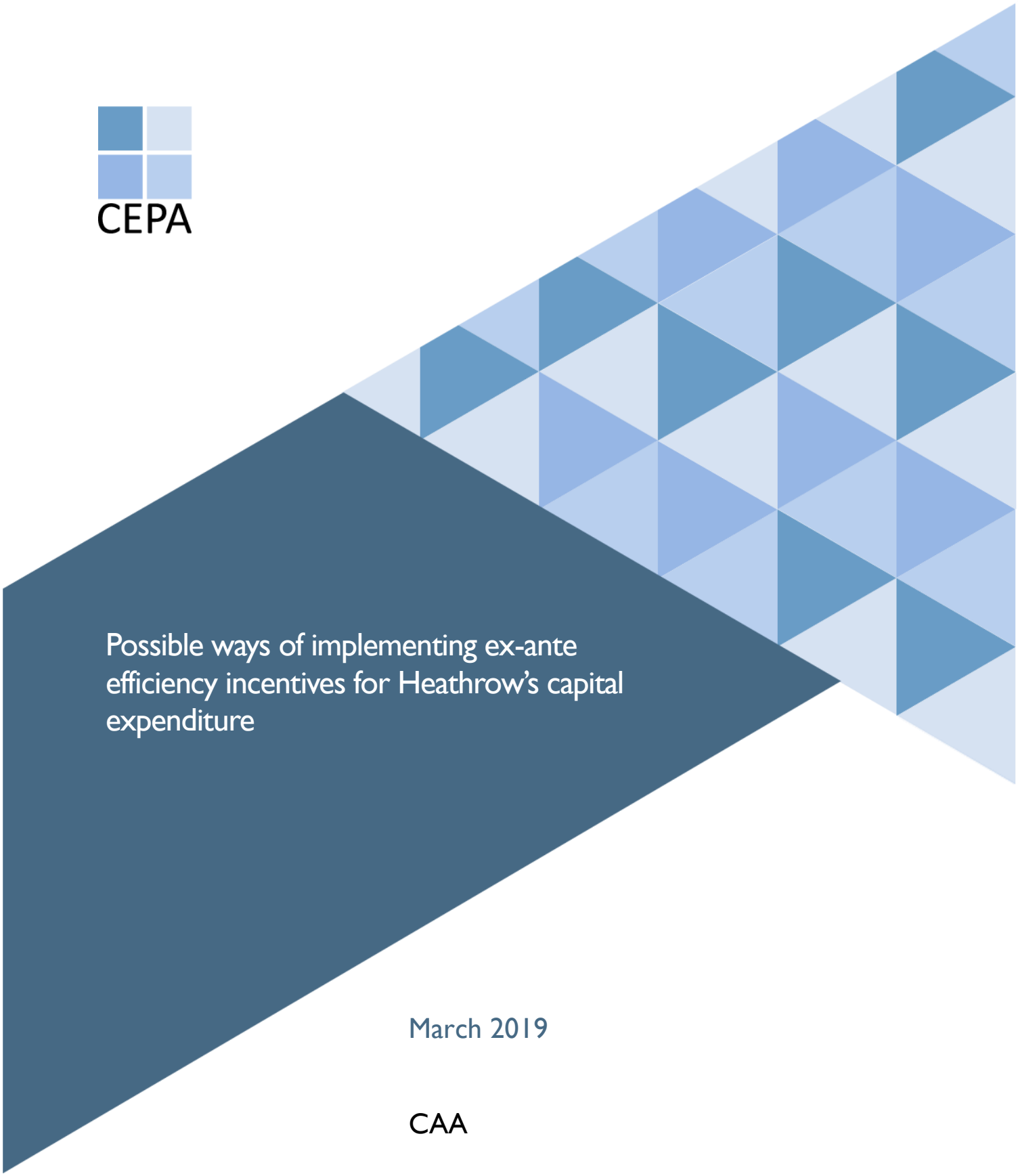

Possible ways of implementing ex-ante efficiency incentives for Heathrow's capital expenditure

March 2019

CAA

FINAL REPORT

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CONTENTS

GLOSSARY

Term	Interpretation as applied throughout this report
Efficiency	When we discuss efficiency in this context, this is primarily related to cost efficiency but we acknowledge that there are other considerations such as quality.[1] There are different phases through the project cycle where cost savings can be achieved. For example, design options that deliver the same output for a lower cost, cost savings in negotiations with suppliers or reducing costs in the delivery phase. Our models set the regulatory baseline at different points in time, which will impact on where the efficiencies may be achieved.
Efficiency incentive	Our report involves developing an ex-ante incentive framework to apply within the regulatory regime for Heathrow in future. The core aspect of this is the capex efficiency incentive (where efficiency is in relation to cost efficiency). In designing our options, we have considered wider issues around output-based regulation, delivery incentives and uncertainty mechanisms, many of which will be required in order to ensure that the incentive arrangements can function in practice. These incentives may form part of a broader incentive framework which means that they may need to interact with other aspects of the regime (e.g. with any timeliness incentives or business plan quality incentives).
Delivery obligations	Although we focus on cost efficiency, cost cannot be considered in isolation. The cost expended is linked to the scope delivered. This means we need to link scope of work to the cost allowance. Our preference is that costs are linked to outputs: this focuses HAL on delivering what is required as part of the programme, rather than specifying how this should be done (as would be the case when linking costs to inputs). However, estimates of an efficient cost cannot be developed without consideration for how this can be achieved. 'Delivery obligations' as discussed in this report correspond to the scope of work to be delivered and are equivalent to 'outputs'. In the absence of an agreed scope, the CAA would not be able to distinguish whether any cost savings (or overruns) were due to cost efficiency (or inefficiency) or due to providing a different scope of work. The term should not be read as creating legal obligations which might be included in the licence, rather they form the basis against which cost efficiency is assessed.
Baseline (/ Regulatory Baseline)	This is the term used to describe the cost target used as part of the efficiency incentive mechanism. The reward or penalty to be applied to actual costs will be calculated with reference to outturn costs relative to this term. In our governance model, there is both an initial baseline and a regulatory baseline based on cost information that is updated as the scope is refined. The regulatory baseline governs overall rewards and penalties, while the initial baseline is indicative (although this can be used to set charges).
Flexibility	We refer to flexibility as the scope that HAL has to evolve its design and/or delivery of capex within a given scope of requirements set by the CAA.
Certainty	We discuss in this report the greater certainty that can be provided by an ex-ante incentive regime. We interpret certainty as bounded cost and risk for either HAL or users. In that sense, certainty is a function of HAL/stakeholders' ability to accurately predict the outcome of the CAA's decisions with regard to capex spent by HAL.

[1] We have made sure that our development of models takes into account considerations beyond cost efficiency.

1. EXECUTIVE SUMMARY

This report sets out two practical options that the Civil Aviation Authority (CAA) could develop if it decides to introduce ex-ante capex incentives for Heathrow Airport Limited's (HAL) capital expenditure (capex) in H7. We comment on the practical issues of implementing each option, but at this stage have not conducted a detailed assessment of the options as the details of capacity expansion at Heathrow remain highly uncertain.

Context

For a project of the scale of Heathrow's anticipated capacity expansion, ex-ante incentives[2] could be helpful in maintaining cost discipline. This is important because the CAA's primary duty is to further the interests of users of aviation services. The current ex-post approach applied to Heathrow rests on the CAA disallowing inefficient costs after the fact. Use of this approach may be impractical for a project of the scale and complexity of capacity expansion at Heathrow. Ex-post reviews are inevitably judgement-based and rely on being able to identify relevant evidence after the fact. And a review at the end of a 5-year control period creates an uncertainty that is likely to impact both financeability and the cost of finance.

The CAA has been considering the use of ex-ante capex incentives for Heathrow capacity expansion for some time. Previous consultation papers set out their advantages but the regulator also notes that there are a range of practical issues to be overcome in developing such incentives. The CAA has appointed CEPA to focus on setting out options that describe in more detail how ex-ante incentives might be implemented in practice.

Our starting assumption is that the objective of the incentive is to maintain pressure on the price that Heathrow estimates for the project, expose it to the risk of cost overruns and allow it to benefit from savings that it is able to make while still delivering the expected outcomes. Under the current regulatory framework HAL is effectively remunerated for what it spends efficiently. But there are significant affordability issues related to a project of this scale given the government's aspiration, set out in 2016, to keep landing charges close to current levels.[3] Creating an incentive to support delivery on this aspiration and, where possible, improve on it, could have material benefits to users and the wider UK economy. It is, however, important to note that the incentive needs to take into account HAL's ability to bear cost overrun and to limit the upside that can be earned; any incentive applied should be calibrated to drive the desired behaviour without jeopardising the company's financial sustainability or providing upside without sufficient passenger benefit being delivered.[4]

The planned Heathrow expansion is considerably larger than past airport expansion projects, and it is made up of many programmes of work some of which are inherently more unpredictable than others. At present there is no single design for the project. HAL is considering a number of options. We anticipate that the project will continue to evolve for some time even after the Development Consent Order (DCO) is granted, indeed the DCO may impose conditions that impact the design.

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[2] In this context, ex-ante means a mechanistic/rules-based framework, which considers estimates of future expenditure, rather than using a discretionary review of actual expenditure that has been incurred.

[3] Government decides on new runway at Heathrow, 25 October 2016.

[4] In this report we focus on practical issues we do not seek the scale the incentive, other than on an indicative basis. This work will clearly need to take place before any ex-ante incentive could be put in place.

A core tension within this work is to incentivise cost efficiency through the project (which requires suitable risk exposure for HAL), whilst still maintaining flexibility for HAL to develop and improve its capex plans over time.

With these considerations in mind, two 'straw men' options have been developed. These are titled the **regulatory model** and the **governance model**, and we consider a number of variant options within these two broad models. The models draw upon lessons learned from other large projects and both models start from the same set of underlying assumptions:

- We assume that H7 will start shortly (perhaps six months) after the DCO is granted;
- We assume that shortly after the DCO, HAL will have an overall design for the project that can be used to set the cost baseline determined by the CAA;
- As it is usual practice for CAA to adopt a five-year control period, we assume that H7 will last for 5 years.
- The regulatory baseline creates a cost target for the five-year period;
- Both models utilise a cap and floor mechanism set by the CAA, the values for which are established by reference to the baseline. The ex-ante incentive applies between the cap and floor, such that HAL is exposed to risk (a percentage share of cost overruns) between the baseline and the cap and is eligible for upside (a percentage share of cost savings) between the baseline and the floor. The cap and the floor would be set to represent low probability outcomes for given delivery obligations i.e. it is expected that they would only be breached in extreme circumstances;
- There is no scope for upside below the floor and only efficient costs above the cap will be allowed to be recovered. Both models are subject to an extraordinary review mechanism above the cap or below the floor. A review would seek to implement changes to bring the project back to the original baseline or, where this not practicable or desirable, establish a new baseline for the remainder of the control period reflecting the assessment of efficient costs; and
- Given the Government's aspiration to broadly maintain current levels of passenger charges, we assume that Heathrow will carry cost overruns until the end of the control period or until an extraordinary review. This mirrors current practice under the ex-post incentive regime, but will need to be reconsidered later as HAL may not be able to carry these costs and/ or this could create a financial impact that is unacceptable.

If the CAA concludes that an ex-ante capex incentive is an improvement on its ex-post approach, the assumptions above should be revisited as part of refining and calibrating the model to be adopted. For example, the CAA will need to consider the length of the price control and implications of this choice (which are broader than simply for capex efficiency incentives) when more information is available. For the DCO application, HAL will need to have developed a single settled plan that has been consulted on. This should permit the CAA to further progress development of its H7 proposals.[5]

[5] The assumption used to develop our timelines is that the DCO decision might require some relatively minor changes to the expansion programme, rather than very substantial changes.

Ex-ante model summaries are provided in the text that follows and expanded upon in later sections of the report.

The regulatory model

The regulatory option is developed as a single approach for all cost categories irrespective of their level of definition or predictability. It is similar to regulatory processes elsewhere e.g. setting cost allowances in the water regime. A firm baseline (with an associated cap and floor) would be set as part of the regulatory determination. HAL would then bear a pre-determined share of any under- or over-spends relative to this baseline. Significant uncertainty remains at this point, making it most appropriate to set delivery obligations at a high level. In summary this option works as follows:

- **A single regulatory baseline (cost allowance) would be set at the regulatory determination for delivery over the whole price control period.**
    - **HAL would provide a business plan or capacity enhancement equivalent to the CAA, setting out what it expects to deliver over the H7 price control and the costs associated with delivery of those outputs. This will be informed by engagement with the airlines.**
    - **the CAA, likely with external technical support, would review the plan and set delivery obligations and establish a fixed regulatory baseline for H7 capex.**
- **The regulatory baseline would remain fixed ('firm') over the price control period for a fixed scope. The exception to this is a reconciliation at the end of the period, where an adjustment to the baseline may be required if outturn scope differs from the agreed delivery obligations.**
    - **It is understood that the capex programme will continue to develop after this date. The challenge for Heathrow would be to maintain those changes within the overall fixed cost baseline. The challenge for the CAA will be to identify any changes in scope that might lead to significantly worse outcomes for consumers compared with the plan reflected in the cost baseline and delivery obligations.**
- **For the purpose of comparing actual costs to the baseline, the baseline would be set in nominal terms and allowances are not uplifted for price inflation i.e. there is no mechanistic adjustment to the baseline.**
- **HAL would face a pre-determined share of any cost over- or under-spend for costs relative to the regulatory baseline. We expect that a low incentive strength would apply between the bounds of the cap and floor, given the level of uncertainty about design and costs.**
- **Delivery obligations under this model would be very high level. This provides flexibility for HAL to develop the programme most suitably as more information becomes available. However, delivery obligations are not straightforward to develop as capacity expansion would extend over more than one price control even where H7 starts a short period after the DCO is granted.**
- **All capex (both BAU and expansion) would be included under the baseline because we consider that it is unlikely to be practicable to separate the two for the CAA's purposes.**
- **The CAA would be responsible for setting the rules of how the model will work up-front at the price control determination. This includes the approach to ongoing**

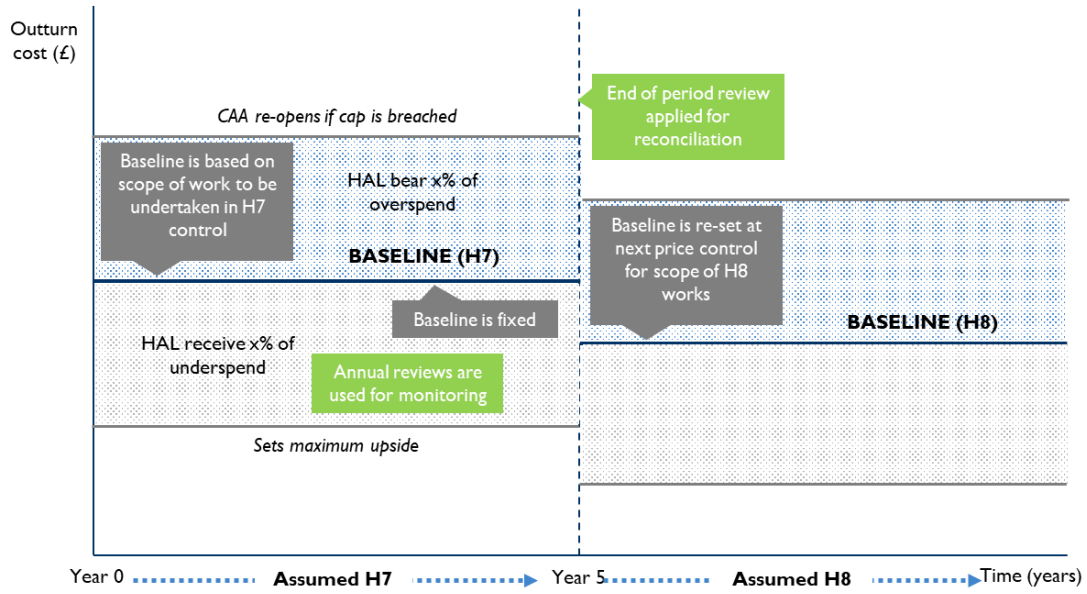
monitoring, the reconciliation process at the end of the price control, any adjustments to the regulatory baseline and the operation of the incentive itself.

- There would be an annual review process that monitors both costs and scope. This is important as the outturn scope is likely to differ to what was expected at the outset of H7. The annual review process would also be used for assessment of whether HAL is expected to breach the cap and floor.
- If costs are forecast to breach the cap or floor (as highlighted during the annual review process), the CAA would undertake an extraordinary review to assess efficient costs. This will not impact on outcomes between the floor and cap, but will determine the proportion of costs that can be recovered.

We also present a single variant to the regulatory option which includes within the incentive a narrower set of cost categories.

A simplified diagram of the regulatory model is presented below.

Figure 1.1: Diagram summary of the core regulatory model



The governance model

The governance option recognises both inherent and timing uncertainty in cost estimates. It mirrors aspects of the current capex governance process at Heathrow. Inherently uncertain categories of cost would be excluded from the incentive. An initial baseline would be set on costs more suited to ex-ante incentives and becomes firm only once those costs reach a certain level of maturity.

In summary this option works as follows:

- An initial baseline would be set at the regulatory determination for delivery of obligations within included cost categories over H7.
  - HAL would provide a business plan or capacity enhancement plan equivalent to the CAA, setting out what it expects to deliver over the H7 price control and the costs associated with delivery of those outputs. This will be informed by effective engagement with the airlines.
  - The CAA, likely with external technical support, would review the business plan and set an initial regulatory baseline for the capex to be delivered over H7. This is for both

expansion and business as usual capex (given that expansion capex touches all parts of the airport we consider that separation will be difficult).

- The baseline would be updated as projects mature in design/ detail to a sufficient level to allow HAL to procure a supplier. It is this evolving regulatory baseline (not the initial baseline) that is binding for the purposes of the incentive.
- For the purpose of comparing actual costs to the baseline, the baseline would be set in nominal terms and not uplifted for price inflation.
- The CAA would monitor progress at programme (groups of projects) level, with separate 'pots' of expenditure associated with each programme.
- Delivery obligations would be set at programme level to allow HAL flexibility to let the work evolve. We expect the CAA to use around 10-15 pots and associated obligations, based on an initial assessment (noting that information on which to base a judgement is limited).
- There would be a more substantial role for the Independent Funds Surveyor (IFS) or a technical adviser in this model as monitoring would be an ongoing process. This party would make recommendations to the CAA on how and when to update the regulatory baseline based on project-level costs. The CAA would not be bound to adopt these recommendations, but would take a proportionate approach; the CAA could step-in for a more detailed review where programme costs diverge materially from the initial view of efficient costs. The IFS could also highlight contentious cost items for detailed consideration by the CAA.
- Despite utilising programmes of projects and 'pots' of expenditure, a single incentive would apply to all included costs at overall baseline level. i.e. programmes would be aggregated and the cap and floor mechanism would work at this overall baseline level (as per the regulatory model).
- The incentive strength would be greater in this model than in the regulatory model. This reflects the greater level of confidence in the baseline.
- In this option ex-ante incentives would not apply for all cost categories. The costs included in the incentive are those which HAL has a reasonable degree of control over and are more predictable in nature. Our initial review finds that the ex-ante incentive would cover around 55% of capex over the H7 period. Costs not included would be subject to ex-post efficiency assessment, similar to the CAA's current approach.

