

# Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes

## Executive Summary

Major infrastructure projects and programmes suffer from a tendency to cost more or take longer than initial estimates outline. The reasons for this are complex. Projects are themselves complicated undertakings, spanning a development time of years or decades, with unique requirements, bringing together multiple stakeholders and a disparate workforce that spans the entire supply chain.

The nature of major projects and programmes means that their estimation of cost and schedule often carries limited accuracy. The uncertainties prevalent in such large activities and an inability to predict the future, be that changing economic or political circumstances, the availability of materials or labour, or the realities of the location, all work against achieving certainty.

Estimation takes place against the backdrop of cost envelopes, risk allocation, and probability calculations. As such, there will always be things which cannot be foreseen or do not go as planned. The challenge of squaring realistic estimates with a procurement process that may favour those who bid the least only adds to the problem.

Scrutiny is too often focused on lowest capital cost whilst the whole life benefit of a project is often discarded. A sentiment which, perhaps surprisingly, is not shared by the British public. Indeed, YouGov polling conducted for ICE shows that only 3% of the public view a low overall cost of construction as the most important factor in determining the success of major infrastructure projects. Meanwhile 74% agree that politicians should talk more about the benefits, rather than the costs, of major infrastructure projects.<sup>1</sup>

None of this is to say that steps cannot be taken to reduce the gap between estimates and outturn. Many in the sector are taking steps to move away from a transactional arrangement to an enterprise model, with seven early adopters forming part of the Infrastructure Client Group's Project 13.<sup>2</sup> More collaborative working, better governance, data-led frameworks and sharing of best practice could all support improvements in project delivery.

<sup>1</sup> YouGov (2019) Total sample size was 2075 adults. Fieldwork was undertaken between 12th - 15th April 2019. The survey was carried out online. The figures have been weighted and are representative of all GB adults (aged 18+). Full question "Thinking specifically about the construction process of major infrastructure projects (e.g. bridges, tunnels, airports etc.) ... To what extent do you agree or disagree with each of the following statements? (Please select one option on each row) Politicians should talk to the public more about the benefits of major infrastructure projects rather than the costs:"

<sup>2</sup> ICG and ICE (2019) [Project 13](#)

## Problem Statements and Recommendations

ICE is making four recommendations for the Government, infrastructure owners and project teams to create healthier expectations and attitudes toward project management, whilst encouraging a narrative shift away from cost only procurement and success metrics. In addition, these recommendations are targeted at instilling collaborative working and adoption of best practice to ensure better outcomes for infrastructure users and the public more widely.

We have set problem statements against each recommendation to clarify what we believe needs to be addressed, and how.

### Scoping projects

- Scope change, scope creep or incomplete designs often occur once work has commenced.
- Too often designers, risk adjusters and contractors work separately or are not brought together at an early stage.
- **Recommendation:** Infrastructure owners should complete scope, design and exploration before commencement of work is allowed, to avoid scope creep or retroactive changes, taking steps to include contractors in design at an early stage.

### Judging success

- Government over relies on cost (and to some extent time) to determine project success and frequently reduces contingency to 'save' money – limiting room for manoeuvre if new information comes to light, or if economic conditions change.
- Scrutiny of projects often focuses on the process of completion against arbitrary budgets and not the wider benefits infrastructure can deliver in the long-term.
- **Recommendation:** The Government and infrastructure owners must move away from capital cost as the most important metric when assessing project benefits, recognising the importance of whole-life economic, social and environmental value.

### Estimating and tenders

- Estimates are often set at a fixed price point, before full project or programme scope and complexity are known
- Tenders are approved based on these early estimates and contracts allocated, potentially years before scope and complexity is understood.
- **Recommendation:** Principles set out in the Outsourcing Playbook should be mandatory for Government infrastructure owners, this includes infrastructure owners undertaking should-cost modelling to help inform their expectations and knowledge of appropriate tender prices during the procurement process.
- **Recommendation:** It should be mandatory for all public infrastructure owners undertaking procurement to award contracts based on a cost estimate range, using a should-cost estimate as a reference point, with an amount of contingency allocated appropriate to the level of project maturity.

## The limitations of estimating major infrastructure projects

Initial estimates which do not match final outturn is not an issue restricted just to the United Kingdom; nine out of ten projects with a value of over \$1bn go over budget or over deadline around the world.<sup>3</sup> Deadline overruns and budgetary inflation are frustrating for clients and contractors alike, even if they are not entirely avoidable: major projects are subject to numerous variables and pressures, are enormously complicated and take years – if not decades – to complete.

Unfortunately, projects in all sectors of the built environment sector, have no consistency in management styles. There are differing approaches to compliance and contingency which are affected by the complexity of projects and the inadequacy of estimates. The problem is structural and difficult, certainly in the short term with current processes in place, to address.

An estimate is only good until it makes contact with a commenced project or programme. Expecting an initial forecast to stand the test of such wide-ranging variables is simply not realistic. However, steps can be taken to better align expected and final outcomes by understanding that the evolution of design and re-forecasting improves as the project is better understood. Fostering better understanding and management of processes and adopting more inclusive measurement metrics, beyond just cost value, will help to reveal the true value of an infrastructure project and improve a project teams ability to manage change events as they happen.

Efforts are underway to address these issues around the world and the sector is not accepting of this situation. By way of example, between 1997 and 2005 the US Government Accountability Office highlighted that there was a lack of useful project cost estimates. US federal and state agencies have since adopted a method of standardising approaches to risk management, with guidance to aid in the development of reliable cost estimates. A standardised approach to estimating costs, providing federal oversight and setting of minimum standards has since been established to ensure greater consistency of approach and allow cross analysis of estimates through regular cost estimate reviews.<sup>4</sup> This is not dissimilar to work being undertaken by the Infrastructure and Projects Authority (IPA) on benchmarking which may result in a similar outcome.<sup>5</sup>

The UK is not an outlier compared to the rest of the world; as Bent Flyvbjerg noted in evidence to the Public Administration and Constitutional Affairs Committee inquiry into the Governments management of major projects, “the UK is just as good or just as bad as other countries however you wish to formulate it.”<sup>6</sup> This paper will examine the reasons why issues occur, why we need to consider changing how we measure success and what can be done to better manage projects.

## The overreliance on early estimates and the procurement process

Deciding final budgets or tendering at an early stage of the process before design, exploration or scoping is complete represents an industry wide obsession with price driven metrics and, when it occurs, a fundamental lack of understanding of the nature of major projects and their true cost.

