Amey

Heathrow Capital Efficiency

Best Practice Review
Heathrow 1045173PO / Final Version

15/04/2025

Document control sheet

Project Name:	Heathrow Capital Efficiency
Project Number:	Heathrow 1045173PO
Report Title:	Best Practice review
Report Number:	003

Issue Status/Amendment	Prepared	Reviewed	Approved
003	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 11/04/2025	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 14/04/2025	Name: Dr Mark Brown Signature: Electronic  Date: 15/04/2025
002	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 06/03/2025	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 10/03/2025	Name: Dr Mark Brown Signature: Electronic  Date: 11/03/2025
001	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 31/01/2025	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 04/02/2025	Name: Dr Mark Brown Signature: Electronic  Date: 05/02/2025
Draft for initial client review	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic 21/12/2024	Name: Dr Mark Brown Armando Espitia-Arevalo Signature: Electronic Date: 21/12/2024	Name: Dr Mark Brown Signature: Electronic  Date: 06/01/2025

Table of Content

1. Executive Summary

1.1 Amey is supporting Heathrow in preparing for the forthcoming H8 regulatory period by assessing the current H7 capex framework and comparing this to best practice' in construction, especially regarding delivery of large-scale projects and programmes. A review of best practice across the construction industry has been carried out and comparisons drawn with both the current H7 framework and Heathrow's delivery model as specified in its Capital Governance Handbook (CGH).

1.2 The conclusions from this review are that Heathrow's preferred approach to capital delivery as outlined in the CGH are closely aligned with 'best practice'; however, the CAA's H7 framework deviates from industry best practice in a number of key areas. As such, it threatens Heathrow's ability to deliver efficiency in ways which can be condensed into several areas of principle:

- **Assumption that *'one size fits all'*:** the application of a single delivery mechanism to all of the projects within a large and multi-dimensional series of infrastructure programmes imposes inefficiency and additional risk onto Heathrow, in particular in respect of larger and more complex projects. This will cause Heathrow to deviate from best practice in a number of areas.
- **Complexity and flexibility**: A *'one size fits all'* approach, with limited flexibility, constrains Heathrow's ability to implement its own capital delivery framework. The ability to operate flexibly is critical to delivering projects efficiently, especially those regarded as large and complex.
- **Approach to contracts**: the introduction of a *'one size fits all'* approach encourages the use of fixed price contracts which best practice clearly states are unsuitable for complex projects. Heathrow's contractors may be reluctant to agree to take on the risks associated with certain fixed price contracts without adding significant premiums and, even then, the terms and conditions attached may be unacceptable to either party.
- **Risk management**: setting fixed costs, scope, and time too early in the Heathrow Gateway Lifecycle (HGL) restricts Heathrow's ability to select a contract model and delivery method that allocates risk in the most effective way. This approach hinders effective risk management and may place significant financial obligations on Heathrow.
- **Delays, Governance, Administration**: project timescale and budget are closely linked. A burdensome change process will risk delaying projects and adding to costs. Excess administrative procedures can also potentially lead project managers to find themselves focusing more on governance and compliance rather than actively managing projects.

1.3 In short, the CAA's framework restricts Heathrow's ability to plan, deliver and agree contracts for projects considering their complexity, which directly conflicts with established construction industry best practice. In addition to the fact that it does not allow Heathrow to adapt their approach based on the nature of the project e.g., digital or IT solutions may demand a bespoke approach that suits needs and scope.

1.4 The paper explores each of these themes and draws explicit comparisons between the H7 framework, Heathrow's CGH and industry best practice. A number of suggestions are proposed to better align the H7 framework with industry best practice in order to provide an enhanced basis for H8. These can be summarised in the following table.

ISSUE	RECOMMENDATION	BENEFIT/OUTCOME
One size does not fit all	Adopt different approach to the delivery of large and complex projects compared with smaller, simpler projects. Technology projects also demand a bespoke approach that suits specific needs and scope.	This will enable Heathrow to better manage project risk and achieve efficient delivery, focussing resources on larger projects and avoiding waste and duplication elsewhere.
Programme management	Move to programme basis for larger complex projects. This implies specifying c.10-15 medium/large programmes requiring a different approach.	Different contracting approach adopted for large/complex projects. Greater focus on customer benefits. Flexibility to adapt during construction increases efficiency
Fixing risks and costs at G3	Identify a risk range at G3 and proceed within this rather than with a fixed price, e.g.: a central point +/- 20%	This will reduce the requirement for changes to be negotiated (so long as the price sits within the range), saving time and admin burden.

ISSUE	RECOMMENDATION	BENEFIT/OUTCOME
Optimising risk allocation	Where risks are being internalised from supply chain, quantify impacts in order to fully understand implications on Heathrow	Ensures that decisions are taken with full knowledge of risk impacts and that any addition to Heathrow's risk burden are transparent
Planning and design – adequacy	Aim to maximise the time and resources to plan and design solutions within the constraints of programme schedules and regulatory timetables	This ensures risks are identified and mitigated as part of the design process. Also, that the need for change during construction is minimised and designs can be 'locked-down'.
IT/Digital Framework	Adopt an agile approach that enables a continuous learning process to ensure innovation and value for money.	Agile projects are monitored through a roadmap of milestones and iterations linked to value delivery. Also, it is expected that lessons learned from each release will be applied to ensure continuous improvement, efficiency, and cost-effectiveness.
Completing CGH	Systematically overlay the handbook's approach on the H7 framework to identify specific points where either can be flexed in order to better align with best practice	Clarity on divergence between Heathrow's CGH methodology and requirements of H7 framework (& hence divergence from good practice).
Defining 'large' or 'complex' projects	A consistent approach is required to the definition of 'large' or 'complex' projects that demarcates such projects as requiring greater flexibility. Several suggestions are put forward	This will provide clarity and transparency when producing future programmes of work, with an explicit demarcation between different categories of project.

2. Introduction

2.1 This investigation into the efficient and effective delivery of capital projects has involved a review of how Heathrow and its regulatory model conform with industry '*best practice*'; how the current model reflects best practice; and suggestions for alternative approaches to improve the framework.

2.2 The work has involved three stages:

- A comprehensive review of the extensive literature on best practice in construction, coupled with consideration of Amey's own experiences in this field.
- An analysis of how best practice compares and contrasts with both Heathrow's internal approach to project delivery and with the implications of the CAA's framework for H7.
- Consideration of how the CAA framework could be adapted to better conform with industry best practice in capital delivery, or how Heathrow could adapt in order to do so.

2.3 Appendix 1 summarises the review of best practice and highlights those areas considered of particular relevance to the H7 framework. This represents the building blocks of our analysis. Appendix 2 summarises our comparison of the attributes of best practice and the H7 framework, together with Heathrow's ideal approach to capital delivery. This work has been supplemented by a number of discussions with Heathrow managers involved in the implementation of H7 capital programmes.

2.4 Section 3 considers several areas of principle that are derived from the more detailed analysis summarised in Appendices 1 and 2. Subsequent sections explore these principles in further detail, outlining examples, potential benefits and commentary applicable to the H7 framework and the Capital Governance Handbook (CGH)[1]. In addition, particular references to IT/Digital solutions have been included in separate boxes across the report. The final section of the paper outlines a number of recommendations for adapting H7 and/or to include in a future framework to better accommodate the principles of best practice in construction.

3. Interrelationship between complexity / risk / contracting models and approach to projects: setting the scene.

3.1 Understanding the intricate relationship between complexity, risk, and contracting models is crucial for successful project delivery. This is key to infrastructure projects in general, across a wide range of sectors. Complexity often dictates the level of risk involved, influencing the choice of contracting models and the overall approach to project management. This section explores how these elements are interrelated and how best practices can be applied to navigate these challenges effectively. The following literature provides valuable insights into this relationship.

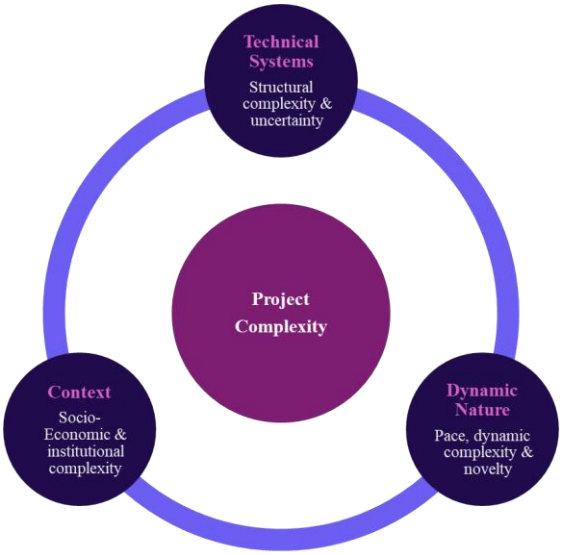
3.2 Bennett and Cropper (1990) propose that integrating conflict analysis with strategic choice offers a comprehensive method for addressing these issues. San Cristóbal *et al* (2018) emphasise that the complexity of a project significantly impacts planning, control, and hinders the clear identification of goals and objectives.

3.3 In this context, the literature has explored the definition of complexity from various perspectives and sectors, without establishing a single method to determine project complexity. However, in the realm of megaprojects, Brady and Davies (2013), building on Hirschman's (1956) initial approach of viewing projects as systems, recognise that the primary challenge in delivering a complex project with many interconnected components is not the system's size, but the difficulty in developing methods to coordinate, adjust, and integrate the parts into a cohesive whole.

3.4 According to de Rezende & Blackwell (2019) complexity factors can be categorised into three dimensions: structural complexity, dynamic complexity, and context. Structural complexity usually involves the core technical aspects of a project and the interdependencies between its components. Dynamic complexity encompasses the pace, evolving nature, and novelty of the project, reflecting the level of familiarity with the proposed solutions. And finally, institutional complexity considers socio-economic trade-offs and organisational challenges.

[1] It is understood that the Capital Governance Handbook is still in a draft version.

The diagram below represents the relationship between the complexity factors present in mega-projects based on De Renzende & Blackwell and Rezende *et all* (2022):



Source: own elaboration based on De Renzende (2019) & Blackwell and Rezende *et all* (2022)

3.5 De Rezende *et al* (2022) consider that project complexity challenges traditional theories and management approaches, favouring subjectivity, systemic thinking, and adaptability. From this perspective, incorporating complexity factors into decision-making is encouraged to better understand projects. Recognising the interdependence of these factors, an integrated and systemic analysis is essential for effective project management.

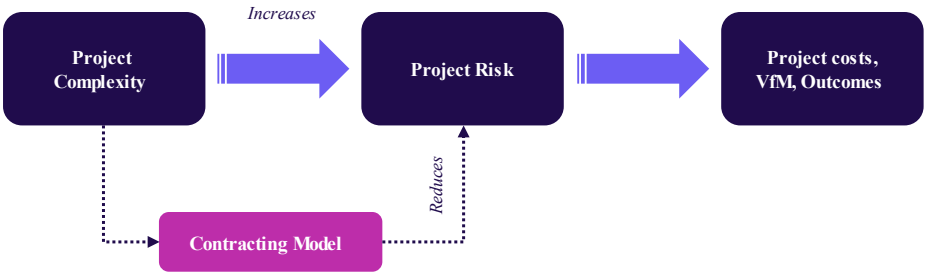
3.6 Moreover, the rapid pace of technological advancements and the global commitment to achieving a net-zero carbon economy add additional layers of complexity to infrastructure delivery. These factors need a more adaptive and responsive model to address emerging challenges and opportunities. The ICE (2022) highlights that embracing these advancements and commitments requires a shift towards more flexible and innovative project management practices.

3.7 Infrastructure projects are ultimately a means to an end, not an end in themselves. The World Economic Forum (2024), recently noted that a customer-focussed approach ensures that the design and build (D&B) process supports whole-life value, extending benefits beyond the construction phase to include long-term efficiency and sustainability.

3.8 The National Audit Office (2020) recognise that project complexity directly affects contracting models as an instrument to manage risk. In other words, the degree of risk and complexity also influences risk-sharing mechanisms, contracting models, and project pricing.

3.9 In this context, contracting models are used to manage and allocate risk to ensure that infrastructure is delivered in an efficient, timely and value-enhancing way, depending on (among other things) the nature of the works and the desired risk-sharing mechanism. '*Risk sharing*' can depend on the instructing party's willingness to pay a premium for a contractor to bear a certain risk. This has the potential to increase the cost of the project. The reason for this premium is because the contractor would then need to price for additional contingencies over which it does not have sufficient control. The defining issues concern which party is best able to manage the risk.

3.10 The diagram below demonstrates how these different principles work together:



3.11 Flexibility in project management is essential for effectively managing the growing complexity of projects and the evolving needs by clients and also technology. Sohi *et al* (2021) recognise that the implementation of a practical and dynamic framework that embeds flexibility into project management processes allows teams to better adapt to changes and unforeseen challenges. This approach not only enhances the ability to meet changing requirements but also significantly improves overall project performance, ensuring successful and timely delivery.

3.12 Effective management of engineering and construction projects is increasingly challenging, evidenced by frequent delays and cost overruns. Corrales *et al*. (2022) highlight the need for new management methods to address these challenges. They argue that combining advanced planning techniques with adaptive strategies is essential for navigating the complexities inherent in such projects. This point is further reinforced by the ICE (2022) who argue for a greater application of 'systems thinking' in the management of major projects.

Why is this important to Heathrow?

3.13 Acknowledging the diversity of projects undertaken by Heathrow is crucial in shaping an approach to capital delivery. These range from highly complex, multi-disciplinary programmes to relatively straightforward asset installations. A flexible and adaptive approach to capital delivery recognises that projects require different managerial and contractual delivery mechanisms, depending on their size and complexity.