We also present a small number of variants to this core governance option. These include the use of market prices to update the baseline, different (earlier) timing for finalising the baseline, using a mechanism where the baseline covers the whole project and on the treatment of excluded costs.

We present below a diagrammatic representation of how the governance model would work, based on the model at the time of the regulatory determination, and how this evolves over time.

Figure 1.2: Diagram summary of the core governance model

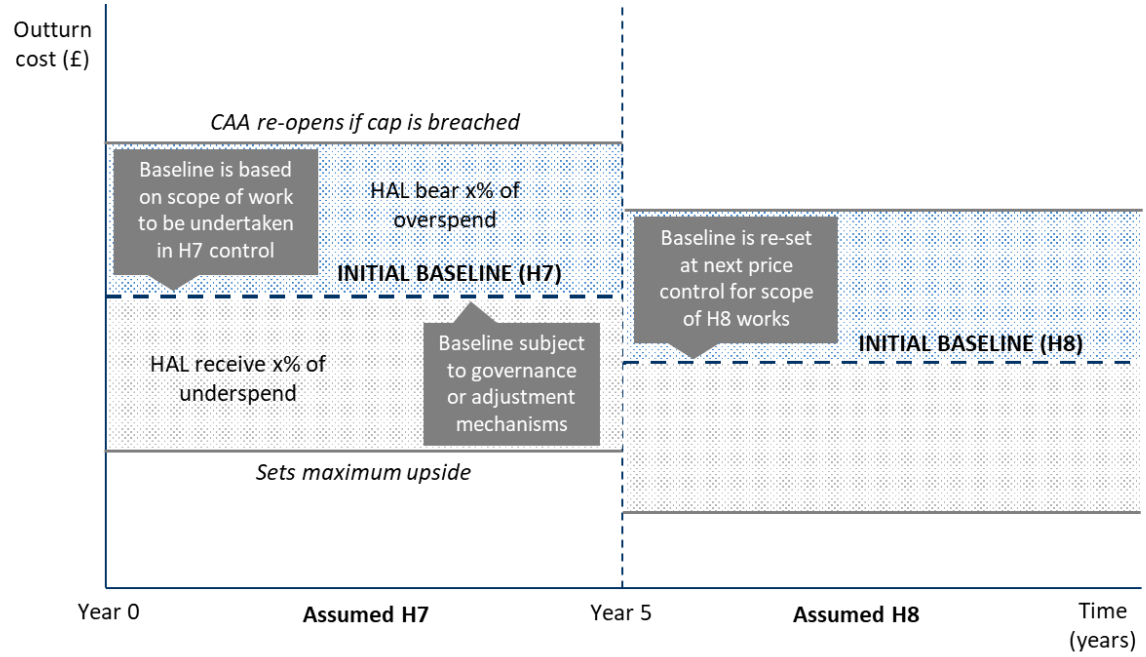
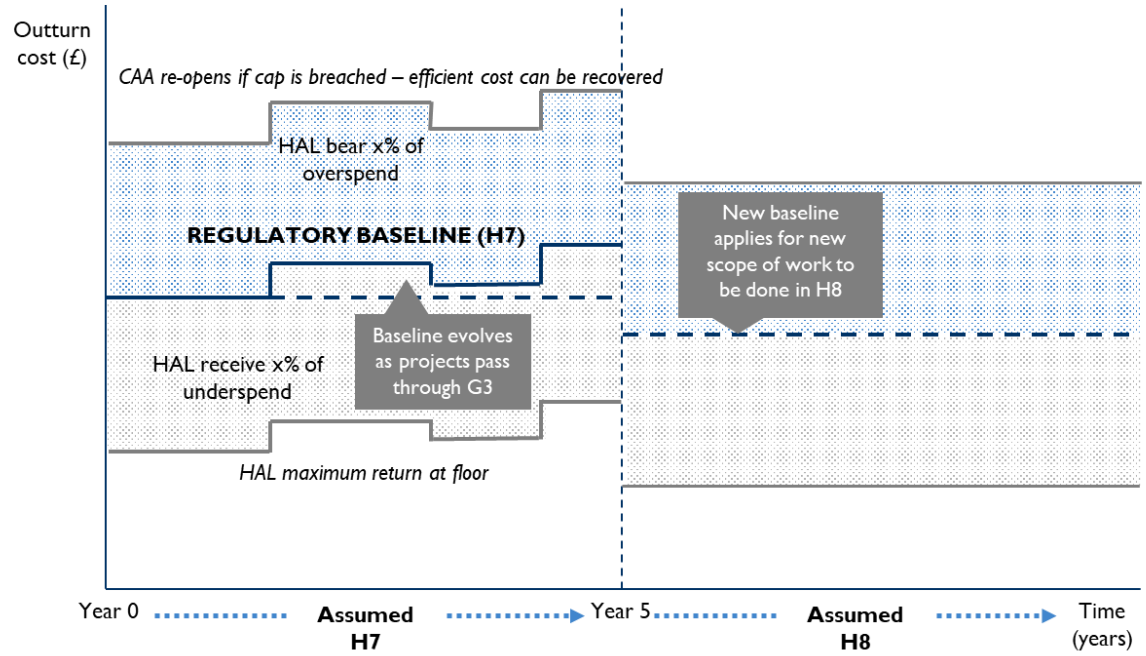


Figure 1.3: Illustration of how the core governance model might look as the price controls evolve



Ongoing monitoring and impact on the CAA

A consequence of allowing flexibility for the capacity enhancement plan to evolve is that ongoing monitoring of progress under both models is necessary so that the CAA can maintain line of sight from the baseline to the actual programme. This is a practical challenge that we consider in more detail later in the report. For each model we envisage an annual review process taking place. It both maintains line of sight and facilitates calculation of the incentive outcome at the end of the control

period. This level of monitoring will require the CAA to be involved as the project progresses, but we anticipate that the regulator will be supported on an ongoing basis by a technical adviser that would undertake the monitoring process and advise the CAA.

Airline involvement

We anticipate that the role of airlines will change under these incentives. At present airlines are involved in capex governance at a granular level on discrete and often optional projects. The nature of the process is expected to change for H7, which is comprised of a series of interrelated projects, many of which are essential to timely delivery of expansion. The nature and scale of the H7 programme means that we consider continuing with the current capex governance process will be impractical and it is unlikely that airlines would have the technical expertise to engage at this level. However, airlines are a key stakeholder and we recognise the importance of their involvement. We would expect there to be effective engagement between airport and airlines in developing the plan for the project both before and after DCO and in the regulatory process that sets the baseline cost. Thereafter this engagement should continue as the project progresses and decisions are made about the design. An important part of the annual review process will be for HAL to evidence that it has listened to and taken on board airline comments on changes that have been made to the programme. In the event of an extraordinary review we would expect airlines to be involved in discussions about whether it is possible to bring the project back in line with the baseline or whether the baseline should be changed.

Next Steps

Although we have sought to consider and address a range of practical issues that could affect the operation of the models, they have not been formally evaluated and we therefore make no recommendations as to the choice of model or variants within it. An assessment of the options against the counterfactual ex-post incentives has also not been undertaken at this stage. Further development of the project approach, design and cost is, in our view, important to being able to discriminate between models and to conclude on the appropriateness of ex-ante incentives. As more information becomes available it will also be possible to calibrate models in particular to consider the appropriate level of risk exposure that HAL would bear and the upside that it could obtain through efficient management of the project.

2. INTRODUCTION

This section introduces the CAA's work to date in the area of ex-ante incentives, and discusses how CEPA's work supports further development of the CAA's approach to ex-ante incentives.

2.1. BACKGROUND

In October 2016, the Heathrow North-West runway was announced as the Government's preferred option for airport capacity expansion in the South-East of England. The CAA had been considering the use of ex-ante incentives for this project even before the Government announced its preferred option, including commissioning a study in early 2016 into potential approaches for ensuring cost efficient delivery of new airport capacity.[6]

The CAA has indicated that it sees a need to develop regulatory mechanisms that incentivise HAL to deliver the capacity expansion in a timely and efficient way, and to facilitate efficient financing of "very substantial expenditure programmes".[7] The CAA recognises the need to strike an appropriate balance between ex-ante and ex-post efficiency incentives and for HAL to work within clear budgets for project delivery. Further work has included:

- A 2017 consultation on the regulatory regime, including incentives.[8]
- An April 2018 consultation on economic regulation of capacity expansion at Heathrow.[9]
- A May 2018 working paper focusing on the cost of capital and incentives.[10]

In these documents the CAA highlighted key advantages of ex-ante incentives as:

- "**Stronger and clearer incentives for HAL to ensure capex is incurred efficiently.**" With an ex-ante sharing mechanism in place, HAL would be aware of the exact percentage of any overspend that it would have to absorb (and what percentage of any underspend that it would get to keep).
- **"Reduced regulatory uncertainty, since the outcome is not dependent on a subjective retrospective review of HAL's performance."** With incentives set ex-ante, HAL is aware upfront of how its expenditure will be treated, rather than waiting for an ex-post review to determine whether costs were incurred efficiently or not.
- "**A focus on preventing overspends rather than disallowing inefficient costs after the event.**" HAL would know in advance what it will receive and what it is being paid to

[6] This was delivered in 2017: KPMG (2017) "Approach to overseeing the cost efficiency of new airport capacity"

[7] CAA (2017) "Economic regulation of the new runway and capacity expansion at Heathrow airport: consultation on CAA priorities and timetable"

[8] The first of several consultations was: CAA (2017) "Economic regulation of the new runway and capacity expansion at Heathrow airport: consultation on CAA priorities and timetable"

[9] CAA (2018) "Economic regulation of capacity expansion at Heathrow: policy update and consultation"

[10] CAA (2018) "Economic regulation of capacity expansion at Heathrow: working paper on the cost of capital and incentives"

deliver, rather than finding out after the fact that some expenditure was considered "inefficient" and is disallowed.

- "**Ensuring that airlines receive some protection from the impact of any overspend.**" An ex-ante sharing factor means that HAL and its customers share in any under or overspend, providing some protection for airlines and passengers.

However, the CAA also recognises the potential disadvantages of using ex-ante incentives. Setting ex-ante incentives relies on the ability to determine in advance the efficient cost over the five-year price control period – this requires reliable cost estimates, otherwise HAL and consumers may be exposed to forecasting risk. These cost estimates need to be closely linked to verifiable outputs, with the ability to accommodate changes (such as to the design). This is a complex process and may prove particularly difficult for some components of the expansion programme given its scale and complexity. Cost and output targets are difficult to determine in advance for a five-year period, given the potential for design changes, scope changes, or other changes that react to circumstances that are difficult to control (such as additional works required from issues identified during site clearing/preparation). The CAA also highlighted that ex-ante incentives based on cost estimates may provide incentives for HAL to inflate its cost forecasts, a risk that the CAA will need to mitigate if it adopts this approach.

2.2. DESCRIPTION OF OUR ASSIGNMENT

CEPA was appointed by the CAA to work alongside its technical adviser (Arcadis) to examine possible ways of implementing ex-ante[11] efficiency incentives for Heathrow's capex.[12] Our assignment focuses on developing illustrative options ("straw men"). The CAA highlighted in its May 2018 working paper that there are practical challenges to applying incentive arrangements such as the ability to accurately forecast capex over a relatively long time period, and so in developing options for ex-ante capex incentives we place extra focus on considering the practical challenges, and how these challenges might be overcome.[13]

We draw on our knowledge of similar incentives in this and other sectors to ensure that our developed options take precedent from other large-scale projects noting that, in addition to being practical, any incentive design should also take account of impacts on HAL's ability to finance the project.

Considering the potential benefits, but aware of the risks to be overcome, in its consultations and working papers the CAA set out three high-level initial options for ex-ante incentives from H7 onwards. These are summarised in Figure 2.1.

[11] In this context, ex-ante means a mechanistic/rules-based framework, which considers estimates of expenditure, rather than using a discretionary review of actual expenditure.

[12] Opex efficiency incentives are outside the scope of this project.

[13] We note that improving the model to address one practical challenge will have implications and other challenges may arise from the mitigation that has been introduced.

Figure 2.1: Summary of the options set out in the CAA's 2018 WACC and incentives working paper

(1) A uniform, moderate incentive (e.g. 25% sharing mechanism) to apply to HAL's entire capex programme.	(2) A moderate (e.g. 25%) incentive to apply only to certain categories of capex, with an ex-post review of the remaining categories.	(3) A weak ex-ante incentive (e.g. 10%) that applies to HAL's H7 capex in addition to ex-post efficiency reviews.
• The 25% suggested incentive rate, towards the lower end of those applied elsewhere, recognising that a cautious approach may be appropriate for the CAA's first use of ex-ante incentives - and is still strong enough to provide a meaningful incentive. • This is the most simple of the three appproaches, as it represents a single approach for all cost categories.	• This option would be most attractive if it appears that some cost categories are much better suited for ex-ante incentives than others. • The administrative burden could be reduced by focusing ex-ante incentives on only the most appropriate categories. • Requires clear boundaries between cost categories, and ways to prevent HAL from 'gaming' by re-allocating costs between categories.	• Retainng ex-post reviews while ensuring that HAL has some financial efficiency incentive across all parts of the programme. • This option could be used alongside stronger ex-ante incentives for appropriate cost categories.

We have developed two models each with variant options, the models draw upon but are not bounded by the CAA's earlier thinking. The two approaches in our straw men options have been developed to draw out the positives that ex-ante incentives can offer while seeking to mitigate the risks. Following the CAA's lead, the options that we have developed are intentionally cautious, with the potential for a lower percentage on the sharing mechanism than has been applied by other regulators, to recognise that this is a new approach for CAA and to minimise the risk of unintended consequences.[14]

Our approach has been to develop the models and refine them using variant options to address particular issues. We present models we consider to be feasible in practice, but further work would be required prior to introducing the incentive mechanism to refine the design and understand more about the implications of the mechanism when more developed information is available on works expected to be undertaken during H7.

We have worked closely with Arcadis to benefit from its detailed knowledge of HAL's expansion programme and the process of estimating costs for different parts of the programme. It is important to note that the information currently available to Arcadis is uncertain and subject to change, for example HAL is currently consulting on several potential masterplans. HAL expects the project to ultimately combine aspects of each of these rather than implement a single option in its entirety. At present there is no agreed scope or cost estimate for the project at a detailed level. We cite the documents that we have used in our analysis but it should be noted that where we refer to aspects of the expansion programme, e.g. delivery obligations, these are purely illustrative at this stage.

2.3. REPORT STRUCTURE

This remainder of this report is structured as follows:

- Section 3 provides background and context for our consideration of ex-ante incentives drawing on lessons from their use elsewhere.

[14] The incentive strength applied to opex has typically been higher than for capex in regulatory precedent, such that the incentive strength for capex is not directly comparable to incentive strengths for totex (whereby capex and opex are bundled together as total expenditure (totex), e.g. as used by Ofwat and Ofgem).

- Section 4 discusses the Heathrow capacity expansion, the level of uncertainty around the detail of this portfolio at this stage of its development and it sets some underlying assumptions for the straw men options.
- Sections 5-6 introduce our two straw men options.
- Section 7 provides a summary and comparison of the two straw men options.

We also include appendices that provide more detailed information on our case studies, cost characteristics and general issues around setting ex-ante capex incentives.

3. BACKGROUND OF EX-ANTE INCENTIVES

This section provides regulatory precedent for ex-ante incentives, including considering:

- **how and why ex-ante incentives may be appropriate for this project or parts of it (rather than relying on ex-post incentives alone);**
- **what lessons we can learn from previous infrastructure programmes and regulatory regimes that apply ex-ante incentives; and**
- **challenges faced when setting incentives, which may represent trade-offs where the CAA will need to make a choice as to how to balance conflicting objectives.**

As discussed in the introduction, our ex-ante models are developed using a range of sources, and we consider that precedent (from regulatory regimes and other large-scale projects) represents an important input. We consider that HAL, its stakeholders and lenders will take some comfort from the use of mechanisms consistent with established precedent.

Although capacity expansion requires a tailored approach to best address its scale and complexity, we consider it a sensible approach to start from tested options which can then be adjusted as appropriate.

3.1. HOW AND WHY EX-ANTE INCENTIVES COULD BE APPROPRIATE

The CAA currently employs ex-post efficiency incentives in the regulatory regime at Heathrow. For capacity expansion it is considering a shift to ex-ante incentives. Table 3.1 sets out a description of the key differences between ex-ante and ex-post incentives.[15]

Table 3.1: Description of ex-ante incentives and ex-post incentives

Ex-ante incentives	Ex-post incentives
• These are set in advance of the relevant activity being carried out, based on an estimate or expectation of expenditure. • In the case of a regulatory regime, ex-ante incentives are set as part of the regulatory determination for the full regulatory period. • The exact values (e.g. price caps, revenue caps) do not necessarily have to be set up front, instead there could be a mechanistic approach to determining incentive values (e.g. setting an initial value which changes each year of the regulatory period according to a pre-selected index or formula). • These mechanisms facilitate an up-front assessment of risk and reduce regulatory uncertainty through the setting of a pre-determined share of under- or overspend. There is no separate assessment of whether the under- or overspend is efficient.	• These apply regulatory judgement after an activity has been carried out based on the actual expenditure but with principles/guidance set out in advance. • In the case of a regulatory regime, the regulatory determination does not set out firm values (e.g. price caps, revenue caps) but instead presents principles and expectations that will be applied in the ex-post assessment. • The regulator would typically undertake a review at the end of the regulatory period of all activity and/or expenditure. • Ex-post incentives rely on a clear framework for how the regulator would apply its judgement, and a track record of it applying that framework Absence of either would make it difficult to assess risk exposure.

