Summary

Having modern and accessible infrastructure throughout the country is essential to our future growth and prosperity. It is one of the five foundations of productivity set out in the government's Industrial Strategy, along with Ideas, People, Business Environment and Places.

In recognition of the importance of infrastructure, government has recently set out a number of key policy commitments. These include increasing the National Productivity Investment Fund (NPIF) to £31 billion, supporting investments in transport and housing infrastructure, and boosting our digital infrastructure, including £176 million for 5G and £200 million for local areas to encourage roll out of full-fibre networks in support of the Industrial Strategy's objectives.¹

A productivity programme for infrastructure

Transforming Infrastructure Performance (TIP) is the government's plan to increase the effectiveness of investment in infrastructure – both *economic* infrastructure such as transport and energy networks, and *social* infrastructure such as schools and hospitals – by improving productivity in the way we design, build and operate assets. It is a substantial change programme with a ten-year horizon that builds on existing best practice and tackles the systemic issues that still limit the performance of UK infrastructure, and it is an important part of the government's plan to implement the Industrial Strategy.

TIP will significantly improve the ways in which infrastructure is planned, procured and delivered to focus on the whole life performance of systems, moving beyond the capital efficiency of individual projects within the system. It will encourage promoters to consider how to integrate projects and programmes across traditional sector boundaries, exploit the opportunities made possible by using new technologies and ensure that the outcomes provide maximum benefit against the expenditure incurred. It will help industry – including delivery organisations, contractors and supply chains – to invest with confidence in more efficient methods of construction and to integrate technology into existing infrastructure to improve its operational performance and the productivity of the sector.

Addressing the core issues

TIP responds to three strategic challenges that are critical to improving the delivery and performance of infrastructure:

- 1. Prioritising investment in the right projects.** Studies show consistently that investing in economic infrastructure contributes to economic growth.² This growth also generally drives increasing demand for infrastructure services.³ However, it is vital to prioritise the right projects in order to maximise the benefits delivered for the amount invested.⁴

¹ HM Government (2017), Industrial Strategy White Paper, and HM Treasury (2017), Autumn Budget 2017.

² For example Investing for Prosperity (2014), LSE Growth Commission, London School of Economics; the Eddington Transport Study (2006), the Department for Transport; or Revoltella et al (2016), Linking local business with global growth opportunities: the role of infrastructure.

³ National Infrastructure Commission (2017), Economic Growth and Demand for Infrastructure Services.

⁴ OECD (2009), Infrastructure Investment: Links to Growth.

2. **Improving productivity in delivery.** The wider construction sector has a turnover of £370 billion, contributing £138 billion in value added to the UK economy, employing 3.1 million people (9% of the total UK workforce).⁵ However, the industry's rate of productivity improvement lags behind other sectors of the economy which harms wages, long-term economic growth and living standards, and increases the cost of construction. Analysis commissioned by the Construction Leadership Council (CLC) suggests that significant productivity gains could be achieved through the adoption of digital and manufacturing technologies, the transition to new collaborative business models and better integrated supply chain management practices, creating skilled jobs in manufacturing and digital design.⁶
3. **Maximising the overall benefits of infrastructure investment.** The demands on infrastructure networks are changing as a result of demographic movements, population growth, regional rebalancing, the impact of digital technology, and changes in the way business operates and citizens interact. Advances in technology provide new opportunities to enhance the performance of existing assets and future-proof the design of new infrastructure through increased integration between networks and across sectors. They also provide opportunities to enhance performance using smart sensors, artificial intelligence (AI) and data.

Building on the past

The UK's world class regulatory regimes and open business environment already make it attractive to private investors: Nabarro LLP's 2016 Infrastructure Index judged the UK as number one for attracting investment.⁷

The government has strengthened effective delivery by moving away from stop-start planning for economic infrastructure. It has developed the UK's National Infrastructure Plan since 2010,⁸ published the National Infrastructure Delivery Plan 2016-2021, and created the National Infrastructure Commission (NIC) to drive better long-term strategy and planning. It has also improved capability to deliver projects on time, including by increasing the efficiency of the planning system. As of March 2016, more than 90% of Nationally Significant Infrastructure Projects were decided within the one-year statutory deadline from the start of the examination since the first decision in 2011 after the regime was set up.⁹

By implementing the recommendations of the 2010 Infrastructure Cost Review, government has already delivered improvements to the capital phase of infrastructure projects. It set out efficiency savings of 15% in the construction of new projects and programmes across all sectors in the 2010-2014 period of the Cost Review.¹⁰

The major public capital economic infrastructure delivery bodies are now funded on a multi-year basis, including Highways England, Network Rail, HS2 and the Environment Agency flood risk management programme. This allows better planning and allocation of capital resources, bringing public infrastructure in line with the regulated utilities sector and closer to best practice in the private sector. **There is a strong platform to build on.**

⁵ ONS (2017), Annual Business Survey, UK non-financial business economy: 2016 provisional results (Figures include construction contracting, construction services and construction products. Contracting defined as SIC 41, 42 and 43 and Self-employed construction contractors).

⁶ Construction Leadership Council (2017), Innovation in Buildings Workstream: Demand Creation, Investment and Volume Surety.

⁷ Nabarro LLP (2016), Infrastructure Index.

⁸ HM Treasury and Infrastructure UK (2010), National Infrastructure Plan 2010.

⁹ 'Infrastructure and Projects Authority (2016), National Infrastructure Delivery Plan 2016-2021.

¹⁰ HM Treasury (2014), Infrastructure Cost Review: Measuring and Improving Delivery.

The IPA

Building on this platform, the **Infrastructure and Projects Authority (IPA)** enables long-term planning to be translated into successful project delivery and to improve infrastructure performance and value for money.

The IPA is uniquely placed to work across government to support the successful delivery of all types of infrastructure and major projects. The IPA's purpose is to improve the way infrastructure and major projects are delivered in order to support government priorities and improve people's lives, aspiring to create the best performing project system of any government in the world.

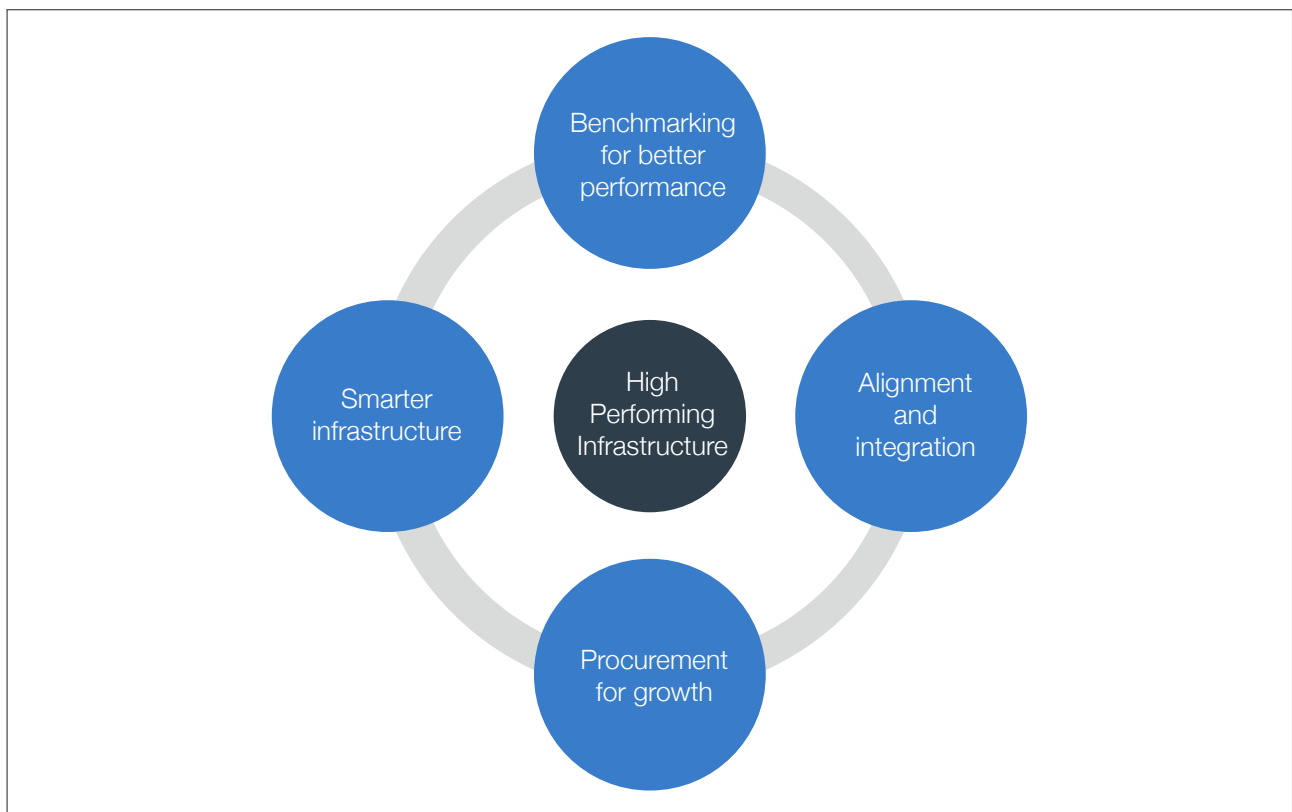
To achieve this, the IPA prioritises the following four activities:

- Setting up projects for success
- Creating market confidence
- Building delivery capability in government
- Measuring and improving performance

The IPA will lead the TIP programme, building on the successful initiatives of the past, and will work across Whitehall, and with regulators, the NIC, regional stakeholders, and industry participants to ensure that the major strands of work underway are brought together under an integrated programme.

An integrated change programme

TIP is a transformation programme with ambitious objectives for change over the course of the next 10 years. This report sets out in four sections how challenges will be addressed to drive improved performance spanning the whole investment lifecycle from policy to operation.



1. The first section – **Benchmarking for better performance** – covers the use of cost, schedule and performance benchmarks to support the selection, budgeting and design of projects. This means developing disciplined approaches to the definition of required outcomes and ensuring that they can be delivered in line with whole life performance, cost and schedule targets. Before a project is initiated, government should articulate the desired outcomes from infrastructure investment. At this policy stage the primary interface is between the centre of government (through setting strategic cross-cutting policy and regulation) and the *Sponsor* (in many cases a government department).
2. The second section – **Alignment and integration** – covers interventions to ensure that projects and programmes are planned in an integrated way, looking across sectors and tiers of government so that they are designed from the outset to support priority economic, social and environmental objectives. As projects are initiated and planned, these objectives must flow through the interface between the *Sponsor* and *Client* (the body responsible for overseeing delivery in accordance with the sponsor's objectives, for example HS2 Ltd or Crossrail Ltd in the transport space). This is to ensure the projects are set up to meet the intended investment outcomes.
3. The third section – **Procurement for growth** – covers building smarter commercial relationships between clients and the supply chain to drive long-term value for taxpayers and the users of infrastructure, and ensure a sustainable supply chain. This will include examining traditional procurement and contracts. As projects move to market, into procurement and a commercial relationship, the primary interface is between the *Client* and the *Supply Chain*.
4. The fourth section – **Smarter infrastructure** – covers interventions to increase the use of technology and innovation to drive more productive delivery and smarter operation of our infrastructure assets. The government will use its large and stable pipeline of projects to drive more investment into state of the art technology for construction, as well as providing public funding for skills and R&D. Through delivery and into operation, the interface transfers from the *Supply Chain* back to the *Asset Owner/Operator*.

The IPA has identified a number of **immediate priorities for the first two years**, set out in the box below.

Immediate priorities for the first 2 years of the programme

1. **Benchmarking**: establish a new IPA benchmarking team to define cost and performance benchmarks. The team will support current initiatives in transport delivery and continue to roll out a more consistent approach to benchmarking in business cases across major infrastructure projects. It will also work with the National Infrastructure Commission and with regulators to understand performance outcomes, and lead the way and build support for greater international collaboration, for example through the G20 Global Infrastructure Hub and the OECD, working with the latest academic research.
2. **A framework for cross-sector integration**: develop the integrated approach adopted in the Cambridge – Milton Keynes – Oxford corridor, and apply it to other regional investments such as the Midlands Engine, Thames Gateway and Northern Powerhouse to focus projects and programmes on government priorities for economic growth, business productivity and housing.
3. Support the roll out of the **Procuring for Growth Balanced Scorecard** developed by the Crown Commercial Service, and work with professional bodies and the Infrastructure Client Group to improve commercial models across private and regulated sectors.
4. Work with the Department for Transport, the Department of Health, the Department for Education, the Ministry of Justice and the Ministry of Defence to put government projects at the forefront of construction innovation: **apply the presumption in favour of offsite construction by 2019, as announced at the Autumn Budget 2017, in project planning and procurement processes**; identify and address obstacles to faster uptake; and explore opportunities to extend modern methods of construction to other high potential sectors.
5. **Support delivery of the Construction Sector Deal**, working across government and with industry, to support innovation and skills in the sector and a greater emphasis on procuring for value to support the transition to modern methods of construction.
6. **Use digital technology and innovation to improve the way we deliver and extract maximum whole life value from infrastructure**, including through:
 - a) **supporting effective delivery of the Digital Built Britain programme**;
 - b) building on examples of good practice such as smart motorways, and **setting out the IPA's role in implementing relevant recommendations from the NIC's technology study and National Infrastructure Assessment** on making better use of our existing infrastructure; and
 - c) **IPA joining the Infrastructure Industry Innovation Platform (i3P)**, and continuing to engage with other innovation initiatives, to strengthen its role in identifying and championing good practice.
7. **IPA's core role to support and assure projects**: its tools such as the Project Initiation Routemap and its performance framework, and its role in advising ministers on the selection and initiation of major projects will help roll out the principles of TIP. IPA-led independent project reviews will be used to embed TIP concepts into current and emerging large infrastructure investments. It will refresh the Government Construction Strategy in 2018 to reflect the objectives set out here.

