ICE Briefing Paper: The cancellation of HS2's northern leg – learning lessons

September 2024

Introduction

In October 2023, then UK Prime Minister Rishi Sunak cancelled the northern leg of the High Speed 2 (HS2) rail network, citing costs and changed circumstances.[1] The consequence of that decision is that the UK currently has the worst outcome – a truncated rail line that may degrade rather than improve rail services to the North. There is still no answer to future capacity constraints on the West Coast Main Line. The new government has confirmed that it is not reversing the decision to cancel Phase 2 of HS2.

It has also become clear that lessons were being learned from Phase 1 of the project. Better practices and efficiency gains that would have benefited Phase 2 delivery have now been lost.

Governments worldwide are finding that rising costs and delays are making it much harder to follow through on original infrastructure project visions. The cancellation of HS2's northern leg is a symptom of broader market capacity issues impacting infrastructure pipelines worldwide. But its problems also run far deeper.

HS2 was first proposed in 2009 and greenlit in 2012. Since then, it has attracted controversy and been subject to countless reviews. However, it is worth noting the following:

a) All official reviews since 2009 have recommended that the project should proceed.
b) Parliament has consistently voted in support of HS2-related legislation.
c) HS2 has had overwhelming support from the cities that would benefit from new growth opportunities.

The arguments over HS2 have somewhat overshadowed the many positives arising from the project. HS2 has already generated investment in businesses, communities and transport links along the route.

What has been achieved so far on Phase 1 demonstrates the civil engineering and construction capability in the UK to deliver a project of this scale. HS2 has driven innovation in delivery practices, including pioneering ways to reduce the impacts of large-scale infrastructure projects. Thousands of engineers, apprentices and other professionals have been trained and upskilled.

Learning lessons

The demise of HS2 has attracted wide interest, and given that similar projects will be scoped worldwide, there are many lessons to learn. As a global learning society, the ICE is well placed to lead this work.

This briefing paper sets out the following lessons for future major infrastructure projects from the cancellation of the northern leg of HS2:

1. **Who is in charge of infrastructure projects must be clear.**
    - **Establish processes to protect institutional memory.**
    - **Avoid duplication of roles across project teams.**
    - **Ensure departmental oversight is focused on the right areas.**

[1] Prime Minister's Office, 10 Downing Street (2023) PM redirects HS2 funding to revolutionise transport across the North and Midlands

2. **Stronger client and departmental capability is needed – particularly on technical assurance and 'owning the project'.**
    - **Use independent, expert 'challenge panels' for design control.**
    - **Project sponsors need to prioritise appropriate recruitment and training.**

3. **Any programme of this scale and significance needs more development time before commencing works.**
    - **Sufficient time is needed to assess alternative options, build in flexibility and challenge designs and specifications.**
    - **Give due consideration to how major projects interact with other infrastructure to maximise benefits and minimise disruption.**

4. **The contracting approach should set up the project for best-practice delivery.**
    - **Contracts need to be based on mature designs and extensive risk mitigation.**
    - **Clients need to retain the ability to be a 'guiding mind' overseeing technical development.**

5. **Major projects and programmes require clarity and consistency on outcomes to achieve political and public buy-in and deliver value for money.**
    - **An overarching transport strategy would clarify the strategic need for major projects.**
    - **Initial planning should be agnostic about transport infrastructure and modes.**
    - **The benefits of major projects are understated and need to be better articulated.**

Approach

Through its Next Steps Programmes, the ICE convenes global public debates to discuss what needs to happen next on key policy issues affecting civil engineering and society.

This Next Steps Programme has focused on decision-making in upstream planning, procurement and delivery on HS2 and the people, culture and context within which those decisions were made. It has sought to understand what went wrong, what went well, how mistakes could have been avoided, and what lessons the profession and policymakers need to learn.

This final briefing paper is based on interviews and written submissions from key decision-makers involved throughout HS2's life cycle, infrastructure professionals and other experts.

It reviews how the consequences of individual or aggregated decisions may have contributed to then Prime Minister Rishi Sunak's final decision to cancel the northern leg of HS2 in October 2023.

Typically, decisions are based on facts and value judgements of the individuals or teams involved in making them. Both facts and value judgements are also informed by the context (for example, external factors or organisational culture) within which decisions are made.

A different individual or team within a different context may make different decisions from those made. How decisions were made was a critical factor that informed the ICE's work in developing this briefing paper.

The development of HS2

In 2005, the Labour government commissioned the Eddington Transport Study to examine the long-term links between transport and the UK's economic productivity, growth and stability. The study concluded in 2006 that the UK's transport network was broadly adequate and the country did not need a high-speed railway. Eddington stated that while the benefits of high-speed rail were likely to be both 'real and substantial', other solutions could achieve those goals, perhaps at a much lower cost.[2]

Despite Eddington's recommendations, politicians decided a few years later to take forward HS2. Rail passenger demand continued to grow at pace, while the 2007–08 global financial crisis led policymakers to consider the case for major projects as a way to deliver post-recession economic growth and modernise ageing infrastructure networks.

2009 saw the completion of the West Coast Main Line (WCML) modernisation programme, which began in 1998. The attempt to allow faster and more frequent trains without shutting the line completely and without total replacement of the line was likened to 'open heart surgery on a marathon runner mid-race'.[3]

The ensuing cost and schedule overruns on the WCML, along with a decade of disruption to passengers and freight, played a large part in subsequent governments' decisions to pursue new-build rail options rather than upgrading the WCML further. It also became clear that the WCML modernisation programme would not solve long-term capacity issues.

