Why Does UK Infrastructure Cost So Much?

Authors:
Graham Winch
The Productivity Institute

Date:
February 2026

The Productivity Institute
Productivity Insights Paper No. 075

Key words

Infrastructure costs; infrastructure productivity; Baumol effect; citizen voice

Acknowledgements

This work was supported by the Economic and Social Research Council [grant number: ES/V002740/1]

I am very grateful to The Productivity Institute reviewers, and particularly to Prof Bart van Ark, for their valuable feedback on earlier drafts. Full responsibility for the final version remains my own.

Suggested citation

G. Winch (2026) *Why Does UK Infrastructure Cost So Much?* Productivity Insights Paper No. 075, The Productivity Institute.

The Productivity Institute is an organisation that works across academia, business and policy to better understand, measure and enable productivity across the UK. It is funded by the Economic and Social Research Council (grant number ES/V002740/1).

The Productivity Institute is headquartered at Alliance Manchester Business School, The University of Manchester, Booth Street West, Manchester, M15 6PB. More information can be found on The Productivity Institute's website. Contact us at theproductivityinstitute@manchester.ac.uk

Abstract

The performance of infrastructure projects, particularly megaprojects, has long been of concern to the UK government. In this Insights Paper we investigate the high, and growing, costs of UK infrastructure development relative to other economic activities. We first address the question of whether the cost problem in the UK is worse than in comparator countries. Having shown conclusively that it is not, we move on to investigate why infrastructure development costs should be inflating faster than costs in the economy across comparator countries, with particular attention to the UK. We identify four possible explanations for this phenomenon: the Baumol effect; citizen voice; the technological sublime; and the iron law of megaprojects. We argue that the latter two undoubtedly contribute to high infrastructure cost levels, but that they display no discernible trend that might have caused the relative infrastructure cost inflation over the past 50 years which appears to have started around 1970. We review the available evidence for the UK on the Baumol effect and citizen voice, concluding that both are likely at play. We then identify potential areas for further research on high infrastructure relative cost inflation.

Why Does UK Infrastructure Cost So Much?

> "We know we can't get anything built on time or on budget in this country pretty much…. basically every other country is better than us" Darren Jones, Chief Secretary to the Treasury (Financial Times 01/04/25)

> "The government must be far more radical if it is to improve growth prospects substantially. Dramatic reductions are needed, for example, in the cost of constructing infrastructure" Martin Wolf (Financial Times, 31/03/25)

Introduction

Martin Wolf articulates a widely held view that the cost of delivering new and refurbished infrastructure assets is too high, given their central importance in providing the infrastructure services that are essential for enabling growth and achieving our aspirations for a more sustainable economy and society. Infrastructure services are therefore *foundational* for the performance of the high-growth sectors in the economy (UKG, 2025) – appendix 1 provides more information on the role of infrastructure in the UK industrial strategy. Infrastructure services underpin all socio-economic activity ranging from generating the energy that powers that activity to providing the shelter for health care for those who are temporally inactive and education for those who are soon to be active. Infrastructure services are provided by the operation of physical assets that have previously been delivered by investment projects of various kinds. In other words, infrastructure assets are the *outputs* of investment projects and infrastructure services are the *outcomes* of those projects. The central challenge that Wolf poses is that the higher the capital cost of infrastructure assets, the less the volume of infrastructure services that can be afforded by society.

There is undoubtedly a cost challenge in infrastructure development. In the UK, construction outturn costs rose 30% more than the rise in GDP per capita between 2007 and 2024 (NIC, 2024a) and a similar trend exists in the USA (Goolsbee & Syverson, 2023). Globally, average project cost per square foot rose much faster than the consumer price index in most economies (McKinsey, 2017). On these data, there is an emerging cost crisis in infrastructure investment just as we need to increase significantly infrastructure investment if we are to meet aspirations to address global warming (McKinsey, 2022; NIC, 2023) and other grand challenges. If investment expenditure for a given set of infrastructure assets is higher than it needs to be, then it follows that the total amount of infrastructure services provided by those assets that society can afford will be lower, some less valuable services will not be provided, and hence the overall level of socio-economic activity and its rate of growth will be reduced. It will also raise the costs of developing green infrastructure relative to continuing to use existing fossil-based energy systems that do not require large investment projects to continue to provide infrastructure services.

We can identify two distinct, but interrelated, aspects to this cost challenge. The first is the performance of the project management process by which the specified asset is delivered to the budget and schedule set at Final Investment Decision (FID)[1] in conformance to the specification and

[1] FID is the go/no go point at which investors finalize the decision to proceed with the delivery of the investment project. However, there is evidence that on some projects, the "real" decision to proceed is taken earlier during project shaping which "locks in" the decision at FID which becomes a formality (Cantarelli, Flyvbjerg, van Wee, & Molin, 2010). This is an important project governance problem which need much further research.

applicable regulatory requirements (Barnes, 1988; Winch, Maytorena-Sanchez, & Sergeeva, 2022). It is this aspect of performance that exercises Darren Jones above, a view which he reiterates in his foreword to the government's new Infrastructure Strategy (HMT, 2025). We dub this *project delivery performance*. The second is the performance of the processes leading up to FID which we dub *project shaping performance*. Project shaping is the iterative socio-economic process by which the value of the potential infrastructure services to be delivered by the asset is appraised, internal and external stakeholders' interests are negotiated, technology choices are made, and cost benefit ratios are calculated (Miller & Lessard, 2000; Winch et al., 2022). The aim of this process is to finalize the investment cost of a given asset specification that will yield the desired set of infrastructure services as the basis for FID.

The paper proceeds as follows. We first address Darren Jones' criticism by evaluating the research on the UK's relative performance on infrastructure development. Finding that there is no systematic UK disadvantage, we turn to addressing Martin Wolf's argument regarding rising infrastructure costs relative to the rest of the economy. We identify four possible explanations for this relative cost escalation before concentrating on two of them – Baumol effect and citizen voice. A review of the evidence of the UK experience on both these drivers of cost escalation follows. In a concluding discussion, we suggest some of the implications of failing to address the problem of infrastructure shaping and delivery performance for the widely advocated green transition of economy and society.

Project Delivery Performance: UK in Comparative Perspective

There have been four main ways of comparing internationally the performance of the construction sector in general and the infrastructure subsector in particular. These comparatives studies focus largely on project delivery performance both for data reasons, and the policy focus on schedule and budget overruns. These ways are:

- Macro-economic studies using national accounts data, focused on productivity comparisons.
- Pricing studies in which a standardized building type is priced by experts from different countries.
- Matched case studies of various kinds.
- Performance comparisons using proprietary data bases.

The significant number of comparative studies of these first three kinds[2] conducted prior to 2000 have been reviewed (Edkins & Winch, 1999a), and so we will focus here on those conducted since that date. Broadly summarized, the 1999 review found that

- No systematic evidence that project delivery outturn costs[3] were any higher in the UK than comparator countries
- The UK was the home of many world class construction firms, but these were focused on design (architecture and engineering) rather than the effective organization of project delivery. Notably, the UK had no world class tier one contractor.

[2] None of the fourth kind was conducted prior to 2000 so far as we are aware.
[3] Outturn costs are the sum of the budget set at FID and any escalation of that budget during project delivery.

- There was a tendency towards higher levels of specification in the UK, but whether this was due to overspecification or owners seeking added value in asset performance in use was unclear.
- The design culture in the UK favours bespoke solutions.
- Labour productivity tended to be lower due to a reliance on a craft organization of work, low levels of training, and lack of investment in modern technology.

Macro-economic studies have been popular over the years. These focus on Sector F of the Standard Industrial Classification (SIC), and are therefore focused on project delivery performance. However, there are some sector-specific distortions when comparing construction productivity between nations. A generic issue affecting all international productivity comparisons is that the US definition of "value added" is net output in European terms, including intermediate purchases (Mason, O'Leary, O'Mahony, & Robinson, 2008). Unless corrected, this would have the effect of flattering comparative US productivity. A second issue is that the proportion of repair and maintenance in overall output is not controlled in the comparative studies, yet this does vary significantly between countries (Vogl & Abdel-Wahab, 2015). A third issue is the treatment of self-employed and informal labour which may be measured inconsistently across different countries and change over time (Vogl & Abdel-Wahab, 2015; Winch, 1998a).