Governance

The programme will report to **ministers from the Treasury and other infrastructure departments**: this group of ministers will take strategic decisions on behalf of government and hold the programme to account for delivery.

The IPA will work with existing governance and delivery structures, coordinating with stakeholders across central and local government, industry, regulators, clients, asset owners, non-governmental organisations and academics to build **open, inclusive and transparent** working arrangements for the programme. The government will support the TIP programme by:

- using its sponsorship and procurement purchasing power to drive change in the design and delivery of programmes and projects;
- developing policies and adapting regulation to force the pace and scale of change;
- working across Whitehall departments to coordinate infrastructure improvement initiatives, including the Transport Infrastructure Efficiency Strategy, and the government's Industrial Strategy;
- building partnerships with industry, through organisations or groups such as the Construction Leadership Council, the Infrastructure Client Group, and the Construction Industry Training Board, who have an important role to play delivering TIP objectives; and
- bringing clarity and cohesion to the multiple initiatives and stakeholders already engaged on this agenda, ensuring existing workstreams are joined up and pointing in the same direction.

Improving infrastructure productivity and performance

The imperative

Infrastructure investment can drive economic growth and productivity. It can unlock housing development, improve the performance of transport networks – supporting the movement of people and goods around the country in an efficient and predictable way – as well as energy and digital networks, by using current capacity better or adding to it, and support high quality public services.

The 2017 National Infrastructure and Construction Pipeline sets out around £600 billion of public and private infrastructure investment over the next 10 years.¹¹ This reflects government ambitions to invest more to upgrade our infrastructure, and growing demand for infrastructure services.

Alongside the levels of investment required to meet demand, there are a number of constraints emerging on the supply side. It is estimated that around 30% of the UK-born construction workforce are aged over 50,¹² and 11% of the UK construction workforce are non-UK nationals.¹³ The proportion is much higher in London, where research indicates approximately 45% of the construction workforce are non-UK nationals, mainly from other countries in the EU or EEA.¹⁴

The UK construction supply chain is characterised by high levels of fragmentation and relatively low levels of investment, innovation and productivity. Traditional procurement practice tends to encourage individual transactional relationships with suppliers and a reliance on tried and tested technology, without providing a sufficient incentive for investment and adoption of innovative techniques.

Together, these present a substantial challenge to delivering such an increase in infrastructure investment on an efficient and effective basis, and an imperative to address the issues that might limit the ability of government and the private sector to respond.

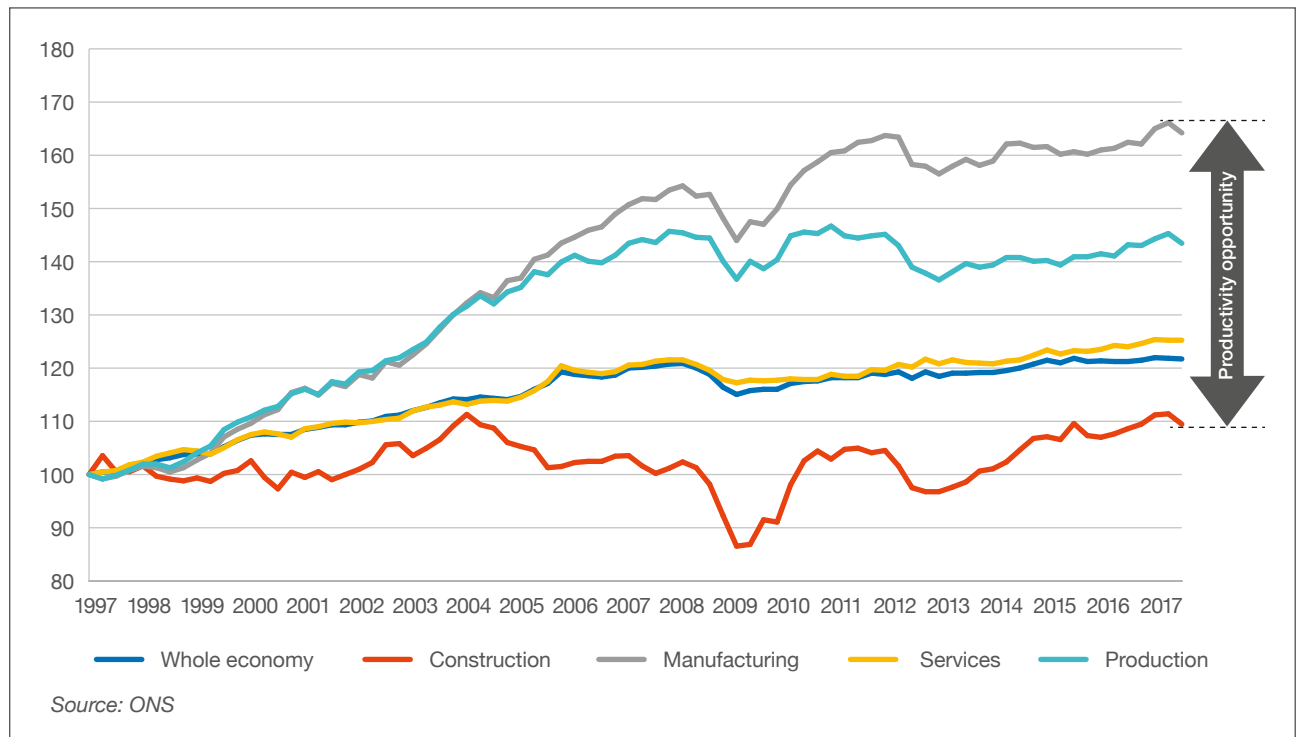
One of the key input metrics in measuring performance is productivity growth in the construction sector, which has lagged behind other sectors of the economy, set out in Chart 1 below.

¹¹ Infrastructure and Projects Authority (2017), Analysis of the National Infrastructure and Construction Pipeline.

¹² ONS Labour Force Survey data, in CITB (2017), Migration and Construction: The view from employers, recruiters and non-UK workers.

¹³ ONS (2017), Dataset: International migration and the labour market, UK. Accessed at: www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/internationalmigration/datasets/internationalimmigrationandthelabourmarketuk

¹⁴ ONS Labour Force Survey data, in Construction Products Association (2017), Brexit Construction Issues. Accessed at: www.constructionproducts.org.uk/media/264067/cpa-brexit-issues-for-construction-march-2017.pdf

Chart 1: Productivity Growth – Output per worker (1997=100)

The challenges facing construction and infrastructure are both widely recognised and reported by industry. There has been a broad consensus since Sir John Egan’s 1998 Rethinking Construction report, and others since, that “the industry as a whole is under-achieving. It has low profitability and invests too little in capital, research and development and training.”¹⁵ Mark Farmer’s Review of the UK Construction Labour Model found that “the use of competitive tendering is widespread throughout the industry and there appears to be very low usage of more collaborative and integrated design, procurement and construction delivery models.”¹⁶

Poor productivity of the construction sector and the impact this has on infrastructure performance is a global challenge. A recent study highlighted that construction is one of the least digitised industries in the world, with lower levels of automation than, for example, advanced manufacturing or the automotive sector.¹⁷

The industry leadership in the UK has recognised this and started acting on it, with the Construction Sector Deal recently announced.¹⁸ Other initiatives include the Infrastructure Client Group’s work From Transactions to Enterprises with the Institution of Civil Engineers to drive long-term value for clients and the supply chain.¹⁹

¹⁵ The Construction Task Force (1998), Rethinking Construction.

¹⁶ The Construction Leadership Council (2016), The Farmer Review of the UK Construction Labour Model.

¹⁷ McKinsey Global Institute (2017), Reinventing Construction: A Route to Higher Productivity.

¹⁸ BEIS press release. Accessed at: www.gov.uk/government/news/government-and-industry-cement-deal-to-give-uk-construction-the-edge

¹⁹ Infrastructure Client Group and Institution of Civil Engineers (2017), From Transactions to Enterprises: a new approach to delivering high performing infrastructure. Also known as Project 13.

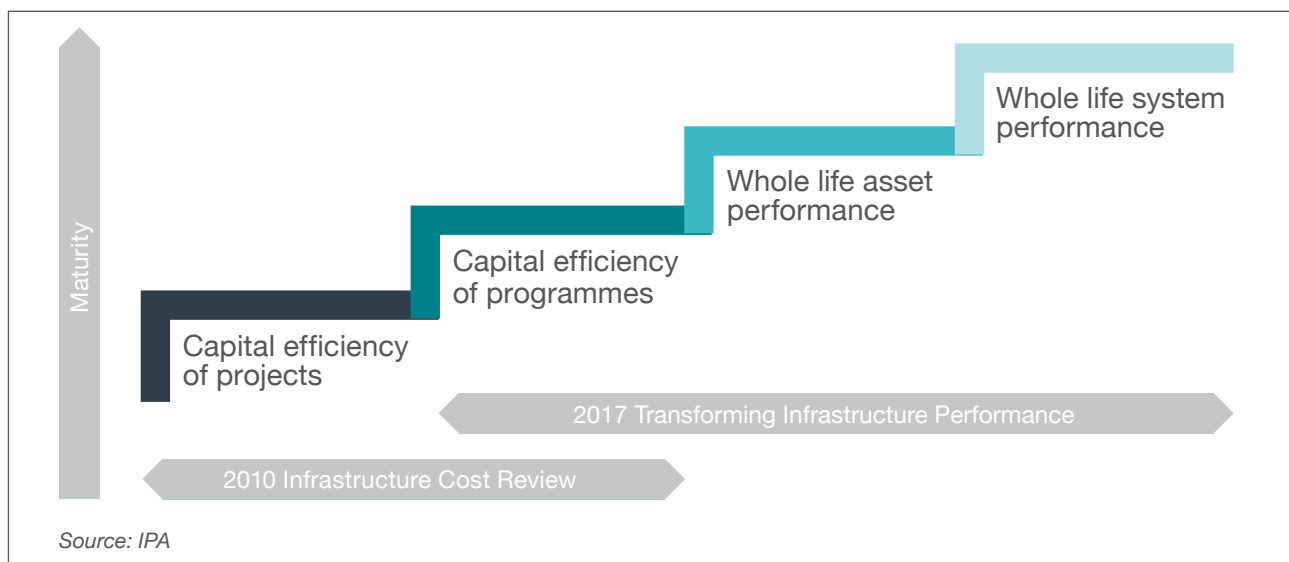
Progressing towards whole system performance

The TIP programme will, over time, change the ways in which infrastructure is planned, procured and delivered. To drive whole life value from assets, the IPA will look at how whole life performance of assets can be assessed between sectors.²⁰ This will require a shift in mindset away from siloed, project-based, thinking into a more strategic appreciation of how different networks interact and rely on each other for their performance – whether during normal operation, or under stress from cyber threats or a natural event such as flood.

Cost effective delivery during the capital phase of a project is important but it is only one ingredient of delivering whole life value and high performance. Focusing solely on the upfront capital costs of delivering an asset, and not how to deliver best value over its whole operational lifetime, can lead to missed opportunities to deliver better value for money and benefits to consumers and society.

The IPA will lead and support work to improve overall value for money – by considering the whole life performance of assets, and through focusing on the potential benefits of connecting different assets and networks, as illustrated in Figure 1.

Figure 1: Steps from efficiency to performance



The TIP programme will support sponsors, clients and industry to develop their capability and capacity, to address improving the whole life system performance of our infrastructure projects, programmes and networks.