3.14 We have identified five general aspects of 'best practice' in project management that have relevance to Heathrow's capital delivery programme. We have also concluded that the CAA's H7 framework deviates from each of these aspects of best practice in a number of key areas, as highlighted in Appendix 2. This threatens Heathrow's ability to deliver efficiency and customer benefits. The five areas can be summarised as follows:

- **Complexity and flexibility**: H7 stipulates a *'one size fits all'* approach to projects and programmes of all varieties. This constrains Heathrow's ability to implement its own capital delivery framework, which attempts to be far more flexible and responsive to projects of different scale and complexity. The ability to operate flexibly is critical to the efficient delivery of larger, more complex, projects.
- **Approach to contracts**: While Heathrow recognises the value of utilising a number of contracting models, depending on the project's size and complexity, H7 effectively stipulates the use of fixed price contracts in most cases. Heathrow's contractors might be hesitant to accept the risk associated with fixed price contracts. This poses a risk for Heathrow, as it could lead to significant premiums being added and, even then, the terms and conditions might not be acceptable to either party.
- **Risk management**: Setting fixed costs, scope, and time too early in the Heathrow Gateway Lifecycle (HGL) restricts Heathrow's ability to select a contract model and delivery method that fully addresses risks before prices are fixed. This limitation hinders effective risk management and could internalise financial risk within Heathrow.
- **Governance & Administration**: Heathrow's Capital Governance Handbook provides a clear approach to the management and administration of projects that aligns well with 'best practice' literature. However, the CAA's H7 regime conflicts with many of the core principles within this handbook. In particular, this threatens to extend project timescales, complicate relationships with stakeholders and increase admin burden and costs.
- **Focus and agreement on customer benefits.** Projects exist to deliver customer or user benefits. As complexity increases, it becomes increasingly important to ensure these are delivered and that sufficient flexibility exists to amend designs and specifications accordingly. While Heathrow's own capital delivery handbook emphasises the importance of benefits realisation and outputs delivery. The

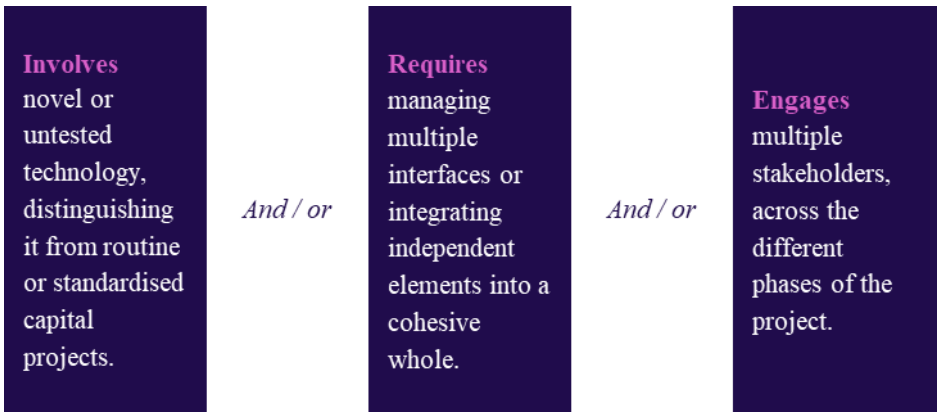
de facto emphasis of H7 on compliance with pre-defined deliverables has a narrow focus and limits Heathrow's flexibility and ability to adapt in order to maximise benefits.

3.15 In short, the CAA requires Heathrow to plan, deliver and agree contracts without any distinction regarding the nature or unique needs of each project. This *one size fits all* approach is at odds with the CGH and conflicts with established construction industry *best practice*.

3.16 Below, we run through each of these elements explaining how the H7 framework deviates from best practice and what the implications of this are for Heathrow.

4. Complexity and flexibility

4.1 Analysis of major projects reveals that complexity is a key determinant of whether a project will exceed its budget and estimated timescale (Corrales & Veiga, 2022). The Infrastructure and Projects Authority (IPA) (2020) recognise management of complexity as one of the eight principles for successful delivery of major projects. The diagram below presents how complexity can be measured by various factors:



4.2 According to the ICE (2022) a customer-focused approach can significantly enhance the delivery of complex infrastructure projects by integrating the various project elements into a cohesive system. This approach stresses the desired benefits and incorporates those who will operate the assets and those who will use them into the planning and design. Such an approach is crucial for managing the intricacies of modern infrastructure projects.

4.3 In addition to these factors, complex projects involve increased uncertainty and unpredictability. Practical examples of such factors, all familiar to Heathrow, include:

- Procurement challenges, such as varying material quantities or unexpected shortages.
- Severe weather conditions.
- Changes in local laws.
- Labour issues, including cost fluctuations, skill shortages, and labour relations risks.
- Interface risks, such as ensuring technology aligns with infrastructure, require a thorough, practical understanding of complexities, especially with the digitalisation of traditional activities and assets.
- Operational constraints limiting site access, particularly at Heathrow, where full operations must continue during construction.
- Security incidents.
- Contractor delays, often caused by overruns on other projects.
- Force major events, such as the COVID-19 pandemic.

4.4 These uncertainties demand a thorough, practical understanding of complexities, especially with the digitalisation of traditional activities and assets, to ensure technology aligns with infrastructure.

4.5 A key principle underpinning best practice in construction is ensuring the ability to manage the inherent complexity of the typical major project environment. The National Audit Office (NAO) (2023) recently concluded that a failure to manage complexity is one of the main causes of chronic cost and time overruns at HS2's Euston Station project.

4.6 To effectively manage complexity, it is essential that project leaders can make informed, timely, and clear decisions. Additionally, where risk or uncertainty exists in the design phase, the framework must provide enough flexibility in the schedule and contracting model to address these uncertainties during the delivery phase. This is particularly relevant to projects involving data, digital, and technology (DDaT) solutions, as their unique nature requires not only an understanding of specific needs but also the flexibility to adapt to rapid advancements.

Box 1: Complexity and IT solutions.

DDaT projects are unique as they can be rapidly deployed and adapted to meet evolving needs. Unlike traditional infrastructure projects, which often require a more extensive planning and long-term commitments, DDaT projects can be implemented quickly and decommissioned with minimal disruption. This flexibility allows organisations to respond swiftly to changes, secures resilience, and promotes innovation, ensuring that their technological solutions remain relevant and effective.

According to the Cabinet Office (2023) highlights that iterative development is essential for effective DDaT solutions. This can be achieved by adopting an Agile approach, enhancing the quality and functionality of IT/digital solutions, enabling early issue detection and resolution, and promoting continuous improvement, significantly reducing the risk of project failure and securing the best value for money.

4.7 DDaT projects benefit from an adaptive framework that allows controlled change to be introduced throughout the project's development. In particular the *Digital, Data and Technology Playbook*[2] (Cabinet Office, 2023) suggests that an 'Agile' approach is the most appropriate method due to its inherent flexibility, iterative nature, and focus on continuous improvement. In DDaT projects, where detailed requirements often evolve over time, Agile enables a rapid, responsive development cycle.

4.8 Through a series of short sprints, teams can test and learn, validating benefits and refining solutions in real-time based on user feedback. This iterative approach allows for the discovery of user needs, potential solutions, and the identification of issues early in the development process, reducing risks, improving the final product's quality, and securing best value for money. This conforms with the approach to partnering and collaboration promoted by Heathrow's CGH. The diagram below presents the key elements of implementing an Agile approach:

4.9 Recent literature reflects that project complexity is a result of the interaction of interdependent elements, best understood through feedback loops leading to emergent behaviours (de Rezende L. B., Denicol, Blackwell, & Kimura, 2022). This challenges a more traditional project management approach (i.e., in

[2] Government guidance on sourcing and contracting for digital, data and technology projects and programmes.

which projects progress seamlessly through a pre-ordained cycle), demanding systemic thinking and adaptability rather than relying solely on linear process and predictability[3].

4.10 These conditions largely reflect a systems and dynamic approach to infrastructure development recently promoted in two publications i. *A systems approach to infrastructure delivery* (Institution of Civil Engineers - ICE, 2022) and ii. *Principles for Projects Success* (Infrastructure Project Authority, 2020, p. 7)

Implications of H7

4.11 The H7 framework restricts Heathrow's ability to adapt to change or respond to unforeseen events. The introduction of the Delivery Obligations (DOs) restricts the possibility of taking another course of action which becomes apparent post-G3, even if it may be more efficient or better value, because the outputs would not align with agreed DOs.

4.12 While the CAA acknowledges this reduced flexibility, it dismisses its impact, justifying it as necessary for controlling Heathrow's capital expenditures. It is argued that it is essential for Heathrow to balance the operation, maintenance, and development of airport services while keeping spending within control. However, this approach overlooks specific needs of more complex projects, where rigid frameworks can be counterproductive.

4.13 Failing to differentiate between simple and complex projects restricts the flexibility necessary for effective risk management and change adaptation. This lack of distinction undermines best practices, limiting Heathrow's ability to tailor approaches to meet specific project needs and hinders the capability to manage risks and respond to evolving circumstances efficiently.

4.14 The loss of flexibility post-G3 in handling the inevitable complexities is likely to impact Heathrow's ability to deliver value efficiently and foster innovation. It is also likely to add significantly to the risks borne by Heathrow, which is examined in the next section.

Heathrow Implications (CGH)

4.15 The complexity at Heathrow arises partly from the challenge of operating alongside one of the world's busiest airports, with c.70,000 staff working on a constrained site that requires significant night work and faces numerous operational and safety challenges. It also reflects the need to manage multiple multi-disciplinary projects with many interfaces.

4.16 Heathrow's CGH emphasises the importance of adequate front-end planning in order to understand complexity and define and mitigate risks prior to setting a firm price and finalising delivery contracts. Heathrow also favours a partnering approach with suppliers in order to maximise opportunities for innovation and flexible delivery. Adequate front-end planning accords with best practice and is the most effective way of reducing the need for subsequent change orders. The Thames Tideway project provides evidence of this, in which designs were 'locked-down' after a thorough planning and design phase, with change only permitted in exceptional circumstances. This also accompanied a systemic approach to delivery of an agreed solution, focussed on a 'minimum viable product'.

4.17 One dilemma faced by Heathrow is that the regulatory timetable places a limit on the time available to plan before delivery must commence. This timetable may also be driven by legislation, such as that governing the introduction of new security systems. While theory dictates that the time available for planning and design should be maximised, in practice, a limit exists on the time that can be realistically devoted to planning and design before construction or installation must commence.

4.18 This highlights the need to allow a balance between structured planning and the ability to adapt mid-delivery to evolving circumstances. This is of particular importance to larger, more complex projects,

[3] View: Rodrigues, A. G., & Bowers, J. (1994). The role of system dynamics in project management. Proceedings of the 1994 International System Dynamics Conference. https://systemdynamics.org/wp-content/uploads/assets/proceedings/1994/rodri214.pdf and K., & Pollack, J. (2008). Tools for Complex Projects (1st ed.). Routledge. https://doi.org/10.4324/9781315550831.

where the time available for planning may be limited and the likelihood of a need for change is greatest. Again, this emphasises the point that '*one size does not fit all*'.

4.19 Recognising the size and complexity of a project can help in understanding that certain details may not be fully known or understood, even when an investment decision has been agreed. This could lead to adjustments or changes in later phases. Identifying whether a project is unique can involve defining the extent to which designs can be locked down, as opposed to permitting an unlimited flexibility to cake changes post-G3.

4.20 In this context, strong governance and clear definition of roles and accountabilities could provide substantial value. The definition of roles could include defining whether projects are sufficiently well understood for costs to be defined at G3 or if subsequent changes are likely to be required, and also who internally is better placed to make decisions.

5. Approach to contracts

5.1 Contracting models are used to ensure that infrastructure is delivered in an efficient, timely and value-enhancing way. It is widely accepted that a core role of a contract is in accurately reflecting the risk to be borne by each party.

5.2 Understanding the essential needs and delivery methods provides valuable insights into the specific requirements of various project types. Different contracting mechanisms, including fixed-price, target-price, and alliances, are designed to optimise contract and risk management for a range of projects.

5.3 In 2021, the Government Commercial Function published risk allocation and pricing guidance, providing a description of the following three key types of contracts:

TYPE OF CONTRACT	DEFINITION	LEVEL OF RISK TRANSFER TO SUPPLIER	RISK ALLOCATION CONSIDERATIONS
Fixed or firm price	The supplier takes cost risk of the input required to deliver the specification	High	This requires an unambiguous scope and specification otherwise a high-risk premium will be charged.
Cost-plus contract	The supplier recovers all actual costs incurred for the management and delivery of the services including overheads, with an additional profit margin applied	Low	Uncertainty in output definition. There is minimal/no cost-risk transfer to the supplier as it is able to recover all costs incurred in delivering a service over the contract term. A degree of risk on performance can be transferred via a success fee.
Target-cost contract	A variant of cost plus including an incentive to the supplier to make efficiencies.	Low	This can be used in similar circumstances of output uncertainty to cost-plus. However, it transfers some risk to the supplier as an incentive should actual costs be lower or higher than the target cost. This incentivises the supplier to make efficiencies.

Source: own elaboration based on (Government Commercial Function, 2021)

5.4 For major projects[4], or those with a high degree of complexity, the choice of contract model plays a critical role in ensuring the delivery of the expected infrastructure. It is essential to acknowledge that the contract model needs to reflect the specific requirements and realities. Particularly, fixed price contracts are discouraged both by Government sources and industry practitioners. This is because – as set out in the table above – the Government advises that fixed price contracts require an 'unambiguous scope and specification' if they are to be used.

[4] There is no universal definition of a 'major project', but they are commonly defined as having 'high monetary value, time and schedule urgency and complexity' (Major Projects Association). The Chartered Institute of Building suggests they should have costs in excess of £10m. HMG tends to define them as exceeding departmental spending limits.