HS2 is named as a spiritual successor to HS1, which has serviced the Channel Tunnel rail link in South East England since 2007. HS1's construction was finished within its agreed funding envelope, although at a higher cost and later than its initial targets. It has delivered significant journey time reductions, greater reliability, and the economic and lifestyle benefits of urban regeneration along the route.[4] The completion and successful operation of HS1 spurred further discussion about new high-speed lines in the UK.

In 2009, the Labour government created HS2 Ltd, and in 2010, following the general election, the Conservative/Liberal Democrat coalition government committed to developing the project.

The formation of the coalition government changed the political constituency dynamics of the route. Mitigations, such as tunnelling and cuttings, were made to reduce the project's visual and environmental impact throughout the Chilterns, naturally resulting in increased costs.

The three most consequential decisions on HS2

January 2009 – Establishment of HS2 Ltd

In 2009, the then Labour government established HS2 Ltd to consider whether there was a case for high-speed rail to the West Midlands and, if so, how it could be achieved.

HS2 Ltd's report later in 2009 estimated the cost of designing and building a line from London to the West Midlands at between £15.8 billion and £17.4 billion at 2009 prices. Additional costs would include rolling stock at around £3 billion.[5]

An initial assessment in March 2010 of a core network linking London to Birmingham, Manchester and Leeds estimated the cost at around £30 billion (excluding rolling stock).[6]

[2] House of Commons Library (2010) Eddington Transport Study
[3] Rail Engineer (2015) HS2 – The Story So Far
[4] Steer (2020) Delivering for Britain and Beyond – The Economic Impact of HS1
[5] HS2 Ltd (2009) High Speed Rail: London to the West Midlands and Beyond, Part 9 of 11
[6] Department for Transport (2010) High Speed Rail Command Paper

February 2020 – Following the publication of the Oakervee Review, then Prime Minister Boris Johnson decides to proceed with HS2

In 2019, Sir Douglas Oakervee was asked by then Prime Minister Boris Johnson to review 'whether and how' to proceed with HS2. The Oakervee Review's remit included HS2 Ltd's ability to deliver the project, the full range of costs and benefits, and the potential to reduce costs and reprioritise parts of the project.[7]

The Oakervee Review concluded that, on balance, HS2 should continue. Its reasoning included the cost of cancellation arising from sunk costs, the detrimental impact it would have on the supply chain, rail capacity and reliability challenges still needing to be addressed, and the lack of ready alternatives to HS2. It said the government should re-commit to the full Y-shaped network because Phase 1 only represented value for money with the northern phases.

The outcome of that review was Boris Johnson's decision to proceed with HS2. The cost of delivering the entire Y-shaped network was revised from £72 billion to £98 billion in 2019 prices.[8] However, the government did not adopt all of Oakervee's recommendations, including one to remove HS2 Ltd's involvement in the development of Euston station.

October 2023 – Then Prime Minister Rishi Sunak decides to cancel HS2's northern leg

In October 2023, Prime Minister Rishi Sunak announced the cancellation of Phases 2a and 2b and confirmed that completion of HS2's London Euston terminus, with a smaller, simplified design, would be contingent on private investment. He also announced the allocated budget would be reallocated to other transport schemes. By then, the cost of delivering HS2 – which had already been scaled back with the removal of the eastern part of the network to Leeds[9] – had reached between £53 billion and £71 billion in 2019 prices.[10]

That decision has cost over £2.1 billion, according to HS2 Ltd. That figure includes costs linked to design, preparation of the Hybrid Bill, enabling works, environmental works and asset write-downs.[11] In total, closing down work on Phase 2 is expected to take three years to complete and cost up to £100 million.[12]

[7] Department for Transport (2020) Oakervee Review of HS2
[8] Department for Transport (2020) HS2 6-monthly report to Parliament: October 2020
[9] ICE (2021) Will the Integrated Rail Plan be a game-changer for the North and Midlands?
[10] Department for Transport (2023) HS2 6-monthly report to Parliament: June 2023
[11] HS2 Ltd (2024) Annual Report and Accounts 2023–2024
[12] National Audit Office (2024) HS2: Update following cancellation of Phase 2

Why did the UK Prime Minister decide to cancel HS2's northern leg?

In this section, we explore some factors and decisions that may have resulted in HS2 Phase 2's cancellation.

Whatever the reason for Rishi Sunak's decision, the starting point is that as Prime Minister he *could* make the decision. Despite the Department for Transport and HS2 receiving authorisations to spend and permission to proceed through Hybrid and other Bills, ultimately none of that matters if the UK government decides not to act on Parliament's instruction on investment.

The only political control over the Prime Minister's decision was based on how much political capital cancelling the project would cost. However, political support for HS2 had begun to evaporate, while voters were ambivalent about the project.[13] This meant very little political capital needed to be spent, and despite some complaints from senior politicians, no one was willing to make cancellation an issue on which to resign. This suggests that political support for HS2 was weak despite significant majorities in parliamentary votes on the project.

The Prime Minister exercised his powers to cancel the northern leg; however, previously assumed powers of the UK's executive vs. the legislature are being tested through judicial reviews (most notably on triggering Article 50 to initiate Britain's departure from the European Union). No such challenge was brought to test whether new primary legislation was needed to cancel HS2.

Why might political support have evaporated?

Political support for HS2 could be seen as being constructed on tactical concessions given to parliamentarians and other senior political figures to secure their support. Therefore, the buy-in on the strategic case for HS2 would have been shallow.