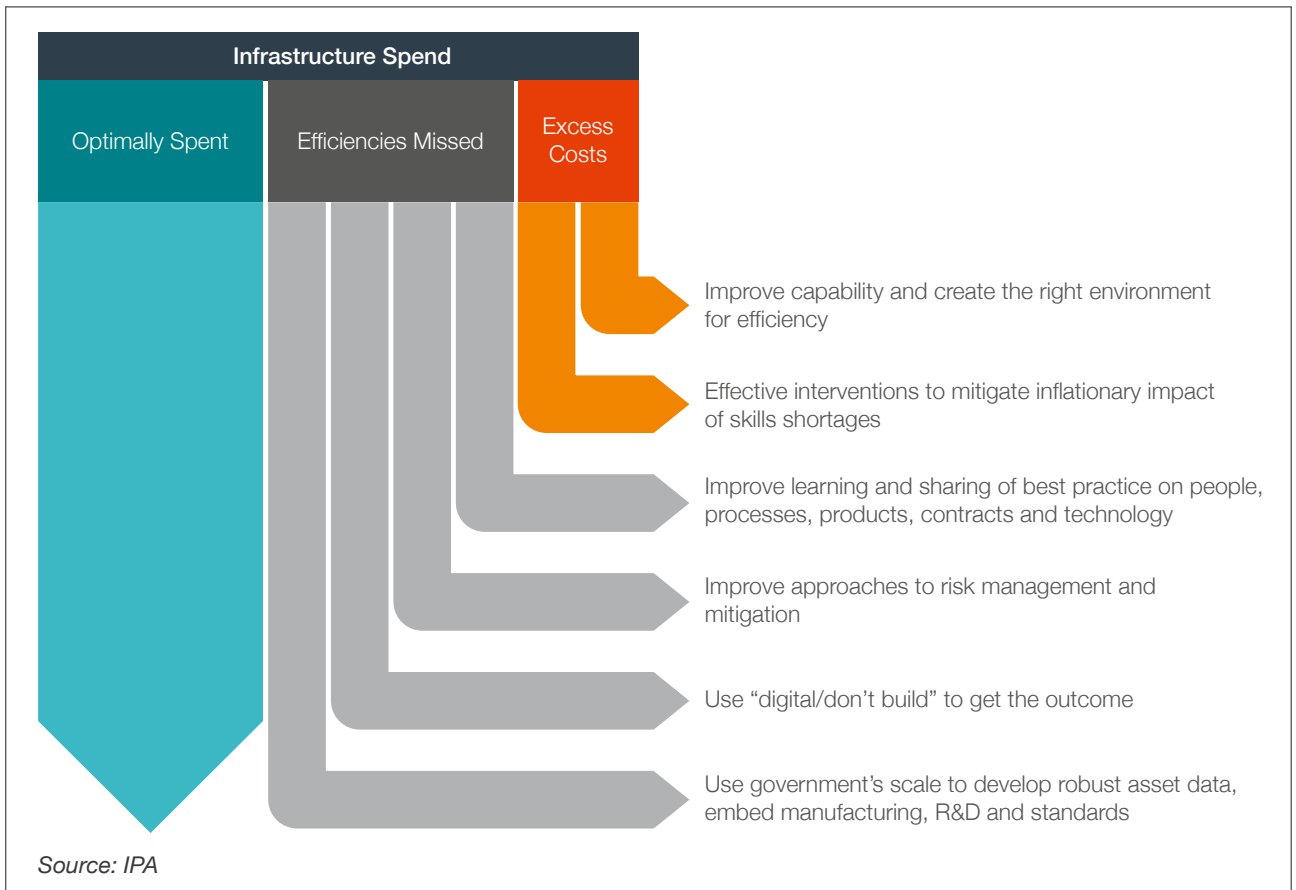
A partnership with stakeholders

In gathering data and evidence for this report, the IPA has consulted with a wide range of stakeholders representing clients from the public and private sectors, consultants, contractors, academia, industry associations and regulators.

The IPA is grateful for their input and feedback, which suggested that within total infrastructure investment a proportion was optimally spent but, across the system, there were opportunities for further efficiencies and to tackle drivers of excess cost, set out in Figure 2. Their input with case studies of best practice and barriers to improvement have steered the interventions set out in this report.

²⁰ “whole life performance” measures both the construction and operational performance of assets. It will include costs and schedule in construction and delivery of services and benefits in operation.

Figure 2 – Efficiency Opportunities



This feedback suggests that to improve infrastructure performance, the focus should be not only on cutting costs and *improving efficiency* in project delivery, but also on seeking to *maximise the benefits* from infrastructure investment. There are a number of levers that can help drive change and deliver high performing infrastructure that supports strategic economic, social and environmental objectives. These include:

- establishing clear measures that describe the required outcomes from investment in infrastructure;
- improving business cases and aligning strategic priorities throughout the investment lifecycle with a focus on delivery of benefits;
- building greater client and sponsor capability, in particular improving commercial relationships to focus on whole life outcomes; and
- incentivising productivity improvement in both delivery and operation through technology, modern methods and driving investment in the key future skills.

Industry is already responding. Through the Industrial Strategy and the Construction Sector Deal, government and industry will develop the infrastructure industry’s response to the challenges faced by the sector (see Box 1).

Box 1: The Construction Sector Deal²¹

The government's recently published Industrial Strategy strengthens the five foundations of productivity: **innovation, people, infrastructure, places** and the **business environment**.

The White Paper includes plans for several Sector Deals: partnerships between government and industry aiming to increase sector productivity. The government and the construction sector, through the Construction Leadership Council and with the leadership of Andrew Wolstenholme, have agreed a Sector Deal to transform the productivity of the sector to benefit the wider economy.

The Deal will substantially boost the sector's productivity, through greater investment in innovation and skills, creating new and well-paid jobs and maximising its export potential. It will also reduce the environmental impact, improve the efficiency and reduce whole life cost of new projects and buildings – to help build the houses, schools, hospitals and major transport projects we need. It contains commitments to work collaboratively in four key areas:

Procuring for Value: encouraging construction clients to procure on the basis of whole life value, and to measure the performance of assets and contractors. This will create the market pull for improved construction products and technologies, and drive changes in the business model contractual and payment practices.

Industry-led Innovation: delivering greater investment in the development and commercialisation of digital and manufacturing technologies, to significantly improve productivity, the quality, sustainability and safety of infrastructure and buildings.

Skills for the Future: increasing investment in skills development and adopting a more strategic and co-ordinated approach to recruitment, and equipping workers with the skills and related training such as health and safety.

Exports and International: developing a competitive advantage for the UK construction sector, through adopting new technologies and a more co-ordinated approach to bidding for projects overseas.



The government is taking immediate steps to support the Sector Deal objectives. Firstly, it will use its substantial pipeline of construction projects to drive innovation and increase the adoption of modern methods of construction. Five government departments have committed to adopt a presumption in favour of offsite construction by 2019 across suitable capital programmes, where this represents best value for money.²² Across the Department for Transport, the Department of Health, the Department for Education, the Ministry of Justice, and the Ministry of Defence, this currently represents a potential pipeline for modern methods of construction of around £20 billion a year. Secondly, the government committed to invest £170 million as part of the Sector Deal, to support innovation in the sector.²³ Through the TIP programme, the government will work with industry to implement the Sector Deal and boost construction productivity.

²¹ HM Government (2017), Industrial Strategy White Paper.

²² HM Treasury (2017), Autumn Budget 2017.

²³ Ibid.

Professional bodies and industry associations across the sector support this drive for reform, including the Institution of Chartered Surveyors, the Construction Products Association, the Civil Engineering Contractors Association, the Association for Consultancy and Engineering and the Institution of Civil Engineers, which sponsors the work of the Infrastructure Client Group on initiatives such as Project 13, described in Box 2.

Box 2: Project 13 – From Transactions to Enterprises

Project 13 is an industry-led initiative to outline and establish a **better business model for infrastructure delivery**, improving productivity and performance, and mitigating the skills risk.

Working with suppliers, contractors, sponsors and clients, it will set out a clear ambition for what this new model should look like across the whole supply chain and from the whole life of the assets.

The programme is designing a **blueprint for the future** of the industry based on an enterprise relationship that maximises performance, rather than a transactional one which transfers risk.

By using examples of the best current practice and applying these lessons consistently across the whole industry, it aims to create a step-change that will deliver better outcomes across the board.

The implementation phase of the programme will begin in March 2018, sponsored by the Infrastructure Client Group.



The Department for Transport has published its Transport Infrastructure Efficiency Strategy (TIES), which is closely aligned to the TIP objectives, set out in Box 3.²⁴

Box 3: Transport Infrastructure Efficiency Strategy

The Transport Infrastructure Efficiency Strategy is a joint strategy developed by Crossrail, Highways England, High Speed Two (HS2 Ltd), Network Rail, Transport for London and the Department for Transport. The organisations will collaborate to maximise the opportunities to drive efficiency across the wave of new transport projects in delivery or in the pipeline. They will seek to learn from each other's experiences and collaborate with their shared supply chain.



The strategy will be closely aligned with TIP, and will support the leadership and vision of the CLC. It will target key stages in the asset investment lifecycle where there is greatest opportunity to deliver efficiencies, focused around 7 challenges:

- Judge strategic choice and trade-offs based on whole life cost and wider benefits
- Improve the way we set up our projects to maximise value and prevent inefficiency throughout delivery

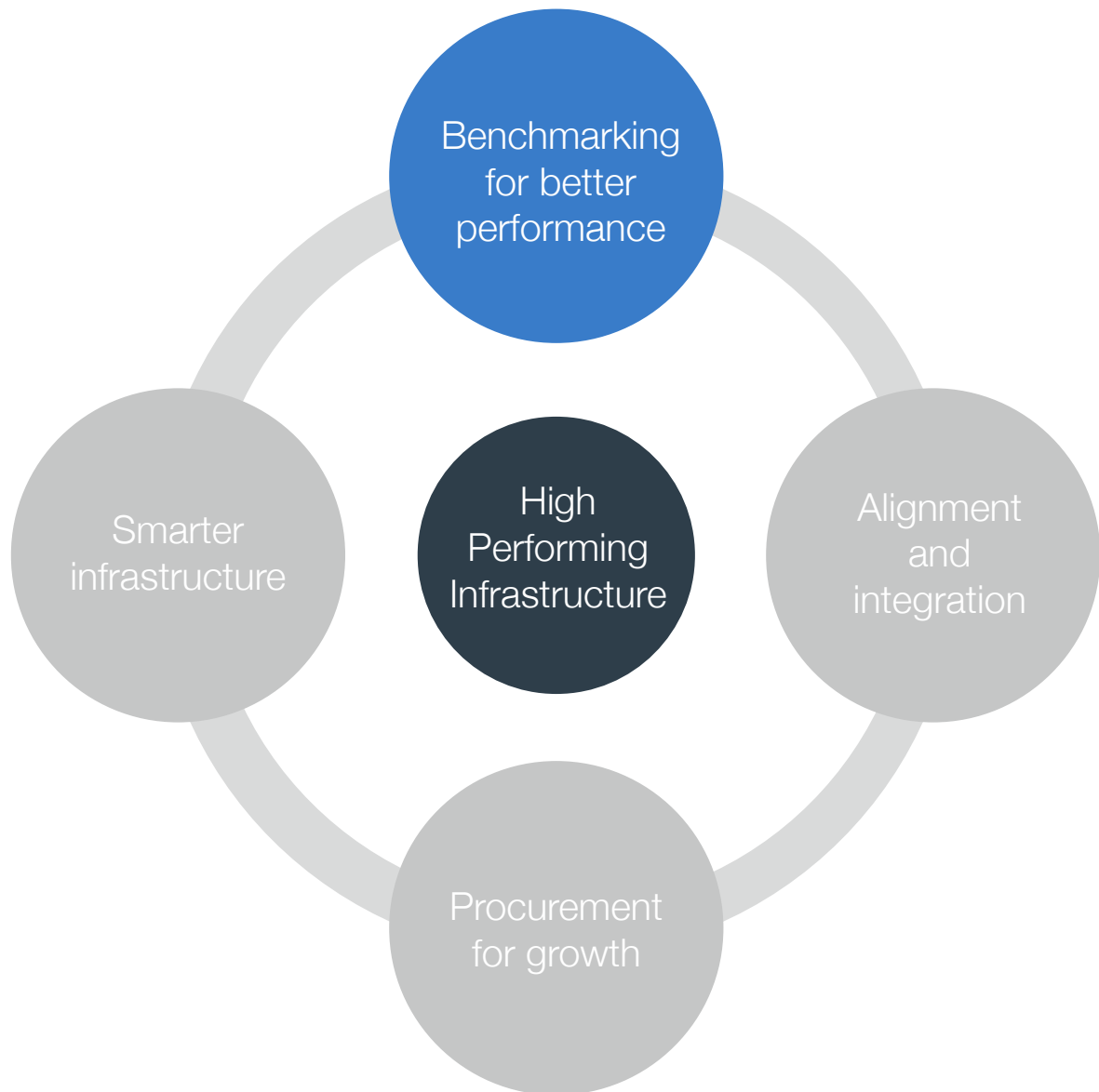
²⁴ Department for Transport (2017), Transport Infrastructure Efficiency Strategy.