5.5 Inappropriate contracting models result in imbalance between the treatment of cost estimates and analysis of risk. According to the NAO (2020) this leads to risks being allocated to parties unable to manage it. Consequently, this results in missed cost and schedule targets, failure to achieve desired benefits, and poor value-for-money in projects.

5.6 The IPA's Principles for Project Success (2020) guidelines advise that in order to plan realistically the following approach should be applied: use of "ranges *for costs, benefits and delivery dates*, ***adjusted as certainty increases through the life of the project***" (emphasis added) (2020, p. 7). This is particularly crucial in DDaT projects, where the fast-paced environment demands that contracts evolve and respond dynamically to specific needs (Cabinet Office, 2023).

Box 2: Approach to contracts IT solutions

Appropriate planning and preparation are crucial, especially for contract completion According to the Cabinet Office (2023, p6) DDaT contracts *"should be structured to drive collaboration, improve value for money, and deliver a sustainable, resilient and effective relationship,* ***focussed on outcomes and the safeguarding of public data."*** (Emphasis added)

It is advised that contracts ensure that *"risks are allocated appropriately and that the pricing and payment mechanism corresponds with the approach to risk and incentivises the desired behaviours and outcomes".* (Cabinet Office, 2023, p6)

5.7 Precedents from elsewhere in recent construction activity (e.g. Thames Tideway, HS2, Crossrail, etc) suggests that cost-plus or target-cost contracts are more appropriate and acceptable to these types of complex projects. Fixed price contracts place risk with those least able to manage it (i.e. the suppliers) and therefore invite over-pricing in response to manage such risks.

Implications of H7

5.8 There are two important contractual issues from CAA's H7 regime:

- A practical provision ensures that prices are fixed at G3, as this is the price added to the Regulated Asset Base (RAB), with Heathrow assuming 25% of the risk for any subsequent price variations.
- Detailed requirements for DOs that will be implemented across all projects, specifying detailed expectations for cost, time, and quality.

5.9 The H7 framework is predominantly structured around fixed-price contracts, which significantly limits flexibility in how risk is allocated across projects. This *one size fits all* approach discourages the use of more progressive contracting models that are better suited to efficiently distribute risks and responsibilities.

5.10 Under the H7 framework, budget, timeline and scope of projects are defined at G3, prior to making any investment decisions. This pre-defined approach creates pressure to lock in these elements early, which can lead to the adoption of contracting models that are unsuitable for the specific needs of larger and more complex projects.

5.11 As a result, these contracts may not provide the necessary flexibility to manage unforeseen challenges, which could ultimately impact project delivery. This is a particular issue for larger, complex projects and it is accepted that smaller, less complex projects may lend themselves far more to fixed prices.

5.12 This pre-emptive decision-making at G3 often leads to an imbalance in how cost estimates and risks are managed, especially in large or major projects. By locking in scope, budget, and schedule too early, there is limited room to adjust as new information emerges or as project complexities become clearer, typically during the building phase. This can result in inaccurate risk assessments, as fixed-price contracts do not typically accommodate the variability required for complex projects, where unforeseen events or changes are common.

Heathrow Implications (CGH)

5.13 While it is recognised that Heathrow has the autonomy to select contract models, the prevalence of fixed-price arrangements in practice, caused by the need of locking in several variables at G3, limits Heathrow's ability to adopt more suitable contract models that could enhance risk management and improve the efficiency of achieving outcomes.

5.14 Heathrow also places emphasis within its capital delivery methodology on programme as opposed to project structures. This implies the need for a partnering approach with contractors and supply chain as opposed to the widespread use of more tactical, narrow fixed price contracts. Heathrow's ambition for a programme focus aims to introduce greater delivery flexibility while maintaining the necessary definition of works and business justification. With this approach, Heathrow seeks to capture potential efficiencies from a programme level perspective.

5.15 A programme-led approach allows for better structuring, which can reduce administrative burdens by minimising the number of suppliers involved, something we explore in a different section. This streamlined approach not only enhances coordination but also simplifies management processes, potentially leading to more efficient project delivery.

5.16 The ability to adapt the forms of delivery to unforeseen risks and events is essential for the successful delivery of large-scale projects. This must be complemented by robust risk management strategies and flexible contract arrangements to ensure comprehensive project success. This will also help ensure that the supply chain is willing to price contracts within affordable limits.

5.17 Industry best practice guidelines consistently stress that fixed-price contracts are not suitable for complex projects. These best practices advocate for more flexible contract structures that can accommodate the dynamic nature of large-scale, high-complexity initiatives. The rigid framework imposed by H7, however, fails to align with these recommendations, limiting Heathrow's ability to manage risks effectively and adapt to changing circumstances during the course of a project.

5.18 H7 is incompatible with best practice in this regard, as it encourages the adoption of a single contracting model and prevents Heathrow from advancing its preferred approach to capital delivery. Contracts can be compatible with a partnering approach and reflect a number of NEC contract variations (rather than a simple fixed price). Other (less complex) projects could continue to be delivered using fixed price contracts of the H7 regime.

6. Risk Management

6.1 As stated in the previous section, in practice, the treatment of cost estimates, approach to risk assessment and choice of contracting models in major projects and programmes are intimately linked. If a supplier is put in a position where they are managing an inappropriate balance of risk then the outcome is highly likely to be poor value for money, underperformance against the core contract objectives, and/or an onerous contract which could ultimately lead to its collapse.

6.2 NAO's report on HS2's Euston Station project refers to one major cause of failure as being HS2 fixing the price at too early a point before all the risks and uncertainties were fully understood and mitigated. The report states: "*While it was necessary to look again at the design and costs of the station in 2020, the budget for Euston station was fixed too early and too low for what was intended to be achieved*" (2023, p. 12).

6.3 Risk assessment involves the distribution of risks across the parties best positioned to manage them. When risk allocation is misaligned, such as assigning risks to parties without the capacity to mitigate them, it undermines the effectiveness of the proposed management approach. This misalignment can lead to projects running over schedule or budget, as the parties involved may not have the necessary capacity or knowledge to handle the risks appropriately.

6.4 Flyvbjerg's work (2006, 2014, 2021 and 2023) consistently emphasises that flexibility and adaptability in project management are crucial for managing unforeseen risks. Rigid planning can lead to significant issues when unexpected challenges arise, highlighting the need for adaptable risk management strategies.

6.5 In this context, a broad consensus exists that effective risk management relies on contracting mechanisms and incentives designed to align with each party's ability and position to manage specific risks (National Audit Office, 2020). Contracts can be structured in a way that promotes efficient risk management and minimises potential disruptions.

6.6 The table on the right, published within the *Risk Allocation & Commercial Pricing, Guidance* (2021) by the Government Commercial Function, sets out the benefits of placing risk with the party best able to manage it:

Placing risk with the party best able to manage it should create:	Placing risk with the party which is not best placed to manage it is more likely to create:
Better pricing from suppliers which more accurately reflects the risk they are managing	Artificially high bids from suppliers (or bids that are potentially too low for a supplier to make appropriate profit)
Fewer performance and commercial issues during the contract term	Increased likelihood of performance and commercial issues during the term of the contract
A reduced likelihood that the contract fails completely, and the supplier prematurely exits the agreement or becomes insolvent	Increased likelihood of contract failure and early termination/exit
Greater opportunity for open and honest dialogue for mutual benefit	Increased likelihood of sub-optimal dialogue and relationship with the supplier

Source: (Government Commercial Function, 2021, p. 11)

6.7 As observed, aligning risk management responsibilities with the appropriate parties can lead to better project outcomes. Assigning risks to well-positioned parties enables more effective mitigation strategies. This not only reduces the likelihood of project delays and cost overruns but also enhances the overall quality and success of the project.

Box 3: costs and risks assignment in DDaT Projects

In DDaT projects , it has been recognised that assuming a normal distribution for cost overruns leads to a severe underestimation of the risk of large overruns . In particular, Flyvbjerg *et al* (2022) suggest that interdependencies among IT system components can trigger chain reactions , resulting in substantial overruns .

Implications H7

6.8 Basing the *ex-ante* price of a large of complex project at G3 will result in significant financial risk being imposed on Heathrow. When a portfolio of projects is considered (comprising projects of varying degrees of complexity and size) the cumulative value of over-spend on projects is likely to far exceed that of under-spend (even if the number of over and under-spending projects is equivalent). This is because comparative evidence tells us that large projects tend to over-spend by large amounts while small projects under-spend by comparatively lesser amounts. Therefore, the argument that G3 is a fair point at which to fix prices for large or complex projects will risk significant losses to Heathrow.

6.9 The DfT's own guidance supports this view. They advise project developers to add premiums to project costs to reflect '*optimism bias'*; that is, the systematic under-pricing of projects due to inherent optimism about construction outcomes (Department for Transport, 2024). For building projects, such as terminals, they advise uplifts of 44% at 'Stage 3' (equivalent to Heathrow's G3; Network Rail's GRIP5; or National Highways' 'construction preparation'). This premium should be reduced as the project subsequently develops. This is at odds with the H7 requirement of fixing prices at G3 with no such risk or optimism bias premium added.

How Big Projects Performed
Source: Flyvbjerg Database

Project type	Mean cost overrun (%)	Projects (A) with ≥50% overruns (%)	Mean overruns of A projects (%)
Nuclear storage	238	48	427
Olympic Games	157	76	200
Nuclear power	120	55	204
Hydroelectric dams	75	37	186
IT	73	18	447
Nonhydroelectric dams	71	33	202
Buildings	62	39	206
Aerospace	60	42	119
Defence	53	21	253
Bus rapid transit	40	43	69
Rail	39	28	116
Airports	39	43	88
Tunnels	37	28	103
Oil and gas	34	19	121
Ports	32	17	183
Hospitals, health	29	13	167
Mining	27	17	129
Bridges	26	21	107
Water	20	13	124
Fossil thermal power	16	14	109
Roads	16	11	102
Pipelines	14	9	110
Wind power	13	7	97
Energy transmission	8	4	166
Solar power	1	2	50

Only 8.5% of projects in the Oxford database met cost and schedule targets while just 0.5% satisfied benefit goals as well. Projects with modular construction performed best.

Source: (Flyvbjerg & Gardner, 2023, p. 192)

6.10 For additional context, the Flyvbjerg database of major projects lists airport projects as having a mean overspend of 39%, with 43 projects having overspends in excess of 50%. In comparison, water projects have mean cost overspends of 20%; rail 39% and aerospace 60% (Flyvbjerg & Gardner, 2023, p. 192). This indicates that airports (such as Heathrow), like other comparable sectors, do not have an equivalent value of under-spend and over-spend against budget. Thus, the G3 estimate is not a reliable guide to the out-turn cost of major projects and programmes for which risks are not fully defined or mitigated.

6.11 The rational way of Heathrow responding to this would be to increase in the risk allowance for larger projects and programmes, in line with industry observations and evidence. Reference to the DfT report or Flyvbjerg's analysis, both cited previously, suggests a further risk premium of 39%-44% can be added to cover likely risks and threats to the budget. This would amount to inflating the G3 budget by a further 39%-44% to allow prices to be fixed at this point.

6.12 This clearly demonstrates that G3 is not an appropriate or reliable point at which to fix the prices of large projects or programmes because the risks of over-spend (and extended timescales) are considerable (around 80%) (Flyvbjerg & Gardner, 2023) and the response to create more certainty on breaking projects down places an unreasonable burden on the project owner.

Heathrow Implications (CGH)

6.13 Heathrow's approach recognises the critical importance of identifying and understanding potential risks at early stages in the HGL to ensure that all stakeholders have a comprehensive grasp of the implications of capital expenditure decisions. This is even clearer from a Programme level perspective, where a higher-level perspective allows Heathrow to implement a systematic view of the capital investment. This identification process is encouraged as part of a systematic approach conducted during the risk management stage.

6.14 Heathrow's structured risk management framework helps identifying, assessing, and managing risks throughout HGL. In less complex and straightforward projects, this approach can be highly effective, as the risks are often more predictable and manageable. This approach aligns with best practice, and it is expected that the systematic management of risks in such projects can lead to more efficient and cost-effective project delivery.

6.15 However, when large, complex projects are considered, Heathrow's normative approach is undermined by H7, which compels prices to be fixed in advance of risks being fully understood or mitigated. It

appears (from the partial information available) that the general approach of Heathrow under H7 is to internalise risk, in order to expedite projects. This effectively shifts the risk, which would typically fall on the supply chain, but due to the limitations of H7, the supply chain is unwilling to accept it.

6.16 This may well be the most pragmatic approach to an imperfect situation. However, it is important that Heathrow understands the quantum of additional risk being borne because of this. This will provide evidence to table with the CAA on the implications of H7 for efficiency and cost, both of which are likely to be sub-optimal.

6.17 This also reinforces the point that '*one size does not fit all*' and that different approaches are required for complex versus more straightforward projects. It also supports the recommendation in the previous section that a programme approach be adopted for large and complex projects, where a more progressive approach to risk can be applied.

7. Delays, Governance, Administration

7.1 As highlighted previously, unexpected delays or issues are common in most infrastructure projects, underscoring the importance of Heathrow to gain more flexibility to address these challenges in a timely and effective way.

7.2 Within the construction industry, there is a clear and accepted relationship between delays to projects and cost overruns. Schedule overruns are extremely common, with Flyvbjerg (2021) suggesting that only 1-in-10 major projects is delivered to schedule. Other estimates suggest that 80-90% of major projects experience delays or cost overruns, or both.