In addition, HS2, as a project, had to navigate six Prime Ministers, eight Chancellors and nine Secretaries of State for Transport in the time up to Phase 2's cancellation. All of these senior decision-makers will have had different ideas of why HS2 was important, with some seeing it as a project focused on either speed, capacity, economic growth or demonstrating Britain's modernity.

These value judgements will have informed the decisions made by senior politicians. Over time, this meant decisions were no longer aligned to any central purpose, and the narrative over the need for HS2 was constantly shifting.

A second reason political support could have evaporated is that, in addition to changes in senior politicians, the key players involved in developing HS2 also changed. This included CEOs, chairs, senior responsible officers within the Department for Transport (DfT) and other senior directors across HS2 Ltd and DfT.

Over time, these changes will have reduced the institutional memory of previous decisions (and lessons learned so far on the project) and why those decisions were made. Additionally, the personnel changes will have meant that intended future decisions, not made but tacitly understood, would have been lost. One example is the expectation that HS2 would use standardised designs for bridges; this was not followed through in procurement decisions, with huge cost implications.

The final and most well-documented reason for the Prime Minister's decision to cancel was the many cost increases. As highlighted in the timeline above, the cost of constructing the project had well exceeded forecasts by October 2023. This raised questions about what the final outturn price for the project would be once construction for Phases 2a and 2b had commenced.

[13] YouGov (2024) Support for High Speed Rail HS2

At a time of constrained public finances and a 'cost-of-living crisis' in the UK, a project that had and would continue to exceed its budgets would have been difficult to justify. This is especially true in a political environment where support was already weak and the narrative on the need for HS2 had shifted frequently.

Why wasn't Phase 2 paused instead?

Despite this, some have raised the question of why the decision jumped immediately to cancellation rather than a pause to take stock and see what could be done to reduce costs while still securing the main benefit of HS2. Construction of Phase 2 would have benefited from lessons learned and efficiencies developed over time on the project. Early on, the supply chain had to invest massively in plant and upskilling, which would result in efficiencies later in the project. Cancelling Phase 2 means those opportunities to reduce costs have been lost.

Fiscal rules set by the then chancellor Jeremy Hunt in 2022, particularly the requirement for debt to be on course to fall as a share of national income in five years, may have influenced the decision to cancel HS2's northern leg. The rule was meant to be a strong political message and a way to ensure long-term financial sustainability. However, delaying investments expected to deliver economic benefits and introducing more uncertainty about the government's commitment to major infrastructure projects undermined, rather than supported, those objectives.

It has also been suggested that the decision to cancel may have been linked to a wider political need which had little to do with HS2 and spiralling costs, and more to do with the upcoming election and building an image for the Sunak government as being distinct from other political parties, willing to challenge the status quo and committed to investing in other projects.

There have been suggestions that previous decisions about the line may have been made for political reasons – notably removing the Golborne Link, which was in Graham Brady's (then an MP and Chair of the influential 1922 Committee of backbench Conservative MPs) constituency.[14] While that decision helped with affordability, other benefits were lost.

The rest of this section explores why the project was sold on transactional factors, why there were changes in personnel, and why the forecasted costs kept increasing.

Why was the project sold on transactional factors?

There are three reasons why the project ended up being principally promoted to politicians on transactional factors.

The first is that, in the early stages of the project, ahead of the 2010 general election, proponents of the scheme decided to move quickly with project planning and development to try to escape politics and overanalysis slowing things down. The lesson learned from previous projects, such as Crossrail (opened in 2022 but where the initial need was identified in 1974), is that even when a need is identified, there is no guarantee that the political system will allow that need to be translated into a project in a timely manner.

A consequence of moving so quickly was the limited time to promote a consistent strategic story on the need for HS2. This became a bigger problem as both coalition parties in government after the 2010 general election went into that election backing HS2, with limited time to analyse the need for it (the initial analysis on the case for HS2 was published in March 2010, less than two months before the election). The Conservative Party backed the project in the election for other tactical purposes, principally using it to argue against the need for a third runway at Heathrow.

From the outset, the discussion about HS2 was focused on transport, not outcomes. The initial narrative was framed around the journey time savings from London to cities in the North and Midlands, but messaging quickly became unclear – encompassing speed, capacity, economic rebalancing and emissions savings.

The lack of a well-embedded strategic story for HS2 meant that a significant cohort of the public was indifferent to the project. Therefore, it did not take much for them to become detractors, particularly as planning approval and then construction for Phase 1 started.

[14] New Civil Engineer (2022) HS2 | Engineers warn cancelling Golborne link 'hobbles the value' of high-speed rail network

Second, the nature of securing planning approval for rail projects in the UK – the Hybrid Bill process – further reinforced the project's being sold on a transactional basis.

The Hybrid Bill process naturally lends itself to granting concessions – such as extra tunnels – to constituents to secure the support of their MPs for the final vote. However, poor scope control meant the costs associated with these concessions were not made clearer to the public. This allowed costs to rise and limited debate on the trade-offs between the UK-wide value of the project and the costs of appeasing local opposition in the proximity of the works.

Lastly, in the absence of a strong strategic case, many considerations as part of the business case would have been proposed to ensure that the project's benefit-cost ratio (BCR) was high. It has been suggested that aspects of the HS2 project, such as the number of train paths per hour or the design speed of the railway, were pushed to the limits of what was needed. This was to increase the value of benefits to ensure the overall proposal achieved a BCR closer to 2. For example, based on transport modelling in use at the time, time spent on trains was seen as wasted time and, therefore, a faster journey meant more productive use of time off trains.

Why were there so many changes in personnel?