The most rigorous study of this kind (Mason et al., 2008) found that UK construction labour productivity performance, unlike the economy as a whole, was superior to France and Germany, but weaker than the US despite having (with France) a significantly higher proportion of repair and maintenance work than the US and Germany (Vogl & Abdel-Wahab, 2015). This study corrected for the US value added definition, included the self-employed, and used expenditure Purchasing Power Parity (PPP). However, this study identifies a significant anomaly. While reported labour productivity is relatively good, capital intensity is around half of that of comparator countries. It is difficult to see how relatively good labour productivity can achieved with half the capital; this suggests some kind of measurement problem. One possible source of this is the treatment of construction plant. In addition to plant owned by construction companies[4], plant hired *with* driver is allocated to construction; but plant hired or leased *without* driver is allocated to 77.32 of the SIC[5] (Vogl & Abdel-Wahab, 2015).

A more recent study (McKinsey, 2017) covered a much wider range of comparator countries for construction as a whole. It reported on construction labour productivity in 2015 against productivity growth 1995-2015 establishing a categorization of "declining leaders" (including the US and France); "laggards"; "accelerators" (principally middle-income countries); and "outperformers" (northwest Europe, Canada and Australia). The UK is characterized as an "outperformer" because its rate of productivity growth has been marginally positive over the 20-year period and its comparative productivity in 2015 was relatively high. Hower, these results are for "employed" workers only, are converted at exchange rates due to the lack of construction-specific PPPs, and do not adjust for differing levels of repair and maintenance in the mix nor US-type value added problems.

[4] Our own field observations in the 1990s suggested a much greater propensity to hire plant in the UK than France. Moreover, a typical French site would have a concrete batching plant on site, while UK companies purchased ready-mixed concrete (23.26).

[5] In the following analyses, the current SIC 2007 is used, although some earlier studies will have used previous versions.

Overall, we can conclude from these data that there is no evidence that productivity in Sector F as measured by comparing sectoral macroeconomic data in the UK industry is not as good as that in peer countries, and, tentatively, that there has been a slight improvement in the UK's relative position. However, confidence in this conclusion is tempered by the sheer difficulty of making international comparisons of construction productivity using macro-economic data for the reasons discussed above.

A focus particularly on infrastructure, as opposed to the whole of construction, costs began some 15 years ago with an influential and extensive report (HMT, 2010a, 2010b) that reviewed the literature to date, conducted matched case studies with other European countries, and surveyed expert opinion. This report reported on

- Macroeconomic studies concluding that there is no systematic productivity disadvantage for UK infrastructure.
- Pricing studies finding that the UK was, with the Nordic countries, the most expensive for infrastructure in 2007. However, such studies remain highly sensitive to fluctuating exchange rates and differences in the construction economic cycle and so reporting for individual years is unwise (Edkins & Winch, 1999a).
- Matched case studies indicating that high speed rail was significantly more expensive in the UK.

We now turn to discussion of four recent studies using proprietary data bases which are also largely focused on project delivery performance. All these data-bases contain at least 1000 data points, with the individual infrastructure project being the unit of analysis. In contrast to productivity studies, which rely on national statistical series where the strengths and weaknesses of the data bases are widely understood, one problem with project performance data is understanding the underlying quality of that data. The very fact that the data bases are proprietary – and hence the intellectual property of their commercial owners – makes methodological scrutiny difficult. We therefore describe the different data collection methods as best we can using published information.

An early benchmarking exercise focused on engineering construction delivery performance for process plant (Merrow, Sonnhalter, Somanchi, & Griffith, 2009), comparing the UK with western Europe and the USA (Gulf of Mexico). This drew on the extensive Independent Project Analysis (IPA) data base which currently contains many thousands of projects. The data are all collected through face-to-face interviews on the project against standardized research protocols at multiple points during the project life-cycle to support project owners' decision-making at stage-gates (Merrow, 2024). The comparative analysis drew on the 1,011 of the 11,000 projects in the IPA Downstream Process Plants Database valued at $3m or more (2003 USD) and "authorized"[6] between 1998 and 2008 to create a study-specific data base of which 60 were in the UK. From these data a Labour Productivity Index (LPI) value was calculated for each project in the dataset by comparing the number of hours needed to complete a project relative to the reference group of which the project is a member. The Labour Cost Index (LCI) was created by multiplying the LPI by the relative mean weighted hourly wage rate converted at exchange rates. Unlike the LPI, the LCI is very heavily influenced by currency fluctuations.

The IPA data show that LPI is on average 11% higher (i.e. less productive) in the UK than in US Gulf Coast, and 5% higher than continental European projects, with only France being higher than the UK.

[6] We take this to mean FID.

However, turning to LCI, this productivity disadvantage is entirely compensated by lower wages (at 2009 exchange rates) in the UK, so the UK is not at a cost disadvantage when competing internationally for investment. These differences cannot be explained by higher levels of capital being available to workers in US Gulf Coast or continental Europe – these were the same as the UK – or the quality of the workers available. Rather, the differences reported can be explained by differences in project management practices.

The Boston Consulting Group (BCG) report drew on its own proprietary Prism data base for its analysis of the relative performance of the UK infrastructure sector, enhanced by public sources (BCG, 2024). It is unclear from the report how exactly BCG acquired its internal data, so we presume that they were acquired during consultancy assignments for the project owner or other internal stakeholders. The Prism database contains 2300 projects across 16 countries to create reference classes for various types of economic and social infrastructure. The outturn unit cost (e.g. road per lane kilometre) of each project within the reference class was then ranked. These outturn costs were deflated in local currencies and then converted to sterling using exchange rates at the time of project completion.

BCG found that UK projects were typically within the middle of the rankings overall with the median project in continental European countries typically cheaper, and those in the US and Australia more expensive. Breaking down the data by reference class, road and rail were relatively expensive in the UK, while social infrastructure was relatively cheap. However, if the Elizabeth Line and Northern Line extension were removed from the data set, the UK's relative performance on rail was much improved[7]. This research found that UK comparative project delivery performance is middling across all types of infrastructure for both budget and schedules overruns (BCG, 2024: Figures 7 & 8). It is also worth noting that 47% of projects in the BCG data base are on budget or early (flattered by a relatively good US performance) and 59% of projects are on schedule or early (flattered by relatively good US and Australian performances) on a P50 basis[8]. The UK performance of 49% of UK projects meeting estimated schedule is exactly what would be predicted at P50, although only 33% of projects meeting estimated budget is disappointing.

A more recent analysis of the relative project delivery performance of the UK infrastructure sector similarly found that the UK was not an outlier in the performance of its infrastructure sector (NIC, 2024b). Using Oxford Global Projects (OGP) data for the outturn costs of some 1500 projects converted at 2022 PPPs. It is unclear how OGP acquire their data, but NIC describe it as being sourced "from a mix of direct contributions from organisations, and publicly available information including news sources and academic articles" (NIC 2024b: 5). This suggests that it contains significant inconsistencies. From its own analysis of this data set, the National Infrastructure Commission reported that overall, there was no unit cost disadvantage or advantage for UK infrastructure projects compared to similar projects internationally. The exception to this generalization is for some well-known megaprojects such as Elizabeth Line, HS2[9], and Hinckley Point C, where the UK does appear to have a significant cost disadvantage, and rail electrification.

[7] HS2, being incomplete, was apparently not in the dataset.
[8] A P50 is the value that has a 50% chance of being achieved, so if estimating is accurate, 50% of projects will exceed the estimated values.
[9] Even here, HS2 is a complete outlier, and is on track (pun intended) to be the most expensive high-speed railway in the world, ever (NIC, 2024a).