- Create a transport infrastructure benchmarking forum to share best practice and innovation
- Establish a common approach to estimating cost management to improve cost confidence and assurance
- Promote long-term, collaborative relationships with industry to reduce transaction costs in procurement and maximise innovation
- Challenge standards to enable innovation and drive efficiencies
- Exploit digital technologies and standardise our assets to enable the adoption of best practice from the manufacturing sector, such as off-site construction

To ensure the TIP objectives can be advanced across all infrastructure sectors, the IPA will work at the heart of government and with regulators, clients, asset owners and operators to help ensure regulatory frameworks and incentives are aligned and good practice is shared across the public-private boundary, including through engagement with regulators via the UK Regulators Network.

Within industry – across infrastructure clients and the supply chain – there is a consensus for action. The following four chapters set out the issues and priority actions that will be taken to address the challenges.

Benchmarking for better performance



Over the next 10 years, our ambition is to ensure all major projects and programmes are selected and prioritised using benchmarked data on costs and performance.

Developing and sharing cost, schedule and benefits benchmarks will help identify cost drivers and challenge costs.

Performance measures will strengthen business cases to help government and other sponsors select the projects that best meet the needs of users, asset owners and society.

Benchmarking for better performance

The challenge

Measuring the performance of infrastructure is difficult.

Benchmarking is the process of comparing the cost, schedule and performance of a project against other similar projects. Properly applied it enables sponsors, clients and delivery bodies to estimate the time, cost and performance of a planned project more accurately. To be effective, it requires data from a range of comparators, which is detailed and accurate enough to make a meaningful comparison, and the effective collection and sharing of this data between different sponsors and clients.

While cost and schedule benchmarking is used across the public and private sectors, infrastructure project sponsors do not always have access to robust and sufficiently granular data against which to benchmark their cost and schedule estimates. Even where data is available, sponsors are not consistently required by project approvals processes to use benchmarks. This needs to change so that all infrastructure projects routinely collect and share data, apply benchmarks from reference projects and develop more sophisticated tools to assess the delivery parameters for their projects.

The challenge will be to ensure data is collected, and deployed to support the consistent application of these benchmarking techniques, to further strengthen business cases and investment appraisals for major projects. The TIES will drive this effort across transport bodies, and the IPA will strengthen discipline on benchmarking for the major projects it supports and assures.

As well as the challenges of applying cost and schedule benchmarks, there are no consistent units of measurement for infrastructure performance, either in the UK or in other countries. The application of Cost-Benefit Analysis during planning stages provides an estimate of the benefits, but there is no established process through which the actual performance data of each asset, its contribution to the network, or its contribution to the wider system are measured, collected, collated and applied in designing future projects.

What we will do

The IPA's first priority will be to support sponsors and clients to use cost and schedule benchmark data consistently when scoping and designing major projects. **The IPA will establish a benchmarking team in 2018 to promote the effective use of cost and performance benchmarking in three ways**, coordinating with the Department for Transport's benchmarking plans set out in TIES.

First, the team will support projects to access suitable and reliable benchmark data against which projects can compare their whole life cost and schedule estimates.

This will include collecting and sharing useful information about common cost drivers across projects and programmes. The IPA will consult sponsors and clients to gather their views on how this support can be most effective.

Second, it will use the IPA's assurance tools to ensure major projects have benchmarked their whole life cost and schedule estimates during the development of

business cases. This will help to strengthen the evidence base in the approvals process, and it will help sponsors and clients to improve their capability in incorporating benchmarks in the estimating process.

Finally, it will work with the Treasury to provide constructive challenge to ensure that estimates are made with due regard to comparator data, including where appropriate international projects. This challenge will help projects ensure they are making scope and design decisions in a way that balances the trade offs between initial costs and long-term benefits, consistent with value for money considerations.

As the IPA improves the collection, sharing and application of cost and schedule benchmarks, it will aim to **establish a set of performance metrics.** By drawing together stakeholders from across government, the NIC, the UK Regulators Network, industry and academia, **the TIP programme aims to develop the means to measure not only the operational performance of individual assets, but also the performance of the networks and systems within which they operate.** No other country has yet developed and embedded infrastructure performance measures across sectors in this way.

The NIC is consulting on a series of measures to consider the performance of the UK's economic infrastructure at a system level, as part of its National Infrastructure Assessment (NIA).²⁵ These measures are focused on economic infrastructure aligned with the NIC's three objectives, but will also be useful to build on in considering measures for social infrastructure.

There is need for a comprehensive set of metrics that can be applied across sectors if the government is to use performance in project options selection. Many of these metrics will be specific to the needs of individual projects and programmes, while others will assess common measures that apply across all sectors. This will build on the high level sector performance metrics set out in the 2011 National Infrastructure Plan and the commitment made in the National Infrastructure Delivery Plan 2016-2021 to consult on an improved performance measurement framework.²⁶

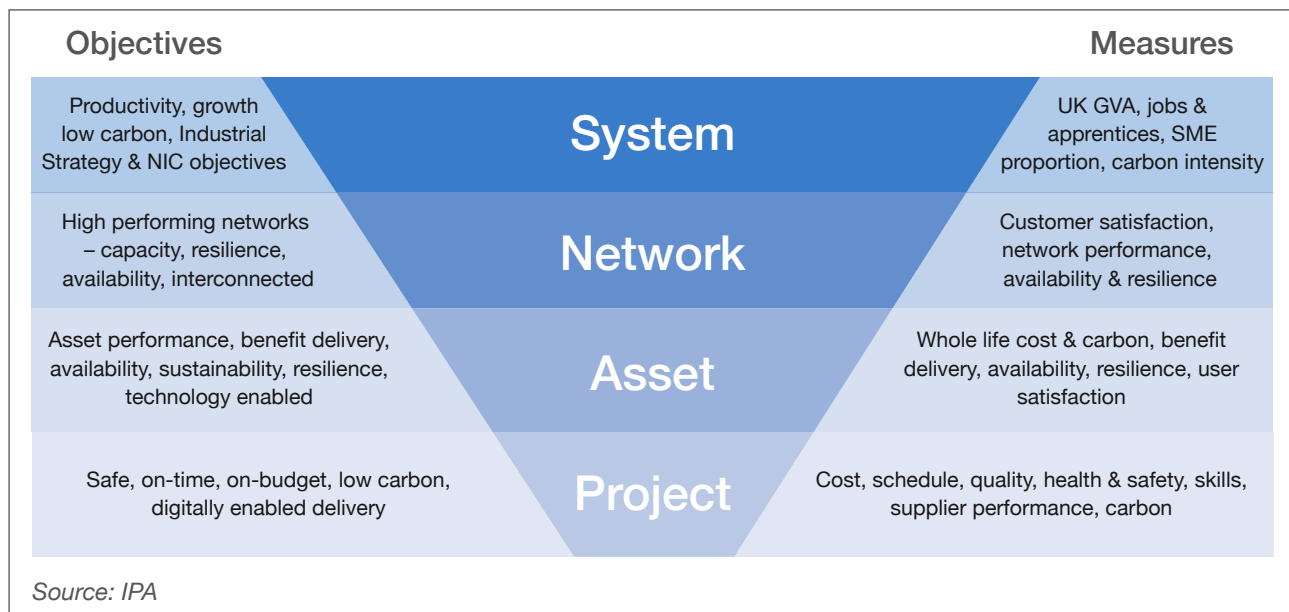
To get an holistic picture of performance, it is necessary to consider **inputs** – for example the unit costs of road surfacing materials – **outputs** – for example a new motorway – and **outcomes** – for example reduced congestion and journey times from the new motorway.

In general, performance can be measured at four levels. Figure 3 sets out examples of potential objectives at these different levels, as well as metrics that could measure performance against each objective.

²⁵ National Infrastructure Commission (2017), Congestion, Capacity, Carbon: Priorities for National Infrastructure.

²⁶ HM Treasury and Infrastructure UK (2011), National Infrastructure Plan, 2011; and Infrastructure and Projects Authority (2016), National Infrastructure Delivery Plan 2016-2021.

Figure 3: Example Objectives and Measures



- At a **project** level, traditional benchmarks and performance indicators measure the delivery of the capital phase of the project, driving improved performance and competitiveness.
- Once constructed, further performance indicators are used to measure delivery of benefits and operational performance indicators for the **asset**.
- Completed assets often integrate into an existing network: for example a new motorway will form part of the Strategic Road Network. Measures at a **network** level assess performance of the wider network: for example overall lane availability of the network or customer satisfaction.
- **System** level measures assess how interconnected assets and networks support the delivery of the wider economic, business and social and environmental objectives of the government, including job creation, boosting productivity and economic growth, as well as broader measures linked to – for example – the objectives of the Industrial Strategy and the NIC.

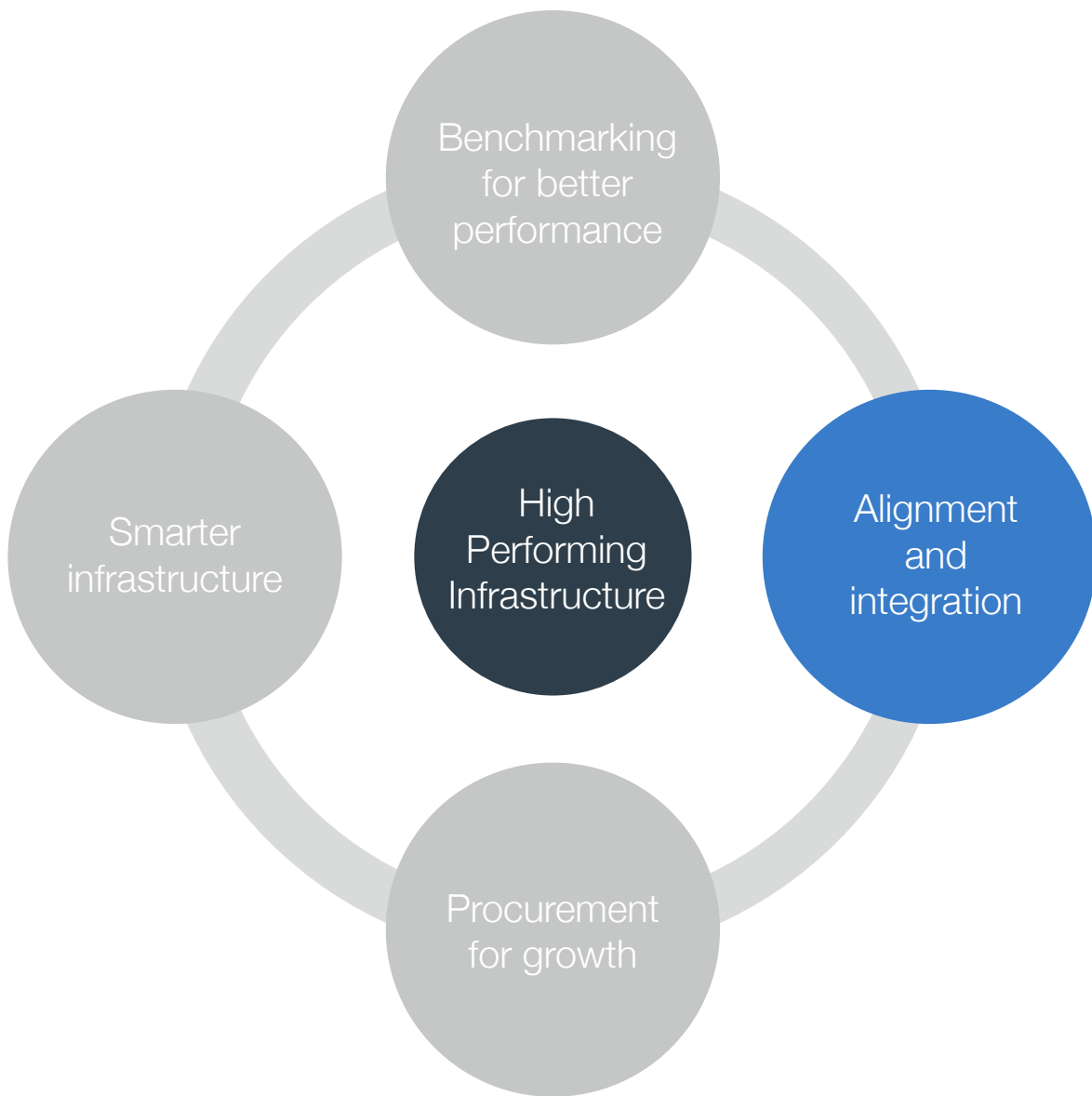
Priority interventions

TIP will focus on 5 priority interventions in this area:

- **The IPA will establish a new benchmarking team in 2018 to promote the effective use of cost and schedule benchmarking of infrastructure projects and programmes, as well as better performance measurement.** This will support the interventions below.
- **Cost and schedule benchmarking:** major projects will provide benchmarked cost estimates, including whole life costs, as part of the business case approval process. The IPA will consult with departments and clients to provide support and challenge to these cost estimates, drawing on benchmarked data from comparable projects. The IPA will produce a new Project Initiation Routemap module on benchmarking to support sponsors to initiate projects based on reliable cost and performance data.²⁷
- **Benefits realisation:** the government will ensure that infrastructure projects' business cases demonstrate clearly how they have considered the widest possible range of benefits to be delivered through the planned investment. This could include wider economic benefits to industry and society, for example through: regeneration of underperforming areas, enabling business expansion, encouraging innovation, improving connectivity, tackling congestion and lowering carbon. The IPA will help ensure that projects have a plan that joins up across central government, and where appropriate with local government and industry, for the delivery of the anticipated benefits and for measuring the actual achieved benefits, in order to provide a data reference point for future projects.
- **Performance measurement:** the IPA will work across government and with the NIC, regulators, industry, academics and international organisations to develop a system of performance metrics that aims to measure the performance of assets, networks and systems once in operation. Once established, these performance metrics will help to ensure that projects and programmes include cost, schedule and performance benchmarks in their business cases. This will allow a more informed judgement of trade-offs – from the very first decision-making stages – to ensure the right projects are designed and delivered.
- **International benchmarking:** to support these interventions, the IPA will seek to build support for greater international collaboration, for example through the G20 Global Infrastructure Hub and the OECD, working with the latest academic research.