There are two reasons why there was so much change in personnel. The first is the changing nature of HS2 Ltd's role. Initially set up to examine the case for high-speed railways to the West Midlands, the organisation then scaled up significantly to focus on getting the Phase 1 Hybrid Bill into and through Parliament. It then became responsible for delivering the project.

Each change in role for HS2 Ltd would have seen key people move on, but any project of this length would have naturally seen key people move on over time. For example, those brought in to secure political buy-in may have preferred to move on once the delivery stage commenced. Similarly, specialist talent would have been brought in to deliver the Hybrid Bill. Each change also meant changes in the culture, behaviour, focus, strategic alignment and organisational balance of HS2 Ltd.

The second reason is the nature of UK politics over the last 15 years. Ministers in the UK often change frequently, with Prime Ministers undertaking reshuffles of Ministerial portfolios to meet political objectives or to fill gaps left by resignations.

Over the last 15 years, however, the changes have been unprecedented. Between 2009 and 2023, the UK had six Prime Ministers, nine Secretaries of State for Transport and eight Chancellors. Compare this to the 15 years before 2009, when the UK had three Prime Ministers, seven Secretaries of State for Transport and three Chancellors.

Some of these changes were the result of general elections; these elections also saw changes to the Members of Parliament serving on the Hybrid Bill Select Committee, which determined appropriate mitigations along the route.

Frequent political changes will have resulted in many changes in the political case for HS2, as well as the depth of political buy-in from those accountable for the political outcomes of the project.

Why did costs go up?

While politicians may have had a loose awareness of the case for HS2, one thing they would have been very aware of is the increases in the forecasted budget for construction. Many of the reasons why construction forecasts fail to meet outturns on major projects have previously been explored by the ICE,[15] and many of these have been addressed through the development of the Construction Playbook (even if governments have failed to reinforce the Playbook as rigorously as they should). This section explores five of the most striking reasons HS2's forecasted costs would have escalated.

Unrealistic budgets given the limited design

The first is that unrealistic budgets were set for the project from the start in 2010, given the limited knowledge and level of detailed design work at that stage.

[15] ICE (2019) Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes

During the Phase 1 Hybrid Bill process, the HS2 design was immature. It was a 'level 0' design, according to the RIBA framework (where contracts would not typically be sought until a 'level 3' design stage was met).[16] However, in 2013 the government had revised the overall HS2 budget to £42.6 billion and stated a 95% certainty (the 'P' number) that it would be delivered on budget. This confidence was received with scepticism by both industry and parliamentarians, given the early stage of the project.[17]

Designers would have been aware that the Hybrid Bill process would introduce revisions to the route, while other mitigations also surfaced (such as additional tunnelling), which would have added significantly to the cost of the project. Yet Parliament was asked to approve a Bill that included timeframes for when the line would open and how much it would cost.

Short timescales for conceptual planning and design

Second, one of the lessons from Crossrail was the need for mature designs before commencing construction, but this was lost on HS2. The initial study by HS2 Ltd in 2009 into the case for a new high-speed line was given a deadline of less than a year, to be completed before the 2010 general election.

This limited the ability to be adaptable in the conceptual stage of the project, which is when costs are lowest and flexibility is highest. Fundamental questions were not answered early on – for example, the speed at which trains would run kept changing and whether it was a purely high-speed railway or a dual railway was unclear.

The pace of delivery continued to be prioritised over design maturity. Even when there was a pause during the Oakervee Review, most contractors did not use the time to progress the design. This meant producing designs very quickly post-Oakervee. The design was still being developed while contractors were already doing early groundwork, but the ICE heard during this consultation that the design should have been taken up to 40% maturity before construction began.

Ultimately, the design costs were so great that they reduced the budget to deliver on some of those design decisions in practice. At the same time, the project was taking on additional costs due to being unable to assess all the designs fully; for example, some assets along the HS2 route are unnecessarily complex and costly to maintain.

Over-specification

HS2 has been criticised for being over-engineered, but the caveat is that the initial study recommended a preference for world-class design and designing a railway for 'the next 200 years' (hence the design speed of 400 km/h); this preference came with increased costs compared to a more conventional railway. The specifications aimed for 36 trains an hour (18 in each direction), which required a high-end level of service (99% reliability). Nowhere else in the world is running that frequency of service.

HS2 Ltd and its promoters saw it as a unique project and wanted it to have its own standards, rather than using existing ones that were well understood. Building to a higher standard with more materials than necessary created unnecessary complexities, inflated costs and increased the environmental impact. For example, the extensive MATs (maintenance access tracks) are a departure from traditional methods, where maintenance is done directly from the railway, and resulted in the construction of almost as much road as railway.

The ICE has been told that the cost difference between a conventional railway and a high-speed railway (as designed for HS2) was 10%, and therefore, given the additional benefits of a high-speed railway, this was preferred. However, it is not clear what HS2 design the conventional railway was compared against, and at 10%, the difference in costs would now amount to close to £10 billion.

[16] RIBA (2020) Plan of Work
[17] Public Accounts Committee (2013) High Speed 2: A review of early programme preparation

Delays in obtaining planning consents

Planning and consenting along the line were not well understood. The volume of planning consents required to build the line was enormous – over 8,000 between Euston and Birmingham New Street, which was higher than anticipated. These consents also required more design refinement than expected.

Local opposition along the route made obtaining consents even more difficult. Statutory bodies, like the Environment Agency, had objectives which sometimes conflicted with those of HS2 Ltd. The Hybrid Bill gave HS2 Ltd the right to override planning authorities – but taking those powers from the usual bodies caused confusion. Delegating the process of gaining planning and other consents and of managing the relationships with those third parties to HS2's contractors also resulted in a loss of control and delays.