7.3 Delays in projects typically result in higher out-turn costs for several reasons. Understanding the specific causes and effects within a project environment is complex. In this context, three key considerations are:

- **the relationship between extended schedules and higher costs: meaning that costs can be driven up by a number of factors when projects are delayed and schedules extended**, including: (i) inflation; (ii) extended rental of equipment, site offices and storage facilities; (iii) de-mobilisation and re-mobilisation costs; (iv) personnel costs which continue to be incurred (such as some management and admin functions); (v) where resources and skills are in high demand and short supply.
- **the causes of schedule overruns** vary between projects. Failing to recognise and manage complexity is considered a significant factor in schedule overruns. After reviewing 86 major projects, industry experts concluded that project failures can be traced back to factors such as size, uncertainty, urgency, or institutional structure, all of which fall under the broader category of complexity (Corrales & Veiga, 2022).
- **the feasibility of some schedules in the first instance** can cause projects to overrun if an over-optimistic initial estimate is agreed upon. In a recent publication, Flyvbjerg (2023) explains that optimism bias occurs when stakeholders deliberately present overly positive projections to secure project approval, thereby intensifying strategic misrepresentation. This may result from external pressures, such as upcoming laws, policies, or regulations; client demands to fast-track asset deployment; or mistakes and misjudgements made by technical advisors and engineers.

7.4 In terms of the financial cost of delays, Flyvbjerg (2021) undertook a statistical analysis of major projects which had overrun and estimates that the impact on cost was an average increase of 4.6% for every year of delay. This closely matches the £3.5Bn recognised by the NAO (2021) impact of the 4-year delay to London's Crossrail project[5].

7.5 It can therefore be appreciated that onerous governance and administrative requirements, such as a burdensome change process, can not only impose extended timescales on projects but can significantly increase costs.

7.6 Where possible, front-end planning can address some of the issues that cause delay and avoid a mid-project admin-burden. This is of particular relevance to digital projects or projects with a significant digital element. Box 4, below, describes a number of commercial considerations for DDaT projects, derived from best practice, which can improve governance and reduce the risk of delays.

[5] Crossrail's costs increased from £15.4Bn to £18.9Bn, while opening was delayed from 2018 to 2022.

7.7 Where project management or regulatory procedures increase the time required to advance a project and where this cannot be mitigated (e.g.: by anticipating impacts during planning and design) it becomes almost inevitable that costs will escalate.

Box 4: DDaT and commercial considerations

According to best practice, contracts involving DDaT solutions should incorporate measures that ensure flexibility and promote a systematic approach to efficient delivery. These measures are likely to impact the time and administrative burden involved in managing these projects.

- **Supplier Lock-In:** To ensure flexibility and avoid dependency on a single supplier's solution, it is advised to follow best practices for system design that prevent lock-in. This risk can be mitigated by maintaining clear documentation of design documents, system architecture, transitions, and risk management plans.
- **Knowledge Transfer:** Retaining ownership of outputs and intellectual property rights ensures information can be distributed, reused or transfer to other projects as needed, with industry days or workshops facilitating the sharing of key learnings.
- **IT Legacy**: Inadequate end-of-life planning can lead to significant costs and security risks, it is advised to include in contracts early planning for expiry, extension, transition, and termination. Collaboration between parties is essential for smooth contract wrap-ups, aligning exit planning with broader strategies to address common legacy IT hazards.
- **Exit and Transition Planning:** Contracts must outline clear exit and transition expectations, including data return obligations and exit plans that integrate outgoing and incoming supplier strategies. Utilising IT demand management and cost optimisation tools can help eliminate unused legacy assets and promote efficiencies in delivering DDaT solutions.

Implications H7

7.8 Under H7, Heathrow is subject to prescriptive obligations (including a timing element) for every single project. Should any of these projects overrun – including for reasons entirely beyond its control – it must renegotiate with airlines or be penalised. To effectively manage and mitigate potential delays that could lead to cost overruns, best practice suggests that Heathrow should be empowered to respond promptly and maintain flexibility throughout the project's progression.

7.9 The H7 framework emphasises cost efficiency and accountability, crucial for ensuring Heathrow meets clear deliverables throughout the regulatory period. It has been said by the CAA that by fixing costs and deliverables before reaching the investing decision, the framework aims to create a structured approach that incentivises reliability and reinforces commitment to agreed-upon deliverables. It can be argued that this clarity helps the airline community to understand timelines and expectations, and foster accountability.

7.10 However, the H7 framework's rigidity in fixing price, scope, and timelines at an early stage can be problematic, especially for large and complex projects. This approach may not fully account for how project managers will have to deal with unique challenges and risks inherent in such projects, potentially leading to unforeseen complications.

7.11 As explained next, the lack of flexibility can result in extended schedules and increased costs, as the framework does not allow any flexibility and/or adaptability needed to address evolving project demands.

Heathrow Implications (CGH)

7.12 The Heathrow Gateway Lifecycle (HGL) serves as a governance mechanism for overseeing projects within each programme. It outlines the process for planning, monitoring, and managing projects from start to finish through a series of stages or "*gateways*." Where each gateway represents a review,

validation, and decision-making point, ensuring projects align with the programme's objectives and contribute to the targeted outcomes.

7.13 This approach encourages a systematic vision of its capital delivery process through disciplined programme management, ensuring coherence, alignment, communication, and control across activities. For instance, the definition of roles within the governance model ensures all parties understand their responsibilities, whether sponsoring, leading, making decisions, or providing support, fostering a clear and accountable project environment.

7.14 On the other hand, it could be argued that Heathrow should attempt to devote greater time to the planning and design of projects to provide increased confidence in risks and costs before reaching the investment decision. This would potentially reduce the demand for change post-G3 but would extend the pre-construction period. While it is good practice to plan and design as thoroughly as possible, there are three factors which, in practice, limit what time can reasonably be spent in preparing and executing projects:

- Heathrow, like several other major asset operators (such as rail and metro operators, power companies, defence organisations) is obliged to develop and improve its assets in line with policy and legal requirements (such as those concerning new airport security systems). Delaying the delivery of some projects have the potential to bring Heathrow into breach of such obligations.
- Heathrow is also required to ensure that capacity keeps pace with growing demand in order to avoid crowding and possible safety issues.
- Viable projects for which a business case has been established, by definition, have economic benefits that exceed total costs. In most cases, delaying such projects will worsen the economic viability of the project. Benefits for those early years lost due to delays will be entirely foregone, whereas costs will still be incurred, albeit a year or two later.

7.15 As seen, given the specific nature and operational conditions of the projects Heathrow typically delivers, the *one size fits all* approach adopted in H7 limits Heathrow's ability to respond quickly to unforeseen events and challenges that may arise during the delivery of each project.

7.16 In all cases, delays to projects have potentially serious implications for the operation of the asset, either in terms of specific legal, policy or regulatory requirements, or denying passengers the timely benefit from improvements. The result is poorer value for passengers and reduced efficiency.

7.17 Therefore, a balance is required between ensuring adequate planning and design of projects and progressing delivery in order to generate benefits from project outcomes or avoid defaulting on obligations. This balance will vary between projects, and good practice involves empowering managers with the flexibility to make decisions and trade-offs that optimise the path between these needs.

8. Recommendations

8.1 This section puts forward a number of suggestions for improvements to the H7 framework in order that it better aligns with best practice in construction. It also suggests how Heathrow may adapt its capital delivery program.

8.2 The suggestions follow identification of a number of concerns regarding a deviation of capital delivery at Heathrow from recognised best practice. In general, Heathrow's preferred approach to capital delivery, as outlined in the CGH does accord with best practice; however, the constraints imposed by H7 make this difficult to achieve. The concerns are as follows:

- A sub-optimal risk allocation may result, involving excessive loading of risk onto Heathrow; and/or escalation of risk allowances in project budgets.
- Innovation and supply chain-led solutions will be curtailed by the inflexibility of the process and the over-specification of tactical solutions at G3.
- Schedules will be stretched by the time taken to negotiate change to DOs at G3 and by the implied pressure to deliver DOs even when it becomes apparent that these are sub-optimal or unworkable; this will inevitably drive cost escalation.
- The inherent reductionist approach implied by the H7 framework (narrow focus; inflexibility) and the constraints upon a systems approach (to manage complexity) will result in downstream operational inefficiencies leading to higher operational costs and reduced benefits.

- While Heathrow recognises the value of adequate 'front end planning' in order to mitigate risks, etc, the constraints of the quinquennial regulatory programme may constrain the time available. This poses a dilemma in planning programmes.

8.3 We have not suggested wholesale revisions to the H7 regime; rather we propose improvements to the framework to better align with best practice.

8.4 We have derived a number of recommendations for Heathrow. These concern both amendments for the H7 framework and changes that Heathrow can implement to its own processes. At the heart of our suggestions is the notion that '*one size does not fit all*'; in particular, that a different approach to delivery and contracting is required for small compared with larger contracts. Our proposals to align the H7 framework with industry best practice can be outlined as follows.

One Size Does Not Fit All

- Having a single framework for a project portfolio as diverse as Heathrow's does not accord with industry best practice. Therefore, the approach to capital delivery should be varied depending on project size and complexity.

Categorisation of Projects

- Categorising projects by size and complexity allows for a tailored approach to contract specification, programme management, and risk assessment. Large and complex projects, which often involve higher costs and greater risks, benefit from a flexible management strategy. This ensures that resources are allocated efficiently, and risks are mitigated effectively
- Various options exist for categorising projects, in particular, according to whether they are large and/or complex and therefore require a more flexible approach to specification of contract, programme management and risk assessment along the lines proposed here (as opposed to other less complex, regular projects which lend themselves more to the defined CAA framework).
- Categorising by size could be based on analysis of the population of H7 projects in order to identify the point above which greater than, say, 50% of value lies (as defined by cost). We would expect this to involve a relatively small number of projects as the distribution of projects by size will be relatively skewed; however, the '50%' cut-off can be adjusted as required.
- Categorising by complexity could be defined in terms of structural complexity, dynamic complexity, and context, as described on p5. Information on such factors such be available from the project risk assessments, including that on number of interfaces, stakeholders (suppliers) and technical fields (civils, electrical, IT, etc) involved.
- Another, statistical option (also see below) would be to accurately re-calculate the 'P' point – the point at which the probability of over-spend = the probability of under-spend. This represents the risk neutral position for Heathrow. Projects which appear above this point in the distribution (which will have a higher probability of over-spend) would be defined as 'large and/or complex' and qualify for the more flexible approach to management.

Programme Approach

- Heathrow favours a programme-led approach. A capital programme structured around 10-15 sub-programmes for the larger, more complex elements would allow Heathrow to conform more closely with best practice and have a better opportunity to implement its own CGH processes.

Risk Management

- It is possible that Heathrow is accepting risks that would normally transfer to the supply chain due to the need to define risks at G3, even if they are not fully understood. This is unlikely to be efficient, as defined by '*best practice'*. The quantitative implications of this should be measured and understood and, where appropriate, Heathrow's risk management processes adapted.
- For large, complex projects, it is highly unlikely that all risks will be identified and mitigated at G3 and therefore that costs can be fixed at this point with confidence. Consideration should be given to identifying a risk range at G3 and proceeding within this, NOT with a fixed price.

Capital Governance Handbook

- It is recognised that the CGH is still in draft: an opportunity exists to systematically overlay the handbook's approach on the H7 framework in order to identify specific points where either can be flexed in order to better align with best practice; or where new/different elements are required in the CGH (e.g., risk management).
- The CGH should also reference the 'Agile' approach to management and delivery of projects with a significant digital element. This will support continuous improvement and enhance efficiency.

8.5 The following table summarises these recommendations and suggests the benefits that could follow.

ISSUE	RECOMMENDATION	BENEFIT/OUTCOME
One size does not fit all	Adopt different approach to the delivery of large and complex projects compared with smaller, simpler projects. Technology projects also demand a bespoke approach that suits specific needs and scope.	This will enable Heathrow to better manage project risk and achieve efficient delivery, focussing resources on larger projects and avoiding waste and duplication elsewhere.
Programme management	Move to programme basis for larger complex projects. This implies specifying c.10-15 medium/large programmes requiring a different approach.	Different contracting approach adopted for large/complex projects. Greater focus on customer benefits. Flexibility to adapt during construction increases efficiency
Fixing risks and costs at G3	Identify a risk range at G3 and proceed within this rather than with a fixed price, e.g.: a central point +/- 20%	This will reduce the requirement for changes to be negotiated (so long as the price sits within the range), saving time and admin burden.
Optimising risk allocation	Where risks are being internalised from supply chain, quantify impacts in order to fully understand implications on Heathrow	Ensures that decisions are taken with full knowledge of risk impacts and that any addition to Heathrow's risk burden are transparent
Planning and design – adequacy	Aim to maximise the time and resources to plan and design solutions within the constraints of programme schedules and regulatory timetables	This ensures risks are identified and mitigated as part of the design process. Also, that the need for change during construction is minimised and designs can be 'locked-down'.
IT/Digital Framework	Adopt an agile approach that enables a continuous learning process to ensure innovation and value for money.	Agile projects are monitored through a roadmap of milestones and iterations linked to value delivery. Also, it is expected that lessons learned from each release will be applied to ensure continuous improvement, efficiency, and cost-effectiveness.
Completing CGH	Systematically overlay the handbook's approach on the H7 framework to identify specific points where either can be flexed in order to better align with best practice	Clarity on divergence between Heathrow's CGH methodology and requirements of H7 framework (& hence divergence from good practice).
Defining 'large' or 'complex' projects	A consistent approach is required to the definition of 'large' or 'complex' projects that demarcates such projects as requiring greater flexibility. Several suggestions are put forward	This will provide clarity and transparency when producing future programmes of work, with an explicit demarcation between different categories of project.

8.6 One further observation concerns the importance of risk management within Heathrow's operational environment. Risk, arguably, carries disproportionately more significance at Heathrow compared with other infrastructure operations. This reflects, in part, the impact of operational disruption at Heathrow and the comparatively high economic and social cost associated with this (e.g. closing a runway for an hour compared with closing a major road or rail line).