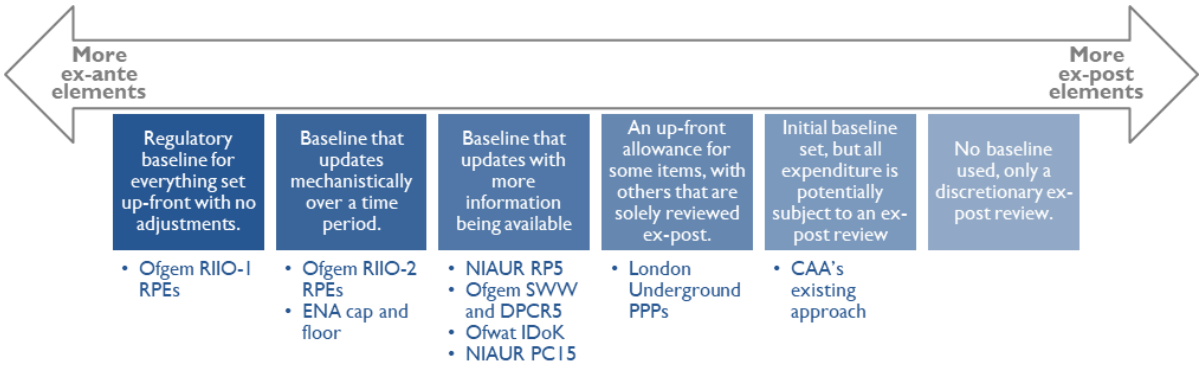
While ex-ante and ex-post define extremes of the approach to setting incentives, in practice approaches sit on a spectrum; regulators (or large-scale infrastructure programme developers) may

[15] We note that HAL has submitted to the CAA a report by its consultants that argues that ex-ante incentives are not well suited to Heathrow's expansion programme, and that this could result in higher costs for users if an ex-ante capex incentive is introduced.

use a combination of incentive types, as illustrated in Figure 3.1. We note that ex-ante incentives have been more prevalent in the energy and water sectors than for airports. This could be because regulators in those sectors have more confidence in the cost allowances they set because:

- those sectors typically include a number of companies conducting similar activities, allowing for benchmarking; and
- it is possible that that energy networks and water companies deliver more "repeat" (similar) projects that allow for cost trends over time to be assessed.

Figure 3.1: Example of types of efficiency incentive with more ex-ante or ex-post elements



As discussed briefly in Section 2.2, in principle ex-ante elements bring strong and clear up-front incentives to consider when incurring expenditure throughout the price control, with reduced regulatory uncertainty given the limited scope for ex-post review. It also focuses on preventing overspends, rather than waiting until expenditure has been incurred before deciding, in an ex-post review, whether cost was incurred efficiently or not. The regulatory uncertainty of an ex-post approach is hard to assess (especially in the case of a project of this scale, which is materially different to anything regulated ex-post by CAA previously). In electing to use ex-ante approaches it must be clear that the subject of the mechanism can manage the risks that are inherent in the incentive and can act on the added clarity to deliver required outcomes more efficiently.

We do not, however, envisage that the CAA would implement efficiency incentives that are purely ex-ante, without any adjustments throughout the price control period (e.g. the option represented on the left-most description in Figure 3.1). We consider some mechanistic adjustments may have merit and ex-post review might continue to be appropriate, particularly for any large elements of the programme where the costs or outputs are inherently difficult to determine in advance.

3.2. LESSONS LEARNED FROM APPLIED APPROACHES TO EX-ANTE INCENTIVES

In developing options, our starting point has been to examine previously applied approaches. While it is unlikely that any example will be a perfect match for capacity expansion at Heathrow, the CAA have made it clear that options must be practical and take into account (among other criteria) the impact of regulatory incentives on affordability and financeability. It is important to investors and financers that they are familiar with components of the approach, and so it is sensible to ensure that the options we develop contain elements that they recognise and can take some comfort in.

To support this, we developed several case studies in two categories: large-scale infrastructure development, and regulatory treatment of uncertain projects. From these we draw six key lessons for the design of incentives and for wider regulatory best practice regarding large investment programmes, as summarised in Figure 3.2, which feed into the development of our straw men

options. We have selected those lessons that appear to us to be most relevant to the development of ex-ante incentives for H7, especially where common themes emerge across the case studies.

The case studies themselves are set out in Appendix A.

Figure 3.2: Summary of lessons learned from studying approaches to ex-ante incentives applied elsewhere

Lesson 1: Cost allowances and outputs should remain flexible for as long as is feasible	Heathrow capacity expansion is a large and complex programme of works, which is expected to span more than one control period (CAA control periods are typically five years). It is important that the design can evolve and that the incentive does not constrain HAL in delivering required outputs. At the same time, if cost allowances and outputs are set too late, efficiency benefits can be muted and there could be scope for delays in delivery.
Lesson 2: Reopeners and adjustments to allowances can be useful tools	While we consider that it is appropriate to consider ex-ante incentives for capacity expansion, we also recognise that some areas of costs will be difficult to set in advance. Reopeners and adjustments which are focused on pre-determined terms (e.g. thresholds at which they are triggers, categories that are included, indices that will be used) can be useful tools for ensuring that allowances remain linked to input costs and required outputs without introducing uncertainty and risk.
Lesson 3: Importance of a programme-level contingency	The Heathrow North-West Runway is a large and complex programme of works, bringing a high degree of uncertainty that makes it difficult to ascertain the most appropriate value of contingency to provide for each of the individual aspects. While some contingency can be allocated to more developed projects from the outset, developers find it useful to also have a contingency that is kept at the programme-level until it is clear where it is required – rather than allocating the entire programme budget to its projects. This contingency enhances the opportunity for flexibility as discussed above.
Lesson 4: There are various approaches to managing risk and uncertainty in contracts	The CAA should consider whether an alternative approach to managing risk could be useful when setting the regulatory approach for the development of the Heathrow capacity expansion. The commercial procurement approach to be adopted by HAL is still uncertain. Until there is greater certainty, the CAA is not in a position to know whether the preferred regulatory incentive mechanism is likely to achieve its desired outcomes given the different procurement approaches that HAL may choose.
Lesson 5: Annual targets are unlikely to be an effective incentive mechanism	Although it may be useful from a planning perspective to set out the anticipated annual expenditure, it would be unsuitable for the Heathrow capacity expansion given its scale and uncertainties – as emphasised through the other lessons in this section, flexibility will be key. There could however be benefit in tracking costs against programme annually, for monitoring purposes.
Lesson 6: Investors seek downside protection	There are various ways in which downside protection can be included to better appeal to investors' risk appetites. Given the scale of the Heathrow capacity expansion programme, the CAA should carefully consider the level of risk that HAL is willing and able (from a financeability perspective) to take on. We consider that a cap and floor mechanism might provide investors with a useful downside protection against 'extreme circumstances'. Sharing mechanisms then provide an ongoing incentive within the cap and floor.

3.3. GENERAL CHALLENGES WITH INCENTIVE DESIGN

In Appendix B we provide a more detailed discussion of the key challenges that exist when designing an incentive model. An important consideration is that there are trade-offs that mean that it is not possible to design a perfect mechanism. The CAA will need to make judgements where tensions exist between competing objectives. In Table 3.2, we provide a summary of some of the trade-offs discussed further in Appendix B.

Table 3.2: Overview of key regulatory choices

Policy option	Issue
Timing of setting a cost allowance and delivery obligations	More detailed information is available over time, meaning later estimates of costs should be more accurate. However, setting allowances later potentially removes the incentive on the regulated company at earlier stages in their project development cycle. In the case of capacity expansion however the parties will need to be mindful of the political pressure to present lower cost options up front which are difficult to deliver in practice.
Level of granularity for cost allowances and delivery obligations	Focusing on aggregate costs is in theory simple, creates a lower resource burden and is flexible, however the ability to set an accurate baseline at this level and monitor it effectively is more challenging.
Level of detail within delivery obligations	More detailed delivery obligations limit the ability to 'game' the incentive by earning rewards for capex efficiency that are due to reductions in scope (either in volume or in quality). However, the additional detail could restrict the flexibility HAL has to improve the overall design.
What costs are included as part of the incentive	Different treatment of some costs can lead to changes in priority or gaming, however including costs that are less predictable or more uncertain, risks a broader range of outcomes and could result in HAL making windfall gains or losses as a result of factors outside of its control.
How to set the incentive strength	Incentive strength should be proportionate to the confidence in the baseline. An accurate baseline might have a strong incentive, while a highly uncertain baseline would justify a weaker incentive.

A consideration of these trade-offs has informed the development of the straw men options and represent a sub-set of the design choices available for creating an efficiency incentive mechanism.

4. APPLYING INCENTIVES TO THE HEATHROW EXPANSION

In this section, we consider the programme of works that make up the capacity expansion, and how its scale and complexity influence the approach to ex-ante incentives. The expansion is among the highest-cost infrastructure projects in Europe, and the construction period is expected to span more than one control period. The construction is made even more complex through being undertaken on an airport that will continue to function throughout the expansion, creating additional interfaces and risks to be managed.

Even with this level of complexity, there will still be some cost categories that can be estimated in advance with some confidence, and to which CAA can attach clear delivery obligations – a key consideration when implementing ex-ante incentives, as discussed in Section 3. Based on analysis of current information we consider that at least 55% of the expected capex cost could be considered to be suitable for ex-ante incentives.

We also consider the current uncertainties about the regulation of HAL for the expansion programme, and make the following assumptions which are used in our ex-ante model options:

- **The H7 control period will begin after the Development Consent Order (DCO) is in place, and H7 will be five years.**
- **The single masterplan will also be completed after the DCO is in place, and will be used to set the regulatory baseline.**
- **There will be a baseline (either initial or firm) set as part of the H7 determination, setting a cost target for aspects of the project that will occur during the control period.**
- **There will be a cap and floor in addition to the cost target, with extraordinary reviews triggered by breaches of these levels.**

The Heathrow capacity enhancement programme is particularly large in scale and complex, given its development alongside existing operational infrastructure. Projects that are expected to cost over £1bn are generically known as 'mega projects', with three additional UK-based examples set out below:

- Crossrail describes itself as the largest construction project in Europe at an initial estimated cost of c.£15bn, a figure which is increasing given recently acknowledged cost overruns.
- HS2 will displace Crossrail as the largest construction project, as it moves into the main construction phase.
- The only other project in construction in the UK of even similar size is the Thames Tideway Tunnel (TTT) at c.£4.2bn.

In reality, Heathrow capacity expansion is a collection of a mega projects each of which includes a portfolio of smaller (although still very large scale in project/contracting terms) projects, all of which must fit together into a master programme to deliver new capacity. As currently described, capacity expansion touches all areas of the airport – from extending the existing airfield to providing new terminal buildings and facilities which support delivery of new capacity. It also impacts very significantly on the areas surrounding the airport, e.g. construction of the new runway requires river and road diversions before wider surface access projects are even considered.

The risk associated with mega projects is generally considered to be inherently greater than for other projects given their long planning timeline and complex interfaces. The planning challenges for

Heathrow are well documented,[16] the project is required to be delivered whilst limiting any increase in noise or congestion and expansion takes place in a densely populated area which requires a large scale commercial and domestic property purchase scheme/compulsory purchase. In addition, the work will take place in and around a busy airport that continues to operate close to its capacity. Maintaining safe operation while construction takes place requires interface management on a level that arguably exceeds the burden on other projects – e.g. HS2 and TTT. Previous large projects at Heathrow, including T5 and T2, have been delivered around other operational assets, although these are not to the scale or complexity of the forthcoming expansion programme.

Given their complexity mega projects are characterised by long development periods. Typically, there are four main stages of development, and at present the Heathrow capacity enhancement project is in the planning stage (which extends as far a detailed feasibility assessment/outline design). This will be followed by detailed design, construction and close out. At present there is no single masterplan and no planning consent (development consent order, DCO). Only in future, post-DCO, will detailed design develop, and that will likely overlap with early phases of site preparation, which effectively makes space for construction work to commence. This uncertainty impacts the timing of associated regulatory control periods and makes setting firm delivery obligations for a control period more challenging,[17] however by the time delivery obligations need to be set more information will be available.

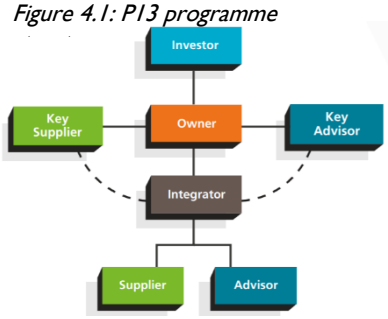
At this stage the procurement approach for the project is not defined in detail. HAL has indicated it expects to use P13, a collaborative approach which involves suppliers working closely with the asset owner and its key advisers (see Box 4.1). This builds on HAL's approach to T5 development and its current practice of procuring through a small number of 'tier 1' suppliers. At this stage there is little information on how the projects which make up the programme will be bundled for procurement.

Box 4.1: Introduction to P13, a collaborative approach being used for the Heathrow expansion

P13 (Project 13) is an initiative launched in 2018 by the Institute of Civil Engineers (ICE), which seeks to improve the delivery of infrastructure projects through a collaborative approach, which is tailored for each user but typically requires clearer coordination between the relevant parties rather than traditional contractual relationships and risk transfer.

Figure 4.1 sets out the basic structure, with the key differences to more traditional models being the addition of an integrator (to act as a coordinator) and there being a key supplier working alongside the owner.

Figure 4.1: P13 programme



HAL proposes implementing P13 for the upcoming capacity expansion, taking lessons learned from elsewhere:

- T5 demonstrated the value of a "**capable owner**", which takes all accountability and most of the risk, and builds a team to mitigate those risks.
- Crossrail highlighted that there should be **performance management** of the supply chain.
- **Off site logistics hubs** used assist delivery: they are located closer to suppliers to facilitate better communication with suppliers, vertical integration by suppliers, and pre-assembly of outputs.
- An **innovation hub** is established to improve communication and knowledge management. This requires selecting individuals who are responsible for bringing together "innovative ideas" (which are

[16] The Guardian, The challenges Heathrow airport must face over third runway, 25 October 2016

[17] Where good quality information does not exist for setting delivery obligations, this uncertainty could also imply greater difficulty in the end of period reconciliation process.

innovative to HAL, but not necessarily new in general) and considering whether they might play a part in addressing key challenges and objectives.

Source: ICE (2018) "P13 Blueprint"; ICE (2018) "From T5 to Heathrow Expansion"

4.1. WHAT WE KNOW ABOUT THE PROGRAMME

At present HAL is still consulting on its plans, although we have a figure for total cost[18] and some understanding at a high level of the components of the expansion programme. However, the information that we are using will change and that change could be significant.

We have drawn upon Arcadis' knowledge of capacity expansion and on materials that the Arcadis team has access to; namely the Purple Book (HAL's estimate of costs) and an indicative schedule of works based upon a report from HAL to the Department for Transport (DfT) on procurement from March 2018. These reports are now out of date or have been superseded, with expectations that the plan with change further. Notwithstanding this, our work uses this material to illustrate how incentive options might work, e.g. which components of the overall project might be subject to a particular incentive and to develop indicative delivery obligations.

4.1.1. Review of cost suitability for ex-ante incentives in H7

As noted earlier, the cost breakdown for the programme includes costs estimates which span the range of uncertainty, i.e. some costs are more predictable than others. At a high level we have reviewed the programme to assess HAL's ability to define and control costs.

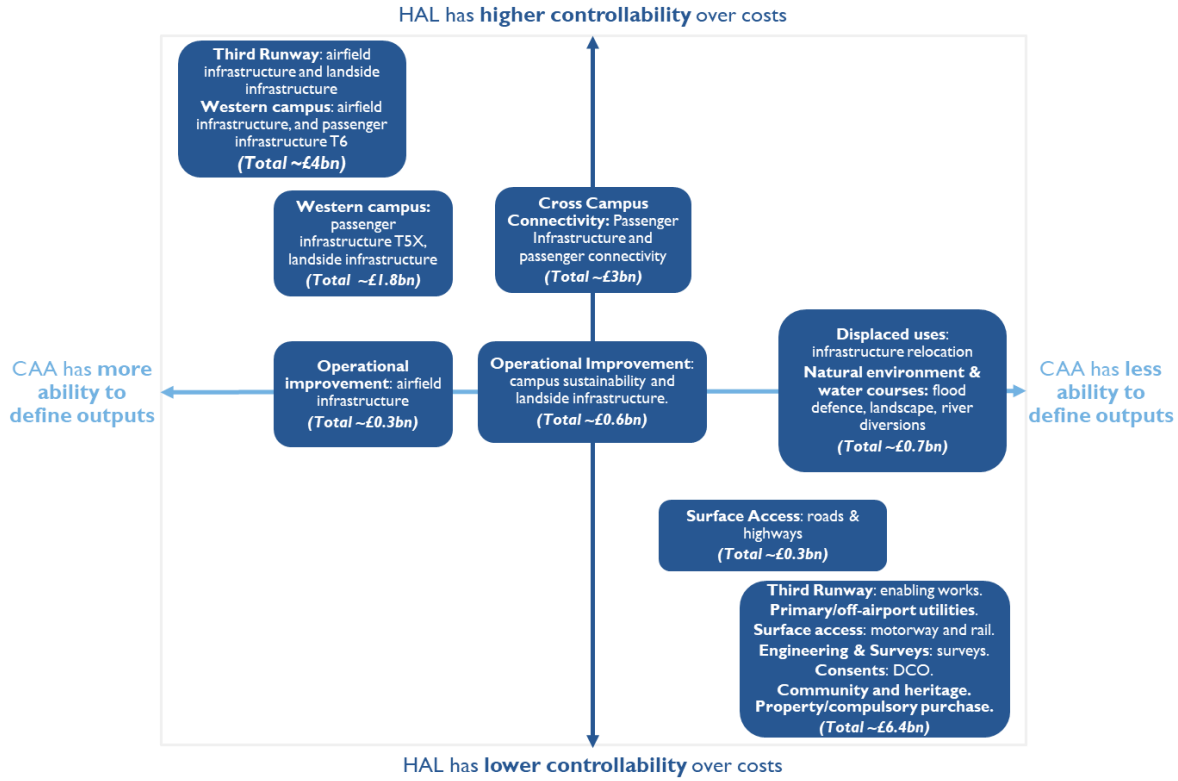
In Figure 4.2 below, we present an assessment of those activities expected to be completed during the H7 price control and an initial approximation of these costs during this period relative to two of the most important assessment criteria, namely HAL's ability to control costs and HAL/CAA's ability to define outputs. Our analysis suggests that HAL will have a medium to high degree of control over a significant proportion of costs and the CAA will be able to define outputs for at least half of the project costs as grouped below.[19]

We then use this analysis to assess which costs might be included within the straw men options set out in subsequent sections of this report.

[18] This is based on HAL's cost plan, The Purple Book, version 0.63 (dated 30 June 2017). We note that HAL reduced its costs for the third runway by £2.5bn in December 2017.

[19] This is based on an assessment of broad cost categories within The Purple Book. Within each cost category, not every £ will perfectly align with the grouping above.

Figure 4.2: Our assessment of suitability of costs for application of an ex-ante incentive mechanism (H7 activities only[20])



Source: CEPA analysis of information shared by Arcadis, based on HAL Purple Book (June 2017).

As noted above, further information will become available in due course and provide greater certainty on the timing and volume of cost associated with different categories. With this information being unavailable at present, our assessment is intended to be indicative.