Inflation

Inflation has also clearly been a factor. The forecasted budgets will have been re-baselined to factor in inflation, as is standard practice. However, since the end of the Covid-19 pandemic, inflation has been significant across the economy, particularly within the construction supply chain, with material and labour costs outpacing inflation across the whole economy.

However, there was a 'head in the sand' mentality about managing the impact of inflation on HS2. The government did not account properly for inflation, outlining that the costs would be held at a particular date (2019 costs), therefore skewing the figures. This contributed to the public and political outcry on costs. The inception phase of projects needs to focus on outturn costs at all times, but nobody wanted ownership of the cost difference. There were no powers in the project sponsor function for the government to take this ownership.

Procurement and contracting

Perhaps the most striking cause of cost increases was the approach taken to procurement and contracting of Phase 1 of HS2. Several factors were at play, which had cascade effects on the costs.

Size of contracts

The first is the size of contracts. The government was concerned it would not get the best contractors to bid on such a large, risky project. HS2 Ltd initially tendered seven contracts. This was driven by a concern, following the collapse of Carillion in 2018 and with Crossrail in construction, that individual contractors would not be strong enough and would need to work through joint venture arrangements. There was also a view, learned from Crossrail, that smaller tenders introduced too many interfaces that had to be managed and assured, with significant costs and time involved in oversight for the client.

Following the awarding of contracts, successful bidders used a provision in their contracts to combine their lots; the seven original tenders became four. The size of these contracts meant an imbalance of power would have occurred between contractors and HS2 Ltd – especially as there was a drive to move as quickly as possible with delivery – and DfT and HS2 Ltd were left with very few levers to influence costs.

On its own, this approach to the size of tenders may not have been a problem. Cost-plus contracts can work if a project is planned and delivered well. However, coupled with the speed at which these huge multi-year, multi-billion-pound civil engineering contracts were awarded relative to the limited design maturity, alongside other decisions, it had a cascade effect on costs.

Transfer of design and assurance to contractors

Second, again, the learning from Crossrail was to reduce interfaces, and the decision was taken to pass design and assurance for project assets to contractors. This had two effects. The first was to eliminate the expectation that project assets (e.g. bridges and other structures) would be standardised, therefore reducing costs through economies of scale. This was another lesson lost from Crossrail, where nine stations had nine different designers, increasing construction and maintenance costs due to their bespoke nature.

The second effect was to remove HS2 Ltd's ability to be the 'guiding mind' for the ongoing technical development of the project. With no effective design authority holding everything together, there were not the required checks and balances to ensure a good, value-engineered design and manage costs.

Approach to managing risk

The third factor is the approach to mitigating risk. Too little time and money was spent on feasibility and the business case before contracts were let. Spending more time on this would have derisked the project further down the line and ultimately saved taxpayers money. Extensive feasibility testing is common practice in the private sector but less so in the public sector, where political factors mean projects risk being cancelled. Derisking early also means projects attract more competitive tenders.

In addition, if design and assurance for project assets were being passed to contractors, then HS2 Ltd also had to transfer risks of long-term deterioration 100% to the supply chain, which introduced a conservative approach to design and, with it, a higher cost of construction. It has also been suggested that project assets were being designed to meet the price, pushing the approach to a cost-reimbursable model rather than one based on should-costs.

Lessons for future major infrastructure projects

It is important to acknowledge that lessons were already being learned from Phase 1. HS2 Ltd has been undertaking a radical transformation to improve delivery of the programme. A new delivery model was developed for Phase 2a, applying Project 13 Principles.[18] Other lessons included a much more mature design and smaller contracts. Alongside efficiency gains, Phase 2 would likely have been more cost-effective and avoided many of the issues that have hampered the project to date.

The UK's supply chain capability is another issue. The leadership and capability of supply chains must be nurtured and grown so these supply chains can take on the huge infrastructure challenges required to meet wider societal objectives. This, of course, requires a consistent pipeline to ensure investment in long-term talent.

With the cancellation of Phase 2, all these expected benefits will be lost. HS2 Ltd and DfT are in the process of resetting the project to focus on delivering Phase 1.[19] The following lessons draw on the insight the ICE has gained through this Next Steps Programme. They are intended to support policymakers, decision-makers and practitioners tasked with planning and delivering future major infrastructure projects.

1. **Who is in charge of infrastructure projects must be clear.**
    - **Establish processes to protect institutional memory.**
    - **Avoid duplication of roles across project teams.**
    - **Ensure departmental oversight is focused on the right areas.**

HS2 Ltd has morphed into various guises throughout its lifetime. First, as an organisation focused on concept and design. Then, as an advocacy body that scaled up significantly to develop and deposit the Phase 1 Hybrid Bill, bringing in a development partner to support this. Then, later, as a delivery organisation, while also focusing on the Hybrid Bills for Phases 2a and 2b.

While staff turnover is expected across a government-sponsored project in a 15-year period, over the series of Ministers and officials involved in HS2, the project failed to retain institutional memory. Mitigating procedures need to be put in place to prevent the loss of knowledge as part of that personnel change.

It became unclear who was making decisions, how they were made and when, and whether those decision-makers had all the information required to make informed decisions. It also meant that external stakeholders, such as local authorities, lacked clarity about how they could influence decision-making.

A major project, such as HS2, often has many clients and owners who set up practices and governance processes unique to that project. This can mean the duplication of roles – with the same functions appearing multiple times between senior contractors, clients and sponsors. The element of 'checkers checking checkers' can impede decision-making and add layers of oversight without necessarily adding value.