8.7 A strong case exists to reflect this disproportionate sensitivity to risk in the capital programme; in particular, ensuring that programmes which are deemed to carry a high level of risk are established and managed differently and with appropriate due process than those with lower risks. This reinforces the above case that '*one size does not fit all'* and for large, complex (and therefore riskier) projects to ensure risks are defined and mitigated before the solution and price are fixed.

References

Bennett, P., & Cropper , S. (1990). Uncertainty and conflict: combining conflict analysis and strategic choice. *Journal of Behavioral Decision Making*, 29-45.

Brady, T., & Davies, A. (2013). Governing Complex Infrastructure Developments: Learning From Successful Megaprojects. *International Symposium for Next Generation Infrastructure.* Wollongong, Australia.

Cabinet Office. (2023). *The Digital, Data and Technology Playbook Government guidance on sourcing and contracting for digital, data and technology projects and programmes.*

Corrales, J., & Veiga, J. (2022). Managing Complexity in Engineering & Construction Projects, Hydrocarbon Processing.

de Rezende, L. B., & Blackwell, P. (2019). Revisiting project complexity: a new dimension and framework. *Modern Project Management*.

de Rezende, L. B., Denicol, J., Blackwell, P., & Kimura, H. (2022). The main project complexity factors and their interdependencies in defence projects. *Project Leadership and Society*.

Department for Transport. (2024). *TAG Unit A1.2, Scheme Costs.* London: DfT.

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*, 219-245.

Flyvbjerg, B. (2014). What You Should Know About Megaprojects and Why: An Overview. *Project Management Journal*.

Flyvbjerg, B., & Bester, D. (2021). The Cost-Benefit Fallacy: Why Cost-Benefit Analysis Is Broken and How to Fix It. *Journal of Benefit-Cost Analysis*.

Flyvbjerg, B., & Gardner, D. (2023). *How Big Things Get Done: The Surprising Factors Behind Every Successful Project, from Home Renovations to Space Exploration.* Macmillan.

Flyvbjerg, B., Budzier, A., Seok Lee, J., Keil, M., Lunn, D., & Bester, D. (2022). The Empirical Reality of IT Project Cost Overruns: Discovering A Power-Law Distribution. *Journal of Management Information Systems*, 607-639.

Government Commercial Function. (2021). *Risk Allocation & Commercial Pricing, Guidance.* London: HMG.

Hirschman, A. (1956). *Development projects observed.* Washington: The Brookings Institution.

Infrastructure and Projects Authority. (2020). *Principles for Projects Success.* London: IPA.

Infrastructure and Projects Authority. (2022). *Annual Report on Major Projects 2021-22.* London: IPA.

Institution of Civil Engineers - ICE. (2022). *A systems approach to infrastructure delivery - Part 2: Putting the principles into practice.* London: The Institution of Civil Engineers.

National Audit Office. (2020). *Lessons learned from major programmes.* NAO.

National Audit Office. (2021). *Crossrail – A progress update, Department for Transport, Transport for London and Crossrail Limited.* NAO.

National Audit Office. (2023). *High Speed Two: Euston.* London: NAO.

San Cristóbal, J., Carral, L., Díaz, E., Fraguela, J., & Iglesias, G. (2018). Complexity and Project Management: A General Overview. *Advances in Civil Engineering*.

Sohi, A., Bosch-Rekveldt, M., & Hertogh, M. (2021). Four stages of making project management flexible: insight, importance, implementation and improvement. *Organization, Technology and Management in Construction: an International Journal*, 2117-2136.

World Economic Forum. (2024). *Implementing a life-cycle approach to infrastructure: A policy roadmap for cities (Model Policy).* Cologny.

Appendix 1: Best Practice Framework

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Enabled Leadership	Leadership should be empowered to deliver their delegated responsibilities, ensuring that each one clearly understands their role and the expected outcomes.	Project inception	For projects to succeed, there must be a clear alignment between accountabilities and responsibilities. Effective project management and governance requires that project management is empowered to make decisions as defined/delegated by the Project Board. 'Owners must own' projects and their outcomes. The rule for effective empowerment is that responsibility for key decisions is matched with accountability for the corresponding outcomes. Concurrent with this, good governance requires that management follows set procedures for Health & Safety, stakeholder consultation, adherence to quality standards, etc.	▪ Crossrail – requirements for governance and programme integration emphasised the need for clear responsibilities & accountabilities; also, for decisions to be made by the appropriate delegated authority. ▪ UK water industry enhancements – leaders and project managers have clear delegated authorities for decision-making within a framework of defined outcomes and process-compliance around issues such as stakeholder consultation and environmental management. ▪ GOV.UK (2021) established a clear and effective delivery approach. Workstream leads prioritised backlogs and conducted knowledge-sharing kick-off sessions to minimise assumptions. Also, implemented a "pairing by default" approach to foster peer learning and shielded the team from time-consuming, non-essential tasks.	1. Crossrail – Learning Legacy series, Programme Governance, learninglegacy.crossrail.co.uk 2. Crossrail – Learning Legacy series, Systems Integration and Assurance, learninglegacy.crossrail.co.uk 3. ICE, Project 13, Collaboration for Innovation, ICE, 2021 4. IPA/DfT, Lessons from Transport for the Sponsorship of Major Projects, IPA, DfT, 2019 5. NAO, Progress in Implementing Recommendations for HS2, 2021 6. OECD (2017), Getting Infrastructure Right: A framework for better governance, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264272453-en 7. European PPP Expertise Centre. (2018). Ex-post assessment of PPPs and how to better demonstrate outcomes. European Investment Bank.
Reliable and accurate project schedules	Develop detailed and realistic timelines that account for all project phases and potential delays.	Planning and design	When schedules are well-structured, they provide a roadmap for progress, enabling teams to track milestones, allocate resources effectively, and maintain focus on core needs. In contrast, inaccurate schedules can lead to project overruns and cost escalations, significantly impacting the overall success of the initiative. Overly optimistic	Repeated delays to the HS2, Euston Station project, were caused by unrealistic schedules, necessitating re-work and further delays.	1. NAO, Progress in Implementing Recommendations for HS2, 2021 2. Lorko, M., Servátka, M., & Zhang, L. (2023). Hidden inefficiency: Strategic inflation of project schedules. Journal of Economic Behavior & Organization, 206, 313-326. https://doi.org/10.1016/j.jebo.2022.12.014 3. Littell, N., (2024) "A Reliability Approach to Cost and Schedule Project Management Estimation", The Journal of Technology, Management, and Applied Engineering. doi: https://doi.org/10.31274/jtmae.16996 4. Flyvbjerg, Bent & Skamris, Mette & And, Holm &

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
			timelines may create a false sense of security, resulting in a failure to meet deadlines and deliver on promises. It is far more efficient to establish a realistic schedule from the outset, allowing teams to anticipate challenges and respond proactively, rather than adopting an overly bullish schedule that ultimately leads to setbacks and increased expenses.		Buhl, Søren. (2004). What Causes Cost Overrun in Transport Infrastructure Projects? Transport Reviews. 24. 3-18. 10.1080/0144164032000080494a.
Extensive planning & front-end preparation	The quality of planning and adequate front-end preparation is vital for projects to succeed. Emphasising the development of "shovel-worthy" projects through strategic investment and collaboration, which ultimately leads to shorter build times and smoother execution.	Project planning and inception	The quality of planning and adequate front-end preparation is essential for project success. Adopting a "shovel-worthy" projects rather than merely "shovel-ready" ones. This approach emphasises investing sufficient time and resources into strategy, planning, and early design, involving full collaboration with delivery and technology partners. A comprehensive planning phase aligns stakeholders and helps identify and resolve issues before committing to a specific solution. It is relevant to acknowledge that whilst this may lead to a lengthier planning phase, it often results in significantly shorter build times and a smoother execution process.	▪ BaE Systems Carrier Programme was built around ‘left-shift’ thinking (ie: front end loading). Projects which involved public inquiries (T5; most new UK motorways) were required to undergo lengthy and thorough planning in order to satisfy the needs of the Inquiry; The length of Inquiries has received much criticism, however, once a solution was agreed, construction tended to be relatively rapid.	1. ICE, A systems approach to infrastructure delivery, Vol 1, 2021; Vol 2, 2022 2. ICE, The Infrastructure Governance Code, 2023 3. IPA, Infrastructure and Projects Authority, Principles for Projects Success, 2020 4. National Infrastructure Commission. (2024). Cost effective delivery of infrastructure projects. Retrieved from https://nic.org.uk/studies-reports/cost-effective-delivery/

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Programme complexity & delivery mechanisms	Identify and understand relative programme complexity and adjust delivery mechanisms accordingly	Programme delivery	Complexity plays a vital role in project success, highlighting the importance of understanding and managing it effectively to achieve planned outcomes. Complexity in projects arises from multiple factors such as interfaces between different systems or components, diverse and often conflicting stakeholder interests, the novelty of the proposed solutions, and the need to operate within a dynamic and/or constantly evolving environment. Complexity often introduces uncertainty and variability, making the project more difficult to manage/plan. For instance, complex interfaces between systems can lead to coordination challenges, while managing diverse stakeholders often results in competing priorities that need to be balanced. Innovative solutions bring untested approaches and unknown risks, and delivering in a live environment requires adapting to ongoing changes without risking daily operations.	Corrales analyse the performance of 86 major projects and conclude that complexity is consistently a significant contributory factor to project failure. ▪ IPA (2020) list management of complexity as one of the eight principles for success in delivery of major projects.	1. Corrales et al (2022) (Corrales, J, Veiga, J.P, Technicas Reunidas, Managing Complexity in Engineering & Construction Projects, Hydrocarbon Processing, May 2022) 2. San Cristóbal, J. R., Carral, L., Diaz, E., Fraguela, J. A., & Iglesias, G. (2018). Complexity and project management: A general overview. Advances in Civil Engineering, 2018, 4891286. https://doi.org/10.1155/2018/4891286 3. Bennett P. and Cropper S., Uncertainty and conflict: combining conflict analysis and strategic choice, Journal of Behavioral Decision Making. (1990) 3, no. 1, 29–45, https://doi.org/10.1002/bdm.3960030104, 2-s2.0-84980187049.
Cost Management	Agree costs once solutions are defined and risks are understood and measured.	Complexity dependent; for complex projects, Detailed Design; for less complex Outline Design	Fixing costs too early or before the solution is clearly defined and risks are fully understood can lead to budget overruns, unforeseen challenges, and compromised project quality. When the specifics of the solution remain uncertain, costs cannot be reliably determined, potentially leading to budget overruns. A thorough understanding of the project scope and associated risks is essential for establishing accurate and sustainable cost estimates. While some projects may attempt to mitigate this when incorporating a substantial risk allowance, this strategy can drive costs beyond acceptable limits and may still prove insufficient.	▪ HS2 – project progressing within risk-defined cost envelope with changes due to consents requirements, systems integration, inflation, scope change. A fixed price approach is not being used and would be unworkable for such a large and complex project. NAO criticise Euston Station plans for fixing price too early. ▪ DfT guidance advises users to adjust costs during a project's development by reference to risk. In a worked example of a 'typical' project, a 'Base Cost' estimate of £250m has only a 12% probability of being achieved and an 80% certainty would require a 25% increase in the cost budget. ▪ Crossrail ▪ Tideway ▪ Hinkley Point Most Network Rail enhancements	1. NAO, Progress in Implementing Recommendations for HS2, 2021 2. IPA/DfT, Lessons from Transport for the Sponsorship of Major Projects, IPA, DfT, 2019 3. DfT, TAG Unit A1.2, Scheme Costs, DfT, 2022 4. HMG, Government Commercial Function, Risk Allocation & Commercial Pricing, 2021 5. National Audit Office (NAO), Value for Money Report, HS2 Euston, March 2023 6. Lorko, M., Servátka, M., & Zhang, L. (2023). Hidden inefficiency: Strategic inflation of project schedules. Journal of Economic Behavior & Organization, 206, 313-326. https://doi.org/10.1016/j.jebo.2022.12.014

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Cost Management Decision efficiency	Create a cost framework that becomes more refined as the project develops, allowing for greater accuracy and flexibility in budgeting.	Design	Ensure that scope and specifications are adequately developed when approving the cost envelope and contingency. This approach allows projects to move forward without eliminating all risks, accelerating schedules while avoiding premature risk pricing. It also provides flexibility for changes, such as integrating innovations, systems, or stakeholder needs, and prevents organisations from being burdened with uncontrollable risks. It also enables consideration of whole-life trade-offs for better decision-making.	▪ HS2 – project progressing within risk-defined cost envelope with changes due to consents requirements, systems integration, inflation, scope change. A fixed price approach is not being used and would be unworkable for such a large and complex project. NAO criticise Euston Station plans for fixing price too early. ▪ DfT guidance advises users to adjust costs during a project's development by reference to risk. In a worked example of a 'typical' project, a 'Base Cost' estimate of £250m has only a 12% probability of being achieved and an 80% certainty would require a 25% increase in the cost budget. ▪ Crossrail ▪ Tideway ▪ Hinkley Point ▪ most Network Rail enhancements	1. NAO, Progress in Implementing Recommendations for HS2, 2021 2. IPA/DfT, Lessons from Transport for the Sponsorship of Major Projects, IPA, DfT, 2019 3. IPA, Infrastructure and Projects Authority, Principles for Projects Success, 2020 4. DfT, TAG Unit A1.2, Scheme Costs, DfT, 2022 5. HMG, Government Commercial Function, Risk Allocation & Commercial Pricing, 2021 6. National Audit Office (NAO), Value for Money Report, HS2 Euston, March 2023
	Project leaders must make informed, quick, and clear decisions. The framework should also provide flexibility in the schedule and contracting model to accommodate risks or uncertainties in the design.	Detailed design - delivery	In complex projects, quick and clear decision-making is essential to avoid delays and mitigate potential risks. Complexity often introduces uncertainty in design, scope, or execution, requiring project leaders to make timely, well-informed decisions to keep the project on track. A rigid framework can hinder responsiveness and lead to inefficiencies or unforeseen costs. Therefore, it is crucial to have a flexible contracting model that can adapt to changing circumstances. This flexibility enables teams to manage risks more effectively, integrate innovations, and respond to evolving project demands, ultimately ensuring successful delivery.	In order to be able to manage complexity, it is critical that those overseeing the project can make informed quick and clear decisions and that, where risk or uncertainty remain in the design, the framework allows for sufficient flexibility in the schedule and contracting model to address this uncertainty. ▪ These conditions largely reflect a systems approach to infrastructure development recently promoted by the Institute of Civil Engineers.	1. ICE, A systems approach to infrastructure delivery, Vol 1, 2021; Vol 2, 2022 2. ICE, The Infrastructure Governance Code, 2023 3. 6. OECD (2017), Getting Infrastructure Right: A framework for better governance, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264272453-en