The most recent comparative analysis focused on overall project duration defined as "announcement to completion" (MACE, 2025), thereby encompassing both project shaping and delivery. The data set was provided by GlobalData which applied a series of filters to its global construction project database of more than 277,000 projects to generate a focused dataset of 5,330 capital projects. The filters were 2010 or later announced, in progress, or completed; "mega-projects" (capital value >$1bn USD); and "gigaprojects" (>$10bn). This data set was then analysed by Bradshaw Advisory on behalf of Mace. Other analyses which we do not report here used AI tools as well. These data are clearly sensitive to the definition and accurate measurement of "announcement", but there is no standard definition of this project event. The results show that for economic infrastructure (energy, utility and infrastructure megaprojects), the UK performance over the entire project lifecycle had the longest mean duration and the largest variance around that mean of the countries compared. On the other hand, UK social infrastructure megaprojects (commercial and leisure) had relatively low means and tight variances. A similar comparison is not offered for megaprojects, presumably due to data limitations[10]. This large UK difference in project lifecycle duration is puzzling, assuming it is not simply a measurement problem, because the regulatory regime which the authors suggest is the principal explanation for longer durations in the UK applies broadly equally across the both the social and economic infrastructure sectors.

These cumulative analyses from over 30 years of comparative research do not support Darren Jones' claim that other countries typically have higher project delivery performance than the UK. They also show that productivity levels in UK construction are no worse than in most comparator countries. While the UK has had, indeed, some "blow-out" projects, they appear to be just as frequent in peer countries – this is certainly true of Germany (Kotska & Fiedler, 2016). The one caveat to this conclusion is that by far the most rigorous comparative analysis – that of IPA – did find a significant UK productivity disadvantage compensated by a labour cost advantage resulting in no cost disadvantage.

Project Shaping Performance: Explaining Infrastructure Cost Inflation

We now take a wider view of the problem encompassing both project shaping and project delivery. The underperformance of the sector that is largely responsible for the final assembly of infrastructure assets is widely acknowledged as a policy problem, both in the UK (HMG, 2017) and around the world (McKinsey, 2013, 2017). Fundamentally, there is an emerging cost crisis in infrastructure investment as it becomes increasingly expensive. The best evidence for this claim comes from econometric work in the USA (Goolsbee & Syverson, 2023) which shows clearly that the construction sector's productivity problem cannot be explained by measurement error, and, more importantly for our argument, that inflation in construction costs started to diverge significantly from inflation in the economy more generally around 1970, and that this cannot be explained by a relative increase in input costs (bought in services and products, and labour) or profits. The phenomenon is therefore within Sector F. Others have also noted this trend without using econometric analysis (McKinsey, 2017; NIC, 2024a) On this evidence, Martin Wolf makes a very good point. There are four potential explanations for this phenomenon, which will be discussed seriatim: Baumol effect (Swei, 2018); citizen voice (Brooks & Liscow, 2023); the technological sublime (Frick, 2008); and the iron law of megaprojects (Flyvbjerg, 2011, 2014). Note that two of these – citizen voice and technological sublime are clearly project

[10] The report also offers data on "residential" megaprojects, but it is difficult to conceive what these might consist of, particularly for the UK.

shaping phenomena, the other two in practice bridge FID. While the iron law of megaprojects and the Baumol effect become manifest in project delivery performance, that performance has its source in decisions made during project shaping.

Sectors where labour productivity growth lags the economy overall are subject to the Baumol effect (Baumol, 1967) whereby their output prices increase faster than prices overall because labour in the underperforming sectors still needs to be paid at the average rate for the economy overall in order to retain that labour[11]. Where that output is not essential to the economy, adjustments are made by reducing demand as relative prices rise (bespoke tailoring, for example), but where the outputs are essential, such as in infrastructure and also many public services such as education and health care, then an increasing proportion of incomes (and taxes) are necessarily devoted to their purchase (van Ark, 2025). The only way to tackle the latter would be through raising productivity in the sector much faster.

It has been suggested that construction is just such a sector (Swei, 2018). Swei calculates the "Baumol variable" for the US construction sector since 1948 and finds that it is positive and significant at the 1% level, indicating the presence of a Baumol effect. He also analyses the trends in the prices of the main inputs into construction – principally building materials – and finds them flat in real terms over the period. This isolates the problem to the construction sector itself, and not its inputs from other sectors. However, the analysis assumes that the quality of construction output is constant throughout the period.

An alternative explanation to the Baumol effect in explaining relative price growth is increasingly wealthy societies choosing to spend economic surplus on both reducing the environmental impact of infrastructure in construction and operation, and on mitigating the loss of amenity for local stakeholders. In response to the social movements of the 1960s[12], the US government began to respond by taking their demands into account during project shaping (Altshuler & Luberoff, 2003). One recent study of the tripling of the real costs of constructing US Federal highways from 1956 to 1993 (Brooks & Liscow, 2023) suggests that this cannot be explained by a Baumol effect; rather it is better explained by a growth in "citizen voice" advocating both environmental protections generally and mitigations for residents locally. The turning point in this process was identified as the passing of the first US environmental protection legislation in 1970. In sum, citizens voice demands higher quality infrastructure, but that quality is not enhancing the performance of the infrastructure services provided to customers but mitigating their impact on external stakeholders and there are important questions around whether the benefits of this higher quality are equitably distributed (Brooks & Liscow, 2023).

A third possible explanation for rising relative costs is the "technological sublime" (Frick, 2008) in which construction professionals – particularly engineers and architects – push ever further the technological limits of what is possible and stress the aesthetic aspects of design, particularly for bridges and similar

---

[11] The original formulation of the problem was in the performing arts. For instance, the productivity of a string quartet can undoubtedly be improved by sacking the second violin, but only with an unacceptable impact on the quality of the output.

[12] It is notable that two seminal books were published in the early sixties: Jane Jacobs' The Death and Life of Great American Cities (1961) and Rachel Carson's Silent Spring (1962).

highly visible structures[13]. Such ambitions are often supported by politicians wanting to make a statement for their city or country and thereby leave a "legacy" (Chaslin, 1985) – the narrative of a "world class" infrastructure asset is an indicator of the technological sublime at play. The technological sublime with its aspirations to generate "awe and wonder" (Frick, 2008: 239) also feeds into citizen voice aspirations for inspirational rather than functional structures. The technological sublime undoubtedly generates additional capital costs, but for it to be an explanation of increasing relative costs over recent decades one would have to show that there is an increasing tendency towards the technological sublime over time. Examination of the engineering achievements of the 19th century (Nye, 1994) suggest that this is unlikely.

A fourth potential explanation for rising relative costs is that the percentage escalation of outturn cost against budget at FID has increased over time due to the iron law of megaprojects (Flyvbjerg, 2014). However, for escalation costs to be a contributor to the rising relative cost of infrastructure investment we would need evidence that this problem has got worse over time, but we are not aware of any evidence that suggests that this is the case. Indeed, the foundational text in the research on project delivery performance (Flyvbjerg, Bruzelius, & Rothengatter, 2003) reports that there is *no* secular trend in cost overruns in their data base of 208 transportation projects across 20 countries completed between 1927 and 1998. Whilst undoubtedly a serious problem for infrastructure investors, distorting their investment portfolios in unpredictable ways, budget escalation after FID cannot be the explanation of increasing relative infrastructure costs on these data.

As noted above two of these potential explanations – Baumol cost disease and the iron law of megaprojects – are empirically focused on project delivery performance, but their drivers are actually within project shaping. All the data to support the iron law of megaprojects are for escalation after FID[14], yet the proposed explanations for these lie in delusion and deception during project shaping (Flyvbjerg, Garbuio, & Lovallo, 2009) on which little evidence, in distinction to inference, is offered. The Baumol cost disease is focused on project delivery performance because all its data comes from Sector F (construction) of the SIC. However, technology choices during project shaping such as a decision to use off-site manufacture of sub-systems also have an important influence on project delivery performance, and the prevailing level of productivity will, of course, affect the calculation of the budget at FID by being embedded in the cost data available to decision-makers. The technological sublime and citizen voice principally have their effects during project shaping. However, if it proves not possible to restrict citizen voice to before FID, then it can generate escalation during delivery; similarly, the temptation under the technological sublime to push technological boundaries can turn an implementation project into an innovation project again generating escalation during delivery as the inherent complexities of innovation work themselves out. It should be noted that these effects can potentially combine in unpredictable ways; for instance, Baumol cost disease and citizen voice can compound each other (Onayev, Espey, & Swei, 2022).