The lack of a coherent organisational model that was regularly reviewed and updated – ahead of each key decision point – was perhaps one of the root causes of the misalignment and unrestrained decision-making around scope. This was exacerbated by poor change management. The failure to explain decisions and changes heightened the sense of a lack of control and caused political and public alarm at cost escalations.

DfT oversight

When Crossrail ran into cost and time overruns in 2018, Ministers in the Department for Transport became concerned that the lack of departmental oversight on that project had resulted in problems being ignored until too late.

[18] ICE (2019) Exploring Project 13 Principles
[19] National Audit Office (2024) HS2: Update following cancellation of Phase 2

At a time when DfT should have been allowing HS2 Ltd greater freedom as it ramped up for the start of construction, it applied further oversight to try to avoid a Crossrail-esque situation arising on HS2. DfT has become very heavily involved in the project to the point where there is little separation between the client and the delivery body. Excessive scrutineering is not productive. Nor was it the type of oversight required on HS2 – there was a lack of technical design oversight to ensure that what was being built represented value for money.

Neither HS2's nor Crossrail's governance is or was perfect. Crossrail's 'long arm' was too long and allowed problems to develop to the point where visibility had to be increased. However, it did help shield the project from excessive political interference. Crossrail set up a joint sponsor unit that represented Transport for London's (TfL), DfT's and HM Treasury's interests in a more controlled, purposeful way. In contrast, HS2 was more subject to political interference, leaving it highly exposed to change.

2. **Stronger client and departmental capability is needed – particularly on technical assurance and 'owning the project'.**
    - **Use independent, expert 'challenge panels' for design control.**
    - **Project sponsors need to prioritise appropriate recruitment and training.**

During discussions, we have heard that the model of departmental sponsorship works. But only if it is reinforced by strong departmental capability and robust advocacy.

2017, in particular, was a pivotal moment for HS2. During a period of political upheaval following the EU referendum, there were numerous Ministerial and staff changes just at the critical point when HS2 Ltd was ramping up to become a major delivery organisation. The loss of 'guiding minds' and champions for the project meant that the capability to challenge the design and costs was eroded across the government, DfT and HS2 Ltd.

Technical aspects of the project were outsourced to contractors, and there was an increasing reliance on consultants. While design consultants felt able to challenge HS2 Ltd, the failure to explain decisions and cost implications heightened the sense of no control. The ICE has also heard that designers were frustrated by the inability to pursue innovations because of the relentless focus on meeting programme and cost milestones.

Among this, the use of expert 'challenge panels' could have been improved. Three initial challenge panels (covering the strategic, technical and analytical aspects of HS2) only met until 2012 and lacked the diversity in viewpoint and expertise required to provide robust challenge.[20] The Oakervee Review recommended setting up technical challenge panels covering engineering (design and construction), procurement and cost control, and systems including integration.

People/workplace culture

Workplace culture and support for programme teams on major infrastructure projects are also important. The ICE has heard that issues including lack of clarity across different parts of the project, constantly shifting deadlines, lack of leadership and a relentless focus on costs contributed to unsatisfactory working conditions, low morale and a high risk of burnout.

Governmental and civil service capability

Civil servants had substantial influence over the project, but little experience of delivery. The Infrastructure and Projects Authority's (IPA) Major Projects Leadership Academy (MPLA) has improved skills in the civil service, but has its limitations. It teaches leadership skills, but not technical knowledge, so civil servants often do not understand the detail and science of the major infrastructure projects they are leading. The speed at which civil servants change posts, often within less than two years, also makes it difficult to develop and retain expertise in key positions.

[20] Transport Committee (2011) High Speed Rail

One of the lessons of Crossrail is that sponsoring departments should focus on recruiting good people, not cost.[21] However, lower salaries and HM Treasury's reluctance to raise them to compete with the private sector mean the civil service can struggle to recruit the best talent with relevant STEM expertise to sponsor units.

Ministers are often selected for political reasons rather than because of any particular expertise in their portfolio. The recent trend of rapid turnover of Ministers afforded limited opportunity for office-holders to master their brief. This means Ministers also often lack sufficient understanding of infrastructure delivery and budgets. More stability in appointments is required, but will inevitably be subject to wider political factors. Ensuring Ministers receive appropriate advice before making decisions or even training to understand how a project works at budget and programme level would help.

The scale of mega-projects requires expert oversight and visibility, both deep down and across the project, of what progress is being made. The expected merger of the National Infrastructure Commission (NIC) and the Infrastructure and Projects Authority under the new government is an opportunity to strengthen support for major infrastructure planning and delivery. However, the scope of the body's powers remains uncertain. Some have argued that a dedicated Department for Infrastructure (with a Minister for Infrastructure) or a super-project management office is needed to strengthen civil service capability and oversee major infrastructure projects adequately.

3. **Any programme of this scale and significance needs more development time before commencing works.**
    - **Sufficient time is needed to assess alternative options, build in flexibility and challenge designs and specifications.**
    - **Give due consideration to how major projects interact with other infrastructure to maximise benefits and minimise disruption.**

The conceptual stages of a project are where the most value can be achieved – client control and flexibility are high and cost expenditure is low.

Spending time understanding what is required and acceptable, including how it compares with alternative options, and allowing more focus on design detail and how this translates to delivery, is vital. Engineers will not arrive at cost-effective designs if they are following an inappropriate scheme. Key decisions should happen by considered choices rather than be subject to chance. More time in development should also help shorten the planning consent process.