4.2. UNDERLYING CONTEXTUAL ASSUMPTIONS

The limited information available at this stage requires us to make some further assumptions. These general assumptions apply to all straw men options developed in Sections 5 and 6, in the following areas:

- When the H7 control period will commence, relative to the expansion programme timeline.
- When the single masterplan will be finalised.
- Control period length.
- Regulatory baseline acting as a cost target.
- Cap and floor mechanism.
- Extraordinary review.

[20] Cost information is included only to provide an illustration of the proportion of the project that falls into each quadrant of the diagram. The cost allocation used in this model is consistent with the breakdown provided in The Purple Book, but we note that this has been superseded.

- Treatment of overruns.

We have based these assumptions on information that is in the public domain at present. We do not comment on the likelihood that these assumptions will hold by the time the CAA has to make its decision on H7. We briefly discuss each of these assumptions in turn below.

When the H7 control period will start relative to expansion programme timeline

We assume that the H7 control period begins shortly (perhaps 6 months) after the DCO for the expansion has been given. We understand that there are likely to be conditions attached to the DCO and we would expect there to be a period after DCO approval when the expansion plan and design, is refined in response to those. We expect this refined version of the programme to form the basis of cost assessment for the H7 price control.

At this stage we have no information about the likelihood and magnitude of these conditions. Clearly substantial additional requirements could impact the time line for the price control and so this represents a risk that the CAA will need to consider further as it develops thinking on the time period to be covered by the H7 review.

When the single masterplan will be finalised

At present, HAL is considering key components of the overall programme with the aim of formulating a preferred masterplan. There are currently multiple masterplans, rather than a single version. While this might be a reasonable approach for developing the best single masterplan, it makes it more difficult to anticipate the contents of that single masterplan.

Once the DCO is in place, we understand that this single masterplan will be developed and finalised, along with an overarching programme for the project. Some, perhaps material, uncertainty of scope and cost will remain but there will be significantly greater certainty on the scope and cost of the project than is the case today.

We assume that the masterplan will be used to form the delivery obligations for H7 and set the baseline around which ex-ante incentives will operate.

Control period length

We assume a five-year regulatory period; however, we consider that a six-year or seven-year control could make some forms of ex-ante incentive easier to apply e.g. because delivery obligations are more straightforward to specify for the whole project. However, decision about extending a control period requires more information than is available at this stage, including a more certain programme and project durations.

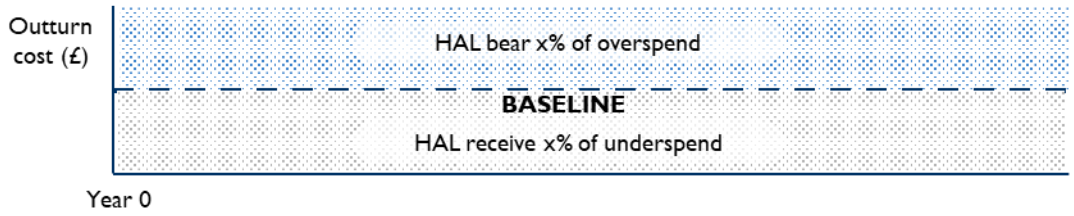
Regulatory baseline acting as a cost target

Under our five-year assumption, not all works will be completed within H7; further costs are expected to be incurred during H8. However, based on the current plan the majority of construction will be complete in H7, with some activities due to start in the mid- or late-2020s. **Our illustrative delivery obligations focus on the scope of work currently envisaged for H7**. This scope and associated costs set the baseline for H7.

Both our models start from the setting of a regulatory baseline (cost allowance(s) set as part of the H7 determination). This acts as a cost target for the project within the control

period. Our baseline effectively mirrors a target cost contract by offering both upside (potential for additional return) and downside (risk exposure), as demonstrated in Figure 4.3 below. The baseline is measured as a total over the price control period, rather than being based on annual targets.

Figure 4.3: Indicative ex-ante mechanism



This approach means that HAL could potentially earn significant additional revenues if they underspend. Our straw men options assume that the sharing mechanism would be symmetrical, but that does not have to be the case, and the CAA can adjust this when there is sufficient certainty to undertake detailed calibration of the incentive.

The implication of this is that the regulatory baseline is very important in each of the straw men options, with clear delivery obligations necessary to ensure that "underspend" represents cost efficiency or outputs being delivered through a change in scope, rather than not delivering these outputs. Some of our options allow the baseline to move after it is initially determined as part of the price control but this would not replace the need for the CAA to spend time and effort on setting the baseline in the first place. Setting the baseline in all options is a material challenge. There is substantial information asymmetry: HAL has access to detailed information that the CAA will not necessarily have and there is no 'alternative price' such as that delivered in a competitive process e.g. PPP or PFI type bids.

The setting of the baseline is crucial. The development of our models considers how to best achieve this on an ex-ante basis, and how this can be used for any ex-post review.

A further challenge is that the nature of the incentive mechanism means a financial incentive exists for HAL to inflate the baseline, as over- or under-spends are relative to the baseline figure. Detailed ongoing scrutiny of the baseline will be essential for any of our approaches to work in practice. The CAA will need to consider how it would address the requirement to set a reliable figure, its ongoing information requirements and the technical support needed to interrogate the data provided and potentially produce alternative estimates.

Cap and floor mechanism

In each of our models we propose the use of a cap and a floor related to cost variation from the baseline. We consider that the presence of these features helps address multiple issues and the cap and floor represent the simplest and most effective way to address these challenges.

A description of the operation of the cap and floor is contained below.

Table 4.1: Description and rationale for use of cap and floor

Cap	Floor
• The cap represents a level of cost above which the project would be reassessed in its entirety. The estimate of efficient cost would remain firm for the remainder of the price control.	• The floor represents a low probability outturn for expected costs for given delivery obligations. • The incentive operates to provide HAL with a share of savings between the baseline and floor.

Cap	Floor
• Such an assessment would be triggered by a forecast breach of the cap (as set out as part of the annual review process discussed later). • HAL faces the sharing factor between the baseline and cap. It can then quantify its maximum risk. • However, where costs above the cap are considered inefficient, HAL is unable to recover. This means that HAL's exposure is not limited for cases of inefficiency. The baseline is reset to cover efficient costs, although this assessment would be undertaken in the round.	• Below the floor, HAL would not receive financial rewards for outperformance, with the benefit reducing airport charges. • The floor caps the maximum upside available to HAL under the ex-ante capex incentives (rather than acting as a floor on HAL's revenues). This restricts the ability to benefit from delivering less scope than expected through gaming. This also provides protection to consumers if the incentive mechanism is not properly specified.

The rationale for the cap and floor is as follows:

- *Certainty*: The cap and floor recognise that the project will have material areas of uncertainty post DCO. They place bounds on HAL's risk exposure and upside.
- *Financeability*: The cap provides the ability for the CAA to step in, should the performance on capex potentially put HAL's financeability at risk for efficient expenditure.
- *Affordability*: The cap sets bounds on the costs borne by users for capex (subject to any extraordinary review).
- *Information provision for the CAA (signalling)*: The CAA is able to monitor expected costs and information is available for all parties. Good information is a requirement of the ability to mitigate cost escalation.
- *Ability to mitigate*: The cap is triggered through a forecast breach – this means that the CAA can step in and help HAL resolve issues of cost escalation, with timely provision of certainty.
- *Consistency with target cost contracts*: The mechanism partly mirrors a target cost approach to contracting. HAL, its supply chain and lenders are familiar with this approach.
- *Restricting benefits from gaming*: The floor provides some protection on gaming any flaws in the ex-ante capex incentives.

Extraordinary review

Both models are subject to an extraordinary review mechanism above the cap or below the floor. There is no scope for upside below the floor and only efficient costs above the cap will be added to the baseline. A review would seek to implement changes to bring the project back to the original baseline or, where this not practicable or desirable, establish an assessment of efficient cost for the remainder of the control period. It will also provide an opportunity to understand the cause of the breach and establish mitigations to reduce any negative effects going forward.

This extraordinary review considers the basis for an increase in costs above the cap. Where this is found to be due to inefficiency, the review will not allow revenue to be recovered, protecting users from inefficient costs. Where this is found to be due to changes in efficient costs, the baseline will be reset i.e. the mechanism is protective (although a proportion of the increase in cost up to the cap is still faced).

The extraordinary review would also consider whole project costs to ensure that there has not been inappropriate substitution between capex and opex, given the change in expected capex.

Treatment of cost overrun

Given the Government's aspiration to broadly maintain current levels of passenger charges, we assume that Heathrow will carry cost overruns until the end of the control period or until an extraordinary review. This mirrors current practice under the ex-post incentive regime but would need to be reconsidered in more detail within the development of the incentive as HAL may not be able to carry these costs and/ or this could create a financial impact that is unacceptable.

5. STRAW MEN: REGULATORY OPTION

5.1. SUMMARY OF REGULATORY OPTION

The regulatory option is developed as a single approach for all cost categories irrespective of their level of definition or predictability. It is similar to regulatory processes elsewhere e.g. setting cost allowances in the water regime. A firm baseline (with an associated cap and floor) would be set as part of the regulatory determination. HAL would then bear a pre-determined share of any under- or over-spends relative to this baseline. Significant uncertainty remains at this point, making it most appropriate to set delivery obligations at a high level. In summary this option works as follows:

- **A single regulatory baseline (cost allowance) would be set at the regulatory determination for delivery over the whole price control period.**
    - **HAL would provide a business plan or capacity enhancement equivalent to the CAA, setting out what it expects to deliver over the H7 price control and the costs associated with delivery of those outputs. This will be informed by engagement with the airlines.**
    - **the CAA, likely with external technical support, would review the plan and set delivery obligations and establish a fixed regulatory baseline for H7 capex.**
- **The regulatory baseline would remain fixed ('firm') over the price control period for a fixed scope. The exception to this is a reconciliation at the end of the period, where an adjustment to the baseline may be required if outturn scope differs from the agreed delivery obligations.**
    - **It is understood that the capex programme will continue to develop after this date. The challenge for Heathrow would be to maintain those changes within the overall fixed cost baseline. The challenge for the CAA will be to identify any changes in scope that might lead to significantly worse outcomes for consumers compared with the plan reflected in the cost baseline and delivery obligations.**
- **For the purpose of comparing actual costs to the baseline, the baseline would be set in nominal terms and allowances are not uplifted for price inflation i.e. there is no mechanistic adjustment to the baseline.**
- **HAL would face a pre-determined share of any cost over- or under-spend for costs relative to the regulatory baseline. We expect that a low incentive strength would apply between the bounds of the cap and floor, given the level of uncertainty about design and costs.**
- **Delivery obligations under this model would be very high level. This provides flexibility for HAL to develop the programme most suitably as more information becomes available. However, delivery obligations are not straightforward to develop as capacity expansion would extend over more than one price control even where H7 starts a short period after the DCO is granted.**
- **All capex (both BAU and expansion) would be included under the baseline because we consider that it is unlikely to be practicable to separate the two for the CAA's purposes.**
- **The CAA would be responsible for setting the rules of how the model will work up-front at the price control determination. This includes the approach to ongoing**

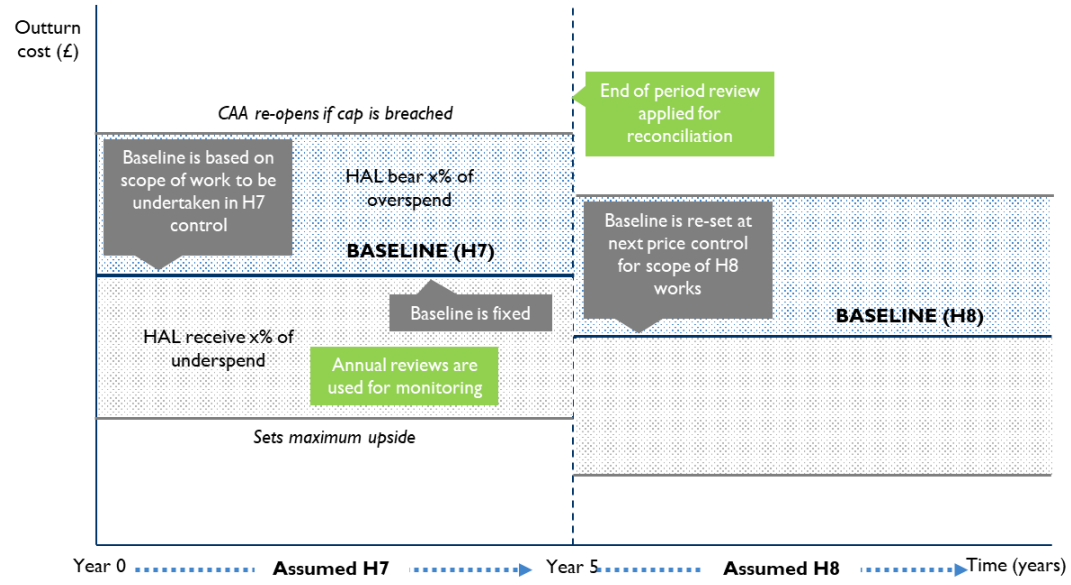
monitoring, the reconciliation process at the end of the price control, any adjustments to the regulatory baseline and the operation of the incentive itself.

- **There would be an annual review process that monitors both costs and scope. This is important as the outturn scope is likely to differ to what was expected at the outset of H7. The annual review process would also be used for assessment of whether HAL is expected to breach the cap and floor.**
- **If costs are forecast to breach the cap or floor (as highlighted during the annual review process), the CAA would undertake an extraordinary review to assess efficient costs. This will not impact on outcomes between the floor and cap, but will determine the proportion of costs that can be recovered.**

We also present a single variant to the regulatory option which includes within the incentive a narrower set of cost categories.

A simplified diagram of the regulatory model is presented in Figure 5.1.

Figure 5.1: Diagram summary of the core regulatory model



5.2. FURTHER DETAIL ON REGULATORY OPTION

5.2.1. Setting, updating and monitoring the baseline

Costs subject to ex-ante incentives

Under this option we assume all capital costs (both BAU and expansion capex) would face an ex-ante capex incentive and all face the same level of incentive. We do not consider there would be benefits from separation, especially given the challenges it would cause around cost allocation for an integrated programme of works.

It is acknowledged that some costs within the overall figure are inherently difficult to estimate and control, irrespective of this all are captured within the incentive in the core model. This is because we expect there to be significant flexibility to adjust components within the overall baseline and that flexibility can be used to manage uncertainty. In our core model we anticipate the incentive being

lower in this model than under the governance model e.g. HAL bearing [10]% of any overrun not [25]%.[21]

However, Figure 4.2 suggests that a large sum (up to £7.5bn[22]) of costs fall into this more difficult to control/estimate category so we also include a variant option in which costs that are inherently more difficult to forecast are excluded from the incentive mechanism and are instead made subject to an ex-post review.

Level of granularity

The regulatory baseline described here is a single headline regulatory capex allowance; the incentive would operate relative to this baseline figure. However, the information required to set the baseline initially and provide a reference for ongoing monitoring/ reconciliation will need to be at a much more granular level.[23] Our previous work on capex governance at Heathrow suggests that HAL has project management systems able to support this information requirement. Nonetheless, estimating and monitoring delivery and costs in more detail will likely require the CAA to procure additional specialist resource/advice.

Setting a baseline

Under this model the CAA would be responsible for setting a firm baseline or regulatory allowance at the outset of the H7 price control period. This requires an ex-ante estimate of efficient costs for the scope of work expected to be delivered within the H7 price control. Under our core model, this baseline will be fixed for the H7 regulatory period (for 5 years in nominal terms[24]), subject only to any agreed mechanistic adjustments to the baseline discussed below.[25]

Airport expansion activities will extend beyond a single price control period. Setting the baseline, therefore, requires an assessment of the costs associated with full completion of some outputs and partial completion of others (within the price control). This means that even though delivery obligations for this model are expected to be very high level they are not straightforward to set on a basis that allows the project flexibility to develop and maintains cost control. As a result, HAL could be exposed to some windfall gains or losses owing to factors that may not be within its control.

The project design submitted as part of the DCO process and the H7 business plan submitted by HAL will provide important information to the CAA for setting this baseline. The CAA will be responsible for reviewing HAL's documents and making a decision, with support from their technical advisers and learning from the engagement process between HAL and the Airlines. This assessment should include consideration of which outputs to include within the incentive mechanism and an estimate of efficient costs for delivery of those outputs.

The CAA would be responsible for setting a new baseline for the subsequent regulatory period (H8). This will be informed by learning from the monitoring of the H7 price control period, however assumptions would need to be made on what will be delivered towards the end of the H7 price

[21] Figures are indicative and subject to calibration by the CAA, where a model is selected.

[22] This is based on evidence provided to us from Arcadis. We note that this programme has been superseded and any figures are indicative.

[23] This is likely to be at least as granular as Level 4 of HAL's WBS.

[24] This reflects current practice.

[25] This assumes that there is no extraordinary review, discussed later within this section.

control when setting costs and on outputs for the H8 price control (while H7 is ongoing). This is similar to the issues the CAA currently deals with as part of price control reviews, albeit on a larger scale.

Price inflation adjustment mechanism

For the purposes of comparing actual costs to the baseline, we propose that the CAA would set the baseline in nominal terms for the scope to be delivered within the price control. There would be no within-period adjustment for outturn inflation.[26] Expected external price changes would be included in the baseline set at the regulatory determination in this core regulatory model.

However, following the application the incentive, costs would be added to HAL's Regulatory Asset Base (RAB) in accordance with the CAA's current approach.

It is our understanding that HAL provides its business plan in nominal terms and we do not know if HAL prices its contracts with suppliers using fixed nominal prices or with price adjustment mechanisms. If HAL develops a business plan in nominal terms and sets an ex-ante price with suppliers in nominal terms with no adjustment mechanisms, we consider that an allowance in nominal terms is most suitable. A nominal approach also creates less scope for gaming around which inflation assumptions are built in.

Alternative approaches could be suitable include setting a cost allowance that is linked mechanistically to outturn general inflation e.g. CPIH or RPI, or specific production price indices. Other regulated industries have applied such approaches. This would not fundamentally change the model. When further information is available on specific costs, the CAA can consider the most suitable approach.

Delivery obligations

At the H7 determination there will remain significant uncertainty around the individual projects and programmes that make up overall investment programme. We focus on a single high-level delivery obligation intended to capture the key outputs delivered in H7 meaning HAL will retain flexibility to deliver an efficient design throughout the price control. A single delivery obligation means that the focus is on the overall programme and while there might be outputs that underpin the overarching delivery obligation, the baseline is set at an aggregate or holistic level, rather than focusing on detail.

Using the expansion programme that Arcadis currently has access to,[27] airport expansion is expected to be substantially complete five years after the DCO is granted. Our proposed overarching delivery obligation for H7 would be for HAL to reach this point of substantial completion (as per the illustrative text box below). The main exclusion from the current plan would be T6 and its ancillary facilities as these are not needed until other new capacity is taken up.