[13] The French for a significant infrastructure element such as a bridge is "ouvrage d'art", where "art" refers to the particular technological prowess required for design and construction.
[14] An important exception to this generalization is research on Olympic projects, where FID is effectively taken at bid stage and the successful city is henceforth locked in. As a result, Olympic projects display the highest levels of cost escalation of all infrastructure projects (Flyvbjerg, Budzier, & Lunn, 2021).

The Twin Drivers of Rising Infrastructure Costs: **Baumol Effect**

We have identified two possible explanations for the rising relative costs of infrastructure investment over the last 50 years: Baumol effect and citizen voice. We argued above that there is little convincing evidence that the UK has a systematic disadvantage in comparison to peer countries, but also that the UK does have a shared problem with peer countries of infrastructure investment costs rising faster than general inflation. This is fast becoming an urgent policy problem as our aspirations for a low-carbon future, faster economic growth, and addressing housing crises in most developed countries depend on infrastructure investment[15]. We now turn to the evidence that the Baumol effect and/or citizen voice play a significant role in UK infrastructure investment cost inflation. We are aware of no UK econometric work similar to that on the US (Brooks & Liscow, 2023; Goolsbee & Syverson, 2023; Swei, 2018), so in this review we largely draw on comparative studies reviewed above to provide additional insights into which potential initiatives could be taken in the UK to address the problem. One of the problems in this complex area is that poor performance in one area could be counter-balanced by better performance in another to achieve the overall “middling” UK international comparative performance identified above, so identifying relatively weaker areas can help to generate possible foci for improving overall project shaping and delivery performance.

Before moving on to a deeper analysis of UK construction productivity, we need to clear up a typical confusion in analysing infrastructure productivity, because the sector often adopts the project management definition of “productivity”. This is deeply embedded in project practice, where “productivity” is defined in earned value analysis (Fleming & Koppelman, 2016; Winch et al., 2022) as the ratio between planned expenditure and actual expenditure at a given point in the project lifecycle and usually measured in labour hours. This is very different from the definition of productivity as a ratio of inputs (typically labour, but also total factor) and outputs (the value of the asset delivered by the project) used in economics (Haynes, 2020). While the project management definition can be helpful in controlling project delivery performance, it cannot address the issue of rising infrastructure costs.

Figure 1 shows the trend in labour productivity growth for UK construction as essentially flat and underperforming the economy in general, although the infrastructure sector (principally civil engineering) does perform a little better than the sector as a whole (ONS, 2021). Analysis from the USA provides a similar, if not worse, picture (Goolsbee & Syverson, 2023). These trends are global phenomena (McKinsey, 2017), and the divergence of the trends appears to have started around 1970 (Goolsbee & Syverson, 2023; Margirier, 1988). This is Exhibit A for the Baumol effect, and its symptoms can be seen in the relatively low pay and difficulty of attracting younger workers to the sector resulting in an aging workforce relative to other sectors (ONS, 2021).

[15] Housing development requires infrastructure investment. Not just access roads, but also urban transit, electricity and water supplies and waste disposal. Many housing developments in the UK are constrained by one of more of these infrastructure gaps.

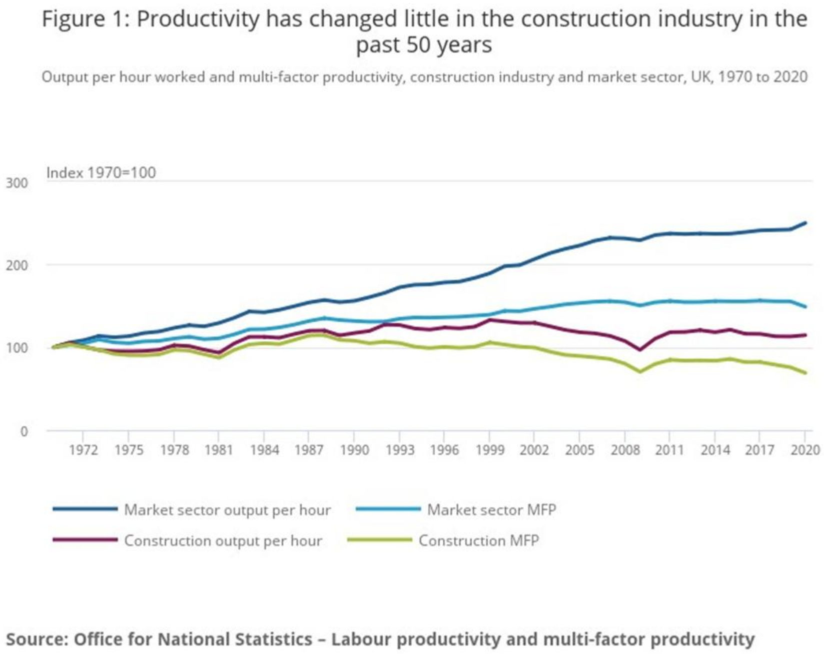

Figure 1: Comparative Productivity in the UK Market and Construction Sectors (Source: ONS, 2021: Figure 1).

However, some of the productivity comparison between the construction sector and the rest of the economy sector is compositional to construction's disadvantage because the construction SIC includes repair and maintenance while many manufacturing sectors do not (Vogl & Abdel-Wahab, 2015; Winch, 2003). Further, one of the principal means of improving productivity in construction is to move production off-site (Bertram et al., 2019; Farmer, 2016). Initiatives to improve productivity by using more prefabricated components provided by off-site manufacture have the perverse statistical effect of reducing productivity (Rathnayake & Middleton, 2023). This is because the supply of such components is no longer in the construction SIC, which captures site activities alone, but in the relevant manufacturing one[16], leaving construction with the onsite activities which have not been successfully prefabricated. Increasing pressure to produce off-site will likely suppress the rate of growth of construction projectivity as measured conventionally. However, this cannot be an explanation of the poor productivity growth performance of UK construction because there was a *reduction* in the proportion of total value added in construction derived from manufacturing 2000 to 2014 both in the UK and more widely in EU countries (Kuusi, Kulvik, & Junnonen, 2022).

A total value system[17] approach to construction productivity (Kuusi et al., 2022) yields additional insights. This research places construction in its broader economic context by including the SIC sectors that provide inputs to the final assembly of constructed assets on site summarized as primary, manufacturing, and services[18]. They principally use EU KLEMS data over the 2000 to 2014 period to show that construction (sector F) accounts for only around half of EU construction value added,

[16] e.g. 23.61 concrete products; 16.21 wood products; 25.1 steel fabrication

[17] Kuusi and colleagues use the term construction "value chain" which in fact represents a "value system" of buyer and supplier firms terminating in final consumption, as opposed to an internal value chain for a single firm (Porter, 1985).

[18] "Primary production = industries A and B, manufacturing = industries 10-33, construction = industry F, and Services = all other industries" (Kuusi et al, 2022: table 1).

although this figure is higher for the UK than all other comparator countries. The balance is made up principally by inputs from services at around one third, followed by manufacturing and a small contribution from the primary industries. Interestingly, the UK share of services and manufacturing in total system value added is relatively low. Over the period, the share of services in total construction value system has increased by nearly 3%, half of which is driven by increases "professional, scientific, technical, administrative, and support services", while that from manufacturing has dropped by a similar amount. No further data are provided on what is going on here, but one possible explanation is the separation of the project management of onsite execution through the development of Engineer, Procure, and Construction Manage (EPCM) and associated procurement routes (PwC, 2024) from site management of trade packages. Overall, their analysis found that the rate of productivity growth at the construction value system level was higher than that for the construction sector alone.