As far back as 2019, the ICE recommended that scope, design and exploration should be completed before commencement of work is allowed, to avoid scope creep and to limit later changes, as well as to include contractors in design at an early stage.[22]

The ICE has also been leading work on the scope of a Design Champion role.[23] This could be required on the board of every major infrastructure project to advocate for design principles at the highest level. The role of a Design Champion was first recommended by the NIC in 2018 to facilitate the delivery of its design principles on all nationally significant projects. These principles seek to ensure that projects are developed with respect for people and places, address the climate challenge and deliver value.[24]

Politics drove HS2's accelerated development phase and high specifications

HS2 developed incredibly quickly from a concept in 2009, through to a public consultation on the route in 2011, to being given the green light by the Conservative/Liberal Democrat coalition government in early 2012.

HS2 Ltd undertook a large amount of work in only ten-and-a-half months in 2009. The short timeframe was precipitated by the upcoming 2010 general election, with concerns from the then Labour administration that a new government would not proceed with HS2 if detailed designs were undeveloped.

[21] Department for Transport and Infrastructure and Projects Authority (2024) Sponsoring a Major Project: The Crossrail Experience
[22] ICE (2019) Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes
[23] ICE (2023) Defining and developing the Design Champion Role: Research report
[24] NIC (2018) National Infrastructure Assessment 1

In this short time, HS2 Ltd conducted a route engineering and alignment study between London and the West Midlands, station layouts, facilities and passenger circulation, a demand model to provide transport forecasts, environmental and sustainability reports, as well as the business case appraisal. That such a vast amount of work was completed in a short period is a remarkable achievement.

However, it is likely that not all factors affecting the cost were considered and, due to the speed with which HS2 Ltd's initial proposals were developed, the opportunity to build in greater flexibility was lost, the government of the day being keen to act quickly to accept the proposals and avoid the project becoming embroiled in a political row.

The proposals that emerged from this work included a preference for world-leading design, longevity and a very high line speed of up to 400km/h – all of which had cost implications and consequences. It is unclear how rigorously these proposals were scrutinised and challenged.

Stating how much the project would cost when the design was so immature was a fundamental mistake in terms of future political and public support. To manage expectations, major projects should provide only an order of estimate (using reference class forecasting) that accounts for risks and unknown costs at the outset. More detailed costing can come later as the design matures. Negotiating costs down to the lowest possible degree at that stage is fruitless because they will inevitably rise later.

The Hybrid Bill process can also be improved. The Hybrid Bill is necessary because it allows for permissions to proceed, land purchases and more. However, designs need to be between 4% and 7% complete to go through the Hybrid Bill stage, but so much of that is guesswork, and the risks are unknown and unappreciated at that point.

Integrated planning

More time also needed to be spent planning how the route would interact with the rest of the transport network and other infrastructure to minimise disruption and align national and regional planning. While some work was carried out, such as the 2013 HS2 Growth Taskforce Study to identify opportunities,[25] we have also heard that more could have been done to integrate HS2 and maximise the benefits to the regions. These benefits should then be a major input to the cost-benefit analysis.

For instance, the focus on linking cities at maximum speed meant there was no thinking about what this meant for the purpose and location of the stations. Giving cities more say in where the stations would be located could have driven discussion about how HS2 would interact with the rest of the network and where development capacity was most available. Instead, an appraisal methodology that prioritised speed led to a route that was not the most cost-effective and where the stations were an afterthought.

Similarly, the narrow focus to planning the route underplayed how it would disrupt other infrastructure. Some of this disruption is not just during construction but will be permanent. Much greater planning effort needs to be put into thinking about where wider development can occur but also where disruption might be significant.

4. **The contracting approach should set up the project for best-practice delivery.**
    - **Contracts need to be based on mature designs and extensive risk mitigation.**
    - **Clients need to retain the ability to be a 'guiding mind' overseeing technical development.**

As outlined in this paper, one factor that led to an increase in HS2's costs was the approach taken to procurement and contracting of Phase 1.

The size of the contracts used on HS2 Phase 1 – which included design and build aspects – meant that contractors were in a more dominant position to make demands on changes to contract terms. The cost increases that resulted from this ultimately led to HS2 Ltd pushing back the 'notice to proceed' deadline initially from November 2018 to June 2019 to allow contractors to reduce costs, later revised to April 2020 following the Oakervee Review conclusions.

[25] UK Government (2014) HS2 Growth Taskforce

The contractors also had an incentive to put the price up as, because costs went down, they would make more money from the contract incentives.

The ICE has also heard that HS2 Ltd became overwhelmed by compensation event claims from the contractors, which would entitle them to additional time and/or money. These claims exist under the NEC contracts used. However, the volume of claims was much higher than is typical on large projects. Many were accepted because HS2 Ltd could not recruit enough capable staff to deal with them in time.

With these contracts including design and assurance aspects, the expectation that many project assets would be standardised was lost. It also meant HS2 Ltd lost the ability to act as the 'guiding mind' for the ongoing technical development of the project, eroding its capability as an intelligent client. On any project of this scale, control and visibility of designs are key to cost control.

The importance of mature design and the planning process still tends to be underestimated on major infrastructure projects. On HS2, the contracting approach combined with immature designs and consents greatly impacted subsequent cost escalation. Sponsoring departments and clients must be ruthless in gate reviews and controls until design and planning are sufficiently mature.

The benefits of different approaches to procurement (contractor design and build vs. adopting a consultant's design) could be evaluated in greater detail. The contracting approach on HS2 also contrasts with other countries, particularly France, where fixed-price contracts are normal but are based on a more detailed and mature design and where risks have to be mitigated to the minimum. Another approach could have been to contract the project as a system, not as a series of separate work packages with interfaces.