Perhaps the greatest challenge is a reliance on early estimates, before much of the design work has been completed. Using this to inform bid prices and the expectation these estimates are deliverable, is in part driven by the temptation to pursue lowest price tendering – or an over-emphasis on cost over value or quality.

This has driven the sector to bid unrealistically in order to win work. There is a fear of losing out, or scaring away finance or clients, if the true costs, an estimate range, or full risk contingencies, are presented too early. This is a longstanding concern, with a 2011 study describing lowest price tendering as encouraging “contractors to price work at unrealistically low levels.”<sup>7</sup>

Encouragingly the Government has made efforts to understand the client-side role, with a recent Cabinet Office based Government Commercial Function review making admission that “Encouraging the market to compete on price alone can create false economies and

<sup>3</sup> Bent Flyvbjerg (2014) [What you should know about megaprojects, and why: An Overview](#)

<sup>4</sup> WSP (2018) [Risk Management of Infrastructure Projects in the Development of Capital Cost Estimates](#)

<sup>5</sup> IPA (2019) [Best Practice in Benchmarking](#)

<sup>6</sup> Public Administration and Constitutional Affairs Committee (2018) [The Government's Management of Major Projects .HC 1631](#)

<sup>7</sup> Constructing Excellence in the Built Environment (2011) [The business case for lowest price tendering?](#)

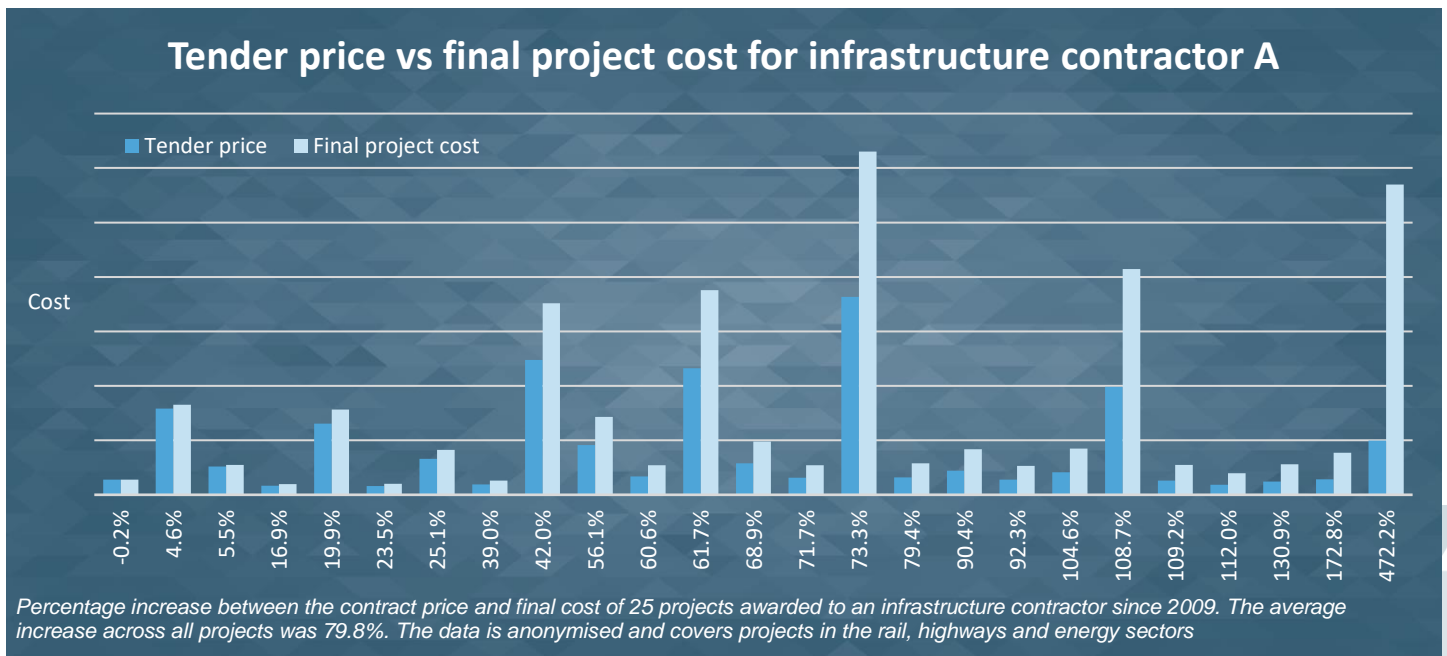
unhealthy markets and should be avoided” and that “on occasions there has been a bias towards low cost bids.”<sup>8</sup> To illustrate this point, clients often tender on the basis of a split between cost and technical attributes which would have the potential to support a technical-led acquisition. The reality is quite different as, in practice, technical ability is a near constant between any two bidders. This gives cost a disproportionate role in any award which is often decisive, as, if two contractors score broadly the same on a quality metric, cost will be the differential.

Perhaps more tellingly, however, this has also encouraged a fallacy loop whereby clients believe early estimates are deliverable, despite all evidence to the contrary, driving a fixation on a single price point when a range, taking into account inaccuracy and risk, would be more appropriate at the early stages of a project. This tendency has undermined the reliability of estimates for later work based on these bids – a paper analysing 258 transportation infrastructure projects found “overwhelming statistical significance that the cost estimates used to decide whether important infrastructure should be built are highly and systematically misleading.”<sup>9</sup>

When tender prices are treated as final costs by clients long before a project reaches adequate maturity where scoping, design or discovery is at an advanced stage a lack of expertise about the nature of infrastructure projects is revealed. As projects mature, estimates improve in accuracy, simply because more is known about the location and what factors need to be taken into consideration. Whilst the current IPA guidance rightly highlights this,<sup>10</sup> this advice seems to be disregarded on most projects. Recognition of how a project evolves, and estimates change as knowledge about a project improves, must become standard across the sector with budget processes which reflect this.

Below is a graph with figures provided by an infrastructure contractor of the differential between 25 projects awarded to that contractor between 2009 and 2018. The average increase between the tender price and project cost was 79.8% with only one project in that timescale being delivered within the original tender price. It is important to stress that when costs increase this is emphatically not a question of the sector seeking profit, indeed pre-tax margins in construction have fallen from just under 3% in 2013 to an average of -0.9% in 2018.<sup>11</sup> However, it is a consequence of the interplay between risk, cost and time, where a change in one of these factors will impact negatively on the other two.

The sector faces a twin market failure; unforeseeable cost increases driven by external and project risk and low margins enforced not by high confidence to deliver at low cost, but by a fear of not gaining a contract which stifles innovation, skills and sustainability.