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Efficient change control process	Ensure that project modifications are quickly assessed, approved, and implemented, minimising disruptions to timelines and budgets.	Detailed design and delivery	Efficient change control is critical for maintaining programme schedules and minimising delays. In complex projects, changes are inevitable, whether due to evolving requirements, unforeseen challenges, or stakeholder input. A streamlined change management process ensures that adjustments are identified, evaluated, and implemented swiftly, preventing disruptions to the overall timeline. Change control helps manage costs more effectively by avoiding unnecessary rework and delays. This proactive approach not only keeps the project on track but also enhances cost efficiency, allowing for better resource allocation and minimising financial risk associated with uncontrolled changes.	Good practice also requires an effective change control process because good programme integration generally requires change mid-programme to optimise outputs and respond to unforeseen perturbations.	1. ICE, A systems approach to infrastructure delivery, Vol 1, 2021; Vol 2, 2022 2. ICE, The Infrastructure Governance Code, 2023 3. ICE, Project 13, Collaboration for Innovation, ICE, 2021 4. Crossrail – Learning Legacy series, Programme Governance, learninglegacy.crossrail.co.uk 5. Crossrail – Learning Legacy series, Systems Integration and Assurance, learninglegacy.crossrail.co.uk
Intelligent risk-sharing	Assign risks to the parties most capable of understanding and mitigating their impact. This approach leverages each party's expertise and position, ensuring risks are managed by those best suited to handle them.	Risk approach should be determined at design, as risks become understood	Intelligent risk-sharing ensures that risks are borne by the parties best positioned to manage them. When risk allocation is misaligned—such as assigning risks to parties without the capacity to manage them—it undermines effective risk management and increases the likelihood of projects running over schedule or budget. It is essential to design contracting mechanisms and incentives that take into account each party's position and ability to manage/mitigate specific risks.	Misinformation about costs, schedules, benefits, and risks is common throughout project development and decision-making processes, often leading to cost overruns, delays, and benefit shortfalls that undermine project viability. Flyvbjerg's (2014) paper underscores the need for intelligent risk management in megaprojects. This approach ensures efficient resource allocation and effective risk mitigation, ultimately improving project benefits and reducing the likelihood of overspend.	1. DfT, TAG Unit A1.2, Scheme Costs, DfT, 2022 2. Flyvbjerg, B, Garner, D, How Big Things Get Done, Macmillan, 2023 discuss the propensity of major projects to over-spend, with 80-90% being shown to be delivered over-budget. 3. Flyvbjerg, B., 2014. What you should know about megaprojects and why: an overview. Proj. Manag. J. 45, 6–19. https://doi.org/10.1002/pmj.21409

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Form of Delivery Contract	The choice of delivery contract is crucial in effectively managing project risk. Contracts should be designed to ensure that risks are allocated to the parties best positioned to control or mitigate them. A well-matched contract ensures that risks are properly managed, enhancing project success and overall value.	Procurement	Inappropriate contracting models result in imbalance between the treatment of cost estimates and analysis of risk. This leads to risk being allocated to parties unable to manage it. Inappropriate contracting models can lead to significant issues: 1. Imbalance in cost estimates and risk analysis: when contracting models do not appropriately balance cost estimates and risk analysis, it often results in unrealistic budgets and inaccurate timelines. 2. Impact on project outcomes: misallocated risks can cause projects to miss their cost and timescale targets. 3. Value-for-money: Projects that fail to deliver on time and within budget without achieving project outcomes often do not provide good value-for-money.	Government advises that fixed price contracts require an '*unambiguous scope and specification'* if they are to be used. The IPA Principles for Project Success guidelines (referenced by the CAA in the draft Guidance on capex incentives) advise that in order to plan realistically the following approach should be applied: use of '*ranges for costs, benefits and delivery dates, **adjusted as certainty increases through the life of the project**' (emphasis added*)	1. IPA, Infrastructure and Projects Authority, Principles for Projects Success, 2020 2. Babalola, O. G., Bhuiyan, M. M. A., & Hammad, A. (2024). Literature review on collaborative project delivery for sustainable construction: Bibliometric analysis. Sustainability, 16(17), 7707. https://doi.org/10.3390/su16177707 3. Association for Project Management. (2019). Edinburgh Tram Inquiry: Project management for large, complex projects. https://www.apm.org.uk/media/32612/digital_edinburgh-tram-report.pdf

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Validation, Certification & Sign-Off	Validation, certification, and sign-off processes should be appropriately structured to ensure clear agreements and smooth transitions between project phases (e.g. between design and construction). This reduces ambiguity, risks, and helps maintain project timelines and quality.	Design-Delivery	Complex projects require close integration of design and delivery. Validation, certification, and sign-off requirements must be fit-for-purpose to ensure smooth integration between design and delivery. Well-documented interfaces, particularly between key stages such as design and construction or with external bodies like statutory consultees, are common sources of delays and cost overruns. Clear validation and proper verification processes help mitigate these risks by ensuring that all elements meet necessary standards before progressing to the next stage. When these processes are streamlined and aligned with project goals, they help prevent costly rework, reduce delays, and improve overall project efficiency.	HS2 has been delayed by onerous 'L3' sign-off requirements for completed designs. These require consent from statutory consultees as well as full, digital documentation. Rigid imposition of the 'L3' process delayed the onset of construction on several sites. Several changes have been made, including allowing self-certification of some designs with partial information; categorisation of some consents as immaterial, with progress permitted pending a response; targeting L3s that were on a critical path and fast-tracking these.	1. National Audit Office (NAO), *Value for Money Report, HS2 Euston*, March 2023 World Bank. (2020). *Governance infrastructure assessment framework*.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Programme & System Integration	Establish 'programme integration' function to manage interfaces (Systems Integration & Programme Integration)	Establish at inception with ongoing inputs throughout programme	Complex projects and programmes often fail because of poor SI/PI. This is partly due to the number of interfaces to be managed and the challenges in doing so. Embedded, traditional working practices also lead to failures. To mitigate this, best practice suggests forming a small, dedicated 'integration team'. This team should work across the supply chain (where many interfaces exist). These teams are most effective when designed to quickly adapt, allowing them to act fast, fail fast, and learn fast.	▪ The 'V-Model' has been developed to manage SI/PI and is used to manage a number of successful major projects such as Thames Tideway. The V-Model was not just a tool for systems engineers at Tideway – it helped the project organisation to define responsibilities, allocate resources and ultimately focus on bringing an enterprise into operation. ▪ The Great Western Electrification Programme (Network Rail) experienced major schedule and budget failure due to poor SI/PI. Design and installation interfaces were not well managed; technology was poorly integrated (eg: factory trains); there was a consistent failure to re-schedule, re-budget and re-assess construction methods in the face of problems experienced. Triangulum (Manchester, Eindhoven, Stavanger) had a systematic approach to define the ICT reference architecture allowing them to: Provide a unified view and understanding of ICT strategies, identify interfaces between ICT components, and enable exchange and interoperability of components/solutions	1.ICE, A systems approach to infrastructure delivery, Vol 1, 2021; Vol 2, 2022 2.National Audit Office (NAO), Modernising the Great Western railway, November 2016. 3.European Commission. *Triangulum: The Three Point Project / Demonstrate. Disseminate. Replicate.* 2020.
Tailored Contracting Mechanisms	A variety of contracting mechanisms exist (fixed price, target price, alliances, etc) They do so for a reason: different types of projects require a different approach to delivery, depending on risk, operating environment, level of innovation, etc.	All stages of contract	Understanding the essential needs and delivery methods provides valuable insights into the specific requirements of various project types. Different contracting mechanisms, including fixed-price, target-price, and alliances, are designed to optimise contract and risk management for a range of projects. For major projects, particularly those with high complexity, pro forma contracts are generally discouraged because they do not facilitate effective responses to dynamic environments, unknown risks, and the uncertainties associated with developing solutions.	▪ For major projects, or those with a high degree of complexity, fixed price contracts are discouraged both by Government sources and industry practitioners. This is because – as set out in HMG Government Commercial Function – the Government advises that fixed price contracts require an '*unambiguous scope and specification'* if they are to be used. Other forms of contract, such as those within the NEC range, should then be considered.	1. HMG, Government Commercial Function, Risk Allocation & Pricing Approaches, 2021 2. National Infrastructure Commission. (2024). Cost effective delivery of infrastructure projects. Retrieved from https://nic.org.uk/studies-reports/cost-effective-delivery/ 3. Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. Qualitative Inquiry, 12(2), 219-245. https://doi.org/10.1177/1077800405284363

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	EXAMPLE	REFERENCE
Systems Thinking	Consider a project as a cohesive system—major projects or programs consist of intricate networks of interconnected systems and subsystems.	All stages of programme	Adopting a systems approach to infrastructure delivery is crucial for navigating the complexities of large projects. This method ensures that all elements function cohesively to achieve the intended results. It highlights the interdependencies within a major project, recognising that actions in one area can affect others. (i.e., a delay in securing statutory consents can disrupt the construction timeline, resulting in cost overruns and jeopardising the successful attainment of the agreed-upon outcomes) Key elements of a systems approach include: 1. Interdependencies: Each best practice concept supports the others, creating a cohesive framework for project delivery. For example, effective risk management, validation, and certification processes are all interlinked and contribute to the overall success of the project. 2. Managing complexity: Major infrastructure projects are inherently complex and do not lend themselves to simple, siloed methods. A systems approach acknowledges this complexity and provides a structured way to manage it. This involves understanding the various components of the project and how they interact with each other. 3. Holistic view: Considering all elements and their interactions, potential issues can be identified early and addressed proactively, which improves project outcomes and ensures value-for-money.	BaE Systems Carrier Programme was heavily influenced by systems thinking. BaE systems worked intensively with the supply chain on project definition and planning (ie: not only delivery) to achieve higher levels of maturity earlier in the lifecycle and thus increase programme efficiency. This systems approach is now being used on the SSN and Dreadnaught programmes.	1. IPA/DfT, Lessons from Transport for the Sponsorship of Major Projects, IPA, DfT, 2019 2. ICE, A systems approach to infrastructure delivery, Vol 1, 2021; Vol 2, 2022. 3. Rezende, L. B. de, Denicol, J., Blackwell, P., & Kimura, H. (2022). The main project complexity factors and their interdependencies in defence projects. Project Leadership and Society, 3, 100050. https://doi.org/10.1016/j.plas.2022.100050

Appendix 2: Best Practice and Heathrow

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
Enabled Leadership	Leadership should be empowered to deliver their delegated responsibilities, ensuring that each one clearly understands their role and the expected outcomes.	Project inception	For projects to succeed, there must be a clear alignment between accountabilities and responsibilities. Effective project management and governance requires that project management is empowered to make decisions as defined/delegated by the Project Board. 'Owners must own' projects and their outcomes. The rule for effective empowerment is that responsibility for key decisions is matched with accountability for the corresponding outcomes. Concurrent with this, good governance requires that management follows set procedures for Health & Safety, stakeholder consultation, adherence to quality standards, etc.	The H7 framework is disempowering as it reduces flexibility to respond to new information mid-project and imposes a rigid change process on Heathrow that requires airline agreement. It assumes that the prescribed DO change process will operate smoothly without clarity of the process for ensuring this.	The CGH establishes a robust governance structure at Heathrow with clear roles, responsibilities, and accountabilities to ensure effective programme delivery and successful project execution. This structured approach is designed to support the achievement of outcomes and the delivery of agreed outputs by providing a systematic framework for decision-making, oversight, and resource allocation, ensuring that each project progresses efficiently through its lifecycle. The governance structure between Heathrow and stakeholders (in general those involved in sponsoring, approving, and controlling the capital portfolio) was discussed and agreed through the governance forum. A core strength of this governance model is its emphasis on clarity and accountability. (i.e., Executive Sponsor, Functional Sponsor, Managing Sponsor). Defined roles within Heathrow's organisational structure ensure that all involved parties have a precise understanding of their responsibilities, whether they are sponsoring a programme, leading a project, making executive decisions, or providing support functions.