In order to investigate the dynamics of poor productivity growth further, we turn to the research on construction site productivity (Naoum, 2016). There is now a large body of evidence from a wide variety of studies that suggests that there is considerable room for improvement in the organization of work on construction sites during project delivery. Research on work processes on the construction site, mainly through various forms of activity sampling, has identified significant amounts of "wasted" time due to workflows not being well organized (Hajikazemi, Andersen, & Langlo, 2017; Murguia, Rathnayake, Jansen van Vuuren, & Middleton, 2024; Rathnayake, Murguia, & Middleton, 2024; Winch & Carr, 2001). Essentially the call is for better detailed planning of construction processes on site (Ballard & Howell, 1998, 2003; McKinsey, 2017; Winch & North, 2006). The insights gained from this and other research along similar lines will undoubtedly improve onsite productivity if implemented effectively. However, this approach ignores the fundamental driver of improved productivity over time – the substitution of capital for labour. Comparative activity sampling research (Winch & Carr, 2001) found that French workers had significantly different capital available to them – principally in the form of standardized formwork systems with integrated work platforms - than British workers and that French site management paid much greater attention to planning work flows for their directly employed workers, and to rationalizing onsite processes more generally.

Why do UK construction workers have different capital available to them? There are three main aspects to the answer. The first is the generic problem with any capital goods sector that the amplitude of economic cycles is increased compared to consumption goods sectors due to the accelerator effect (Ive & Gruneberg, 2000). The second is that the products produced by contractors are very lumpy, that is large in relation to the overall turnover of the firm (Hillebrandt, 1985). This means that a slight change in tender success rate can have a very significant impact on the turnover of the firm. These two factors, of course, affect all construction sectors, but the third is reported in some of the comparative studies (BCG, 2024; HMT, 2010b; NIC, 2024a) to the effect that the UK government has relative difficulty in sustaining programmes of capital investment which would allow suppliers to make a return on the investments over a longer cycle than the individual project on hand. As a result of all these factors in combination, volatility in construction output is high with changes of over 10% year on year common (BIS, 2013). Suppliers – particularly those supplying on site construction services such as contractors – therefore prefer a strategy of flexibility over productivity (Winch, 1994) which consists, inter alia of minimizing fixed capital investment; sub-contracting most or all of the work; and casualizing the workforce through self-employment. A result of this last effect is minimal investment in human capital development (Winch, 1998a), and a preference for general purpose capital procured through plant hire over developing proprietary systems that rationalize on-site production. This leads to a much greater fragmentation of the supply side through higher levels of subcontracting, relatively high levels of self-employment, and a lack of large, capable tier 1 contractors (HMT, 2010b; NIC, 2024a)[19]. The systems dynamics effects of all this (NIC, 2024a) results in a "constrained supply chain"[20].

The challenges of improving on-site productivity in a production environment that is inherently temporary, open to the elements, and subject to vagaries of regulatory compliance means that moving production off-site into a factory environment where manufacturing production disciplines can be implemented (Bertram et al., 2019; Farmer, 2016) makes a lot of sense. As noted above, this has a perverse effect on measured construction sector productivity, but the aspiration is that it will reduce overall costs of production across the construction value system. To date, however, progress has been limited. TPI research (Peters, Pinkse, & Winch, 2023) on the housing production sector has shown some of the problems that entail. Off-site production can only produce subsystems for final assembly on site because completed assets are too large to transport from the factory. So, the factories are still supplying a construction site and unless on-site production is stabilized to allow the site to receive and install a steady flow of output from the factory storage problems are generated and the efficiencies of manufacturing production are undermined by instability in production levels. The relatively high overheads of higher productivity factory production – particularly if automated production techniques are deployed – make it difficult to absorb the variability in production levels. Merely moving production off-site does not mean that the advantages of flexibility over productivity are removed and the need to bear factory overheads can and does result in off-site production being more expensive in some contexts.

Standardization is linked to, but not the same as, off-site production. However, if off-site production can be combined with standardization of components across a portfolio of projects to generate economies of scale in manufacturing and help to smooth demand across the portfolio, the potential to enhance productivity is increased. This requires large programmes of projects delivering functionally similar infrastructure assets in order to carry both the engineering overhead of developing a standardized design and testing it, and to gain economies of scale through the learning curve. This, in turn, implies centralization of project owner roles away from regional entities to consolidate overall demand[21]. It also requires longer-term commitment to particular types of infrastructure investment than the UK system typically allows.

This is essentially an innovation problem in a sector that has long been characterized as low in innovativeness (BIS, 2013; Winch, 1998b), although on patent data the UK sector is more innovative than some peer construction sectors (BIS, 2013). However, cross sectoral surveys of innovativeness are biased against construction (Winch, 2003) because the design process is excluded from the SIC and allocated to Section M Division 71 (Architectural and Engineering Services) instead. Infrastructure is arguably a highly innovative industry thanks to the technological sublime, but the sector has long focused on product innovation – building higher; bridging further; minimizing embodied carbon etc –

[19] Since the collapse of Carillion in 2018, the UK has only one significant internationally competitive contractor, Balfour Beatty.
[20]https://embed.kumu.io/25787d0212d30e1452cac57375211ac3#causal-loop-diagram/colourised-by-theme accessed 07/08/25.
[21] This is exactly what is happening on the New Hospitals Programme (HOCCPA, 2023).

than the types of productivity enhancing process innovation that characterize other mature production sectors (Gann, 2000).

The Twin Drivers of Rising Infrastructure Costs: Citizen Voice

Our second potential explanation for cost inflation is citizen voice and the effects of regulatory processes on both budget and schedule, a challenge the UK shares with many peer countries (BCG, 2024). There are two main aspects to this. One is environmental regulation where the regulations have become increasingly stringent; the second is land use planning where decision-making has become much slower in recent years. The time taken for the consenting process for major infrastructure projects rose by 65% between 2012 and 2022, while the number subject to judicial review rose by 58% over a similar period (NIC, 2024a). Such delays both increase investment costs in project shaping and incentivize flexibility over productivity in project delivery because forward workload is less predictable.

Both regulatory areas have to make difficult trade-offs between respecting the rights of those affected by the project, including local stakeholders and the primordial stakeholder (Driscoll & Starik, 2004), and imposing additional costs on the infrastructure project. These regulatory regimes impose two types of costs on projects. The first is the costs of meeting regulatory standards, especially environmental standards, where the benefits are externalized to the wider environment and society, rather than benefitting the owner and operator of the asset being created and their customers for infrastructure services. These standards have undoubtedly been increasing over the years, but such standards are important for the democratic legitimacy of any new or upgraded infrastructure project. These can, in principle, be calculated with some certainty during project shaping and hence be incorporated into FID[22].

The second problem is the predictability of the process of regulatory compliance, and the UK appears to perform relatively poorly on this (HMT, 2010b; MACE, 2025). Lack of predictability regarding how the regulations will be applied to the project on hand generates costs through 1) the additional workload of regulatory engagement during project shaping; 2) extending the time taken to obtain regulatory approval; and 3) additional specification to meet the claims of external stakeholders without adding value for the owners and operators or their customers for infrastructure services. Such delays therefore increase investment costs in project shaping and incentivize flexibility over productivity in project delivery because forward workload is less predictable[23]. Again, the systems analysis of "inefficient consenting and compliance" unpacks some of the dynamics here (NIC, 2024a), but focuses on the process of achieving regulatory consent rather than whether those consents remain appropriate.

[22] There will undoubtedly be at the margin a number of projects that are rendered non-viable due to these increasing environmental standards, but this should become apparent early during project shaping and is, therefore, not a significant barrier to appropriate infrastructure development.
[23] The Planning and Infrastructure Act 2025 attempts to address this predictability problem. The UK is not alone here; Governor Newsom (D) of California signed into law major regulatory exemptions for housing and infrastructure development to further its "abundance agenda" as part of its 2025 budget: https://www.gov.ca.gov/2025/06/30/governor-newsom-signs-into-law-groundbreaking-reforms-to-build-more-housing-affordability/ (accessed 07/08/25).