<sup>8</sup> Government Commercial Function (2019) [The Outsourcing Playbook](#)

<sup>9</sup> Bent Flyvbjerg, Mette Skamris Holm, and Søren Buhl, (2002) [Underestimating Costs in Public Works Projects: Error or Lie?](#)

<sup>10</sup> Gov.UK (2015) [Early financial cost estimates of infrastructure programmes and projects and the treatment of uncertainty and risk](#)

<sup>11</sup> ICE (2018) [Improving approaches to risk in the built environment sector](#)

## The challenge of estimating for unknown or unpredictable factors

Early estimates are inherently challenging, due to the nature, scale and complexity of major projects and programmes. A lack of data from incomplete design, scoping and investigation and the nature of working in an established built environment all add to this challenge.

Major projects are intrinsically large scale, complicated and lengthy endeavours which are often one-off assets or bespoke by nature. They represent the labour of hundreds or thousands of individuals from multiple organisations, many of whom will not be core to the project management team. Others are drawn in through the supply chain because of a specialism, pulling together to build an infrastructure asset which faces unique challenges. Making accurate forecasts around cost and scheduling is therefore difficult.

Thames Tideway, for instance, directly employs 400 highly skilled staff working for the core project alongside four main delivery partners with their own staff and supply chains.<sup>12</sup> Work began in 2015 and is due to complete in 2024<sup>13</sup> digging a 25km long tunnel directly under the River Thames built through 24 deep well construction sites.<sup>14</sup> which also interacts with London's existing Victorian sewer network. This is not a light undertaking with exposure to significant and costly risk an ever-present concern.

These challenges are diverse. They might include weather and climate, location or geology, available material or placement. A tunnel dug through clay will have significant needed differences in approach, material and expertise than a tunnel dug through granite and prospecting surveys which indicate one ground type may prove inaccurate once digging begins. An IPA benchmarking study on tunnels found that everything from tunnel length, to width, ground conditions, tunnelling method, length and access arrangements varied on the type of tunnel or project lead for all of the 169 tunnels they studied.<sup>15</sup> This is not unexpected – an individual project will meet the individual needs it seeks to address.

This is a concept which needs to be at the forefront of efforts aimed at improving the reliability of estimates. Whilst efforts can be made, it is impossible to predict every issue over a decade long project, during which immeasurable numbers of decisions and events may occur which could have a positive or negative impact on project costs or schedule. It is worth noting that even if things go ahead of schedule this can be problematic if this forces project managers to reassess the project plan or scope.

## Time as a multiplier of risk and cost

Change events which affect budget or schedule are likely to happen – and are more likely to happen the longer a project is active. Given enough time, a risk factor is more likely to occur the longer that risk factor exists. Whilst time is a factor, however, the attitude toward managing the risk of occurrence can make a fundamental difference to how much of an impact that change event might have on a project.

The most dangerous phase for a project might come as multiple change events and push factors converge to cause a cascading event. For instance, a failure to procure rolling stock for a rail project in time leads to a delay in testing, which means that a fault is detected late, which requires remedial work, which impacts on the schedule for another section of the project. This cascade can lead to significant impacts on cost and time, which accelerates cost severely.

What is often missing is an interventionist risk management culture. Risk is too often recorded but not addressed, with an attitude in much of the sector which allows identified risk to not be proactively assessed to ensure that the appropriate mitigation has taken place. Working collaboratively, as part of an enterprise as encouraged by the Infrastructure Client Group's Project 13<sup>16</sup> and placing risk management at the appropriate level – rather than passing this on from client to contractor, or down the supply chain – would help to ensure change events driven by known risks occur less frequently as time advances.

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<sup>12</sup> Tideway (2019) [About us](#)

<sup>13</sup> Ibid

<sup>14</sup> Tideway (2019) [The Tunnel](#)

<sup>15</sup> Infrastructure and Projects Authority (2018) [Case Study: Benchmarking tunnelling costs and production rates in the UK](#)

<sup>16</sup> ICG and ICE (2019) [Project 13](#)

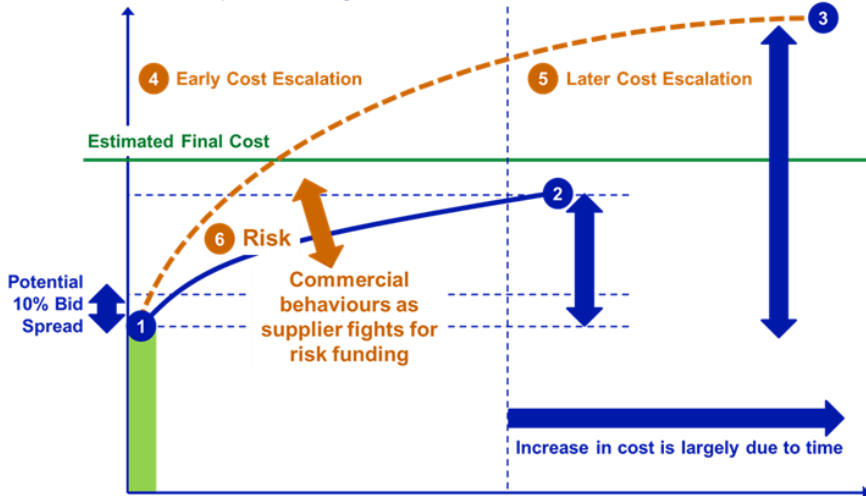
## Forecast and outturn at contract level

There are a number of well-known and identified reasons why a project schedule or budget might slip, and which need to be managed, once a contract is awarded. These break down into external and project delivery challenges.

Some of the factors which increase cost at a contract level are external to a project, of which the two most prevalent are the economic climate and how a project exists within political structures that may change during the course of its lifetime. Others can be managed within a project and should be considered delivery challenges for the owner and project team. These include management of optimism bias, leadership capability, communication and scoping and management of risk, including provision for contingency.

Many of these push factors occur once a project is underway. Something which can affect early changes to scope and impact budgets is access to land. In the energy sector it is often the case, especially for energy pylon corridors, that access to land over the whole route (often tens or hundreds of miles) is impossible, either due to rules around trespass or the need to consult before project initiation, which can mean that surveying work is only carried out after a project is greenlit.