[6] It is understood that the Capital Governance Handbook is still in a draft version.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
Reliable and accurate project schedules	Develop detailed and realistic timelines that account for all project phases and potential delays.	Planning and design	When schedules are well-structured, they provide a roadmap for progress, enabling teams to track milestones, allocate resources effectively, and maintain focus on core needs. In contrast, poorly planned schedules can lead to project overruns and cost escalations, significantly impacting the overall success of the initiative. Overly optimistic timelines may create a false sense of security, resulting in a failure to meet deadlines and deliver on promises. It is far more efficient to establish a realistic schedule from the outset, allowing teams to anticipate challenges and respond proactively, rather than adopting an overly bullish schedule that ultimately leads to setbacks and increased expenses.	The H7 framework makes a strong emphasis on cost efficiency and accountability, which are important for ensuring that Heathrow meets clear deliverables throughout the regulatory period. However, by requiring that costs and deliverables are fixed at G3, there is a strong likelihood, particularly with complex projects, that risks are not fully understood and that schedules may therefore become extended. It is accepted that a clear schedule for most projects incentivises reliability and reinforces commitment to deliverables as agreed upon at G3. This structured approach helps stakeholders understand timelines and expectations, which can foster greater accountability among project teams, suppliers, and airlines. H7 aims to encourage a well-defined project by G3, in an attempt to increase the likelihood of on-time project completion and promotes a culture of responsibility. However, the H7 framework lacks a contextualised understanding of the nature and complexity of the projects to be delivered. Each project can present unique challenges that may not be adequately addressed by rigidly fixing price, scope, and timelines too early in the process. This lack of flexibility can lead to unforeseen complications, which may manifest as delays or increased costs, particularly in larger and more complex projects where adaptability is essential for success.	The CGH makes a significant emphasis and effort on establishing dependable and precise timelines for projects, which underscores a fundamental strength of the governance model in fostering clarity and accountability. This commitment is essential for ensuring that projects are completed on schedule and align with stakeholder expectations. The governance framework distinctly outlines roles within Heathrow's organisational structure, (i.e., Executive Sponsor, Functional Sponsor, and Managing Sponsor). This clear allocation of responsibilities guarantees that all parties involved—whether sponsoring a programme, leading a project, making executive decisions, or providing support functions—fully understand their roles. Furthermore, after the investment decision is reached at G3, the role of Project Managers becomes particularly important in monitoring and identifying any potential delays in the timeline. They are also responsible for implementing the necessary actions, including escalation activities, to mitigate any negative impacts that may arise.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
Extensive planning & front-end preparation	The quality of planning and adequate front-end preparation is vital for projects to succeed. Emphasising the development of "shovel-worthy" projects through strategic investment and collaboration, which ultimately leads to shorter build times and smoother execution.	Project planning and inception	The quality of planning and adequate front-end preparation is essential for project success. Adopting a "shovel-worthy" projects rather than merely "shovel-ready" ones. This approach emphasises investing sufficient time and resources into strategy, planning, and early design, involving full collaboration with delivery and technology partners. A comprehensive planning phase aligns stakeholders and helps identify and resolve issues before committing to a specific solution. It is relevant to acknowledge that whilst this may lead to a lengthier planning phase, it often results in significantly shorter build times and a smoother execution process.	The H7 framework encourages the importance of a thorough planning process prior to making investment decisions. According to the CAA it is expected that this culture of better planning will ultimately lead to improved outcomes and a more robust investment strategy.	The CGH makes a strong emphasis on establishing a robust structure for activities during the early identification and design stages of potential projects (P1 and P2). This focus on thorough planning is critical not only for ensuring that budgets, timelines, and project scopes are agreed upon at Gateway 3 (G3), but also for mitigating the adverse impact on incentives for Heathrow if these agreements are not fulfilled.
Programme complexity & delivery mechanisms	Identify and understand relative programme complexity and adjust delivery mechanisms accordingly	Programme delivery	Complexity plays a vital role in project success, highlighting the importance of understanding and managing it effectively to achieve planned outcomes. Complexity in projects arises from multiple factors such as interfaces between different systems or components, diverse and often conflicting stakeholder interests, the novelty of the proposed solutions, and the need to operate within a dynamic and/or constantly evolving environment. Complexity often introduces uncertainty and variability, making the project more difficult to manage/plan. For instance, complex interfaces between systems can lead to coordination challenges, while managing diverse stakeholders often results in competing priorities that	Under the H7 framework, Heathrow's flexibility in all projects to manage the complexities of large and major projects post-G3 is significantly constrained. This limitation is likely to impact Heathrow's ability to deliver value efficiently and stay within schedule and budget, while also increasing the risks Heathrow must bear. The CAA acknowledges this reduced flexibility but effectively ignores it, justifying it as essential for Heathrow to manage capital expenditures economically and efficiently, regardless of the project's complexity, nature, or scale. The CAA claims that this approach helps Heathrow operate, maintain, and develop airport services to meet users' reasonable demands while keeping control on budget.	The CGH establishes a clear definition of "Key Projects" to ensure that significant capital initiatives at Heathrow are managed effectively and transparently. This definition encompasses four critical criteria: 1. Scope and complexity: - Projects that have bespoke design and delivery responses, or significant interfaces with other projects of significant time criticality; and/or; 2. Airline stakeholder impact: Projects with significant impact (positive or negative) on passengers and/or Airlines (determined by operational or capacity impact during implementation, significant change management for Stakeholders to use new facility, or significant increases in operating costs arising from the proposed project.); and/or; 3. Strategic importance: - High to

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			need to be balanced. Innovative solutions bring untested approaches and unknown risks, and delivering in a live environment requires adapting to ongoing changes without risking daily operations.	The failure of the H7 framework to adapt to complexity or to distinguish sufficiently between complex and simple projects is a fundamental shortcoming.	significant impact on Heathrow KPI's; and/or; 4. Capital value: - Above £20m. To facilitate effective governance of these Key Projects, the concept of an Independent Fund Surveyor (IFS) is adopted. The IFS provides ongoing assessments of the reasonableness of key decisions made throughout the project's lifecycle, ensuring that capital is utilised effectively in alignment with the intended outcomes. This independence helps build trust among all parties that the IFS provides transparent assessments of the project's progress and results.
Cost Management	Agree costs once solutions are defined and risks are understood and measured.	Complexity dependent; for complex projects, Detailed Design ; for less complex Outline Design	Fixing costs too early or before the solution is clearly defined and risks are fully understood can lead to budget overruns, unforeseen challenges, and compromised project quality. When the specifics of the solution remain uncertain, costs cannot be reliably determined, potentially leading to budget overruns. A thorough understanding of the project scope and associated risks is essential for establishing accurate and sustainable cost estimates. While some projects may attempt to mitigate this when incorporating a substantial risk allowance, this strategy can drive costs beyond acceptable limits and may still prove insufficient.	H7 requires that DOs are fully agreed upon at G3, including budget, timeline, and expected outputs. The intent behind this requirement, as per the CAA is to enhance accountability, ensuring that Heathrow commits to clear deliverables throughout the regulatory period. However, this standard applies for all projects, without distinguishing between simpler initiatives and large, complex projects that inherently carry higher uncertainty and risks. By setting fixed expectations for all projects at G3, H7 assumes that all critical project details and risks can be fully understood and agreed upon at this early stage. This generalisation risks oversimplifying complex projects where details often evolve over time, making it challenging to assess all risks accurately at G3.	The CGH emphasises the importance/need of identifying and understanding potential risks at P1 and P2 to ensure that all stakeholders have a comprehensive grasp of the implications of capital expenditure decisions. This identification is also encouraged as part of a systematic approach conducted at a Risk Management stage. The successful identification and allocation of risks can be achieved in less complex and straightforward projects. However, the practical challenges associated with large and complex projects can hinder the effectiveness of this systematic approach. Acknowledging the potential for incomplete risk understanding due to time constraints and the inherent complexities of projects is essential

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
				Consequently, the cost, time, and output commitments for complex projects may be locked in prematurely, which could result in budget and timeline constraints that don't reflect the evolving nature of large-scale projects.	for ensuring that risks are allocated appropriately.
Cost Management Decision efficiency	Create a cost framework that becomes more refined as the project develops, allowing for greater accuracy and flexibility in budgeting.	Design	Ensure that scope and specifications are adequately developed when approving the cost envelope and contingency. This approach allows projects to move forward without eliminating all risks, accelerating schedules while avoiding premature risk pricing. It also provides flexibility for changes, such as integrating innovations, systems, or stakeholder needs, and prevents organisations from being burdened with uncontrollable risks. It also enables consideration of whole-life trade-offs for better decision-making.	The H7 framework does not recognise the concept of a 'narrowing cost envelope' because it effectively requires cost to be fixed at G3 (and also imposes an inefficient change process). An alternative approach such as that implied within target-cost contracts, permits costs to be refined beyond G3, with the expectation that the risk envelope will narrow accordingly. A further potential consequence of the H7 framework is that a risk averse approach is adopted to G3 to guard against subsequently rising costs. This could impact cost estimates which affect out-turns in consequence.	The CGH highlights the necessity of identifying and accurately assessing costs associated with both Programmes and Projects. Heathrow underscores the importance of thorough cost evaluation during the P1 and P2 phases, as well as throughout the entire project lifecycle. A systematic approach to cost management enables enhanced decision-making and accountability, which in turn supports the long-term financial sustainability of Heathrow's capital investment strategies.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
	Project leaders must make informed, quick, and clear decisions. The framework should also provide flexibility in the schedule and contracting model to accommodate risks or uncertainties in the design.	Detailed design -delivery	In complex projects, quick and clear decision-making is essential to avoid delays and mitigate potential risks. Complexity often introduces uncertainty in design, scope, or execution, requiring project leaders to make timely, well-informed decisions to keep the project on track. A rigid framework can hinder responsiveness and lead to inefficiencies or unforeseen costs. Therefore, it is crucial to have a flexible contracting model that can adapt to changing circumstances. This flexibility enables teams to manage risks more effectively, integrate innovations, and respond to evolving project demands, ultimately ensuring successful delivery.	The H7 framework's requirement to establish DOs early in the project lifecycle at G3, combined with the process for agreeing on changes with stakeholders if needed. This could extend project timelines and increase costs during the planning process. By requiring agreements on DOs at an early stage, H7 demands that certain phases and steps, such as detailed designs and refined cost estimates, are completed sooner than may be ideal. This approach can impose additional resource needs upfront, potentially inflating initial costs and impacting the project's timeline. Additionally, H7 does not fully account for the temporality of its five-year regulatory tenure. This fixed timeframe may limit flexibility in accommodating adjustments for long-term projects that span multiple programmes and DOs. Heathrow is responsible for delivering a wide range of initiatives across multiple programmes within the regulatory period, and the rigid structure of H7 can strain its ability to effectively manage these commitments. This limitation may also impact stakeholders, such as airlines, who play a fundamental role in the approval of DOs. Ultimately, H7 framework's early-stage requirements may place substantial demands on Heathrow's resources, potentially impacting the broader portfolio of projects and their alignment with desired outcomes. Also, it adds pressure on project schedules.	The CGH outlines a structured approach to managing Heathrow Programmes that are designed to support and deliver strategic benefits. This approach leverages programme management as a disciplined framework that brings coherence, alignment, communication, and control across the various activities involved. This Handbook establishes a robust governance structure at Heathrow with clear roles, responsibilities, and accountabilities to ensure effective programme delivery and successful project execution. This structured approach is designed to support the achievement of outcomes and the delivery of agreed outputs by providing a systematic framework for decision-making, oversight, and resource allocation, ensuring that each project progresses efficiently through its lifecycle.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
Efficient change control process	Ensure that project modifications are quickly assessed, approved, and implemented, minimising disruptions to timelines and budgets.	Detailed design and delivery	Efficient change control is critical for maintaining programme schedules and minimising delays. In complex projects, changes are inevitable, whether due to evolving requirements, unforeseen challenges, or stakeholder input. A streamlined change management process ensures that adjustments are identified, evaluated, and implemented swiftly, preventing disruptions to the overall timeline. Change control helps manage costs more effectively by avoiding unnecessary rework and delays. This proactive approach not only keeps the project on track but also enhances cost efficiency, allowing for better resource allocation and minimising financial risk associated with uncontrolled changes.	Once projects reach G3, the approach becomes rigid, as there are not opportunities for re-scoping or adjusting. without negotiating the change procedures, largely controlled by airline stakeholders. Hence, after G3 any changes to the DOs are severely restricted, leaving Heathrow and stakeholders with little recourse to adapt to evolving circumstances or new information. The only significant alteration permitted under this framework is the decision to cease delivering the DO, which may result in penalties and hinder the overall project outcomes. This rigidity can create challenges for Heathrow in managing large and complex projects, as it restricts their ability to respond effectively to unforeseen issues or shifts in priorities after G3, ultimately impacting their operational efficiency and capacity to deliver value.	Under the CGH, a degree of freedom is evident during P1, P2, and prior to reaching G3, particularly in the identification, definition, and scoping of the DOs. During these early stages, there is a clear and robust governance structure that facilitates the planning and agreement of projects at the programme level, allowing for thoughtful collaboration and alignment with wider outcomes. However, due to the rigid nature of the H7 framework, this flexibility diminishes significantly after G3 (preparation, implementation, transition and closure). The framework does not accommodate adjustments to the DOs, leaving stakeholders with minimal options for addressing unforeseen challenges or evolving needs. The only change permissible under these circumstances is the cessation of DO delivery, which can occur only after a Portfolio Prioritisation process. This rigidity can hinder Heathrow's ability to respond effectively to dynamic project requirements, potentially impacting overall project success and operational efficiency.
Intelligent risk-sharing	Assign risks to the parties most capable of understanding and mitigating their impact. This approach leverages each party's expertise and position, ensuring risks are managed by those best suited to handle them.	Risk approach should be determined at design, as risks become understood	Intelligent risk-sharing ensures that risks are borne by the parties best positioned to manage or them. When risk allocation is misaligned—such as assigning risks to parties without the capacity to mitigate them—it undermines effective risk management and increases the	Under the H7 framework, the requirement to agree on the scope, budget, and timeline for DOs can result in a preliminary and early assignment of risks without a clear understanding of which party is best positioned to assume and mitigate them.	Under the CGH, a robust and clear risk assessment is encouraged prior to reaching G3. This proactive approach aims to identify and address potential risks early in the project lifecycle, facilitating better decision-making and resource allocation.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			likelihood of projects running over schedule or budget. It is essential to design contracting mechanisms and incentives that take into account each party's position and ability to manage/mitigate specific risks	The early allocation of risks may result in inadequate risk assessment and poor quantification of budgets. This issue is particularly pronounced in large-scale projects, which historically have a higher likelihood of budget overruns. A thorough understanding of the complexities and uncertainties associated with these projects, the financial implications can be underestimated, putting Heathrow at greater financial risk. Furthermore, due to early risk allocation, suppliers may inflate their bids or include contingencies that ultimately shift the financial burden onto Heathrow. This can have impacts on project costs, supplier relationships, as well as quality and timeliness of project deliverables. Finally, the H7 framework constrains the employment of more progressive contracting mechanisms and promotes fixed-price contracts. This reduces the scope for risk sharing and allocation of risk to that party best able to manage it.	However, while this emphasis on risk assessment is beneficial, it does not entirely mitigate potential stress within the supply chain. There remains a risk that they distort their bids or timelines, inflating costs and incorporating excessive contingencies. As a result, the financial burdens associated with these inflated bids may ultimately shift to Heathrow, undermining the intended benefits of thorough risk assessment and placing excessive risk on the project owner. An explicit partnering approach with supply chain members, enshrined in appropriate contracting mechanisms, would help combat this possibility.
Form of Delivery Contract	The choice of delivery contract is crucial in effectively managing project risk. Contracts should be designed to ensure that risks are allocated to the parties best positioned to control or mitigate them. A well-matched contract ensures that risks are properly managed, enhancing project success and overall value.	Procurement	Inappropriate contracting models result in imbalance between the treatment of cost estimates and analysis of risk. This leads to risk being allocated to parties unable to manage it. Inappropriate contracting models can lead to significant issues: 1. Imbalance in cost estimates and risk analysis: when contracting models do not appropriately balance cost estimates and risk analysis, it often results in unrealistic budgets	The H7 framework is heavily weighted towards fixed price contracts. It disincentivises more progressive forms of contract that allocate risk in an efficient manner. Under H7, it can be argued that the projects Heathrow delivers are simplified, as there is an expectation/demand that the budget, timeline, and scope are agreed upon before making an investment decision at G3. This can result in the use of unsuitable contracting models, which	Heathrow is expected to procure capital projects efficiently and economically, emphasising value for money through careful consideration of the project scope, aggregated direct and indirect costs affecting the airlines involved, and the associated programme risks and benefits for users of air transport services. The Handbook recognises the approach taken in the Procurement Code of Practice, which can be updated once agreement is reached with airlines and/or as required by the CAA.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			and inaccurate timelines. 2. Impact on project outcomes: misallocated risks can cause projects to miss their cost and timescale targets. 3. Value-for-money: Projects that fail to deliver on time and within budget without achieving project outcomes often do not provide good value-for-money.	may create an imbalance in how cost estimates and risk analyses are treated, in particular in large and/or major projects. All summaries of 'best practice' that have been reviewed are explicit in their recommendations that fixed price contracts are unsuitable for complex projects.	Heathrow's Handbook is open to a variety of forms of contract but is likely to be heavily constrained by the H7 framework.
Validation, Certification & Sign-Off	Validation, certification, and sign-off processes should be appropriately structured to ensure clear agreements and smooth transitions between project phases (e.g. between design and construction). This reduces ambiguity, risks, and helps maintain project timelines and quality.	Design-Delivery	Complex projects require close integration of design and delivery. Validation, certification, and sign-off requirements must be fit-for-purpose to ensure smooth integration between design and delivery. Well-documented interfaces, particularly between key stages such as design and construction or with external bodies like statutory consultees, are common sources of delays and cost overruns. Clear validation and proper verification processes help mitigate these risks by ensuring that all elements meet necessary standards before progressing to the next stage. When these processes are streamlined and aligned with project goals, they help prevent costly rework, reduce delays, and improve overall project efficiency.	While the H7 framework promotes reaching agreements on fundamental aspects before entering the delivery stage, it also restricts the feedback loop between the design and delivery phases. This feedback is crucial for ensuring that objectives are met cost-effectively and on time, especially in large and major projects. Continuous communication and collaboration during these stages allow for real-time adjustments and refinements, ultimately enhancing project outcomes without compromising governance or accountability. Particularly, once the investment decision is made at G3 this open dialogue is restricted. This may reduce the project's ability to adapt to new insights or challenges that emerge during the delivery phase. This limitation can heighten the risk of misalignments between the original design intent and the actual delivery, potentially jeopardising the project's success.	The CGH presents a structured framework for managing Heathrow programmes and projects. The Handbook establishes a robust governance structure at Heathrow with clear roles, responsibilities, and accountabilities to ensure effective programme delivery and successful project execution. It incorporates validation, certification, and sign-off processes that are carefully designed to facilitate clear agreements and seamless transitions between project phases, such as P1, P2, and P3, as well as across the various Gateways of specific projects. This structured approach mitigates ambiguity and risks while helping to maintain project timelines and uphold quality standards, ultimately contributing to the successful realisation of Heathrow's strategic objectives.
Programme & System Integration	Establish 'programme integration' function to manage interfaces (Systems Integration & Programme Integration)	Establish at inception with ongoing inputs throughout programme	Complex projects and programmes often fail because of poor SI/PI. This is partly due to the number of interfaces to be managed and the challenges in doing so. Embedded,	The H7 regulatory framework adopts a narrow view of project and programme delivery, constraining opportunities for an integrated approach across planning, design, delivery and operations. The	Heathrow recognises the importance of 'programme integration' in the various delivery teams. There is recognition of the need to integrate design, delivery and operational