²⁷ Infrastructure and Projects Authority (2016), Improving Infrastructure Delivery: Project Initiation Routemap.

Alignment and integration



Over the next 10 years, our ambition is to join up how government selects, plans, and delivers major infrastructure projects and programmes.

Integrating planning and delivery of individual infrastructure projects across sectors unlocks opportunities to develop infrastructure networks and systems that support the UK's priority economic, social and environmental objectives.

Aligning these objectives throughout the investment lifecycle will support projects to deliver the right outcomes.

Alignment and integration

The challenge

The UK has been at the forefront of introducing innovative investment models for long-term, strategic planning of infrastructure. It was an early adopter of multi-year government budgets, following the introduction of three-year budgets in 1997.²⁸ In 2010 the government set up Infrastructure UK, a forerunner to the IPA, as a specialist entity within the Treasury, and began publishing pipeline data on future projects to support more strategic forward planning by industry and investors. In 2015, the government established the NIC, a new strategic institution to provide impartial, expert advice to government on meeting long-term economic infrastructure need.

These build on the solid foundation of the Green Book and the five case model.²⁹ The Green Book is guidance for central government. It is produced by the Treasury and sets out how publicly funded bodies should prepare and analyse proposed policies, programmes and projects to obtain the best public value and manage risks. It also covers the evaluation of policies, programmes and projects after they have been implemented, to find out how well they have delivered against their original budgets and planned timescales. The Green Book is widely referred to outside government and is respected internationally as a gold standard for the appraisal of public spending.

The Green Book will be essential in quantifying the expected increases in the effectiveness of infrastructure investment that lie at the heart of the TIP programme. The intention is, therefore, for the principles set out in TIP to be captured and quantified using Green Book techniques, creating a virtuous circle as benefits are realised, or lessons are learnt and fed back into processes to support continuous improvement.

Combined, these strengths provide a platform for driving further improvement: ensuring projects are initiated and integrated to deliver maximum whole life performance, including against key economic, social and environmental objectives.

There must be a clear expectation that project sponsors will set out a strategic case and an economic case that consider the full range of wider economic and social benefits. The appraisal and approval process for the business case is an important mechanism for ensuring these objectives are considered at each stage of assessment and decision-making.

Better integration across sectors means that projects can be consistently selected and planned on the basis of their ability to deliver the government's long-term economic and social priorities, including those highlighted in the Industrial Strategy.³⁰

- **Grand Challenges** – to what extent the investment can support the success of our Grand Challenges on artificial intelligence and data, clean growth, the future of mobility and the needs of an ageing society;

²⁸ Spackman, M., National Economic Research Associates for discussion at the OECD Global Forum on Sustainable Development (2002), Multi-Year Perspective in Budgeting and Public Investment Planning.

²⁹ HM Treasury, The Green Book: Appraisal and Evaluation in Central Government.

³⁰ HM Government (2017), the Industrial Strategy White Paper.

- **Ideas** – how the investment can support the development and commercialisation of new smart technologies, infrastructure and ideas;
- **People** – whether the investment can support the development of skills within the UK workforce;
- **Business environment** – how investments can best support supply chains, and the exporting of goods and services; and
- **Places** – how the investment can act to reduce regional productivity differences, and boost earning power across the UK.

To maximise the contribution that infrastructure investment can make in advancing the government’s economic, social and environmental objectives, it is necessary to take a network- and systems- level perspective when selecting, prioritising, planning and delivering individual projects and programmes. For example, this may mean considering the optimum phasing of release of land for regeneration and housing in developing a transport scheme, which may result in re-scoping a highways project to deliver the maximum combined transport and housing benefits.

The government has taken steps in recent years to reform the model where government projects are seen as ‘belonging’ to one departmental sponsor, to support better integration (both within central government and between central government and regional and local authorities). For example, the Cities and Local Growth Unit (CLGU) is a joint team that reports and is accountable to both BEIS and DCLG Secretaries of State. The CLGU led the negotiations and implementation of ground-breaking devolution deals, supporting the establishment of the six directly elected Metro Mayors and their combined authorities. The CLGU has also led a strategic programme of work with the Department for Transport to look at ways to better integrate planning for transport and housing, and is driving delivery of High Speed 2 Growth Strategies. **The key challenge for government is to consolidate and build on this progress.**

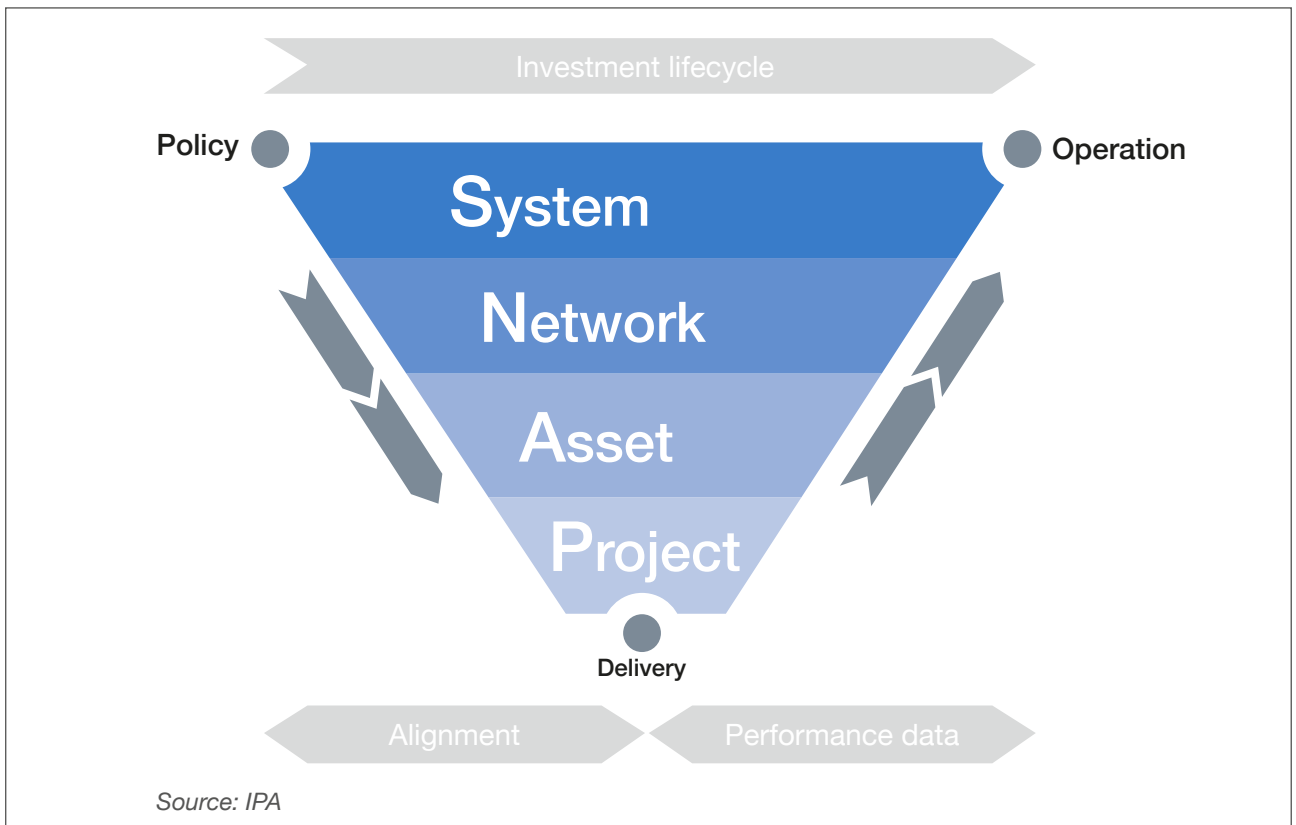
What we will do

Improving alignment through the appraisal and approval stages

Through TIP, the government will seek to address the lack of consistency in alignment through the investment lifecycle as policy objectives move through appraisal and approval, into procurement and delivery and into operation. Improving consistency and clarity would avoid misalignment between policy objectives and project business cases, and support identification of project options that best support the objectives of high performance.

This requires alignment through all the decision-making stages up to delivery of the project – ensuring that System (S), Network (N), Asset (A) and Project (P) objectives are all assessed at each stage – combined with measurement of outputs and outcomes – **performance data** – as the project moves into operation, set out in Figure 4.

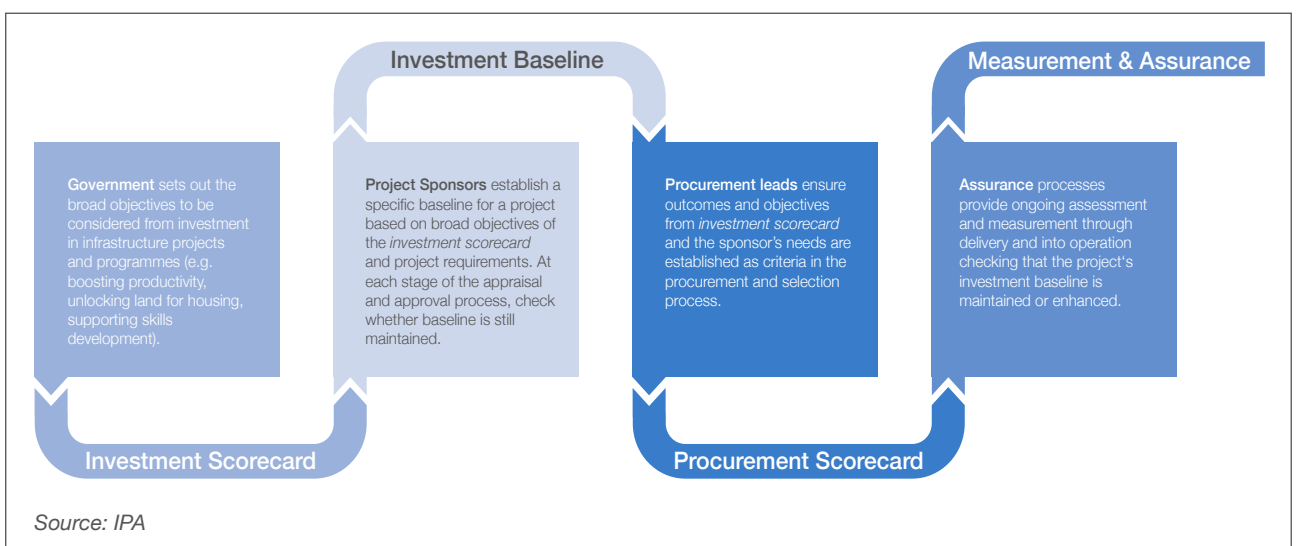
Figure 4: Alignment through investment lifecycle



The TIP programme will explore interventions to improve how key policy objectives for projects are articulated, embedded and delivered during the project lifecycle stages: appraisal, approval and onward to procurement. Interventions will need to be consistent with delivering value for money and apply proportionate thresholds to avoid adding unnecessary burdens and requirements on projects.

An example of how this could work through the investment lifecycle is set out in Figure 5.