Illustrative example of average cost escalation



- ❶ Despite infrastructure procurement typically seeking to evaluate on 60/40 (technical / price), the winning bidder is typically not always offering the greatest technical rating. This is a function of the evaluation model's sensitivity to price.
- ❷ Despite bid price being the key influence on the decision, there are contract price increases from bid to outturn - the average from a sample of projects from Transport for London cited by this study revealed a 46% increase. This demonstrates that price risk is not being transferred through the contract and that bid price has little relevance to final price.
- ❸ Recent major infrastructure programmes can see regular contract level price increases amplifying this observation – a sample of projects from a major contractor cited in this study amounted to a 155% average increase. These contract level increases are not typically visible to stakeholders who review programmes at budget level.
- ❹ Poor asset information, the impact of stakeholder and consent issues, poorly defined owner requirements and inadequate design result in early manifestation of impact, the full extent of which subsequently emerges over time.
- ❺ Poor systems integration, poor integration management, poor contract management and governance result in late stage impacts to time and consequently cost.
- ❻ Substantial risk allowances often enable programmes to maintain budget stability, but drive commercially aggressive behaviours at contract level as suppliers pursue the target inflation they need to survive. The environment created by such behaviours prevents focus on optimising the client's outcomes.

Chart and explanatory text demonstrating average cost escalation percentages for Transport for London capacity scheme and the reasons for this once contract level events take place<sup>17</sup>

Similarly, work in an urban environment which interacts with existing infrastructure or subterranean legacy or archaeological assets, is difficult to estimate costs for. Where there is an existing road in active use, for instance, the true outturn cost is only realisable after that use is suspended and access to the site is available.

Whenever new demands are made after a contract is agreed and underway the result is almost always additional cost and delay. What might seem to be a change which meets short-term objectives, saves money or meets new key performance indicators – scope creep – or is implemented because scope or design was incomplete before commencement can have a profound impact down the line. Agreeing project scope, culture and design before commencement of work would help to reduce change events which push budget and schedule. In a similar way, clients should put a contract to tender at an appropriate time, either accepting higher costs at an earlier stage, where a contractor can assist with, or be involved in, design, or procuring later once more is known.

<sup>17</sup> Transport for London 2019

One project which has successfully sought to minimise contract level cost increases is Istanbul Grand Airport (IGA), which has used a Building Information Management (BIM)–led approach to design and aid implementation of that project. Dr Ozan Köseoglu, Director of BIM for IGA, has stated that a BIM-led approach has allowed for a collaborative environment with subcontractors, who have been integrated into BIM processes. This has been achieved through training, design and the use of mobile tablets and IT on site which has equipped those building the asset with the necessary skills and minute-to-minute knowledge to implement the design as it is updated. This has helped to ‘eliminate’ unforeseen cost overruns by reducing waste on site.<sup>18</sup> In general terms, whilst there are perceived political and procurement pressures to focus primarily on cost, a cost centric outlook does not meet the realities of building complicated largescale projects or the potential desired outcomes.

***Recommendation:** Infrastructure owners should complete scope, design and exploration before commencement of work is allowed, to avoid scope creep or retroactive changes, taking steps to include contractors in design at an early stage.*

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<sup>18</sup> Interview with Dr Ozan Köseoglu in BIMireland.ie (2017) [Using BIM on Istanbul Grand Airport](#)

## Reasons why forecasts and outturn misalign

There are a number of well-established challenges which are risk factors for infrastructure budgets and schedules. These could be external factors or project delivery challenges. These need to be managed, responded to or mitigated in order to minimise project cost or time extensions.

### External factors

#### Political considerations

All major projects can be impacted by political considerations, from the possibility of the need for ministerial planning permission, being owned and financed through departments or weathering changing governments, policies and priorities which might bring new pressures.

#### Economic climate

Economics can affect everything from the availability of finance and labour to increasing costs due to inflation. The IMF found that the 2008 financial crisis impacted on the availability of private capital with more projects facing cancellation or significantly higher financing costs.<sup>19</sup>

#### The public are willing to forgive, if projects exceed estimates

*In which, if any, of the following situations do you think it would be acceptable for major infrastructure projects to cost more than they were originally expected to?*

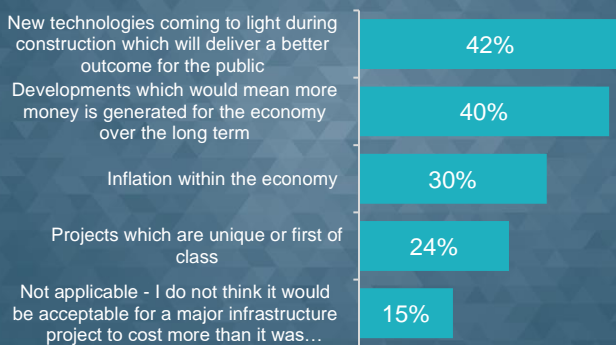


Chart - YouGov (2019) Total sample size was 2075 adults. Fieldwork was undertaken between 12th - 15th April 2019. The survey was carried out online. The figures have been weighted and are representative of all GB adults (aged 18+). Full question "In which, if any, of the following situations do you think it would be acceptable for major infrastructure projects to cost more than they were originally expected to? (Please select all that apply. If you do not think it would be acceptable for a major infrastructure project to cost more than it was originally expected to in any situation, please select the 'Not applicable' option

## Project delivery challenges

### Optimism bias and benchmarking

Optimism bias is the tendency for individuals to believe the best-case outcome for any given project. The Green Book supplementary guidance<sup>20</sup> sets out recommended adjustment ranges for different types of works at various stages of completion.

**155%\***

\*The average cost overrun of 5 major projects covering rail and energy provided to us by a major infrastructure contractor

### Leadership ability and leader personality

The personality and skills of any leader in a project can dramatically impact performance and care must be taken not to place individuals without experience or an appropriate skillset in senior roles.

### Communication and relationships

Poor relationships, poor co-ordination of design and specification and late updates or revisions are major reasons why project co-ordination and communications break down and change events happen.<sup>21</sup>

### Poor management of project risk

A failure to work more collaboratively, as part of an enterprise as encouraged by the Infrastructure Client Group's Project 13<sup>22</sup> can lead to risk being pushed down the supply chain or managed poorly by those least able to manage it.

### Inadequate scoping

Difficulties caused by an inadequate initial scope, or changes post project commencement, can be costly. These are common drivers of additional cost and delay as found by TfL in a study of its Major Stations Programme<sup>23</sup>

### Procurement

Lowest cost driven procurement can cause enormous problems from project inception, ensuring bidders compete on price to the point that they knowingly put in unrealistic bids and estimates, for fear of losing work. This is compounded by an industry where cash flow, and low margins, are a perpetual issue.