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			traditional working practices also lead to failures. To mitigate this, best practice suggests forming a small, dedicated 'integration team'. This team should work across the supply chain (where many interfaces exist). These teams are most effective when designed to quickly adapt, allowing them to act fast, fail fast, and learn fast.	framework largely overlooks the merits of programme integration and conversely, compels Heathrow to break programmes down into a large number of independent projects, each defined by inflexible DOs.	functions and to ensure that effective feedback occurs throughout a programme's activities. The incorporation of cost and risk management strategies within wider teams during the definition and planning stages of specific projects enhances visibility into potential lessons learned. By systematically identifying and addressing risks and costs, teams can capture valuable insights that inform future projects, driving continuous improvement and greater efficiency in project delivery. This focus on collaboration and knowledge sharing ultimately strengthens Heathrow's ability to execute its capital programmes successfully.
Tailored Contracting Mechanisms	A variety of contracting mechanisms exist (fixed price, target price, alliances, etc) They do so for a reason: different types of projects require a different approach to delivery, depending on risk, operating environment, level of innovation, etc.	All stages of contract	Understanding the essential needs and delivery methods provides valuable insights into the specific requirements of various project types. Different contracting mechanisms, including fixed-price, target-price, and alliances, are designed to optimise contract and risk management for a range of projects. For mayor projects, particularly those with high complexity, pro forma contracts are generally discouraged because they do not facilitate effective responses to dynamic environments, unknown risks, and the uncertainties associated with developing solutions.	Given the diverse nature of Heathrow's capital delivery programmes, which encompass a wide array of contract types, complexities, and values, H7 lacks recognition that a one-size-fits-all approach to delivery and contractual frameworks is unlikely to achieve optimal results. In particular, H7 heavily favours fixed price contracts with implications for reduced delivery flexibility, simplistic allocation of risk and price escalation as a result of the need to price-in risk.	Under the CGH, Heathrow has implemented the concept of Key Projects to highlight the significance and scale of specific initiatives. This approach recognises that certain projects require heightened attention to detail and a more thorough planning process, which can ultimately lead to the appropriate selection of contract types. By distinguishing between standard projects and those classified as "Key," Heathrow can streamline the delivery of more straightforward initiatives without introducing unnecessary complexity. Simultaneously, this differentiation allows for a more appropriate choice of contract form for larger and more complex projects, ensuring that they receive the detailed oversight and planning necessary to achieve

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
					successful outcomes. This targeted strategy enhances overall project efficiency and effectiveness, safeguarding stakeholder interests while optimising resource allocation.
Systems Thinking	Consider a project as a cohesive system—major projects or programs consist of intricate networks of interconnected systems and subsystems.	All stages of programme	Adopting a systems approach to infrastructure delivery is crucial for navigating the complexities of large projects. This method ensures that all elements function cohesively to achieve the intended results. It highlights the interdependencies within a major project, recognising that actions in one area can affect others. (i.e., a delay in securing statutory consents can disrupt the construction timeline, resulting in cost overruns and jeopardising the successful attainment of the agreed-upon outcomes) Key elements of a systems approach include: 1. Interdependencies: Each best practice concept supports the others, creating a cohesive framework for	Heathrow operates within an extremely complex project environment, and the H7 framework adopts a simplistic approach to controlling capital expenditure for specific DOs. It is unclear how the framework promotes systems thinking, which is essential in such a multifaceted setting. The intricate relationships between various project elements—such as design, construction, technology, and operations—require a more nuanced approach than simplistic solutions or basic cause-and-effect planning can provide. In essence, a systems thinking approach is vital for navigating the complexities of Heathrow's project	While Heathrow's Handbook does not explicitly refer to systems thinking, the implied normative approach to construction management outlined in the Handbook has much in common with a holistic approach. The Handbook also understands the importance of intelligent risk allocation between client and supply chain; and the need to avoid fixing the solution and costs before the full complexity of the challenge is understood.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			project delivery. For example, effective risk management, validation, and certification processes are all interlinked and contribute to the overall success of the project. 2. Managing complexity: Major infrastructure projects are inherently complex and do not lend themselves to simple, siloed methods. A systems approach acknowledges this complexity and provides a structured way to manage it. This involves understanding the various components of the project and how they interact with each other. 3. Holistic view: Considering all elements and their interactions, potential issues can be identified early and addressed proactively, which improves project outcomes and ensures value-for-money.	environment. Without it, the emphasis on capital expenditure control and the agreement of DOs may inadvertently limit the flexibility and adaptability needed to achieve successful outcomes across all projects, hindering Heathrow's ability to effectively respond to interdependencies and dynamic project challenges.	
Supply chain visibility and effective involvement	Emphasises the relevance of proactive, timely engagement and transparency across all stages of the supply chain. This should be manifested in the contractual framework between client and supply chain. This approach fosters collaboration among stakeholders, enabling better anticipation of challenges, quicker response to disruptions, and alignment of goals to drive efficiency, reduce costs, and achieve overall outcomes.	Planning and design	Ensuring timely visibility across the supply chain is crucial in dynamic and evolving business environments, where challenges can emerge at any point across dispersed programmes and/or projects. Visibility and early involvement facilitate strategic planning by allowing stakeholders to identify risks, mitigate bottlenecks, and align on the overarching purpose and desired outcomes. Early involvement, in particular, encourages cross-functional collaboration, leading to a more cohesive understanding of each role's impact on the supply chain. When everyone understands the broader picture and their part in it, this alignment drives accountability	The onus on fixed-price contracts and the constraints on a more intelligent form of risk sharing increases the likelihood that Heathrow adopts a transactional approach to supply chain management. This disincentivises collaboration and risk sharing, placing emphasis on fixed price contracts. Furthermore, the requirement for highly specified DOs on a project-by-project basis constrains Heathrow from adopting a programme-oriented approach to delivery.	Heathrow's approach to engaging the supply chain is considered as a key element within the Costing Methodology and Certainty. It emphasises involving suppliers from the beginning of the project process, integrating them across all phases from initiation, planning, delivery, assurance to authorisation. It is envisioned that this continuous involvement allows the supply chain to contribute to the cost estimation process, ensuring accurate, realistic estimates and fostering alignment throughout the project lifecycle.

TOPIC / AREA	DESCRIPTION	PROJECT STAGE	RATIONALE	H7 FRAMEWORK (CAA)	CAPITAL GOVERNANCE HANDBOOK (HEATHROW)*[6]
			and commitment, helping to ensure that timelines, quality, and costs remain optimised. Moreover, early visibility empowers organisations to respond to market demands and disruptions with agility, such as through alternate sourcing strategies or dynamic route adjustments. This readiness translates into a competitive advantage, as companies with timely visibility can more effectively manage inventory, reduce delays, and optimise resources.		
Programme-wide risk management Vs. Project-specific risk management	Refers to addressing risks systematically across interconnected projects, spreading and balancing risks rather than isolating them within individual projects. This method considers cross-project impacts, fosters resource flexibility, and aligns risk strategies with overarching goals, enhancing resilience and maximising overall programme success.	Planning and design – primarily	Managing risks at the programme level allows for a holistic view of interconnected projects, spreading and balancing risks more effectively. This can be achieved by securing: 1. Systematic perspective and interdependencies. A programme-wide approach reveals interdependencies between projects, helping to identify risks that could impact overall programme success. 2. Risk spreading and efficient mitigation. Programme-level risk management enables resource flexibility, allowing support to be reallocated across projects to mitigate high-risk scenarios. 3. Strategic decision-making and alignment with programme outcomes. Managing risk at the programme level aligns strategies with long-term objectives.	H7 places significant emphasis on individual projects rather than broader programmes. Specifically, H7 mandates that Heathrow discretely assesses the underlying drivers for each project, acknowledging how these drivers may evolve under a range of plausible scenarios. According to the CAA this dynamic analysis is essential for understanding the project's context and potential future implications. However, this fails to acknowledge the inter-play of programme-wide interactions, costs and benefits.	Heathrow has expressed a clear preference for a programme-led approach to capital delivery. This is of particular importance and relevance to the larger, more complex programmes with several key supply chain members and partners. The extent to which a programme-led approach is possible or is being delivered is not clear at this point.