Figure 5: Key decision stages of the investment lifecycle



Source: IPA

This is consistent with approach and tools being developed by DfT to strengthen the way the department and its delivery bodies apply the business case methodology in the transport sector – which represents the bulk of public investment in economic infrastructure. In TIES, DfT organisations have committed to provide ministers, investment boards and sponsors with proposals that specify the total likely cost of the investment and how it will provide an enabler for wider economic growth. This seeks to build on existing Green Book practices by supplementing existing process with insight from benchmarking. Key tools proposed by DfT to judge the wider benefits of projects for places include:

- gateways for project initiation to review and agree the outcomes and objectives of specific schemes or portfolios (a recommendation in TIES); and
- a ‘rebalancing’ toolkit, which provides a framework to consider how an investment programme or project fits with the objective of spreading growth across the country. It aims to ensure rebalancing is considered more consistently within decision-making by improving the focus, quality and transparency of ‘rebalancing’ evidence in strategic business cases.³¹

Improving integration in project selection and planning

The NIC will continue to play a vital role advising government, looking long-term and across sectors to support growth, international competitiveness and quality of life. The NIC published its final recommendations on the Cambridge – Milton Keynes – Oxford corridor study last month, and the government responded at the Budget with an ambitious strategy to maximise growth in the region. The government is investing in road and rail connections (including East-West Rail and the Expressway), recognises the need for up to one million homes by 2050, and, as a first step, has agreed a deal with Oxfordshire to deliver 100,000 homes by 2031.³² This represents an important milestone in the government’s work to integrate strategic decision-making and planning right from the project selection stage, in pursuit of its core economic and social objectives.

This new integrated approach developed by government, informed by the NIC’s expert advice, builds on progress made in recent years deploying a more structured cross-sector approach to join up project sponsors – both across central government and also between the centre and regional or local authorities – including through the work of the CLGU.

The IPA will continue to work with the CLGU, government departments and local and regional authorities, including engagement with the new Metro Mayor combined authorities, to facilitate integration of infrastructure investment decisions and planning for projects that sit across the boundaries. This will build on the IPA’s work providing support and assurance to major projects and programmes, including the Olympics, Crossrail, High Speed 2, Mersey Gateway Bridge, Thames Tideway Tunnel and others, to ensure projects are set up to deliver the agreed national, regional and local objectives.

³¹ HM Government (2017), Industrial Strategy White Paper.

³² HM Treasury (2017), Autumn Budget 2017.

Priority interventions

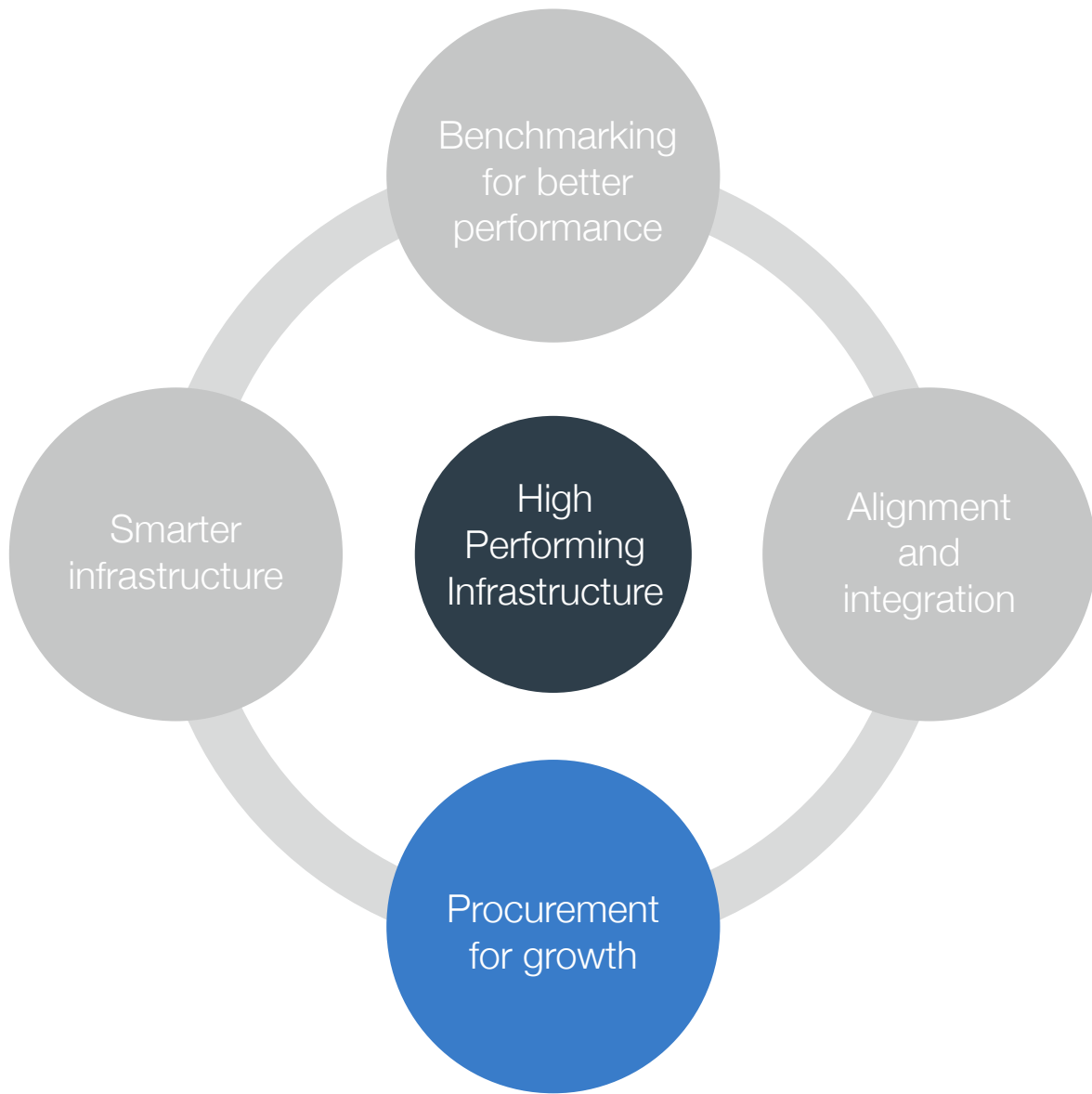
TIP will focus on 3 priority interventions in this area:

- Alignment:** seeking to ensure strong strategic and economic cases for projects from the outset. This means clear articulation and incorporation of wider government objectives to anchor the project from the outset, supported by benchmarked data. **The IPA will look to strengthen use of support and assurance, and work with HMT to ensure approval ‘gateways’ hold projects to consistently high standards by:**

 - building on the successful approach used by the Environment Agency to assess and prioritise their investment programmes, and the Department for Transport’s tools for considering regional factors in investment decisions;
 - embedding of Industrial Strategy objectives into the development of projects from the initial investment appraisal to the procurement stage of appropriate projects;
 - driving more effective implementation of existing tools and guidance, in particular the IPA Routemap. From 2018, at the initiation stage, sponsors of all major infrastructure projects will assess with the IPA whether the Routemap tools should be applied to their project or programme and report their findings through the approval and appraisal process; and
 - using its assurance processes, including post-project evaluation reports, to measure delivery of objectives, considering benefits delivered as well as project cost and schedule, against the investment baseline and feed output to the IPA’s benchmarking team.
- Integrated planning:** building on NIC recommendations, improve coordination in how major programmes are planned to support economic priorities such as productivity and housing. Cross-sector and cross-departmental groups such as the CLGU should play a key role in driving joint decision-making and effective accountability across Whitehall. **The IPA will be at the heart of government efforts to make this model work well, including through:**

 - supporting successful delivery of the Cambridge – Milton Keynes – Oxford corridor projects, and the wider development of the integrated approach being adopted for the programme, capturing the lessons learned; and
 - applying the integrated approach to other suitable regional investments such as the Midlands Engine, Thames Gateway and Northern Powerhouse to focus projects and programmes on government priorities for economic growth business productivity and housing.
- Supporting the devolution agenda:** there is a clear direction of travel towards more devolved project sponsorship and funding. **The IPA will work with regional and local government leaders, to ensure that the appraisal and assurance keeps pace with devolution, and to support joined-up and effective delivery between central and regional or local partners.**

Procurement for growth



Over the next 10 years, our ambition is to enable smarter commercial relationships that support more investment in innovation to drive long-term value for the taxpayers and for users of infrastructure as well as a thriving, world-leading infrastructure industry in the UK.

An aligned and integrated policy framework should flow into procurement and delivery to ensure selection processes and contractual incentives deliver the desired outcomes.

Sponsor and client capability must be developed to support this new strategic approach.

Procurement for growth

The challenge

Procurement is a critical phase of every project, but it is important that desired outcomes are considered, weighted and set at the beginning of the investment cycle.

As such, the key principles already articulated through the project selection, approval and initiation phases must flow through into procurement and the contractual relationship.

A number of **different contracting strategies** are used in infrastructure delivery, with many amendments to standard forms of contract, leading to bespoke commercial approaches being taken on similar projects. This can cause inefficiencies. **Traditional short-term adversarial and transactional relationships can be a disincentive to long-term investment** and encourage a focus on short-term objectives and inappropriate risk transfer. Measurement of supplier performance and approaches to sharing best practice are inconsistent across sectors and clients.

Smarter commercial relationships between clients and their suppliers help align objectives, support the delivery of improved outcomes, boost the productivity of the industry and deliver infrastructure assets that better meet the needs of society and users. Such relationships enable a deeper engagement with the supply chain, with earlier participation in the investment lifecycle where suppliers are incentivised and rewarded for finding better solutions.

There are three key features of smart commercial relationships:

- **Pre-procurement dialogue.** This opens a relationship between the client and supply chain to discuss objectives and build a mutual understanding of desired outcomes, including the benefits articulated in a project's business case. It allows clients to build understanding of capability, capacity and appetite in the supply chain, and provides suppliers with an opportunity to help shape the solution and delivery method.
- **The prequalification and procurement process.** The formal process to select a preferred supplier best able to deliver the scope and outcomes based on requirements including cost, quality and value. Greater consistency will help to reduce bureaucracy, transaction costs and encourage greater participation from SMEs.
- **The contractual relationship between clients and the supply chain.** The process of assigning risk and responsibility and establishing measurement, payment and incentive mechanisms that support the delivery of objectives.

Already there are many exemplar projects that demonstrate the benefits of a different approach. For example the alliancing approach used by Anglian Water in its @One Alliance to build long-term alignment commercial models³³ and Transport for London's Innovative Contractor Engagement model used at Bank Station to incentivise the supply chain to innovate at the procurement stage.³⁴

³³ Infrastructure Client Group and Institution of Civil Engineers (2017), From Transactions to Enterprises: a new approach to delivering high performing infrastructure.

³⁴ Ibid.

When done well, clients and suppliers can use procurement to deliver socio-economic benefits through their projects. For example, Crossrail has used its procurement processes to commit Tier 1 contractors to deliver specific targets. It has created over 700 apprenticeships across the project and enrolled over 15,000 people at the Tunnelling and Underground Construction Academy in Ilford.³⁵ More than 1,000 people who were previously unemployed have gained work on the project. They have been trained in a range of professions from construction to accountancy, quantity surveying to business administration.

There has been some progress in improving the delivery of construction projects across economic and social infrastructure. However, there is opportunity to further develop commercial models and relationships in construction and infrastructure, to unlock greater investment, innovation and productivity.

What we will do

The UK currently spends 14% of GDP on public procurement each year across goods and services, including infrastructure.³⁶ **Therefore, the IPA will ensure the government uses its influence and buying power to break the barriers to improved productivity and help the sector move to smarter commercial relationships. This can help deliver more sustainable margins for suppliers, more innovation, and better value for clients.**

To deliver this goal and to ensure that the pre-procurement dialogue, prequalification and procurement processes, and the contractual relationships support delivery of the outcomes, the IPA will work with and coordinate across current initiatives, including:

- the **Construction Leadership Council and the Construction Sector Deal** to improve procurement across the whole sector, bringing consistency and reducing bureaucracy;
- the **Institution of Civil Engineers' and Infrastructure Client Group's Project 13 programme**, which aims to promote the use of collaborative, rather than transactional, approaches to major project delivery;
- the **Department of Transport's Transport Infrastructure Efficiency Strategy**, which will identify ways in transport bodies can use their spending power to boost productivity in the supply chain; and
- the acceleration of the **Procuring for Growth Balanced Scorecard** approach to public procurement developed by the Crown Commercial Service, including supporting the goals of the Industrial Strategy.

The core principles of securing best value for money from procurement, and ensuring an open and transparent process, will be at the heart of the IPA's approach.