<sup>19</sup> IMF Working Paper (2009) [The effects of the financial crisis on Public-Private Partnerships](#)

<sup>20</sup> The Green Book (2018) [Supplementary Green Book Guidance](#)

<sup>21</sup> Nicholas Chileshe (2011) [Effectiveness of Communication between Contractors and Sub-contractors: Practices, Barriers and Enablers](#)

<sup>22</sup> ICG and ICE (2019) [Project 13](#)

<sup>23</sup> TfL (2019) MPD Major Stations Programme



## What does a good outcome look like?

Broadly, the nature of major projects means that what might be considered good for other types of procurement cannot reasonably be considered possible for major projects. Two issues need to be considered as to how a reasonable measure can be made and then delivered. 1) There is a need to redefine what is a ‘good’ outcome beyond a narrow measure of whether a project meets its initial estimate. 2) There is a further need for the sector to commit to improve processes in a way which can provide better estimates and more realistic expectations based on analysis of past performance, shared widely and over time.

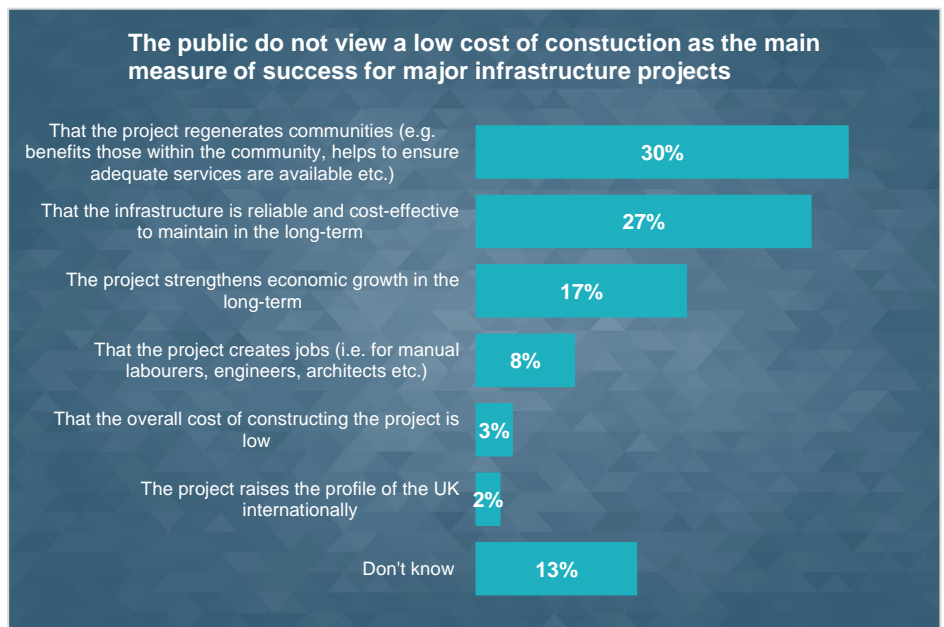
### Going beyond cost metrics

A project is considered to have failed by key stakeholders if there is an overrun or a project goes over budget; the degree of severity is perceived through a lens of reasonableness of the delay or cost increase. This is at turns both a reasonable human response and unreasonable for the major projects in question.

Crossrail’s delay is expected to have an outturn around £3bn over estimated project cost, with a total funding envelope of some £17.6bn and an additional cost for trains and depots of £1.1bn.<sup>24</sup> This is a change from an initial budget of £15.9bn reduced to £14.8bn after some contingency funding was removed following a comprehensive spending review in 2011.<sup>25</sup>

This is a cost overrun of between 10.7% and 26.3%, depending on which figures are used. The lowest figure takes the initial estimate and the new funding envelope without cost for rolling stock and depots and the highest takes the updated estimate with rolling stock and depots included.

A fixation on project cost by decision makers, as a measure of success, is not shared by the British public. When asked whether “politicians should talk to the public more about the benefits of major infrastructure projects rather than the costs”, 74% of GB adults agreed with this statement.<sup>26</sup> The same survey found that the public were much more concerned with whether the project regenerates communities (30%), is reliable and cost-effective to maintain in the long-term (27%) and strengthens growth (17%) than that the overall cost of constructing the project is low (3%).<sup>27</sup>



*From the following, which ONE, if any, of the following do you think is the MOST important when it comes to deciding the success of a major infrastructure project in the UK? (Please select the option that best applies): YouGov 2019 Base: All GB Adults (2075)*

<sup>24</sup> London Assembly (2019) [Derailed: Getting Crossrail back on track](#)

<sup>25</sup> Crossrail (2019) [Funding](#)

<sup>26</sup> YouGov, on behalf of ICE, 2019

<sup>27</sup> Ibid

## Whole life benefit

The Government and Greater London Authority are right to be concerned that problems on what was an on-target project manifested so close to completion and valid criticisms can be made about Crossrail’s governance; the National Audit Office issued a memorandum noting that “reporting within, and by, Crossrail Ltd was neither timely, nor sufficiently clear, as to the impacts and magnitude of the range of probable consequences of issues within the programme” and a “much-reduced level of internal scrutiny during 2017–18 and 2018–19 as the Crossrail Board continued with its plans to reduce central resources.”<sup>28</sup>

Whilst steps should be taken to improve management at Crossrail and in the sector more generally, those issues should also be set against the wider benefits Crossrail will likely bring to London and the wider economy. The business case estimated an addition of £42bn to the economy, far exceeding the cost of the project, including its overrun.<sup>29</sup>

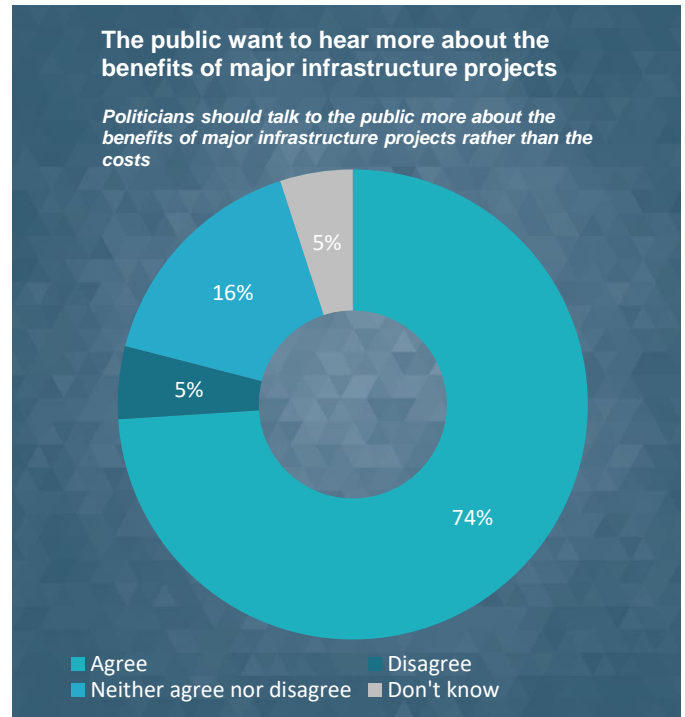
Placing additional emphasis on matters other than outturn cost or deadline, to give greater consideration to the benefits, is necessary. On most metrics, major projects will meet their goals in terms of their initial business case. The necessities the project set out to meet will be met; capacity will be increased, journeys will be faster, there will be substantial economic, social and environmental benefits to be secured.