An interesting theme that emerges from the case study research is that specification standards are higher in the UK[24]. This has led to a consistent charge that UK infrastructure is over-engineered (Edkins & Winch, 1999b; HMT, 2010a), but this could also be because UK infrastructure owners are investing in higher value assets than their peers. For instance, it has been argued that the UK has a relatively high population density with relatively high standards for both environmental protection and health and safety (HMT, 2010a), although others have questioned this explanation (BCG, 2024). An important issue here is the relationship between investment costs and operating costs – higher initial investment can reduce operating costs by, for instance, reducing maintenance close downs, reducing energy requirements and so on. Greater initial investment can also deliver greater value for customers of infrastructure services, even if these cannot be directly monetized. There is, however, evidence there is a tendency towards overspecification in the UK. HS2 was specified as the fastest high speed rail line in the world (Winch, 2025), while on Hinckley Point C, the UK regulator required significant redesign of an established French design adding considerably to the investment cost (BCG, 2024).

Addressing the Causes of Cost Inflation

How might the Baumol effect and citizen voice be addressed in order to reduce the rate of inflation in infrastructure costs below that of inflation more broadly, or even to reduce investment costs in real terms? The NIC (2024a) suggests two other system dynamics: “lack of clear strategic direction” by government and “client and sponsorship challenges”. We will discuss these seriatim. Government is heavily involved in the infrastructure sector – either directly or through agencies – in two distinct ways. Firstly, it is the source of regulation in response to citizens voice and other pressures, and so only government action can address this source of cost inflation. Whether it is able to do this is largely a political question. Earlier attempts to deregulate have foundered, with citizens voice having a ratchet effect (Altshuler & Luberoff, 2003). Second, it is a major owner, investor, and operator of infrastructure assets to provide essential services[25] in its own right, accounting for around 38% of infrastructure investment in 2021 (NIC, 2023). Its investment policies, therefore, have a significant impact on demand in the sector (NIC, 2024a; PwC, 2016). Yet, UK public capital investment has been relatively volatile in international comparison, further disincentivising replacing labour with capital in infrastructure. A further issue is that most UK infrastructure is owned and operated by private firms under regulated asset base regulation (Helm, 2009), but this can reduce incentives for owners to bear down on infrastructure investment costs because higher costs mean a higher value of asset base against which regulated profits can be made (Averch & Johnson, 1962; Merrow, 2024).

The capabilities of project owners[26] have long been identified as a major factor in project performance during both shaping and delivery (Maytorena-Sanchez & Winch, 2022; Merrow, 2024; Morris & Hough, 1987; Winch & Leiringer, 2016). As the Infrastructure Cost Review put it

[24] Literally in some cases – the standard height for a UK motorway bridge is 5.03m compared to 4.6m in The Netherlands.
[25] The direct involvement of UK government in the provision of infrastructure services is relatively low in international comparison, principally restricted to road and rail transportation. In the USA public provision is much higher including airports, water and ports, principally by city governments (Wahba, 2024).
[26] We prefer “owner” to “client” because the latter is a contractual role, while the responsibilities of project owners are broader than commercial concerns, including realising the outcome benefits from the investment project output.

> One of the common key factors reported by the interviewees in the development of successful projects is the existence of competent public sector in-house technical teams who are able to manage the relationship with the contractor, manage the private sector's capacity and make good use of competition (HMT 2010b: S4.21).

These include the strategic capability to develop and implement robust business cases; the governance capability to ensure that FID is rigorous and the project is delivering what it is supposed to be delivering; and the commercial capability to do deals with suppliers on favourable terms (Winch & Leiringer, 2016). A major governance issue for government projects is confusion between the notional project owner and the sponsoring government department and a general lack of capacity and capability due to restrictive public sector personnel policies (NIC, 2024a; Simcock, 2025; Stewart, 2025). Commercially, reliance on two-stage tendering and alliance-type incentive contracts common on infrastructure projects can add around 25% to investment costs at FID (Merrow, 2023). Comparative research has also shown that UK owners tend to lack the technical capabilities to challenge design proposals (HMT, 2010b) during project shaping or to challenge contractors' scheduling proposals during project delivery (Merrow et al., 2009) compared to owners in other countries resulting in higher investment costs and loss of productivity. Although there has been much improvement in UK government capabilities since the foundation of the Major Projects Authority in 2011, much more remains to be done.

Concluding Discussion

We started from the observation that there is a serious problem of relative cost inflation facing the infrastructure sector in both the UK and more widely affecting both *project shaping performance* and *project delivery performance*. We addressed Darren Jones' argument that UK project delivery performance is worse in the UK than elsewhere and found that there is no evidence that this is the case; project budget and schedule overruns are an international phenomenon. On the evidence we have, another international phenomenon is the greater infrastructure cost inflation compared to the economy overall which appears to have started around 1970. We therefore turned to Martin Wolf's assertion on infrastructure costs. We identified four possible explanations for this phenomenon: citizen voice; the technological sublime; the Baumol effect; and the iron law of megaprojects. The first two of these are project shaping phenomena, and the second two while manifest during project delivery also have their roots in project shaping. We argued that the technological sublime and iron law of megaprojects undoubtedly contribute to high infrastructure cost levels, but that they displayed no discernible trend that might have caused the relative infrastructure cost inflation over the past 50 years. We reviewed the available evidence for the UK on the Baumol effect and citizen voice, concluding that both were likely at play. We then identified the important of both strategic leadership from government and infrastructure owner capability for addressing these two explanations.

Rising relative infrastructure costs are an increasing issue because tackling the grand challenges that we all face – particularly achieving net zero - requires much increased levels of infrastructure investment (McKinsey, 2022; NIC, 2023). Ironically, the environmental and stakeholder concerns articulated through citizens voice have added considerable additional costs to infrastructure investment projects, and this may have been justified when the benefits of infrastructure investment were not evenly distributed (Altshuler & Luberoff, 2003; Brooks & Liscow, 2023). However, global warming and the housing crisis is a challenge we all face, and so important questions arise around the continued legitimacy of local stakeholder interests and environmental protections that make necessary infrastructure developments more expensive. This is an important potential area of research.

In order to explore these issues more deeply we urgently need to replicate and develop the econometric research that has been done in the USA (Brooks & Liscow, 2023; Goolsbee & Syverson, 2023; Swei, 2018) for the UK case. Can we observe more robustly the Baumol effect and citizen voice in the UK infrastructure cost data? Presently we are relying on inference rather than analysis. We also need to update the KLEMS analysis of the total construction value system (Kuusi et al., 2022) to see whether the decline in the contribution of manufacturing to overall construction value added has continued over the last 10 years in the light of recent policy initiatives to increase pre-manufactured value (appendix 1). To explore these issues qualitatively, we need more case studies along the lines of those available on US infrastructure projects (Altshuler & Luberoff, 2003; Hughes, 1998) to understand how the socio-economic project shaping process is suffused with politics, and how that shaping process might be improved.

A puzzle revealed by the econometric analyses reported above is that the trends in both productivity and construction costs started to separate from the trends in the overall economy to their disadvantage from around 1970 onwards. Why did this happen? Assuming that this is not an artefact of the data, what changed at that time to initiate this separation? Potential lines of enquiry include the growth of environmental legislation from 1970 on in the USA (Altshuler & Luberoff, 2003; Brooks & Liscow, 2023) and the demise of large-panel prefabrication systems in the UK (Finnimore, 1989), again during the 1970s.

Productivity remains at the heart of the issues we have covered here, yet there remains considerable confusion within the sector[27] around the project management and economic definitions of productivity with the more common focus on the project management definition. What is needed is research on productivity in the sector as an innovation problem of substituting capital for labour throughout the project delivery process which starts during the project shaping process in complement to the site efficiency line of construction productivity enquiry. Recent innovations policies have advocated off-site manufacturing measured by "pre-manufactured value" (Farmer, 2016) without paying attention to how on-site processes can be rationalized so that they can be synchronized with off-site process to "pull" manufactured sub-systems onto site rather than "pushing" them out of the factory door which is, for instance, all too common with modular housing (Peters et al., 2023).