Indicative high-level delivery obligation for H7 price control determination

The expansion programme should be substantially complete by the end of H7. This includes:

- all enabling works (as defined in HAL's Purple Book) are signed off as completed to facilitate expansion;

[26] Alternative models do exist whereby the baseline is set in real terms. This is then adjusted to reflect outturn price inflation, either through general price inflation indices e.g. CPI, RPI, or specific indices e.g. Producer Price Indices.

[27] This is based on The Purple Book (30 June 2017). The plans are expected to have evolved since then, and continue to change up to the DCO.

- a runway that is fully constructed and available for operational testing (the runway should be sufficient to handle x flights per day/ week/ year); and

- new terminal buildings and extended buildings identified as part of DCO submission are constructed (though not necessarily fitted out) to an appropriate standard; noting that T6 and ancillary facilities are not included.

Etc.

In terms of the above example, the CAA would need to define what is meant by the terms 'completed' and 'appropriate standard'. CAA and HAL currently employ a capex trigger mechanism which involves a term definition sheet, this could be utilised for the purpose of developing a more precise obligation.

In designing the delivery obligation, the CAA should ensure that during the reconciliation process it would be able to understand whether the volume and quality of work anticipated in the ex-ante cost estimate has been delivered. As noted previously, this process may result in some windfall gains or losses for HAL to owing to factors that may not be in its control.

Role of Airlines and the Independent Funds Surveyor (IFS)/technical adviser

The role for airlines in this option is expected to be more limited than under the current capex governance process. This is intentional because the focus is placing the onus on HAL to deliver the programme of work efficiently, flexibly and in a timely manner. However, the airlines are an important stakeholder and would have a role in understanding and agreeing what outputs are specified within regulatory baseline, which they would be able to do through engagement with the CAA's price control process. Operation of the incentive would not preclude ongoing dialogue between HAL and the Airlines. However, this dialogue would not routinely impact the baseline.

We discuss below an annual review process and we expect that information would be sought from and shared with airlines as part of this process.

The IFS (or a similar technical adviser) would have two main roles under this model: i) helping provide the CAA with information to assist setting an efficient regulatory baseline, and ii) monitoring HAL's performance during the price control and producing an annual review on forecast outturn cost. This is especially relevant as the model includes a cap and floor on expenditure which operates based on expected outturn cost.

5.2.2. Operation of the incentive

In this section we consider incentive strength, the monitoring and review process, the cost cap and floor, reconciliation, the form of revenue adjustment and an appeals process.

Incentive strength

The ex-ante model proposed involves HAL facing a proportion of both over- and under-spend relative to the baseline, through a sharing mechanism. Under the core regulatory model this is assumed to be the same for both over- and under-spends and applicable to all costs within these bounds. This need not be the case but we do not attempt to calibrate the approach in this piece of work.

We consider that the inclusion of all costs (including those which are more difficult to set ex-ante incentives for) in the core model and the need for high-level delivery obligations (which provide flexibility) favour a low-powered incentive e.g. sharing [10]% of over- or under-spend against the

baseline for the price control.[28] This has been informed by our review of cost characteristics, with Arcadis providing insight in this respect. Where categories of cost are excluded from the mechanism (e.g. under the variant considered below) the incentive strength could increase.

The incentive operates as follows: where outturn cost at the end of the control period is between the cost cap and floor, HAL retains [10]% of any under-spend against the regulatory baseline or faces [10]% of any over-spend relative to the regulatory baseline. No assessment is made between these bounds on whether costs are efficient or not.[29] The incentive mechanism is operated at the end of the price control, based on a review of performance over the whole period.

Cost cap and floor

The incentive operates within a cap and floor which reflect price uncertainty and which are only expected to be breached in extreme situations, e.g. as a one-off occurrence. In circumstances where the cap or floor is forecast (via the annual review process) to be breached, the CAA would trigger an extraordinary review. A review would seek to implement changes to bring the project back to the original baseline or, where this not practicable or desirable, establish an estimate of efficient costs for the remainder of the control period.

The review does not change the outcome up to the cap or floor. HAL would retain [10%] of the over/underspend up to the cap/floor and it would be responsible for any inefficient costs above the cap. This approach means that the certainty over the incentive mechanism between the floor and the cap is maintained, irrespective of the outcome of the CAA's extraordinary review.

The cap and floor would only move in line with any agreed changes to the baseline. They would not move for changes to design and scope save in the case of an extraordinary review.[30]

The calibration of the cap and floor is vital to their operation. This report does not focus on how to set the level of the cap or the floor, although options could include: i) basing it on statistical modelling e.g. at P80 or historic cost performance of other infrastructure projects, ii) related to HAL's overall exposure in £bn terms, or iii) reviewing proposals from HAL on the level of the cap and floor or a mix of these options.

Worked example of cap operations

Worked examples of how review works in practice and the operation of the cap and floor are included in the text box below.

Assumptions:

Regulatory baseline = £100

Cost Cap = £200

Sharing Factor = 10%

Forecast outturn cost = £250

Extraordinary review

[28] The 10% figure is illustrative and subject to calibration by the CAA where used.

[29] Even if the cap and floor levels are triggered, incentive penalties or rewards are not subject to a view of efficiency.

[30] An alternative approach without changing the fundamental features of this model would be to allow changes where both HAL and airlines on a change to the originally developed scope.

The CAA will assess capex as part of an extraordinary review in any instance where the cap is forecast to be breached. The scenarios below illustrate different potential situations and the implications for HAL.

Scenarios

1. CAA identifies all expenditure as efficient

HAL loses 10% of expenditure between £100 and £200 (i.e. £10), but is able to recover the full £50 above the cap.

2. CAA identifies total efficient costs of £200

HAL still faces the £10 penalty on the difference between £100 and £200, not being compensated for any expenditure above that level i.e. £50 (as this is deemed inefficient).

3. CAA identifies total efficient costs of £220

HAL faces a £10 penalty for expenditure between £100 and £200, then recovers £20 of the additional amount.

4. CAA identifies total efficient costs of £180

No revision is made to the ex-ante incentive framework, with HAL ultimately able to recover 90% of costs up to the pre-agreed cap. This means that HAL faces the same outcome as in example #2 (with identified efficient costs of £200). This is to limit the exposure and risk under the core incentive mechanism – however total exposure is not capped where costs are considered to be inefficient.

Monitoring and review process

Monitoring progress is challenging as the actual programme and its costs will inevitably diverge over time from those used to set the baseline initially. The objectives of the review process are to maintain line of sight between the baseline and the actual project, consider the appropriateness of any capex opex trade off, provide early warning of the need for an extraordinary review and facilitate the end of period reconciliation which in turn permits calculation of incentive payments. Achieving these objectives necessitates the review process operating at a granular level and drawing upon multiple inputs, the information for which would come from HAL. Our experience suggests that HAL is capable of providing these inputs:

Monthly monitoring

The monthly monitoring programme involves updated estimates of cost, timings for delivery and an opportunity for discussions between HAL and its stakeholders. This phase predominantly involves HAL providing updates, with the CAA looking to gather relevant information to undertake its annual reviews and final reconciliation.

The approach is consistent with current capex monitoring arrangements under which HAL produces a monthly information pack that is shared with the CAA, airlines and the IFS.

Annual review process

This process is envisaged to be undertaken by the IFS (or an appointed technical adviser), who will have information from its ongoing engagement with the expansion programme. The annual review would seek to confirm whether expected costs and the scope of works completed at a relatively high-level are consistent with the baseline.[31]

[31] This considers whether the costs and scope are broadly as expected and on an 'exceptions' basis, rather than focusing at a very detailed level.

HAL currently uses cost and schedule performance metrics to provide an indication of progress and assess whether this remains on track; these might be a useful start point as long as these metrics are anchored to the baseline being used by the CAA.

The review would also comment on outliers, assess risks and challenges and give an overall indication of whether intervention (e.g. an extraordinary review) is likely to be required in the foreseeable future.

The annual review would consider the whole-life costs of a project. This would look to ensure that there was no systematic substitution of opex for capex (or vice-versa) through gaming of the regulatory determination.

It would also seek to ensure transparency between actual costs and the baseline, i.e. to understand changes and their impact. This analysis is a required step for operation of the cap and floor mechanism. It also helps the CAA gather information to conduct a robust assessment at the end of a price control.

The annual process would result in a report on progress against the baseline highlight important changes to the programme of work that impact on the baseline, notifying the CAA of emerging risks and issues, providing a snap shot of actual costs against those assumed in the baseline and setting out an interim analysis of results under the incentive mechanism.

We anticipate that the CAA will be the main recipient of this report but that it would also be shared with HAL and with the airlines.

End of price control assessment ('reconciliation')

At the end of the control period we anticipate a more substantial review of performance against the incentive. This assessment would centre on whether the delivered scope has met the delivery obligation.

For this approach to be feasible, it is important that there is transparency over changes made in practice but not reflected in the original regulatory baseline. The review would therefore draw upon annual reports for this purpose but would also include calculation of the end of period incentive payment (discussed further below). As such, this final review would be an important input to the next price control (around sharing of over- or under-spends).

End of price control reconciliation process – updating the baseline

The annual review process described above will consider whether the **outturn cost** and **outturn scope** are broadly in line with the baseline. In the end of control reconciliation process, the CAA would use the outputs of the annual reviews to set out, formally, any necessary adjustments for H8 and beyond – and to calculate the incentive payment for H7.

As set out in Table 5.1, we set out three scenarios and how they might be treated in the end of period reconciliation.

Table 5.1: Scenarios for reconciliation

Scenario	Detailed scenario	Appropriate treatment
Design changes	Changes in design (but not scope) that affect the efficient cost – whether increasing or reducing the cost.	**Baseline does not change**.

Scenario	Detailed scenario	Appropriate treatment
H7 scope reductions	Outputs that are no longer expected to be delivered due to agreed scope reductions.	**H7 baseline is reduced** to take account of unfulfilled obligations.
	Outputs (or parts of outputs) delayed until the next price control period.	**H7 baseline is reduced** by an amount representing the efficient cost of the delayed portion. H8 baseline will be adjusted accordingly. Adjustments would need to be net present value neutral.
H7 scope additions	Additions to scope through a new agreed project or output.	**H7 baseline is increased** to allow for efficient costs in delivering the new output.

Design changes do not result in any changes to the baseline where delivery obligations are met, as the design is not itself an input to the allowed efficient cost. The baseline is set based on delivery obligations to allow HAL the flexibility to choose the most appropriate design within the set "efficient cost" for that obligation. The incentives are designed to encourage HAL to select the most cost-effective design.

Changes in scope (reductions, additions, and delays) would have been discussed as part of the annual review process, with awareness of this by HAL and the Airlines, before they reach the end of price control reconciliation process.

H7 scope reductions, as set out in the table, may occur in two scenarios:

- HAL is unable to deliver a full output within H7 as anticipated, and it will instead be delivered in H8. In these cases, the H7 baseline should be reduced to take account of the efficient costs that had been included for delivering that output. If only part of the output is delayed, it will be necessary for the CAA to ascertain an appropriate proportion of the efficient costs (not actual costs) that represents the progress on that output. That proportion will be retained in the baseline, and the remainder moved into H8. This would help to prevent any double-counting (i.e. making a new revised allowance for work that was meant to take place in H7).
- HAL agreeing (with airlines) that specific delivery obligations should not be delivered. In these cases, we assume that the H7 baseline would be adjusted the efficient costs that had been assumed for that output when setting the H7 baseline. The simplicity of this depends on the level of granularity in the H7 price control determination. Where the change in delivery obligation is more granular than was ascertained originally, judgement is required for the size of this adjustment.

We assume that scope reductions from cancellation or delay would be treated equally. We do not propose to reward HAL for removing delivery obligations from the scope of work, where the work is no longer required.[32]

[32] An example of rewarding HAL would be permitting HAL to retain the financing costs on capex not undertaken.

Incentive application timing

Where outturn expenditure differs to the updated baseline, following the end of period reconciliation process, a mechanism is required to establish how any rewards or penalties are returned to/ from HAL. Once the regulatory baseline is updated via the reconciliation above, HAL faces a pre-determined share of any over/under-spend between the baseline and the cap and floor. The reconciliation process permits the calculation of the over/underspend amount

The payment calculation will need to take into account the revenues recovered over the H7 period (including associated financing) relative to the baseline post-reconciliation.

We consider that the incentive will operate through an adjustment to the RAB, whereby the opening RAB for H8 is uplifted for actual capex, net of the incentive payment. A more front-loaded impact of the incentive payment would not fundamentally change this option.

There is a carry cost consideration for under- and over-spend for HAL. In this model, HAL ultimately bears [10]% of deviation from the baseline, but within H7 there is an associated carry cost until the RAB is uplifted for actual capex. The CAA would need to consider whether an adjustment should be applied for these carry costs.

Appeals mechanism

The appeals mechanism would operate in a similar way to other regulatory reviews, whereby an appeal can be made for changes in the licence. Any changes in HAL's price control formula, either within period via an extraordinary review or at the end of the period, would result in a change to HAL's licence. Any such change is appealable as per current arrangements.

5.3. VARIANT TO THE CORE REGULATORY OPTION

We noted earlier that there are feasible alternative approaches that could be adopted by the CAA under this broad model.

We consider that one variant for our regulatory model merits attention – this involves certain cost categories less suited to ex-ante incentives being treated through an ex-post review, rather than as part of an ex-ante capex incentive mechanism. The costs excluded would be those towards the bottom right of Figure 4.2, i.e. those costs that are inherently more difficult to forecast and that HAL has less control over. An example of this might be land acquisition costs. The purpose of utilising this variant would be to reduce the scope for windfall gains and losses, as well as to limit total risk exposure for HAL. Implementing this variant would require the CAA to conduct a detailed review of HAL's cost allocation between included and excluded cost categories.

6. STRAW MEN: GOVERNANCE OPTION

6.1. SUMMARY OF GOVERNANCE OPTION

The governance option recognises both inherent and timing uncertainty in cost estimates. It mirrors aspects of the current capex governance process at Heathrow. Inherently uncertain categories of cost would be excluded from the incentive. An initial baseline would be set on costs more suited to ex-ante incentives and becomes firm only once those costs reach a certain level of maturity.

In summary this option works as follows:

- **An initial baseline would be set at the regulatory determination for delivery of obligations within included cost categories over H7.**
  - **HAL would provide a business plan or capacity enhancement plan equivalent to the CAA, setting out what it expects to deliver over the H7 price control and the costs associated with delivery of those outputs. This will be informed by effective engagement with the airlines.**
  - **The CAA, likely with external technical support, would review the business plan and set an initial regulatory baseline for the capex to be delivered over H7. This is for both expansion and business as usual capex (given that expansion capex touches all parts of the airport we consider that separation will be difficult).**
- **The baseline would be updated as projects mature in design/ detail to a sufficient level to allow HAL to procure a supplier. It is this evolving regulatory baseline (not the initial baseline) that is binding for the purposes of the incentive.**
- **For the purpose of comparing actual costs to the baseline, the baseline would be set in nominal terms and not uplifted for price inflation.**
- **The CAA would monitor progress at programme (groups of projects) level, with separate 'pots' of expenditure associated with each programme.**
- **Delivery obligations would be set at programme level to allow HAL flexibility to let the work evolve. We expect the CAA to use around 10-15 pots and associated obligations, based on an initial assessment (noting that information on which to base a judgement is limited).**
- **There would be a more substantial role for the Independent Funds Surveyor (IFS) or a technical adviser in this model as monitoring would be an ongoing process. This party would make recommendations to the CAA on how and when to update the regulatory baseline based on project-level costs. The CAA would not be bound to adopt these recommendations, but would take a proportionate approach; the CAA could step-in for a more detailed review where programme costs diverge materially from the initial view of efficient costs. The IFS/technical adviser could also highlight contentious cost items for detailed consideration by the CAA.**
- **Despite utilising programmes of projects and 'pots' of expenditure, a single incentive would apply to all included costs at overall baseline level. i.e. programmes would be aggregated and the cap and floor mechanism would work at this overall baseline level (as per the regulatory model).**
- **The incentive strength would be greater in this model than in the regulatory model. This reflects the greater level of confidence in the baseline.**
- **In this option ex-ante incentives would not apply to all cost categories. The costs included in the incentive are those which HAL has a reasonable degree of control over and are more predictable in nature. Our initial review finds that the ex-ante incentive would cover around 55% of capex over the H7 period. Costs not included would be subject to ex-post efficiency assessment, similar to the CAA's current approach.**

We also present a small number of variants to this core governance option. These include the use of market prices to update the baseline, different (earlier) timing for finalising the baseline, using a mechanism where the baseline covers the whole project and on the treatment of excluded costs.

In Figure 6.1 below, we present how the core governance model would work, based on the model at the time of the regulatory determination, and how this evolves over time.