An emphasis on not only whole life cost but whole life benefit, should be made. Getting the project right when built – even if this has a significant additional upfront cost – will very likely be less expensive when consideration is made of the fact that the asset will last potentially hundreds of years and that remedial works will cost more later down the line, in both monetary and opportunity cost terms, if not addressed during construction.

In the long run, projects which meet the needs of the people it is designed and built to serve will have a positive impact on the communities where it is built. The tendency to fixate on the upfront cost of large projects, perhaps because the numbers can be extraordinary, and to strip projects of contingency in the hope for cost savings undermines this long-term return. Whilst contingency risk should be adjusted as projects mature and there should be a bias against over-providing for contingency, recognising that any capital being reserved is not economically productive, stripping a project of funds solely as a political calculation because of identified, but unrealised, cost savings is short-sighted.

In general terms, whilst there are perceived political and procurement pressures to focus on cost, these do not meet the realities of building complicated largescale projects, the best practice inherent in reviewing costs, benefits, scope and design as a project matures or the public’s expectation of what infrastructure should achieve. Instead of focusing solely on cost, a good outcome is a project which is well managed, transparent and meets the wider social and economic benefit metrics which justify its need.

*Recommendation: The Government and infrastructure owners must move away from capital cost as the most important metric when assessing project benefits, recognising the importance of whole-life economic, social and environmental value.*



*Politicians should talk to the public more about the benefits of major infrastructure projects rather than the costs: YouGov 2019 Base: all GB adults (2075)*

<sup>28</sup> National Audit Office (2019) [A memorandum on the Crossrail Programme](#)

<sup>29</sup> Crossrail (2011) [Crossrail Business Case Update: Summary Report, July 2011](#)

## The Olympic and Paralympic Games and Crossrail: Comparing estimates, overrun and social value

The infrastructure which enabled the London 2012 games is considered a crowning success. A Comres poll for the BBC a year after the event found that “two-thirds of the UK public believe that the £8.77bn cost of the London 2012 Olympics was worth the money, with 74% saying they would welcome the Games back.”

The Games cost more than three times the original budget, an increase of 269%. Whilst the budget was recalculated in 2007 once the project was more mature and the final outturn came in on budget, the evolution of the budget and the political and public acceptance of this overspend, compares starkly with attitudes to economic infrastructure like Crossrail.

With an initial estimate of £15.9bn, revised down three years later to remove just over a billion pounds worth of contingency funding following the Coalition Government’s comprehensive spending review. The project has suffered a cost overrun of up to 26.3%.

Whilst the opportunity cost of late opening – and lost fares – must factor, both projects have or will provide boosts to the economy (£9.9bn for the Olympics and £42bn for Crossrail) and will provide social value long beyond their completion dates.

Case Study Statistics <sup>30</sup>	2012 Olympic and Paralympic Games	Crossrail
Initial estimate	£2.375bn (2005)	£15.9bn (2007) £14.8bn (2010)
Outturn	£8.77bn (2012)	£17.6bn (as of April 2019) with additional £1.1bn for rolling stock and depots.
Percentage increase	269.3%	10.7 and 26.3%

<sup>30</sup> Figures for table and case study are drawn from – House of Commons Library (2010) [Financing the London 2012 Olympic Games – Comres](#) (2013) [London 2012: BBC Olympics Legacy Survey](#) Crossrail (2019) [Funding – Public Accounts Committee](#) (2019) [Crossrail: progress review – Crossrail](#) (2011) [Crossrail Business Case Update: Summary Report, July 2011](#)

## What can be done to close the gap between forecast and outturn?

As important as it is to change perceptions of what a good outcome should look like for new infrastructure, it is as important that the industry continue to strive to perform at a higher level. The built environment sector must consider what is within its power to change, commit to make those changes and take a proactive attitude as even incremental improvements would improve its reputation and support the industry's bottom line.

### Establishing what the built environment can control

As with any process, practice, time and dedication should see improvements in execution and this is no less true of managing project expectations and increasing accuracy of forecasts. The second issue to consider is delivery of a commitment by the sector and by clients to improve processes in a way which can provide better estimates and more realistic expectations based on frank analysis of past performance, shared widely.

This process will take time and is not a catch-all solution. It is important to recognise that even if all of the issues raised below and their suggested reforms are carried out and adopted enthusiastically at all levels, it is likely project forecasts will still fail to match outturns, but to a lesser degree and with greater confidence.

### Procurement reform

The Government's recently released Outsourcing Playbook<sup>31</sup> makes sound proposals for better procurement mechanisms as well as noting that there have been significant shortcomings to date. These include should-cost modelling which aids the Government, as a client, in providing information necessary to judge what a project's true cost should be when evaluating contracts, moving away from awarding contracts on lowest cost and apportioning risk on an equitable and incentivised payment basis with project partners best placed to manage it, rather than attempting to pass on all risk to private contractors.

Such an approach is to be welcomed and is very much in line with recommendations made through Project 13, especially in terms of a focus away from transactional, price led, awarding of bids toward improved supplier relationships through an enterprise partnership.<sup>32</sup>

Whilst the principles in the Outsourcing Playbook apply to all Government outsourcing projects, it is not mandatory for "Building, Civil Engineering or Equipment projects."<sup>33</sup> A mandatory adoption of should-cost modelling for Government infrastructure owners would equip them with more knowledge and data to make better informed procurement choices. Following this process an intelligent owner should also acknowledge the inherent uncertainties and risks of a project at its current stage of maturity, awarding contracts on a cost estimate range, informed by the reference point the due diligence undertaken during the should-cost model process provides.