³⁵ Moving you Forward: The Crossrail Apprenticeship Programme. Accessed at: www.crossrail.co.uk/careers/apprenticeship-programme/

³⁶ European Commission Public Procurement webpages. Accessed at: ec.europa.eu/growth/single-market/public-procurement_en

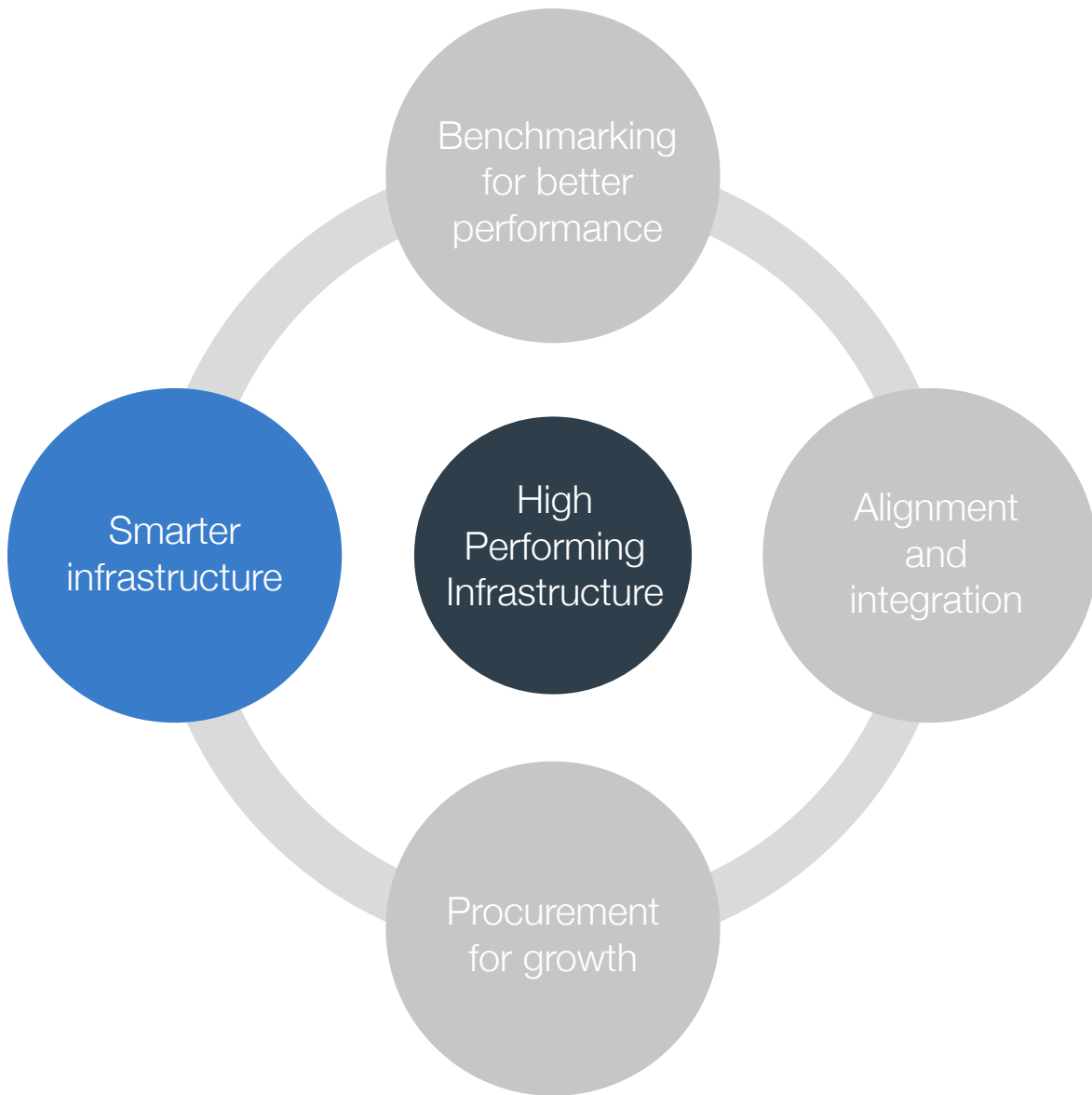
Priority interventions

TIP will focus on 5 priority interventions in this area:

- **Ensuring the government's assurance and approvals processes support a longer-term, collaborative commercial relationship:** the IPA will explore the value of extending long-term budget settlements, as have been agreed in rail, road and flood defences, to other sectors, where appropriate, to allow sponsors and clients to plan on a long-term programme basis. The IPA will also work in partnership with the private and regulated sectors to share best practice and further promote long-term commercial relationships.
- **Building client and sponsor capability:** the IPA will continue to use its client capability framework, to support government construction clients in building their commercial capability to manage and procure for whole life value. The IPA will roll out its client capability framework to government clients, and work with initiatives that target improving capability across private and regulated sector organisations. It will develop **additional procurement training for public procuring bodies, linked to the Major Projects Leadership Academy and Project Leadership Programme.**
- **Standardising and simplifying contracts:** the IPA will update the Government Construction Strategy in 2018 to promote a more joined-up approach to procurement, contracting and risk allocation, working with the Government Construction Board, the Infrastructure Client Group and the Construction Leadership Council, to reduce the unnecessarily bespoke amendments made to standard forms of contract and consider contracting approaches that support more collaborative models.
- **Improving the procurement process:** the government will **update and increase adoption of the Procuring for Growth Balanced Scorecard** for public procurement. It will also **continue to embed standard approaches to prequalification** – aligning with CLC's ambition being developed by Build UK and the Civil Engineering Contractors Association to reduce bureaucracy and costs from better use of PAS 91 prequalification guidance.³⁷
- **Driving supplier performance:** currently, clients measure the performance of their suppliers against bespoke metrics and scales, making it difficult to share performance data across clients and sectors. The IPA will pilot a system, building on the work of the Infrastructure Client Group, to measure and share best practice for the performance of suppliers.

³⁷ British Standards Institution (2013), Construction prequalification questionnaires.

Smarter infrastructure



Over the next 10 years, our ambition is to deliver smarter projects and embed technologies that improve the performance of our existing infrastructure.

Government as the single largest construction client and investor in the UK economy will play a leading role in supporting industry and asset owners to embrace technology and innovation – in both construction and operation – building the future skills and digital capabilities to transform the nation's infrastructure.

Smarter infrastructure

The challenge

Technology and innovation offer a huge opportunity to unlock productivity improvement and performance gains. They provide opportunity to deliver infrastructure faster, that is high performing on a whole life basis at the lowest whole life cost, and to boost the productivity of the construction sector.

A more widespread use of manufacturing in construction can tackle some of the major skills challenges in the construction sector. The Farmer Review warned that “based purely on existing workforce age and current levels of new entrant attraction, we could see a 20-25% decline in the available labour force within a decade.” Pressures such as EU exit, alongside government ambitions to deliver the £600 billion infrastructure pipeline and increase housing supply, exacerbate this trend.

Manufacturing provides opportunity to spread the benefits of infrastructure investment across the country, as components and assemblies can be manufactured away from the construction site, with more regions benefiting from investment in capital and in skills.

Modern methods of construction can also have significant social benefits – for example reducing the disruption to teaching in a school by manufacturing an extension offsite and assembling it over a short period of time during holidays, instead of closing down the facility while building on site for longer.

Technology and innovation have a key role to play in ensuring we get the most out of our existing infrastructure. In particular technology can play a vital role in improving our understanding and use of infrastructure – including by helping to manage demand, increase capacity and improve maintenance. Much of the infrastructure that will be in use for decades into the future is already operational today.

Pockets of new technology use and innovation already exist, but the scale and pace of change is slow in the UK and abroad. The reasons for this include a lack of investment in capital and R&D, and the lack of standardisation.

The government can be a driving force to address these challenges. Government is the largest single client for construction and infrastructure projects. Therefore, it can aggregate and stabilise demand to lead firms to invest in smart construction techniques. It can also put its projects at the forefront of innovation in construction to drive a process of standardisation as seen in the manufacturing sector.

What we will do

The government has identified three core areas in which there is opportunity to use its levers to drive the scale and pace of change through the TIP programme:

1. Smart construction, using modern methods, including offsite manufacture
2. Use of digital technology to make new and existing infrastructure ‘smarter’
3. Sharing of innovation and best practice

Smart construction

The first core area is smart construction. **Smart construction (or ‘modern methods of construction’)** offers the opportunity to transition from traditional construction to manufacturing, and unlock the benefits from standard, repeatable processes with components manufactured offsite. Further information on smart construction is set out in Box 4.

A transition from traditional construction to manufactured offsite solutions will over time require a different blend of skills across the workforce, and investment in innovation. The government announced in Autumn Budget 2017 that it would, in addition to the £170 million committed as part of the Sector Deal to support innovation, enter into a National Retraining Partnership, with the Trades Union Congress and the Confederation of British Industry, to develop the National Retraining Scheme. As a first step, the National Retraining Partnership will oversee targeted short-term action in sectors with skills shortages, initially focussing on construction and digital skills.³⁸

Box 4: Smart construction

Traditional construction methods are relatively unproductive, with projects individually designed and constructed with little consistency in either the design solution or construction method, even for similar projects. This represents a missed opportunity, particularly for buildings that could be repeatable in design.

Smart construction covers a range of techniques with greater levels of activity taking place off site and increased levels of standardisation, underpinned by digital design and engineering.

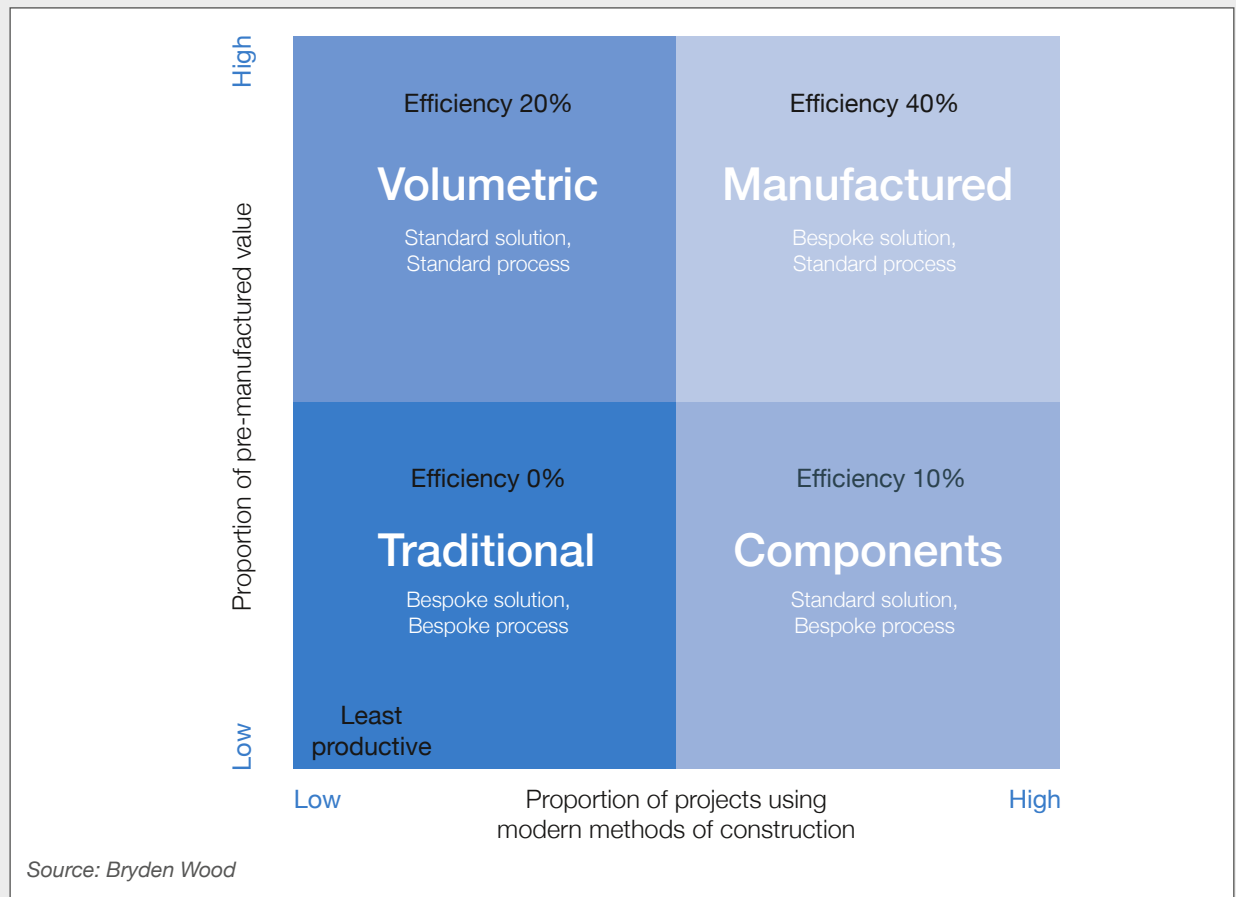
Figure 6 sets out four delivery approaches: a traditional approach and three different types of smart construction. Two of these methods, described in the figure as “**volumetric**” – for example fully fitted modules – and “**components**” – for example – standardised design elements – are already used today in some projects and offer greater efficiency than a traditional approach.