Systems analysis of high infrastructure costs (NIC, 2024a; PwC, 2016) suggest that the levers of change lie largely with government. Only government can mitigate the effects of citizen voice on infrastructure costs, but past experience suggests that this will be very difficult indeed to do with any significant effect. Second, government as a major owner and operator of transportation infrastructure can do much more to set out a strategic direction for infrastructure investment in the UK (HMT, 2025). This, in turn, allows public sector infrastructure owners to take a more strategic approach and to work at the level of the investment portfolio rather than individual projects and programmes and to develop their project capabilities more generally. This then allows commercial arrangements with suppliers at the portfolio level – usually called framework agreements – that can significantly enhance project performance (Merrow, 2023). Within a framework agreement, suppliers have a longer-term

[27] This claim is based on my personal interactions with practitioners in the sector over the last two years.

investment horizon that potentially allows them to vertically integrate, invest in proprietary technologies and off-site manufacturing facilities, invest in human capital development, and learn a lot more from doing[28].

There is a hungry appetite for change in the infrastructure development sector, but remarkably little overall progress. Perhaps part of the reason for this is the tendency to focus on the project delivery performance problem that Darren Jones identifies, rather than on the more significant problem that Martin Wolf identifies, of which ensuring the outturn cost is as close as possible to budgeted cost at FID is only a part. We need much more focus on project shaping in research on productivity and cost in the infrastructure sector.

[28] This is the ambition of the Project 13 initiative by a "club" of UK infrastructure owners https://www.project13.info/

Appendix 1

Infrastructure in the UK Industrial Strategy

The UK Industrial Strategy (UKG, 2025) focuses on 8 high-growth sectors (the "IS-8"). It then identifies a set of "foundational" sectors that provide essential support for those high-growth sectors. Business and Professional Services is one of the IS-8 but architecture and engineering (71) is not identified as one of the "Frontier Industries" within that targeted sector. Construction (41,42,43), is identified as a "Foundational Sector" while some operational infrastructure sectors are singled out such as Electricity transmission (3512) and distribution (3513) and Ports (52101, 5222, 52241). There are no specific mentions of transportation or water. However, in the body of the Industrial Strategy is a number of references to the importance of intra- and inter-urban transportation supporting city-centred growth. There is one reference to water in East Anglia.

The UK government is obliged by law to respond to the infrastructure assessments produced quinquennially by what was the National Infrastructure Commission (NIC, 2023). The UK Infrastructure Strategy (HMT, 2025) is the result of this process. It provides a direction of travel for infrastructure investment, supported by "at least" £725bn over 10 years, although this will obviously be a function of the availability of public and private finance over the period. It announces no specific initiatives to address the issues raised in this paper, apart from supporting the Planning and Infrastructure Bill, and the commitment from the 2025 Spring Statement to improve skill development. Continued support for off-site manufacturing as part of Modern Methods of Construction (MMC) is in the Industrial Strategy. The Infrastructure Pipeline, which was updated in July 2025 provides more specific information on which projects are either approved for detailed feasibility studies or authorized.

Construction therefore has a less central role in the 2025 industrial strategy than in the 2017 version (HMG, 2017). In that strategy, infrastructure was identified as one of the strategic sectors, supported within government by the Transforming Infrastructure Performance (IPA, 2017) initiative which addressed both shaping and delivery performance issues. More broadly the Construction Sector Deal advocated a partnership between government and suppliers of construction services, through which was funded UKRI's £170m Transforming Construction collaborative research programme, principally focused on the productivity problem in the sector to be addressed by the diffusion of MMC and digital technologies.

References

Altshuler, A., & Luberoff, D. (2003). *Mega-projects: The Changing Politics of Urban Public Investment*. Washington DC: Brookings.

Averch, H., & Johnson, L. L. (1962). Behavior of the firm under regulatory constraint. *The American economic review, 52*(5), 1052-1069.

Ballard, G., & Howell, G. (1998). Shielding production: Essential step in production control. *Journal of Construction Engineering and Management, 124*(1), 11-17.

Ballard, G., & Howell, G. (2003). Lean project management. *Building Research & Information, 31*(2), 119-133.

Barnes, M. (1988). Construction project management. *International Journal of Project Management, 6*(2), 69-79.

Baumol, W. J. (1967). Macroeconomics of unbalanced growth: the anatomy of urban crisis. *The American economic review, 57*(3), 415-426.

BCG. (2024). *Reshaping British Infrastructure: Global Lessons to Improve Project Delivery*. London: Boston Consulting Group.

Bertram, N., Fuchs, S., Mischke, J., Palter, R., Strube, G., & Woetzel, J. (2019). *Modular Construction: From Projects to Products*: McKinsey.

BIS. (2013). *UK Construction: An Economic Analysis of the Sector*. London: Department for Business Innovation and Skills.

Brooks, L., & Liscow, Z. (2023). Infrastructure costs. *American Economic Journal: Applied Economics, 15*(2), 1-30.

Cantarelli, C. C., Flyvbjerg, B., van Wee, B., & Molin, E. J. E. (2010). Lock-in and its influence on the project performance of large-scale transportation infrastructure projects: investigating the way in which lock-in can emerge and affect cost overruns. *Environment and Planning B: Planning and Design, 37*(5), 792-807.

Chaslin, F. (1985). *Les Paris de François Mitterrand: histoire des grands projets architecturaux*. Paris: Gallimard.

Driscoll, C., & Starik, M. (2004). The primordial stakeholder: Advancing the conceptual consideration of stakeholder status for the natural environment. *Journal of business ethics, 49*(1), 55-73.

Edkins, A., & Winch, G. M. (1999a). *The Performance of the UK Construction Industry: An International Perspective*. London: Bartlett Research Papers.

Edkins, A., & Winch, G. M. (1999b). *Project Performance in Britain and France: The case of Euroscan*. London: Bartlett Research Papers.

Farmer, M. (2016). *The Farmer Review of the UK Construction Labour Model*. London: Construction Leadership Council.

Finnimore, B. (1989). *Houses From the Factory: System Building and the Welfare State 1942-1974*. London: Rivers Oram Press.

Fleming, Q. W., & Koppelman, J. M. (2016). *Earned Value Project Management* (4th ed.). Newtown Square, PA: PMI.

Flyvbjerg, B. (2011). Over Budget, Over Time, Over and Over Again: Managing Major Projects. In P. W. G. Morris, J. K. Pinto, & J. Söderlund (Eds.), *The Oxford Handbook of Project Management* (pp. 321-344). Oxford: Oxford University Press.

Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. *Project Management Journal, 45*(2), 6-19.

Flyvbjerg, B., Bruzelius, N., & Rothengatter, W. (2003). *Megaprojects and risk : an anatomy of ambition*. Cambridge: Cambridge University Press.

Flyvbjerg, B., Budzier, A., & Lunn, D. (2021). Regression to the tail: Why the Olympics blow up. *Environment and Planning A: Economy and Space, 53*(2), 233-260.

Flyvbjerg, B., Garbuio, M., & Lovallo, D. (2009). Delusion and deception in large infrastructure projects: two models for explaining and preventing executive disaster. *California management review, 51*(2), 170-194.

Frick, K. T. (2008). The Cost of the Technological Sublime: Daring Ingenuity and the New San Francisco-Oakland Bay Bridge. In H. Priemus, B. Flyvbjerg, & B. van Wee (Eds.), *Decision-making on Megaprojects: Cost-benefit Analysis, Planning and Innovation*. Cheltenham: Edward Elgar.

Gann, D. (2000). *Building innovation: complex constructs in a changing world*: Thomas Telford.

Goolsbee, A., & Syverson, C. (2023). *The Strange and Awful Path of Productivity in the U.S. Construction Sector*. Chicago: Becker Friedman Institute.