***Recommendation:** Principles set out in the Outsourcing Playbook should be mandatory for Government infrastructure owners, this includes infrastructure owners undertaking should-cost modelling to help inform their expectations and knowledge of appropriate tender prices during the procurement process.*

<sup>31</sup> Government Commercial Function (2019) [The Outsourcing Playbook](#)

<sup>32</sup> Project 13 (2018) [P13 Blueprint](#)

<sup>33</sup> Government Commercial Function (2019) [The Outsourcing Playbook](#)

*Recommendation: It should be mandatory for all public infrastructure owners undertaking procurement to award contracts based on a cost estimate range, using a should-cost estimate as a reference point, with an amount of contingency allocated appropriate to the level of project maturity.*

## Data-led frameworks

The key impediment to improving estimates is a lack of quality and comparable data. Ending this 'information deficit' must be a key plank of work to improve the accuracy of estimates and is being actively pursued by Government through the IPA using initiatives like their benchmarking project.<sup>34</sup>

The sector has responded to the need to improve data capture analysis, retention and sharing however these efforts have not been coordinated. There is no single standard for data collection, which makes records difficult to compare. A lack of trust and openness between companies is prevalent as is a concern about loss of competitive advantage, which serves to hinder co-operation.

Some companies are emerging in this space stemming from academic disciplines, who have managed to convince clients and contractors to share anonymised project data and use these data-led algorithms to learn how projects perform and make predictive models for outcome and risk. Two examples include nPlan,<sup>35</sup> and Whole Life Consultants<sup>36</sup> who have taken an approach of working with a number of companies on a confidential basis to gather data which allows for analysis which can predict schedules and costs and labour models respectively. This work could prove highly valuable, reducing workload, providing a model independent of client or contractor to test against and potentially providing a level of accuracy in forecasting many times better than existing approaches

Infrastructure owners and their supply chains must make greater use of data-led shared frameworks, pooling knowledge and enabling efforts by universities and innovation organisations to utilise technology to provide estimates which improve their accuracy.

## Integration of governance structures and improving expertise

Integration of governance structures at multiple levels between clients and contractors could help to improve communication and project management. Of particular relevance is the need for expertise to be developed about how clients and contractors operate – industry may need to have a better understanding of how their clients operate and make decisions, particularly considering the fact that government culture can be very different from that of business, whilst clients and owners sometimes lack expertise about the industry they are engaging with. The civil service, by its nature, operates in a way where specialisms are not always developed, and oversight is not always managed by individuals with sector specific experience, meaning that what might seem obvious to a contractor is often alien to a client.

Likewise, scope processes could be improved at the outset by greater consultation at project commencement, allowing multiple experts from different disciplines the opportunity to review and for additional checks to the accuracy of the assumptions and data which feed into a projects initial scope.

Individual major projects, especially in comparison to smaller projects and programmes, often have many organisations, or even multiple clients and owners, who set up practices and governance processes which are individual to that project. One factor of concern is the duplication of roles – with the same functions appearing multiple times between senior contractors, clients and sponsors. There is an element of 'checkers checking checkers' which can impede decision making and add layers of oversight without necessarily adding value. Whilst this is a by-product of a lack of trust or attempts to integrate organisations vertically throughout a project, the sector has to find ways to simplify these processes.

A step could be for all major projects senior leadership to establish dedicated boards for individual major projects on a corporate model and ensure they comply with the principles set out in the UK Corporate Governance Code.<sup>37</sup> These principles include:

<sup>34</sup> IPA (2019) [Best Practice in Benchmarking](#)

<sup>35</sup> nPlan (2019) [Website](#)

<sup>36</sup> WLCUK (2019) [Website](#)

<sup>37</sup> Financial Reporting Council (2018) [The UK Corporate Governance Code](#)

- The adoption of an effective and entrepreneurial board whose role is to promote the long-term sustainable success of the company, generating value and contributing to wider society,
- Alignment of purpose, values and strategy with culture,
- Ensure necessary resources are in place to meet objectives and measure performance against those objectives, establishing a framework of prudent and effective controls which enable risk to be assessed and managed,
- Ensure effective engagement with and participation from stakeholders
- Ensure that workforce policies and practices are consistent with the company's values and support its long-term sustainable success, allowing the workforce to raise any matters of concern.

## The absence of standardisation

There are few consistent approaches to management structure, data capture, risk or project management in the built environment sector, with different contractors on the same project sometimes adopting different approaches, and each major project essentially being established from the ground up. This is especially true when comparing major projects which exist in isolation from other projects and a consistent failure to learn lessons.

The sector can, however, work to improve and achieve standardisation where there are obvious benefits. Indeed it is making efforts, particularly through initiatives such as offsite manufacture and construction.<sup>38</sup> Crossrail has helped to serve as a test bed for this and the development of a robotic drilling rig which may have served to improve scheduling and reduce cost, demonstrating “benefits in productivity, accuracy and importantly, safety”.<sup>39</sup> Other developments, such as late procurement of rolling stock and station completion, which have delayed integration with signalling technology have undoubtedly caused the project to slip.<sup>40</sup> Making a reliable forecast, or creating a reliable model, can be more of an art than a science, even if a scientific and data-led approach is adopted, if only due to human trial and error.

Applying this to project teams, however, remains elusive, especially as once a major project or programme finishes, and without a pipeline of similar scaled work, that team will tend to dissipate, along with the lessons, dynamics and experience which was collectively gained.

## Cultural evolution

There is a need to regard contingency as a vital component to be planned for and managed, rather than thought of as a failure if it occurs, and a recognition that complex tasks are more likely than not to require that contingency. This needs to take into account that the progression of time makes the likelihood of a change event occurring more, not less, likely. Moving away from a mindset which is prevalent in much of the sector that risk is something to take note of, rather than actively manage in an audited way, is a necessity.

There is also a pressing need to adopt a culture which is inclusive and brings contractors, designers and risk managers together. Too often projects allow designers and contractors to work in isolation, whereas ensuring they work together would work to ensure all partners in delivery understand each other's roles and what they are trying to achieve. Already discussed is the work at IGA, which has used a BIM led approach to design and aid implementation of that project. Drawing contractors into the design process has helped to ensure they intimately understand the design and are better able to deliver the build phase of that airport.

Closer working relationships would also serve to ensure quicker reaction times to issues as they occur and increase trust. One concerning anecdote raised in relation to a number of projects was a lack of understanding of the purpose of cost adjustment warnings passed up from the supply chain to the client on a project. A lack of understanding of contract requirements and a presumption that these warnings were either unimportant or an attempt to request more funds meant that they were being ignored by the client, which led to what could have been minor costs escalating as they were not addressed. Ensuring appropriate training, and leadership, and ensuring that appropriate steps are in place to enable the supply chain to effectively communicate with clients or project managers about realities ‘at the coalface’ are vital to ensure small problems do not become cascading ones.