Figure 6.1: Diagram summary of the core governance model

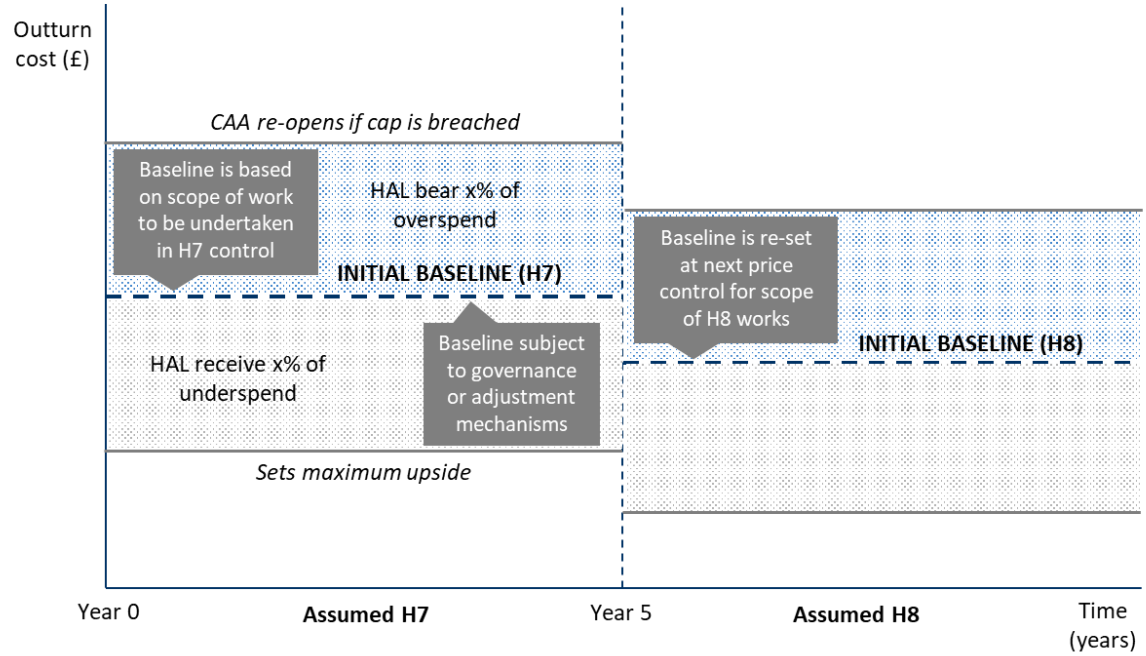
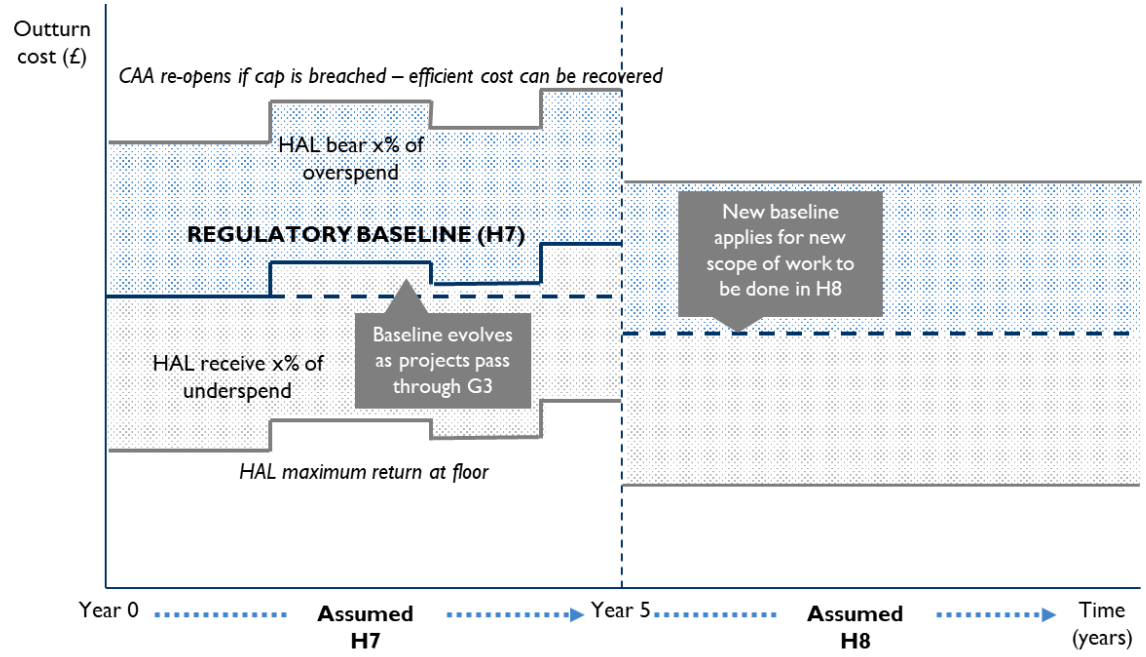


Figure 6.2: Illustration of how the core governance model might look as the price controls evolve



The application of the mechanism is relative to the regulatory baseline at the end of the period.

6.2. FURTHER DETAIL ON GOVERNANCE OPTION

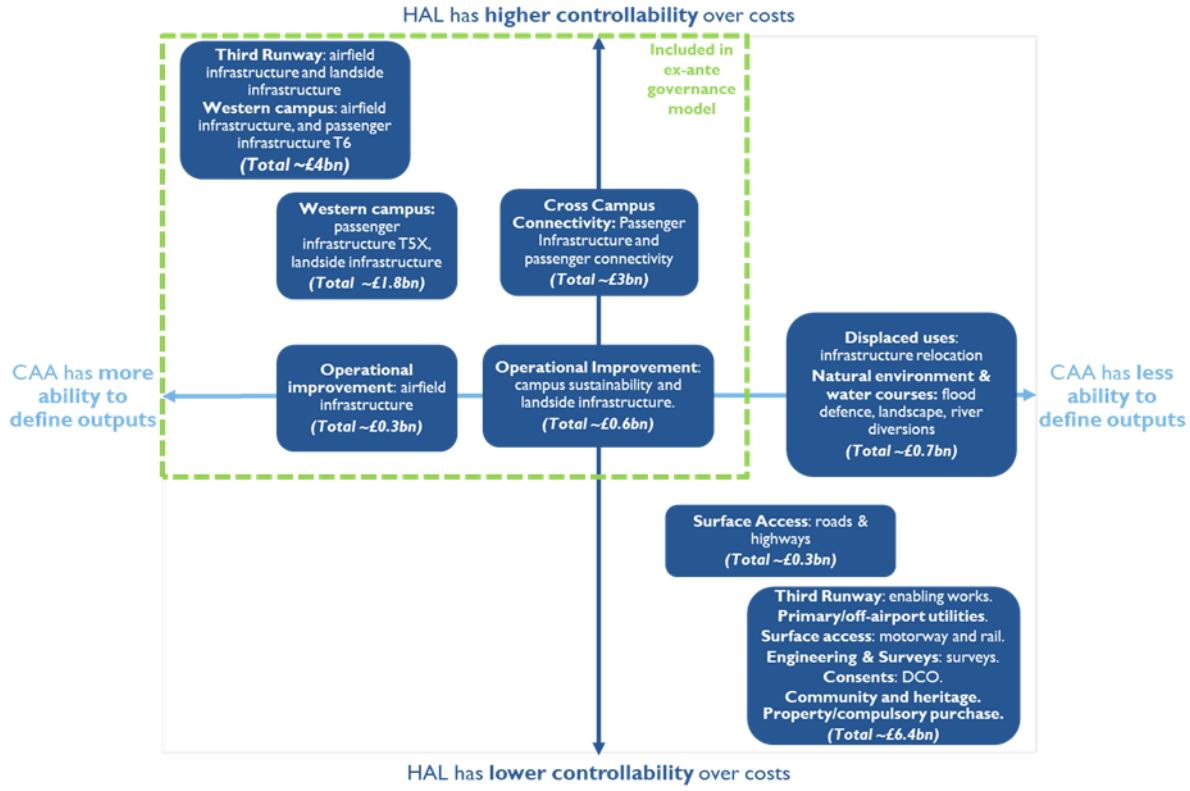
6.2.1. Setting, updating and monitoring the baseline

Costs subject to ex-ante incentives

When considering the costs subject to an incentive, we consider both the individual cost items and the overall implications of the costs subject to incentives and those treated in a different way e.g. scope for gaming through allocation. We discussed in Section 4.1.1 the suitability of costs for inclusion within a baseline for an ex-ante incentive. This includes characteristics of these cost categories, such as the degree of control and the ability of the CAA to set delivery obligations. The figure below shows which costs could be subject to ex-ante incentives under the governance option in H7. Additional detail on what is included in each of these categories is provided in Appendices C & D.

As with the regulatory option, we do not propose to delineate between BAU and expansion capex, given the integrated nature of the works and scope for gaming.

Figure 6.3: Costs included in the ex-ante incentive as part of the governance model



The costs in the green box would be subject to the incentive. They cover around £9bn of expenditure. The costs not subject to the incentive represent a large expected value of capex (£7.5bn), however we consider that these are less suitable for application of a higher-powered incentive. We consider that these cost items are separable (either physically or based on the timing of delivery) and can be made subject to ex-post review.

Figure 6.3 is intended to be illustrative. The exact cut-off between costs in or out of the incentive is a judgement call, with the CAA able to refine which costs are included when more detail is available on the programme.

Level of granularity

There are multiple levels of granularity relevant to the operation of the governance option:

- **Total aggregated costs (portfolio)**:
    - The baseline against which outturn costs is assessed is based on all aggregated costs included within the incentive.
    - All costs under the ex-ante incentive mechanism would face the same treatment.
    - The cap and floor mechanism would be set and assessed relative to total costs within the incentive.
- **Programme level costs:**
    - The CAA would make an assessment of efficient costs for the purpose of developing an initial baseline for H7. This would be based on information provided by HAL, including the outcome of engagement with airlines and with a supporting review from technical advisers.
    - The CAA would monitor costs at programme level (illustrative programmes of costs are shown below). Monitoring at this level provides greater insight and reduces the asymmetry of information that is present in the arrangements.
    - Delivery obligations would be set at the programme level to provide HAL with some flexibility to change the projects that are included within an overarching programme.
    - Cost within each programme would be updated (by the CAA) as individual projects reach a certain point in the project development cycle. For the core model we assume that this point is reached when HAL has a project developed and costed in sufficient detail for it to be priced externally (the equivalent of G3 in the current capex governance process).
    - The CAA would monitor projects within a programme and identify issues at this level. There would be no mechanistic trigger for identifying issues in terms of changes in the expected programme level costs; it would be up to the CAA to take a proportionate and targeted approach. The decision on where costs have differed to those expected will be informed by the initial baseline.
    - Costs would be updated as part of an annual update process, whereby the changes within the year are consolidated. This would prevent constant changes to the baseline and be useful for ongoing monitoring against the baseline and cap or floor levels.
- **Project level costs:**
    - While the CAA is focused on programme level costs, this model requires reference to project level costs. We consider this is possible because HAL's project management systems are capable of operating at this level, however the CAA's involvement at the project cost level would need to be more targeted to be practical.
    - Individual project cost estimates would be updated within the baseline as projects reach the required level of maturity. We anticipate that the IFS or technical adviser

would monitor progress at the project level and report to the CAA to inform their programme level monitoring.

- The IFS or technical adviser would indicate to the CAA on an exceptional basis whether individual project cost estimates are considered not to be robust, and where significant divergence from the initial baseline occurs the adviser will notify the CAA that the programme may need to be made subject to more rigorous review.

The process will be crucial to the success of this model and further work will be required to finalise these arrangements.

Based on analysis undertaken by Arcadis, we provide further detail below on what the pots of programme level costs monitored by the CAA might be. These are intended to be illustrative and further work would be required prior to implementation, however this gives some insight into how the model might look in practice. There are ten programmes shown below and linked to Figure 6.3.

Figure 6.4: Description of programme-level activities[33]

Third runway – airfield infra (£1.9bn)	Third runway – landside infra (£0.5bn)	Western Campus– passenger infra (£0.5bn)	Western Campus– passenger infra T6 (£0.5bn)	Western Campus– passenger infra T5X (£0.9bn)
Noise insulation (£0.8bn)	Cross campus connectivity (£2.3bn)	Cross campus passenger infra (£0.7bn)	Operational improvements (£1.0bn)	Western Campus– landside infra (£0.9bn)

The pots together would form the overall baseline in this model. Further information on these costs are available in Appendices C & D.[34]

Given the stage of the programme, we do not have a clear picture on the number of projects. To illustrate the scale that could be involved, if an average sized project was £60m, there would be 150 projects in total across these included costs.

Focus of the CAA

The CAA's involvement is intended to remain proportionate. Monitoring by the CAA would take place at the programme level. Where costs and scope are aligned with what was expected (by reference to the initial baseline) and the IFS/ technical adviser is satisfied that work is progressing as planned, the CAA could adopt a light-touch approach, whereby the cost estimates provided by HAL to update the baseline would be approved without the need for detailed scrutiny. This approach places a degree of weight on the initial baseline which we know is uncertain and it may create an incentive to keep costs at the baseline, rather than below it. One of the variant options considers an incentive/sharing mechanism around the initial baseline to address this issue.

[33] We have separated some cost categories noted in Figure 4.2 (e.g. cross-campus connectivity) and areas where we have consolidated multiple items into a single pot (e.g. operational improvement).

[34] Note that these appendices include all costs linked to the programme, not restricted to those in H7.

Where divergence from the initial baseline occurs, for example as a result of cost escalation or differences in scope, the CAA would increase its level of scrutiny. This would include analysing costs at a project level within the affected programme and the overall forecast cost at the aggregate level.

The CAA would have the ability to trigger an extraordinary review if costs were seen to be escalating to a level that could breach the cap or there was clear evidence that there was a lack of cost control.[35] If the cap were breached the extraordinary review would be used set a firm baseline for the remainder of the price control based on the judgements made as part of this review. This could involve revisiting risk share and incentive values.

Setting a baseline

The baseline would be set by the CAA for all costs included as part of the ex-ante incentive. We refer to two concepts in relation to the baseline for this model.

- **Initial baseline**
    - At the outset of the H7 price control period, the CAA will use an ex-ante estimate of efficient costs for the scope of work expected to be delivered during the H7 price control for those costs included in the mechanism. In this respect this model is not unlike the regulatory model.
    - However, this is the starting point for a baseline that recognises uncertainty and which will evolve over time, meaning the initial baseline is not the estimate of efficient costs that is used to calculate rewards or penalties under the incentive mechanism.
    - The initial baseline would be informed by the business plan submitted by HAL, informed by discussions with stakeholders and subject to review by the CAA and their technical advisers.
    - The initial baseline is used to set charges for the H7 period and for setting the initial level of the cap and floor. Charges may then need to be revised for the next control period to reflect movement in the baseline.[36]
- **Regulatory baseline**
    - The regulatory baseline refers to the baseline that evolves through the H7 price control. At the outset, the regulatory baseline is equivalent to the initial baseline.
    - The estimate of efficient costs will be updated as parts of the work programme move through the project development cycle, the baseline is updated (unlike in the regulatory model).

[35] This would represent a severe case in line with the principle of an extraordinary review, especially given that the cap and floor mechanism exists. A benefit of an ex-ante incentive mechanism is the certainty it provides and clear rules are needed such that this certainty remains. The CAA has ability to step in at a more granular level in updating the regulatory baseline, so there is existing control.

[36] As the baseline is evolving, we do not propose that charges are changed within period, however this is possible, in a similar way to the development capex adjustment in Q6.

- The baseline is updated based on CAA determined cost estimates established on advice from the IFS or technical adviser, this is intended to maintain discipline on the baseline and restrict the ability of the baseline to increase.[37] It means that any increase up to the point in costs is scrutinised and is not simply a pass-through of costs.
- The regulatory baseline at the end of the H7 price control will be the figure used for calculating rewards and penalties under the ex-ante capex incentive.
- As the regulatory baseline evolves, the timing of finalising cost allowances occurs after and not during the H7 price control process.

We consider that the regulatory baseline should be updated based on projects reaching a certain point of development. This fits with the processes used as part of HAL's existing capex governance process and we consider that this approach is feasible given HAL's project management systems.

There is no further adjustment to the baseline once projects have reached this stage i.e. they are not updated when suppliers price them contractually (although we present a variant that uses supplier prices as the basis for updating the regulatory baseline) or for any change in outturn cost.

Timing for updating

The point of development that we consider is most appropriate to use as a benchmark for maturity is Gateway 3 (G3) in HAL's current capex governance system. The scope and broad design are finalised at this point such that HAL is able to start procurement. By having greater availability of information and setting the baseline at this point, costs can be estimated with more confidence and HAL could be made subject to a more powerful ex-ante incentive. Setting the baseline later, reduces the scope for windfall gains and losses owing to forecasting errors.

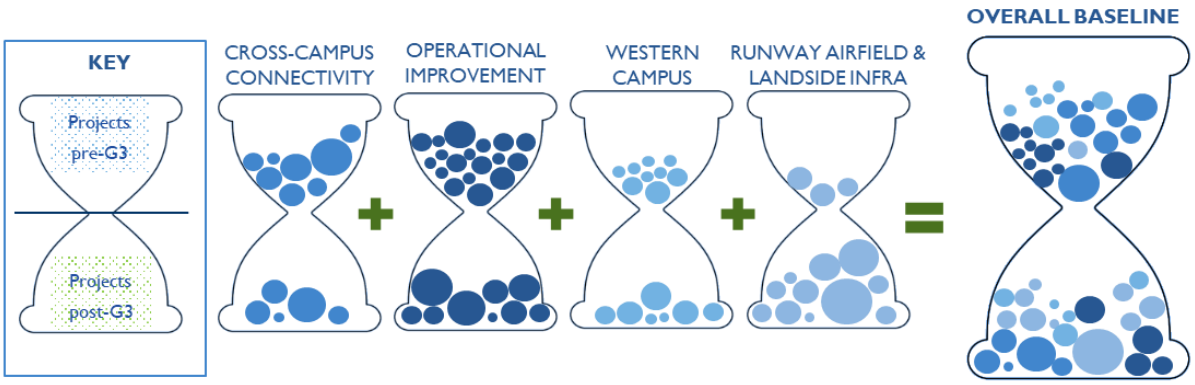
The incentive applying at this point of the project development cycle is appropriate because:

- Design can still evolve within bounds as suppliers look to refine this with HAL during the procurement process.
- It creates an incentive for HAL to enter into cost efficient agreements with suppliers.
- There is an incentive for HAL to deliver the outputs for an efficient level of cost.

A visual representation of programmes being revised based on updated project costs is shown below. As projects (represented by individual circles) reach a certain point, their cost becomes firm (represented by the bottom half of the hourglass). The programmes denoted are illustrative.

[37] In practice, we would expect the determination of efficient cost to be more akin to approval of costs by the CAA, however where there are material increases in expected cost, the CAA would scrutinise costs in more detail.

Figure 6.5: Demonstration of how pots would work, with each hourglass representing a single pot that feeds into the overall baseline, and each circle within each hourglass representing a project.



Price inflation adjustment mechanisms

In this model, with the baseline being updated as projects move through the development cycle, we do not see the need for any bespoke adjustment mechanism (although this is possible without fundamentally changing this option – see discussion of this in the regulatory model).

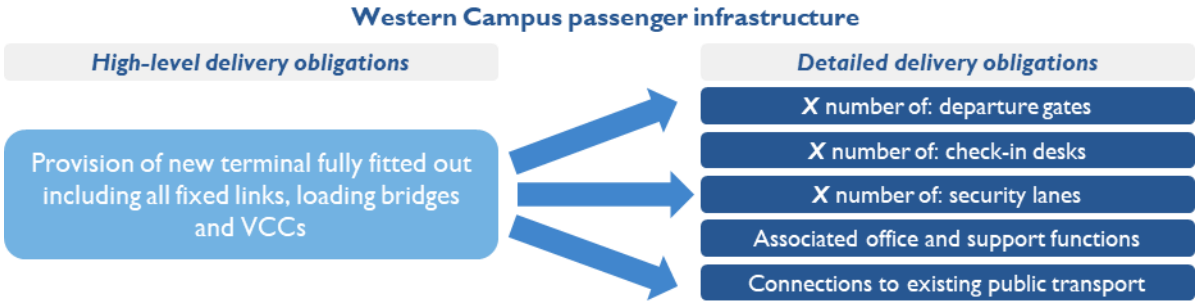
For the purposes of comparing actual costs to the baseline, we propose that the baseline would be in nominal terms. However, following the application the incentive, costs would be added to HAL's RAB in accordance with the CAA's current approach.

Delivery obligations

Delivery obligations would be set for each pot of cost and are likely to be more detailed (i.e. disaggregated) than is the case for the regulatory model, given the stronger financial incentive relative to the regulatory model and with incentives only being applied to certain cost categories.