Hajikazemi, S., Andersen, B., & Langlo, J. A. (2017). Analyzing electrical installation labor productivity through work sampling. *International Journal of Productivity and Performance Management, 66*(4), 539-553.

Haynes, M. (2020). *Productivity*. New York, NY: Columbia University Press.

Helm, D. (2009). Infrastructure investment, the cost of capital, and regulation: an assessment. *Oxford Review of Economic Policy, 25*(3), 307-326.

Hillebrandt, P. M. (1985). *Economic Theory and the Construction Industry* (2nd ed.). Basingstoke: Macmillan.

HMG. (2017). *Industrial Strategy: Building a Britain Fit for the Future*. London: HM Government.

HMT. (2010a). *Infrastructure Cost Review: Main Report*. London: HM Treasury.

HMT. (2010b). *Infrastructure Cost Review: Technical Report*. London: HM Treasury.

HMT. (2025). *UK Infrastructure: A 10 Year Strategy*. London: HM Treasury.

HOCCPA. (2023). *The New Hospitals Programme*. London: House of Commons.

Hughes, T. P. (1998). *Rescuing Prometheus: Four Monumental Projects that Changed the Modern World*. New York, NY: Vintage.

IPA. (2017). *Transforming Infrastructure Performance*. London: Infrastructure and Projects Authority.

Ive, G., & Gruneberg, S. L. (2000). *The economics of the modern construction sector*. Basingstoke: Macmillan.

Kotska, G., & Fiedler, J. (2016). *Large Infrastructure Projects in Germany: Between Ambition and Realities*. London: Palgrave Macmillan.

Kuusi, T., Kulvik, M., & Junnonen, J.-M. (2022). Productivity Growth in Construction Value Chains. *International Productivity Monitor*(42), 3-32.

MACE. (2025). *The Future of Major Programme Delivery*. London: MACE.

Margirier, G. (1988). *Le Secteur du Bâtiment et des Travaux Publics dans la Crise: Comparaison France, RFA, Italie, Royaume-Uni.* Paper presented at the Europe et Chantiers: Le BTP en Europe, Strutures Industrielles et Marché du Travail, Paris.

Mason, J., O'Leary, B., O'Mahony, M., & Robinson, K. (2008). *Cross-country Productivity Performance at Sector Level: The UK compared with the US, France, and Germany*. London: Department for Business, Enterprise and Regulatory Reform.

Maytorena-Sanchez, E., & Winch, G. M. (2022). Engaged scholarship in project organizing research: The case of UK infrastructure. *Project Leadership and Society, 3*, 100049.

McKinsey. (2013). *Infrastructure Productivity: How to Save $1 trillion a Year*: McKinsey.

McKinsey. (2017). *Reinventing construction: A route to higher productivity*: McKinsey Global Institute.

McKinsey. (2022). *The Net-zero Transition: What it would cost, what it would bring*: McKinsey & Co.

Merrow, E. W. (2023). *Contract Strategies for Major Projects: Mastering the Most Difficult Element of Project Management*. Hoboken, NJ: Wiley.

Merrow, E. W. (2024). *Industrial Megaprojects: Concepts, Strategies, and Practices for Success* (2nd ed.). Hoboken NJ: Wiley.

Merrow, E. W., Sonnhalter, K. A., Somanchi, R., & Griffith, A. F. (2009). *Productivity in the UK Engineering Construction Industry*. London: Department for Business, Innovation and Skills.

Miller, R., & Lessard, D. R. (2000). *The strategic management of large engineering projects : shaping institutions, risks, and governance*. Cambridge, MA: MIT Press.

Morris, P. W. G., & Hough, G. H. (1987). *The Anatomy of Major Projects: A Study of the Reality of Project Management*. Chichester: Wiley.

Murguia, D., Rathnayake, A., Jansen van Vuuren, T., & Middleton, C. (2024). Measuring construction productivity across projects: multilevel three-dimensional framework. *Journal of Construction Engineering and Management, 150*(11), 04024151.

Naoum, S. G. (2016). Factors influencing labor productivity on construction sites: A state-of-the-art literature review and a survey. *International Journal of Productivity and Performance Management, 65*(3), 401-421.

NIC. (2023). *The Second National Infrastructure Assessment*. London: National Infrastructure Commission.

NIC. (2024a). *Cost Drivers of Major Infrastructure Projects in the UK*. London: National Infrastructure Commission.

NIC. (2024b). *Cost Drivers of Major Infrastruture Projects in the UK: Methodology and Technical Annex*. London: National Infrastructure Commission.

Nye, D. E. (1994). *American technological sublime / David E. Nye*. Cambridge, MA: The MIT Press.

Onayev, A., Espey, C., & Swei, O. (2022). What explains the rising price of highway infrastructure? *Journal of Management in Engineering, 38*(4), 04022030.

ONS. (2021). *Productivity in the construction industry*. Newport: Office for National Statistics.

Peters, S., Pinkse, J., & Winch, G. M. (2023). *Driving Change in UK Housing Construction: A Sisyphean Task?* Manchester: The Productivity Institute.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York NY: Free Press.

PwC. (2016). *High Speed Rail International Benchmarking Study*. London: PricewaterhouseCoopers.

PwC. (2024). *Engineering, Procurement and Construction Management (EPCM) and Delivery Partner Models*. Dubai: PwC.

Rathnayake, A., & Middleton, C. (2023). Systematic review of the literature on construction productivity. *Journal of Construction Engineering and Management, 149*(6), 03123005.

Rathnayake, A., Murguia, D., & Middleton, C. (2024). Measuring activity-level construction productivity. *Journal of Construction Engineering and Management, 150*(8), 04024099.

Simcock, J. (2025). *Why Government Projects Really Fail and What Can Be Done About It.* Leeds: Emerald.

Stewart, J. (2025). *Major Projects Governance and Assurance Review*. London: Department for Transport.

Swei, O. (2018). Long-run construction cost trends: Baumol's cost disease and a disaggregate look at building material price dynamics. *Journal of Construction Engineering and Management, 144*(7), 04018058.

UKG. (2025). *The UK's Modern Industrial Strategy*. London: UK Government.

van Ark, B. (2025). Is Baumol's Cost Disease Still Haunting Public Services Productivity? In B. van Ark, S. Millard, A. Pabst, & A. Westwood (Eds.), *Joining Up Pro-Productivity Policies in the UK*. London: NIESR.

Vogl, B., & Abdel-Wahab, M. (2015). Measuring the construction industry's productivity performance: Critique of international productivity comparisons at industry level. *Journal of construction engineering and management, 141*(4), 04014085.

Wahba, S. (2024). *Build: Investing in America's Infrastructure*. Washington DC: Georgetown University Press.

Winch, G. M. (1994). The search for flexibility: the case of the construction industry. *Work, employment and society, 8*(4), 593-606.

Winch, G. M. (1998a). The growth of self-employment in British construction. *Construction Management & Economics, 16*(5), 531-542.

Winch, G. M. (1998b). Zephyrs of creative destruction: understanding the management of innovation in construction. *Building Research & Information, 26*(5), 268-279.

Winch, G. M. (2003). How innovative is construction? Comparing aggregated data on construction innovation and other sectors–a case of apples and pears. *Construction Management and Economics, 21*(6), 651-654.

Winch, G. M. (2025). *So, What Went Wrong With HS2?* Manchester: The Productivity Institute.

Winch, G. M., & Carr, B. (2001). Benchmarking on-site productivity in France and the UK: a CALIBRE approach. *Construction Management & Economics, 19*(6), 577-590.

Winch, G. M., & Leiringer, R. (2016). Owner project capabilities for infrastructure development: A review and development of the “strong owner” concept. *International Journal of Project Management, 34*(2), 271-281.

Winch, G. M., Maytorena-Sanchez, E., & Sergeeva, N. (2022). *Strategic Project Organizing*. Oxford: Oxford University Press.

Winch, G. M., & North, S. (2006). Critical space analysis. *Journal of Construction Engineering and Management, 132*(5), 473-481.