The third type of smart construction, “**manufactured**”, is not widely used, but offers the greatest opportunities to improve delivery efficiency and boost productivity. This approach enables high levels of customisation by developing and using standard components and assemblies, but follows production processes, embedding best practice from the manufacturing and automotive sectors into construction delivery. The manufactured approach reflects the ambition of the Construction Sector Deal.

These four approaches are set out in the quadrants in Figure 6, together with Bryden Wood’s assessment of relative value from different approaches.

³⁸ HM Treasury (2017), Autumn Budget 2017.

Figure 6: Smart construction



There are a number of factors that currently prevent wider uptake of a manufactured approach, limiting capacity development and the scale and pace of potential productivity benefits that could be unlocked. Together, these represent a market failure and include:

- fragmentation in the industry – both from clients and supply chain – which acts as barrier to development of standard solutions that can be deployed across sectors;
- an inaccurate perception of poor quality and poor design from “pre-fabrication”;
- a lack of long-term planning, confidence and predictable demand for products to justify investment in facilities capacity and capability; and
- the barriers posed by large upfront investment requirements in the key processes and specifications to meet product quality requirements without a common approach across sectors and projects.

The government responded to these challenges in Autumn Budget 2017 by committing to use its purchasing power to drive adoption of modern methods of construction, by creating a large and stable pipeline. Five departments – the Department for Transport, the Department of Health, the Department for Education, the Ministry of Justice, and the Ministry of Defence – will adopt a presumption in favour of offsite construction by 2019 across suitable capital programmes, where it represents best value for money. This will complement the measures to be taken as part of the Construction Sector Deal.

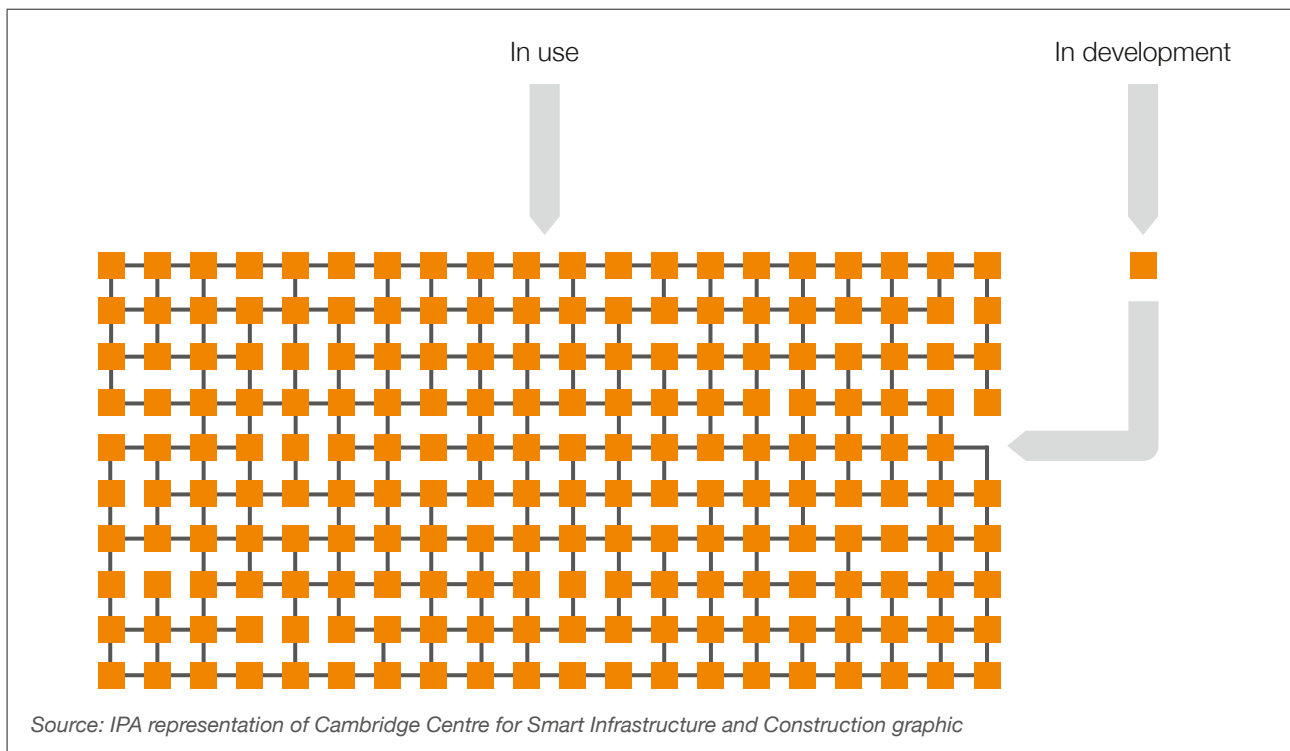
Smarter infrastructure

The second core area is **wider use of technology and innovation to extract maximum whole life value from our infrastructure at the lowest whole life cost.**

Smarter infrastructure means targeting more value for every pound invested, maximising the availability and infrastructure services extracted from assets, and reducing cost and carbon across the whole life of the assets. It also means building on the UK’s position at the vanguard of built environment and digital economies, supporting domestic and international growth. This means improving the delivery of new infrastructure so that it can capture the benefits of new and emerging technologies over its operational life, unlocking performance benefits, and so that it can provide performance data to inform better understanding of our assets and networks, including through digital technologies.

The drive to deliver smarter infrastructure applies both to new projects and existing infrastructure. Getting the most out of our existing assets, networks and systems means improving, for example, availability, capacity and resilience; while reducing congestion, carbon intensity, emissions and running costs, and the need for new build. It is estimated that the addition of new assets adds less than 0.5% each year to the value of existing infrastructure, as represented in Figure 7.³⁹ **Improving the performance of existing assets is important if we are to make a material impact on our networks and systems in the coming years and decades.**

Figure 7: Infrastructure in use and development



Harnessing digital technology to support smart infrastructure

Digital technologies have enormous potential to transform the economy: a recent study found digital technologies including AI created a net total of 80,000 new jobs annually across a population similar to the UK. By one estimate, AI could add £232 billion to the UK economy

³⁹ Smart Infrastructure: Getting more from strategic assets, Cambridge Centre for Smart Infrastructure and Construction, 2017.

by 2030.⁴⁰ At Autumn Budget 2017, the government set out a number of measures, including investment in AI and further investment from the NPIF in new 5G infrastructure, as noted above.

The UK's digital infrastructure will support adoption and use of new technologies that support smart infrastructure. Technology can improve the performance of infrastructure in many ways and there are numerous examples of it being deployed and rolled out across infrastructure networks to deliver benefits. For example:

- **Increasing capacity, reducing congestion:** the **smart motorways programme** is a technology-driven approach to increase capacity and relieve congestion, through enabling traffic to use the hard shoulder, monitoring congestion levels and adjusting the speed limit when needed to smooth traffic flow. Highways England's analysis since the first smart motorway scheme opened in 2006 suggests that journey reliability improved by 22%, personal injury accidents reduced by half and, where accidents did occur, severity was much lower overall, savings lives.⁴¹
- **Collection and use of data to improve maintenance efficiency and optimise asset life:** for example, the Cambridge Centre for Smart Infrastructure and Construction is working with the Staffordshire Alliance to deploy fibre optic sensors on two railway bridges.⁴² Among other benefits, clients will be able to compare data captured from instrumentation to track the performance of an asset over its entire life, and make maintenance decisions based on real performance data. Data captured on the real-world performance of the assets will also feedback into improved future designs.

Looking forward, the NIC through its National Infrastructure Assessment and specific study into new technologies, is exploring what impact technologies can have in meeting demand for infrastructure, and what enablers are needed to support deployment at scale to get the most out of our existing infrastructure.

As part of this work, the NIC is exploring how digital data and technology can be harnessed to improve the way we maintain and extract maximum performance from infrastructure. Looking to the longer-term, this includes consideration of how we can unlock the potential of transformative technologies such as the Internet of Things, machine learning and AI.

Digital Built Britain

The success of the government's 2011 programme to embed Building Information Modelling (BIM) into centrally procured government construction projects has enabled the development of the next stage of digital technologies into the delivery and operation of infrastructure – Digital Built Britain.

The Digital Built Britain programme is now formalised as a government partnership vehicle at the 'Centre for Digital Built Britain' at the University of Cambridge,⁴³ with access to world class academic research into sensor technologies and AI, providing an opportunity to scale investment in collaboration with private sector organisations.

⁴⁰ HM Government (2017), Industrial Strategy White Paper.

⁴¹ Highways England, Smart motorways programme webpage. Accessed at: www.highways.gov.uk/smart-motorways-programme/

⁴² Cambridge Centre for Smart Infrastructure and Construction, Monitoring and modelling of dynamic strain of railway bridges using fibre optic sensor networks and BIM. Accessed at: www-smartinfrasturcture.eng.cam.ac.uk/what-we-do-and-why/projects-and-deployments

⁴³ Centre for Digital Built Britain. Accessed at: www.cdabb.cam.ac.uk

The Digital Built Britain programme will be a key part of the government's plan to continue developing our digital data capabilities, including towards a 'digital twin',⁴⁴ machine learning and AI. The outputs of a comprehensive information management landscape for the built environment and a digital twin of the real world estate will help inform government decisions on what to build, where and how, to maximise whole life performance and benefits. In addition it will guide in the maintenance, refurbishment, and replacement or disposal of our existing assets.

Through the TIP programme, the IPA will continue to work across government, and with regulators, clients and asset owners and operators, to support and champion initiatives for promoting uptake of digital technology that can help unlock the benefits of smart infrastructure for new and existing assets. This includes supporting the Digital Built Britain programme, as part of the wider development of capabilities (with due regard to security considerations) for capturing, communicating and making best use of digital data.

Supporting innovation and sharing best practice

The third core area is innovation and sharing best practice. There are many individual examples of innovation being used and developed, and good practice shared to improve delivery of projects and performance of infrastructure.

For example, in 2012 Crossrail established *Innovate18* to capture, develop and implement innovative ideas from their programme partners. The techniques, products and methods used on Crossrail are now providing a benchmark for other construction projects through the establishment of the **Infrastructure Industry Innovation Platform** (i3P). Launched in October 2016, i3P is an independent innovation community governed by representatives from its member organisations. Membership is open to clients (currently major infrastructure projects and construction programmes) and their supply chains across the infrastructure industry. The **IPA will formally join i3P** to support faster uptake of innovation and best practice across government.

⁴⁴ There are a number of definitions in use. For the purposes of this document, a digital twin is defined as “a computerised version of a physical asset. It carries the characteristics of the physical asset in production and service – having the capacity to dynamically exchange information as data through technology such as sensors with its real world surroundings to inform location, simulations, usage, reliability and efficiency of performance.”

Priority interventions

TIP will focus on 4 priority interventions in this area:

- **Support smart construction (demand side):** use the government's purchasing power to build critical mass in sectors amenable to modern methods, starting with the five departments that will adopt a presumption in favour of offsite construction by 2019. The IPA will work with departments and industry bodies such as the CLC to implement this, including identifying and addressing obstacles to faster uptake. Over the course of the TIP programme, the IPA will also explore opportunities to support uptake in other high potential sectors such as housing, as supply capacity and capability matures.
- **Support smart construction (supply side):** the government has committed to invest £170 million to support innovation in the sector, including to develop and commercialise digital and offsite manufacturing technologies through the Construction Sector Deal. Through TIP, the IPA will work across government and with industry to support final agreement of the Sector Deal, to ensure effective delivery of the key enablers to modernising construction, and to identify and help address workforce capacity or capability gaps.
- **Drive faster uptake of digital technology:** support coordination of cross-government and cross-sectoral uptake of technology solutions, to improve the way we design and make best use of our infrastructure, building on upcoming NIC analysis and recommendations. As part of the TIP programme, there are a number of strands where the IPA will support government efforts to help ensure:
 - infrastructure projects (for new assets or renovations) are planned from the initiation stages to be 'smart' – for example designed to use digital technology to maximise whole life asset value (such as through energy efficient design and management), or to capture data that can be communicated and analysed to optimise wider networks and decision-making;
 - continued development of the Digital Built Britain programme, working across government and with relevant stakeholders, and identification of opportunities where government levers can help drive progress (for example building on the BIM Level 2 mandatory requirement for central government procurement); and
 - relevant NIC recommendations from its National Infrastructure Assessment and study into new technologies are taken forward, helping to ensure coordination across government and, as appropriate, with regulators, sponsors, clients and asset owners.
- **Catalyse and disseminate innovation and best practice:** the IPA will formally join i3P to support faster uptake of innovation and best practice, and to provide a coordinating role across government.

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