5. **Major projects and programmes require clarity and consistency on outcomes to achieve political and public buy-in and deliver value for money.**
    - **An overarching transport strategy would clarify the strategic need for major projects.**
    - **Initial planning should be agnostic about transport infrastructure and modes.**
    - **The benefits of major projects are understated and need to be better articulated.**

From the outset, the discussion about HS2 was focused on transport, not outcomes. The government did not have an overarching transport master plan within which to situate HS2. This should set out the need for HS2, how it would fit into the wider transport network and ensure subsequent decisions do not deviate from the original purpose. Instead, the project arose from a politician's vision and subsequent attempts at justifying it have been 'after the fact' rather than true drivers.

While the initial narrative and business case for HS2 were framed around journey time savings from London to cities in the North and Midlands, the messaging then became unclear – encompassing speed, capacity, British prestige, economic rebalancing and emissions savings – particularly when spread over 15 years and so many different decision-makers.

During this time, other needs on the transport network were neglected because of the focus on HS2. For example, in 2020, the National Infrastructure Commission's assessment of rail needs for the Midlands and the North found that the weakest links were East–West, not North–South.[26]

Had the original HS2 proponents worked back from 'what was the goal', the answer may not have been a high-speed solution. To avoid building infrastructure for infrastructure's sake, upstream planning needs to start by being agnostic about transport infrastructure and modes to establish the right solutions.

Thinking about benefits, not costs

Confusion about outcomes and the wider value of a project also leaves nothing to judge decisions against when problems with projects are inevitably encountered. Policymakers will, therefore, often narrow decisions down to a single lens – the

[26] National Infrastructure Commission (2020) Rail Needs Assessment for the Midlands and the North

cost. Constrained public finances and the frequent shifting of the narrative on the need for HS2, resulting in eroded political support, made the Prime Minister's decision to cancel the northern leg of the project in October 2023 easier.

That extends to wider discussion about critical infrastructure projects. There is an onus on the engineering profession and membership bodies like the ICE to make the case for infrastructure investment by emphasising the wider benefits to society rather than defaulting to discussing the costs.

Indeed, the benefits of HS2 have generally been understated, as they have been on other major rail projects. The Oakervee Review noted with surprise that HS2's business case did not try to estimate many potential benefits to the UK economy in the project's benefit-cost ratio, such as changes to land use through commercial and residential development, even though economic rebalancing was one of the primary drivers in the strategic case.[27]

Benefits calculation on major projects needs to be better articulated. On HS2, the business case only stacks up by going to Manchester. The cancellation of Phase 2 has eroded the benefits of Phase 1. HS2 had limited development opportunities around its stations compared to urban lines like Crossrail so the realisation of its benefits is limited to major city centres. However, in reality, connectivity would have delivered huge benefits to other areas.

HM Treasury's Green Book guides project appraisals, but its methodology at the time may not have been suitable for taking into account the wider benefits that HS2 would provide. The Green Book has since been reviewed and updated and now requires project proposals to contain a much clearer outline of their strategic objectives from the start and how these link to the government's priorities. The review said that only options with a 'strong strategic case' would now enter the BCR stage of the process.[28] This may, in part, be trying to directly address lessons arising from HS2.

Conclusions

It is ironic that delivering HS2 Phase 2 would most likely have been much more straightforward and efficient in comparison to the difficulties faced on Phase 1. Lessons were being learned and acted upon through new approaches to design, contracting and delivery. Efficiencies built up over time would have reduced costs. Specialist skills had been developed, with many more jobs and apprenticeships also to be created.

However, Phase 2 is no more and those expected benefits will be lost. Confidence in the UK construction sector has been undermined. Supply chain capability depends on a consistent pipeline to ensure investment in long-term talent.

It also means that the need for additional capacity on the UK's key rail corridors between London, the Midlands, the North West and North East of England and into Scotland remains unaddressed. Phase 1 will not fix future capacity shortfalls on the West Coast Main Line. There is currently no plan to tackle the poor connectivity within and between the North and the Midlands, which is constraining growth in those regions.

Indeed, as noted at the outset of this paper, the decision to cancel the northern leg of HS2 has left the UK facing the worst outcome – a truncated rail line that may degrade rather than improve the cost and reliability of services to the North. Birmingham will see some benefits from new investment linked to the line, but other cities will not see the economic benefits of improved connectivity. Without a plan to address those gaps, there is a risk that regional imbalances will worsen if the North falls further behind the South East and, increasingly, the Midlands.

It is not possible to separate politics from major infrastructure projects, but delivering those projects requires commitment over multiple political cycles. It is true that HS2 has also coincided with a period of unprecedented political upheaval in the UK. However, the experience shows the need for governments to think long term. Starting by selecting projects based on clear strategic need will make it much easier to build and maintain political and public support, navigate political change and deliver value for money. Getting this right is vital for the UK to prioritise, plan and deliver the infrastructure needed to improve people's lives.

[27] Department for Transport (2020) Oakervee Review of HS2
[28] HM Treasury (2020) Final Report of the 2020 Green Book Review

About the ICE

The Institution of Civil Engineers (ICE) is a 97,000-strong global membership organisation with over 200 years of history.

It is a centre of engineering excellence, qualifying engineers and helping them maintain lifelong competence, assuring society that the infrastructure they create is safe, dependable and well designed.

Its network of experts offers trusted, impartial advice to politicians and decision-makers on how to build and adapt infrastructure to create a more sustainable world.

This project supports the ICE's strategy by outlining how better strategic planning and prioritisation of infrastructure, alongside improving infrastructure delivery, are crucial in helping to achieve better outcomes for society.

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