<sup>38</sup> ICE (2019) [Off-site, on track](#)

<sup>39</sup> Crossrail (2018) [Sustainability Summary 2018](#)

<sup>40</sup> London Assembly (2019) [Derailed: Getting Crossrail back on track](#)

## Sharing of best practice

Unlike other sectors, such as aerospace, best practice is often difficult to find or share, with few mechanisms, forums or incentives to enable peer to peer learning of methods which work. There are common drivers against this, with low profit margins endemic to the sector an innovation which can provide a competitive edge for one company could mean the difference between success and insolvency. A lack of trust and shared frameworks, as set out above, also makes sharing of practice difficult on a practical level.

Yet, the overall effect is an industry which is slow to evolve and adapt to new technologies and which fails to realise efficiency gains. Project 13's early adopters have made a commitment to changing working practice which includes attempts to replicate the alliance model which has worked well in the water sector, with Network Rail implementing next-generation track alliances and Sellafield implementing a Programme and Project Partners model.<sup>41</sup> Improving the culture of the sector so that it is more open, and able, to share best practice could help to reduce project costs long-term as well as ensure lessons hard imposed from previous project overruns are learned and avoided in future.

There are examples of airports which share data, with two major international airports sharing all operational data protected by a non-disclosure agreement and a series of 6 international airports which share data through an academic establishment which protects commercial sensitivities by acting as an honest broker, digesting and anonymising data which are shared with all participants in the project. Initiatives like these should be replicated in all sectors of the built environment sector.

## Conclusion

Overrunning estimates and schedules on Britain's major infrastructure projects are not something which can be solved overnight, nor is it a problem unique to the UK, but it is a problem which must be addressed. There are fundamental issues, from a procurement environment which undermines contractors who bid a realistic price, to much needed improvements in communication and governance and a sector not fit or ready to learn and share lessons which would improve outcomes for all.

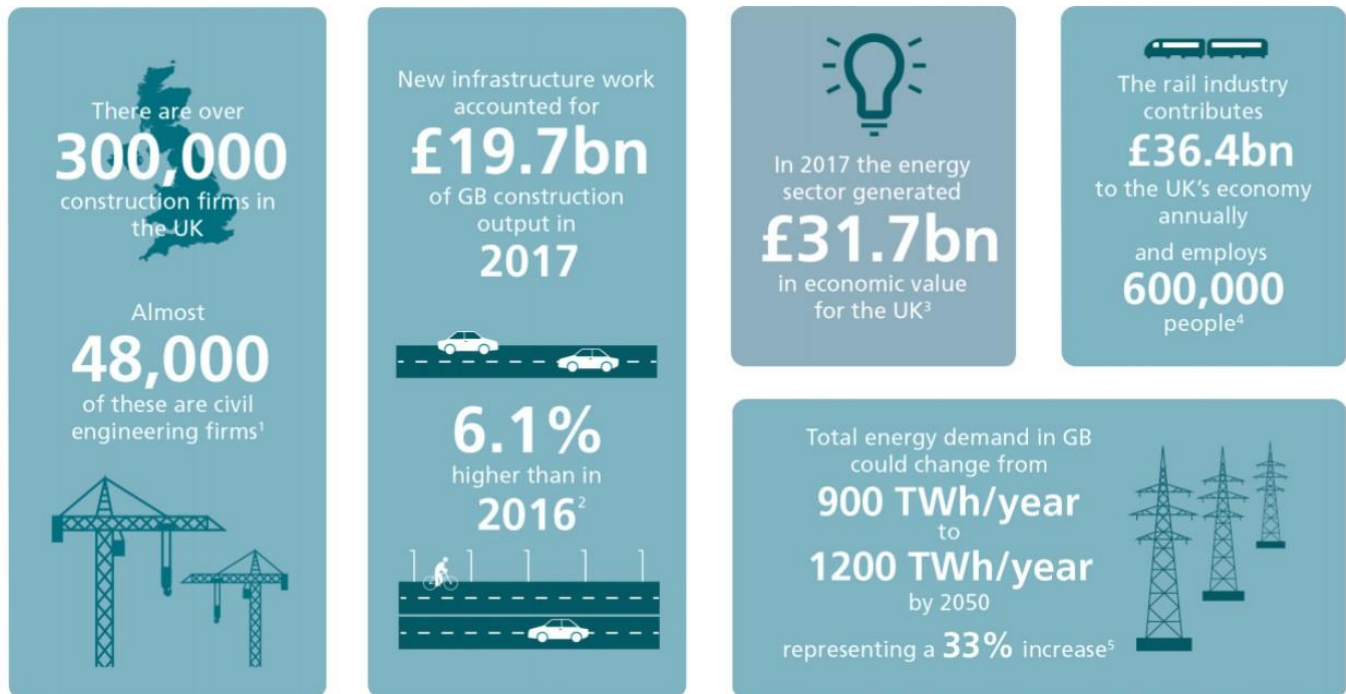
Infrastructure is vital. The assets engineers build help stimulate economic growth, improve health and life expectancy and protects communities from the effects of extreme weather and climate change. These benefits, which far outweigh the costs, should not be forgotten as our need for infrastructure will only continue to grow in the coming decades. This is why it is an imperative that the sector does what it can to deliver roads, railways, airports, energy plants, water and sewage works and flood defences on time and on budget. The more efficiently and effectively private and public capital is deployed the greater the potential returns and the more engineers can deliver.

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<sup>41</sup> ICE (2018) [Project 13 welcomes two new organisations](#)

## GB AND UK HEADLINES

From roads to railways and bridges to power stations, high-performing infrastructure is vital for economic growth and thriving communities.



1. ONS (2018) Construction statistics annual: Number 19, 2018 edition  
4. Oxford Economics (2018) The Economic Contribution of UK Rail

2. ONS (2018) Output in the construction industry  
5. ICE (2016) National Needs Assessment

3. ONS (2018) Gross Value Added (GVA)

## About ICE

### About ICE

Established in 1818 and with over 92,000 members worldwide, ICE is a leading source of expertise in infrastructure and engineering policy and is widely seen as the independent voice of infrastructure. ICE promotes civil engineering and supports the people who work in the civil engineering profession. Our policy activities are targeted towards the outcome of society having more of the infrastructure it needs, by ensuring it knows what to ask for and can trust it will be delivered.

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