At this stage delivery obligations can only be illustrative, but these would be set a programme (rather than project) level. Figure 6.6 demonstrates a high-level and detailed delivery obligations for the Western Campus passenger infrastructure 'pot' (£0.5bn).

Figure 6.6: Indicative high-level delivery obligation for the Western Campus passenger infrastructure 'pot'



Our proposed delivery obligations are linked to outputs rather than inputs. We propose that the delivery obligations are set at a level that is closer to the high-level delivery obligation above rather than the detailed delivery obligations shown. This provides more flexibility for HAL than using detailed delivery obligations and places fewer constraints on how an output is achieved,[38] however it

[38] In developing estimates of efficient cost, we would expect that assumptions on the detailed delivery obligations would be required.

does make the reconciliation process (i.e. reviewing whether HAL has delivered what was agreed) more challenging.

Delivery obligations such as this would need to be established for all programme level pots of cost subject to the incentive so that they form a high-level scope of work against which cost can be monitored. Although more granular that the regulatory model, delivery obligations in this model are intended to cover a quantum of cost that is sufficiently large to allow individual projects to substantially evolve over time.

The CAA would need to consider the most suitable form of delivery obligation once further information is available on the expansion programme. A potential addition to the indicative delivery obligations presented above would be capacity-based metrics e.g. a new terminal that has the ability to deal with a set number of peak hour passengers. Further information on delivery obligations is provided in Appendix D.

Role of Airlines and the IFS/ technical adviser

Airlines would maintain a role similar to their current oversight involvement in the asset management programme at Heathrow, i.e. considering aggregated programme level activities rather than individual projects and advised by the IFS. They would be expected to raise any concerns at programme level only with the IFS and CAA.

In general, we expect airlines to play an important role in determining scope/ outputs, however we do not anticipate airlines having routine involvement at the project level. This is to allow airlines to challenge HAL on delivery, while at the same time emphasising the need for HAL to deliver in a timely manner. The model should not preclude wider airline involvement outside of the incentive mechanism e.g. in the design of large and more critical projects.

The role of the IFS/ technical adviser is discussed in detail above.

6.2.2. Operation of the incentive

Incentive strength

Our starting assumption is that the sharing mechanism under this option could involve a moderate strength incentive, e.g. 20-30%, as per one of the options examined by the CAA (subject to testing). This would be possible because the CAA will possess more (and more accurate) information than under the regulatory model to set an accurate baseline. However, this requires further consideration in particular with respect to the exposure it would place on HAL and how this compares to other regulatory regimes. Such considerations are outside the scope of this report

Cap and floor

The principles of the cap and floor mechanism for the governance model are consistent with the regulatory model, both in terms of the rationale for its application and that they can trigger an extraordinary review.[39]

[39] As part of any such extraordinary review, the CAA may also need to consider the implications of significant deviations from the original capex programme for the assessment of efficient opex and of financeability that it conducted for H7.

In the regulatory model, the baseline is firm for the entire price control, however in the governance model the baseline evolves over time. The relevant question is then what happens to the cap and the floor when the baseline moves. We consider that as the baseline is revised by the CAA, it is appropriate that the cap and floor move together in proportionate terms with the baseline, such that the bands between i) floor and baseline, and ii) baseline and cap, remain fixed in % terms.

This means that the risk exposure within these bounds remains fixed in % terms throughout the price control. The alternative approach is to fix this in absolute terms e.g. to increase the cap to always be £ higher than the regulatory baseline (and the floor to be £ lower than the regulatory baseline).

Using relative changes to the cap and floor levels has the benefit of being compatible with any changes to the regulatory baseline and ensuring that risk for each £ of capex remains the same.[40]

Monitoring and review process

Within the regulatory model, we discussed monthly and annual monitoring alongside an end of price control reconciliation. For the governance model, the end of period reconciliation remains an important feature and operates in broadly the same way as in the regulatory model.

However, the governance model involves a different approach to within period monitoring. Within the regulatory model, time-based monitoring is used (monthly, annual reviews, etc.), whereas given the role of the project development cycle in the governance model, we anticipate two different types of monitoring and review:

- Monitoring of costs for projects less developed than G3 – the efficient project costs are considered at G3. It is important that costs are monitored prior to the baseline becoming firm and the incentive applying; this is to ensure that there is no unnecessary cost escalation before the incentive is put in place. These costs are monitored on an ongoing basis.
- Monitoring of costs for projects beyond G3 – these costs are subject to the operation of the cap and floor, and the IFS or technical adviser will continue to monitor portfolio and programme costs. In addition, an annual review process would be used to consolidate a view of progress and performance.

As noted above however, it may be useful to consolidate changes to the baseline annually.

End of period reconciliation process

There would a reconciliation process to update the baseline to reflect outputs delivered (or progress towards delivering outputs) to facilitate calculation of the correct baseline value to which the incentive should be applied.

We would expect this to be slightly less onerous, based on the information available,[41] than the regulatory model for three reasons:

[40] If the baseline falls by more than the original level of the floor, the floor would be negative using an absolute adjustment. This would not be appropriate, although this outcome would be very unlikely to occur.

[41] This includes the current expectation for activities to be completed within the H7 price control.

(1) there is a clearer initial scope of work set, given the inclusion of costs only when the design has been finalised, which is more comparable to outturn scope that has been delivered;
(2) greater monitoring has taken place over the price control, with projects being approved as appropriate rather than set at the H7 determination; and
(3) the time period between the inclusion of some projects within the firm baseline will be less than the regulatory model, which might lead to a closer link between expected and outturn scope.

The higher number of delivery obligations in the governance model (than the regulatory model) does not fundamentally change the requirements for this review. Each delivery obligation needs to be reviewed for progress/completion as in the regulatory model. It also does not substantially increase the level of work required by the CAA, since the higher number of delivery obligations is offset against the reduction in effort required by the clearer scope and closer ongoing monitoring.[42]

A variant option we discuss below involves cost allowances being set for the life of a programme or project, not tied to partial completion within a price control. This would reduce the administrative burden for setting the baseline relative to the core model, but may result in multiple reconciliations at the end of each programme or project.

Incentive application timing

The revenue adjustment process for the governance model works in the same way as the regulatory model, namely that the outturn costs are compared to the final reconciled baseline and the share of the over- or under-spend is adjusted for future revenues.

Appeals mechanism

There will need to be an agile mechanism in place to deal with challenges to additions to the regulatory baseline (both on scope and cost). A starting point could be the mechanism in place under Ofgem's Strategic Wider Works (SWW) model: where a project is approved through the governance process, this represents a change in output to be delivered under the licence, so the regulated company can lodge an appeal with the CMA.

As we do not expect delivery obligations to be part of the licence for HAL, the CAA would need to adapt the process. This raises the risk of programme delay (especially where a project lies on the critical path) so timelines for any dispute resolution process would important. This would need to be considered further and subject to legal input, both of which are beyond the scope of this report.

6.3. VARIANTS TO THE CORE GOVERNANCE OPTION

We set out below variants to the core governance model, which may be used to improve upon the core governance model. Each of the variants are generally independent of one another, although we consider that Variant 1 would also benefit from adopting Variant 3.

[42] The higher incentive strength in the governance model relative to the regulatory model increases the money at stake as part of the reconciliation process and may make the process more contentious and time consuming.

6.3.1. Variant 1 – Use of market prices

Core model: CAA set the baseline based on cost assessment

Rationale for variant: Baseline setting will limit windfall gains and losses and involve a reduced administrative burden for the CAA

The CAA could choose to use market-tested supplier costs obtained by HAL through a competitive process to set a regulatory baseline, rather than undertaking its own assessment of efficient costs after design is complete.[43] In this variant option the baseline would be update at G4 rather than G3. This could be valuable where the CAA is unable to accurately develop/critique baseline costs proposed by HAL. Supplier prices potentially provide an independent view of cost that is moderated by competition for the work (assuming that a market exists or is created). This option is consistent the examples of infrastructure projects discussed earlier in this report.

A key issue with adopting this approach is that it does not incentivise HAL to propose the lowest costs possible until the contracts have been tendered. At that point, it will also be challenging for the CAA to disallow costs. Ensuring that the process leads to the most efficient cost would require the CAA to take a greater interest in procurement processes.

Additional protections could be applied, for example:

- Use of an additional incentive relative the baseline set at the start of H7 (e.g. HAL bears 5% of any over-/under-spend until the baseline is set)[44];
- use of a dead band around the baseline – there is no incentive applied in a narrow band around the initial baseline estimate; and
- requiring HAL to work within a fixed budget envelope (as in the current framework and governance process).

We note that the first of these additional protections could be applied within the core model, using a CAA estimate of efficient costs. This would look to add protection around cost escalation, however as we envisage the CAA setting the estimate of efficient cost, the regulator maintains control around what level of cost escalation is permitted.

6.3.2. Variant 2 – Timing for updating the baseline

Core model: Baseline is updated with project updates

Rationale for variant: An earlier setting of the baseline increases the incentive on design efficiencies and delivers earlier certainty over cost and risk than is the case in the core model

The core governance model involves project reaching a certain stage of maturity - stage G3 acts as the milestone for costs transitioning from provisional to firm at the project level. This approach means that the baseline will only become firm over time. An alternative, which would allow earlier setting of a fixed baseline, could be to apply a proportional approach at the programme level. In this variant the programme level baseline would be firmly fixed when x% of projects within that

[43] The successful bid from a competitive tender process would act as the basis for setting the baseline.

[44] There is an ex-ante incentive applied to the initial baseline value to protect from movements in the regulatory baseline over time. The main incentive would apply relative to this regulatory baseline.

programme have reached an appropriate point, e.g. the baseline is fixed once [50]% of costs have progressed through G3.

6.3.3. Variant 3 – 'Rolling' mechanism[45]

Core model: Price control duration is used for assessment and reconciliation (in a limited way), with scope and costs set for the expected proportion in H7

Rationale for variant: Avoids the need for detailed assessment as part of end-period reconciliation for partial completion of delivery obligations linked to the duration of the price control[46]

This variant proposes that the incentive is not bound by the price control cycle and that costs are assessed over the project life cycle. This would require an initial baseline as in the core governance option, but with that baseline being established for the entire programme of work rather than the portion expected to be delivered within the five year price control period. This baseline would then evolve as costs become more certain (as more projects have their design finalised). Under this option the incentive mechanism would be independent of the price control length – although passenger charges might be updated each five years.

This variant option would involve setting delivery obligation that would indicate completion of a project or programme, such that reconciliation happens on a timely basis. We would expect that these arrangements would mirror the approach used by the CAA as part of capex triggers.

This mechanism aims to address the fact that the project extends beyond a single price control and this raises the risk of work in one control being delayed to the next and remunerated twice.

This variant option becomes more advantageous where project timelines do not align with the price control timelines. For example, if the timescales for expected project delivery discussed in this paper were to slip or extend beyond H7, the relative benefit of this variant increases.

6.3.4. Variant 4 – Treatment of excluded costs ('hybrid option')

Core model: Excluded costs are subject to ex-post review

Rationale: Provides greater certainty around costs not included within the main incentive and an explicit financial incentive over these costs

As note earlier, on current estimates over £7.5bn of capex projects in H7 would be excluded from this incentive. While we consider these costs less suitable to this mechanism, an ex-post efficiency review does not provide certainty and it may be difficult for the CAA to distinguish between efficiency and inefficiency.

As such, in this variant, the majority of these excluded costs would be made subject to the regulatory model (a sub-set of the costs least applicable to ex-ante incentives might still be subject to ex-post incentives). The incentive on these costs would operate as per the description of the regulatory model, with a cost allocation review incorporated within ongoing monitoring to ensure gaming does not take place.

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[45] We note that the term 'rolling mechanism' is used in other regulatory contexts to refer to efficiency mechanisms that have a moving start and end date, for example to equalise incentive strength over time. This is different to the term in this context.

[46] This reduces the need to assess whether progress on unfinished projects is faster or slower than originally expected.

An important consideration around feasibility of this option is the ability to clearly delineate costs between one model and the other. Not doing so would provide an opportunity for HAL to argue that the majority of any overspend falls under the lower powered regulatory model.

7. MODEL SUMMARY

In this section we provide a summary of the two main models presented in the report, highlighting how the models differ.

We discuss the regulatory and governance models in relative terms to understand how the models fundamentally differ. This is assessed at a conceptual level, with a summary of the mechanics following thereafter.

7.1. CHARACTERISTICS OF OUR TWO OPTIONS

Relative to the governance model, the regulatory model:

- **Relies upon less information through the price control:** The governance model utilises more information developed through the governance process and relies more on involvement of the IFS/ technical adviser e.g. to advise the CAA on changes to the initial baseline. This means that the CAA role in the regulatory model is more 'hands off' than in the governance model although ongoing monitoring is required to facilitate the end of period reconciliation process.
- **Includes all costs, including some which are less suitable for ex-ante incentives**: There is greater coverage of costs subject to ex-ante incentives in this option, even where some cost items are less well suited to ex-ante incentives. The assumption is that inherent uncertainty can be managed through the flexibility provided by a high-level delivery obligation and large cost allowance.
- **Utilises a lower powered incentive**: This is because there is likely to be less confidence in the baseline and with greater cost coverage, the financeability implications are greater for a given incentive strength.
- **Relies on a single delivery obligation that focuses on key deliverables in a control period**: There is an overarching obligation in this model, while in the governance model, the delivery obligations are set at a more granular level of detail (assisted by greater certainty being available on the approach HAL will take).
- **Carries risk of windfalls gains or losses for HAL**: The regulatory model will involve the potential for greater windfall gains and losses, as the baseline is based on an ex-ante estimate at a time when high-quality information is not available for all costs.
- **Differs with respect to flexibility and certainty for HAL and for users**: The existence of a single delivery obligation and setting cost and outputs at the regulatory determination will naturally give HAL flexibility in what it does, however the end of period reconciliation of scope and cost provides less certainty around how changes will be viewed. This is mitigated to some degree by annual reviews.

7.2. DETAILED COMPARISON

Table 7.1 provides a high-level summary of the key features of each of our models and how they differ to one another. In this table we compare fundamental characteristics of each model. Note: We focus on our core options in the table.

Table 7.1: Fundamental characteristics of our models

Parameter	Regulatory	Governance
When cost allowances are set	Cost allowances are set at the regulatory determination. These are firm during the price control.	An initial baseline is set at the regulatory determination; however, this evolves over time. The baseline is updated as work packages progress to a certain point in the project development cycle (namely G3).
Level of granularity	Focuses on aggregate cost.	Focuses on somewhat granular cost categories. Greater administrative burden in return for greater transparency and understanding of cost evolution.
Delivery obligation detail	There is a single high-level delivery obligation.	Delivery obligations would be more detailed in this model with better quality information available and projects more advanced.
Costs included	All (or the majority of) costs.	Focuses on a smaller sub-set of more predictable and/ or more controllable costs.
Incentive strength	Low-to-moderate incentive strength.[47]	Moderate incentive strength.

7.3. REFERENCE TO LESSONS LEARNED FROM OTHER INFRASTRUCTURE PROJECTS

At this stage we have not completed an evaluation of the models and or variant options predominantly because the available project information is insufficient to permit this.

In Section 3, however, we identified six lessons from our review of other infrastructure projects. These lessons have informed the development of our two straw men options. We provide below initial thoughts the consistency of our approach with learning from other projects.

- **Cost allowances and outputs should be flexible for as long as possible**: In our regulatory model, we set a single delivery obligation to provide HAL with flexibility, while in the governance model we wait until design has been finalised at project level before setting a firm allowance.
- **Re-openers and adjustment mechanisms should be considered**: Our governance model allows the estimate of efficient cost to evolve over time. In both models we have a detailed monitoring and reconciliation process to ensure that the estimate of efficient costs and scope remains appropriate. The extraordinary review acts as a safety net for all parties if change exceeds the level envisaged when the cap and floor are set.
- **Programme level contingency**: In each of our models, the baseline applies across all costs included as part of the incentive, meaning that risk and contingency on an overall basis is ultimately what matters. This provides flexibility for HAL across programmes and projects.
- **Different approaches exist for managing risk and uncertainty**: We have sought to design the models such that they do not preclude approaches to procurement, especially those which form the basis for how HAL might procure for the expansion programme, e.g.

[47] As per our earlier descriptions, a low incentive strength is around 10%, while a moderate incentive strength is around 25%. These figures are illustrative and subject to calibration where used.

Project 13. However, HAL's approach to project 13 and its implication for ex-ante incentives should be considered further as more information becomes available.

- **Annual targets are not useful for projects of this scale**: Our incentive mechanism is not set on an annual basis, with the incentive payment related to the efficient cost for the length of the price control in the regulatory model. In the governance model, where a cost is set, this applies to the remainder of the price control and acts as the starting point for the following price control.
- **Investors seek downside protection**: We have taken into account the risk to investors based on the costs provided, confidence in setting a baseline and the incentive strength to be applied. The presence of the cap should provide more confidence to investors that there will be protection from downside risk.

7.4. Next Steps

Although we have sought to consider and address a range of practical issues that could affect the operation of the models, they have not been formally evaluated and we, therefore, make no recommendations as to the choice of model or option within it.

An assessment of the options against the counterfactual, ex-post incentives has also not been undertaken at this stage. Further development of the project approach, design and cost is, in our view, important to being able to discriminate between models and to conclude on the appropriateness of ex-ante incentives for this project. As more information becomes available, it will also be possible to calibrate models in particular to consider the appropriate level of risk exposure that HAL would bear and the upside that it could obtain through efficient management of the project.

Appendix A CASE STUDIES

A.1. INTRODUCTION

In this annex, we consider regulatory and commercial case studies that are relevant for the design of incentives for Heathrow.

While it is unlikely that any previously-applied approach will be a perfect match for capacity expansion at Heathrow Airport, we can take important lessons from these examples and modify and merge different approaches to develop the most appropriate approach. We developed several case studies, in two categories: large-scale infrastructure development, and regulatory treatment of uncertain projects.

Large-scale infrastructure development

Large-scale infrastructure programmes, such as the Thames Tideway Tunnel (TTT) and Heathrow Terminal 5 (T5), in a range of sectors include incentives and uncertainty mechanisms that seek to manage or otherwise deal with uncertainty and the level of anticipated change. Change is inevitable in large-scale, long duration infrastructure projects. Although the early years of a programme of work may be developed in detail, later years may be less developed e.g. because work has not yet been procured, and because some elements of the programme are inherently uncertain. We have examined approaches taken in several large-scale infrastructure programmes, summarised in Figure A.1.

Regulatory treatment of uncertain projects

In addition to considering large-scale infrastructure programmes, we have also examined regulatory precedent. In particular, we have sought to understand how regulators have dealt with uncertainty with respect to capex being included in the regulatory determination for a given control period. Figure A.2 summarises the regulatory treatments that we focused on, which emphasise some of the lessons learned from the large-scale infrastructure projects and demonstrate the similarities of issues faced when dealing with multi-year infrastructure projects and regulatory periods.

Lessons learned from applied approaches to ex-ante incentives

From these case studies, we draw six key lessons:

1. Cost allowances and outputs should remain flexible for as long as is feasible.
2. Reopeners and adjustments to allowances can be useful tools.
3. Importance of a programme-level contingency.
4. There are various approaches to managing risk and uncertainty in contracts.
5. Annual targets are unlikely to be an effective incentive mechanism.
6. Investors seek downside protection.

These are discussed in Section A.2 following the case study summaries.

Figure A.1: Summary of key aspects of approaches to incentives and uncertainties in large-scale infrastructure projects

Thames Tideway Tunnel (TTT)

- A £4.2bn tunnel 25km long, with bidders given detailed plans and costs, less flexibility than in many other projects.
- The approach is a hybrid of regulation and project finance: Thames Water ran a competitive tender for BFO of the tunnel, and Ofwat developed a bespoke regulatory regime including a longer single regulatory period to cover construction.
- Asymmetric sharing mechanism, 30% on underspend and 40% on overspend, including annual symmetric 40% sharing mechanism with 'wash up' at the end.
- May apply for additional allowed costs if cost will exceed target by >30% - make losses on that 30%, but allowed additional spending and return on capital.
- Used various contract types, including standard "target cost with sharing mechanism", lump sums, pass-through + fee, and frameworks.

Heathrow Terminal 5 (T5)

- A new terminal and supporting infrastructure including a new ATC tower.
- Recognised that the design, risks, and costs may change as the project evolved, so BAA took on overall risk in their relationship with suppliers including BAA taking out insurance against risk rather than contractors.
- BAA set target costs but implemented an approach allowing the cost to remain flexible while supply and construction began.
- Used a "fixed profit lump sum" approach, and cost changes were treated depending on whether they were from changes in design or scope – while both types of cost increase would be reimbursable, the profit sum would be increased to take account of higher scope costs, maintaining the targeted profit margin, but not to take account of higher costs from design changes (thus lowering the profit margin). Maintaining the distinction between design and scope change was challenging and complicated.

Olympic Delivery Authority (ODA)

- The ODA was set up as a non-departmental public body responsible for construction and preparation of the building and infrastructure for London's hosting of the Olympic and Paralympic games in 2012.
- The ODA's budget increased from £3.6bn in 2004 to £5.2bn in 2007. By 2007, the ODA budget included a £0.5bn contingency, and there was an additional programme-wide contingency of £2.2bn.
- The original cost estimates included a contingency of 10-23.5% for each project, but the NAO criticised the original lack of a contingency for the overall programme. Contingencies are more important the more complex the programme is, and it should reflect a realistic assessment of the risks without being so high that it discourages efficiencies.

There were 120 contracts using a range of NEC3 contract types, including target cost, fixed price, and cost pass-through.

Figure A.2: Regulatory treatment of uncertain projects

Ofgem: Strategic Wider Works (SWW), electricity transmission

Allowances/costs are typically set ex-ante at the price control determination.

- In the RIIO-T1 price control, Ofgem split the network expansion capex for transmission companies into categories with different uncertainty mechanisms.
- The SWW outputs were determined as those outputs where it was less certain whether and when they would be required. These projects' allowances were determined by project-specific revenue adjustments – but some preparatory costs were included in the baseline, where appropriate.
- Some other types of transmission outputs had volume drivers, but this was not considered appropriate for SWW outputs which also have cost uncertainty.
- SWWs are high-value projects, but with different thresholds (£50m-£500m) depending on the size of the relevant regulated company.
- Ofgem undertakes two "needs case assessments" for each proposed SWW: an initial one to determine suitability for SWW, and a final one to make a final decision on the project and costs.

NIAUR RP5 investment funds, electricity transmission and distribution

Allowances/costs are typically set ex-ante at the price control determination.

- For the RP5 price review, NIAUR split the capex allowances into three separate funds with different risk-sharing based on the level of certainty about the outputs and costs. The most uncertain projects were allocated to Fund 3, and for these there was no capex included in the allowance set at the start of the price control, instead the regulator put in place processes to approve these projects later, if required.
- In NIAUR's determination, any Fund 3 capex would have been added to the RAB at the start of the next price control review. The regulated company (NIE) lodged an appeal with the CMA (at that time it was the CC), against aspects of NIAUR's determination. The CMA determined that any Fund 3 capex approved would be added to the RAB within-period instead of waiting until the next price control review.

Interim Determination of K (IDoK), water and sewerage

Allowances/costs are typically set ex-ante at the price control determination.

- To account for uncertainties in Ofwat's five-year control periods, companies or Ofwat may initiate an interim determination if costs or revenues deviate from estimates by 10% or more due to any of a pre-determined list of potential circumstances out of control of the regulated company. The K factor is an adjustment to the wholesale price limits (expressed as a percentage).
- The IDoK retains the incentives (set out in the price control) for companies to innovate and reduce costs, while providing some protection against uncertainties that are out of their control.
- The regulator can take reassurance that the regulated companies will not be able to make significant excessive gains due to changes that are not due to their efficiencies or management decisions.
- As price control determinations, these can be appealed to the CMA.

Ofgem: Real Price Effects (RPEs), electricity distribution

Allowances are typically indexed to an economy-wide inflation measure chosen at the price control determination.

- RPEs are adjustment mechanisms that are intended to account for the difference between economy-wide inflation (to which allowed revenues are often indexed) and the price inflation of the inputs to a company's activities. The adjustments can vary by company or region of the regulated network.
- For RIIO-1, Ofgem set RPEs ex-ante without adjustment during the price control, but for RIIO-2 plans to index the RPEs but with the possibility to set the RPEs to zero if it considers deviations from inflation to be immaterial.
- RPEs are commonly used by other regulators in the UK and elsewhere, but can be applied differently to suit the relevant industry/companies. ORR set Network Rail's input price inflation at 0% in the most recent price control.
- This demonstrates that detailed mechanisms, relying on detailed information regarding the projects, are possible and can represent a valuable addition.

NIAUR PC15 Change Control Protocol, water and sewerage

Costs are typically set ex-ante at the price control determination.

- To account for the uncertainty on the outputs that Northern Ireland Water needed to deliver, NIAUR introduced a Change Control Protocol to govern modifications to the output requirements (and corresponding allowed revenues) during the price review.
- The mechanism sets out pre-defined rules over how changes to outputs and associated cost allowances are updated within a price control period: involving preparation by whoever is proposing the change, followed by an initial assessment by NI Water before it is submitted to NIAUR for consideration and approval.
- This approach ensures that NI Water has the flexibility to change their plans if a solution is devised that better meets the needs of their customers.

ENA proposals for onshore electricity transmission

Typically, there would a point estimate price and the regulatory (or contracting authority) sets a sharing factor (if one is included).

- The Energy Networks Association (ENA), representing UK energy network companies, in 2017 published proposals for "competitively appointed transmission owners" (CATOs) to construct and operate the infrastructure.
- One option is for an "early tender" model, where the infrastructure provider is tendered prior to a project obtaining planning consents – alternatively they can be tendered once planning consents have been achieved.
- In the "early tender" model, ENA considered it inappropriate to require bidders to propose a point estimate for costs, instead setting out a process for bidders to propose a "cap and floor" for the cost.
- To ensure that bidders put forward cost estimates that are well-considered, and to "encourage bidders to reveal their true risk appetite", the ENA also suggested that bidders should propose a sharing factor to be applied to variations to costs within that range.

Ofgem: DPCR5 ex-ante mechanisms, electricity distribution

Costs are typically set ex-ante at the price control determination.

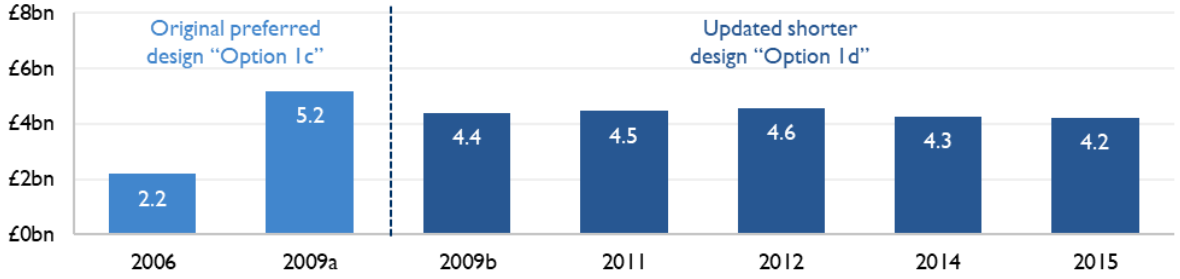
- There was significant uncertainty affecting the extent of network expansion that would be required (and the corresponding capex allowances required), which was addressed through two approaches.
- To address output uncertainty around the extent of expansion to the distribution network, Ofgem included an ex-ante volume driver, to relate allowed revenues to the volume of outputs in this area.
- To address cost uncertainty, there was also a 'reopener', implemented through a close-out at the end of the regulatory period. This allowed Ofgem discretion to recalculate allowed revenues for pre-specified categories of cost. This could be triggered by either Ofgem or the companies, if high-level capex categories (e.g. all network expansion capex) differed by 20% or more from the estimate.

A.2. LESSONS LEARNED FROM APPROACHES TO EX-ANTE INCENTIVES AND UNCERTAINTY

1. Cost allowances and outputs should remain flexible for as long as is feasible

Costs mature over time, and increases are likely in the earlier years of a programme when the design may need to change, and early works may highlight complexities that require design or cost changes. Therefore, setting a fixed price at the start of a long-term project, or multiple-year price control, is very difficult. Early cost increases are common, and one notable example is TTT, with the price changes shown in Figure A.1.

Figure A.1: Evolution of TTT estimated cost between 2006 and 2015, including a design change in 2009



Source: NAO (2017) "Review of the Thames Tideway Tunnel"

In developing T5, BAA was conscious of these issues with setting a fixed price too early, so they implemented an approvals process that would allow project development to progress while retaining flexibility over the price, as summarised in Figure A.2. This process allowed the project to progress while risks and uncertainties around the cost remained. In its report on T5 the NAO emphasised that this approach can be effective only if the client has "strong expert in-house capacity to act as an 'intelligent client'".[48]

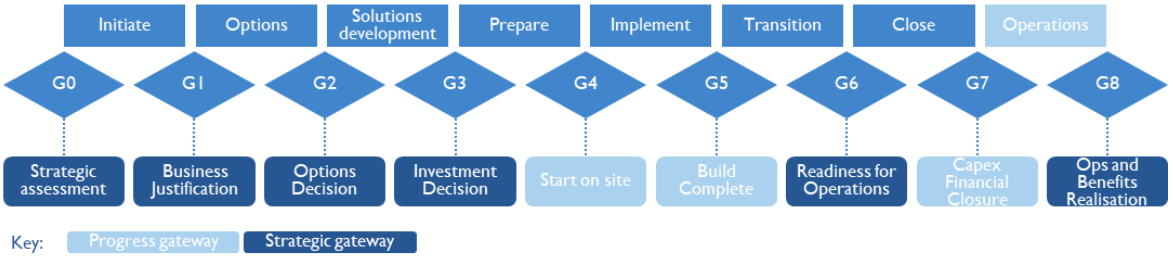
Figure A.2: Approach to retaining cost flexibility in Heathrow T5 throughout project development

Source: NAO (2005) "Improving public services through better construction: case studies"

In its current regulatory approach CAA also recognises that early costs for the capex programme are likely to change as the details/design of capex projects are developed. The existing Governance process was implemented to manage this uncertainty such that projects continue to develop until they reach Gateway 3 and are tendered at Gateway 4 – which are set out in Figure A.3.

[48] NAO (2005) "Improving public services through better construction: case studies" p.6

Figure A.3: The project gateway process



Source: Heathrow Capex Efficiency Handbook

Other regulators have also tried to retain flexibility where the output (rather than the cost of it) is less certain, for example volume drivers in Ofgem's DPCR5, a Change Control Protocol in NIAUR's PC15, and the possibility to approve revenues for certain projects (Strategic Wider Works, SWW) as required throughout the Ofgem RIIO-T1 price control.

Lesson 1: Cost allowances and outputs should remain flexible for as long as is feasible

The Heathrow North-West Runway is a large and complex programme of works, which is anticipated to span more than one control period (CAA control periods are typically five years). In this context, it would be unrealistic to expect that any party would be able to accurately estimate at the very beginning the required outputs, and corresponding inputs and costs, for the entire programme. The CAA should therefore ensure that its approach allows sufficient flexibility to set outputs as he programme develops. The challenge is to retain flexibility whilst maintaining control of overall project costs.

2. Reopeners and adjustments to allowances can be useful tools

Even when outputs and corresponding costs are established, it may be possible and sensible to allow some flexibility to take account of changes to design or costs that are out of the contractor or company's control. Price controls sometimes use reopeners for this purpose.

Cost adjustments have also been used in large infrastructure projects, without reducing the power of sharing mechanisms – e.g. on TTT additional costs can be requested if overall costs are expected to exceed the target by 30%, i.e. £500m at risk (on the £4.2bn).

Alternatively, indices can be used to attempt to track certain type of cost increase e.g. input price inflation. Although most regulatory determinations link allowed revenue to an economy-wide inflation measure, some regulators recognise that input prices may move differently and so include ex-ante adjustments for regional price effects (RPEs).

Lesson 2: Reopeners and adjustments to allowances can be useful tools

While we consider that it is appropriate to use ex-ante incentives for capacity expansion, we also recognise that some areas of the cost will be difficult to set in advance. Reopeners and adjustments which are focused on pre-determined terms (e.g. thresholds at which they are triggers, categories that are included, indices that will be used) can be useful tools for ensuring that allowances remain linked to input costs and required outputs without introducing uncertainty and risk there is a limit on the scale of use without them causing a detrimental impact on progress of the project.

3. Importance of a programme-level contingency

As highlighted by the Olympics Delivery Authority (ODA) case study,[49] HM Treasury recommends that programme budgets include a contingency from the outset, in part to account for "optimism bias" in major projects. This means that the programme manager of complex programmes should

[49] NAO (2008) "Preparations for the London 2012 Olympic and Paralympic Games: Progress Report"

not allocate all available funds to individual projects within the programme – even though those individual project budgets will include some risk allowances. In large, complex programmes, there is a realistic risk that large changes may arise in the earlier years when the design etc. are still being finalised. A contingency, or portfolio risk allowance, would ideally be held at a programme level so that it can be drawn upon for material change as and when required.

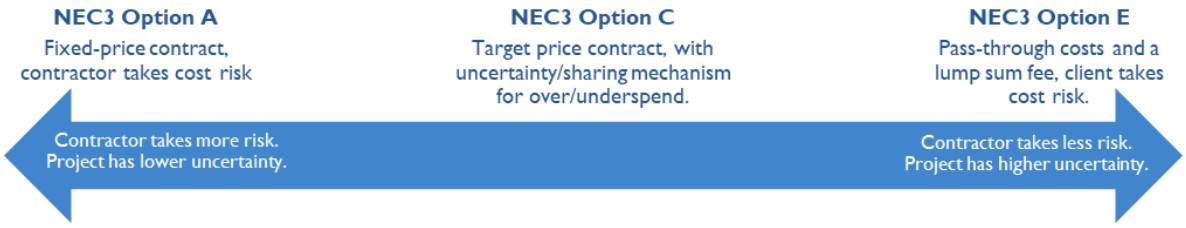
Lesson 3: Importance of a programme-level contingency

The Heathrow capacity expansion is a large and complex programme of works, bringing a high degree of uncertainty that makes it difficult to ascertain the most appropriate value of contingency fund to provide for each of the individual aspects. While some contingency can be allocated to more developed projects from the outset, we consider that it would be useful to have a contingency that is kept at the programme-level until it is clear where it is required – rather than allocating the entire programme budget to its projects. This is relevant when looking at the level of granularity and providing flexibility across projects within an overall portfolio.

4. There are various approaches to managing risk and uncertainty in contracts

The traditional approach is to use contracts to pass risk onto contractors, and to encourage underspend through contractual mechanisms e.g. the target cost approach to contracting that HAL currently employs for many of its capex projects. With a large and complex infrastructure programme the design – and the risks involved – evolve over time. A single programme can be expected to use a range of standard contract types[50] with varying degrees of risk sharing and scope for uncertainty to recognise different cost characteristics, as demonstrated in Figure A.4.

Figure A.4: Examples of types of NEC3 contracts and key features



NEC3 Option C is most often used to attempt to incentivise cost efficiency, while sharing in the risk around deviations from the target cost. All options transfer risk to the contractor, requiring that contractors take out insurance on their projects to protect against risks that might affect their costs and revenues. Variations to this can be used to suit the specific programme or project in question, such as the "cap and floor" proposed by ENA.

For Heathrow T5, BAA recognised the high likelihood of changes to the design and scope, and chose to take on all of the risk itself to allow a more flexible approach to managing its contractors – including making many of its contracts cost pass-through with a set profit lump sum (not margin).

Lesson 4: There are various approaches to managing risk and uncertainty in contracts

The CAA should consider whether an alternative approach to managing risk could be useful when setting the regulatory approach for the development of the Heathrow capacity expansion. The commercial procurement approach to be adopted by HAL is still uncertain. Until there is greater certainty the CAA is not in a position to decide whether the regulatory incentive mechanism adopted is consistent with the procurement approach chosen.

[50] NEC has been in use since 1993, with NEC3 widely used recently, being replaced with NEC4: NEC (Accessed December 2018) "NEC Dictionary"

5. Annual targets are unlikely to be an effective incentive mechanism

A notable aspect of the incentives on the TTT programme is that there are annual cost targets combined with the overall cost target.[51] Given the difficulties with determining the most efficient expenditure level, and when that should be incurred, flexibility around costs is important.

A regulator can consider costs over the timeframe it considers appropriate, meaning that only the total expenditure over a price control period (not the profile of that expenditure) matters. A regulator may wish to introduce monitoring, such that they have information on expenditure and performance against a regulatory baseline. Annual reporting at pre-agreed and appropriate level of detailed would inform the CAA's of which obligations have been delivered at what cost.

Lesson 5: Annual targets are unlikely to be an effective incentive mechanism

Although it may be useful from a planning perspective to set out the anticipated annual expenditure, it would be unsuitable for the Heathrow capacity expansion given its scale and uncertainties – as emphasised through the other lessons in this section, flexibility will be key. There could still be some benefit in tracking costs against programme annually, for ex-ante incentives to operate effectively.

6. Investors seek downside protection

A key principle with risk-sharing is to ensure that parties are allocated only those risks that they are able to manage or mitigate, to ensure that they create incentives rather than simply adding risk. It is important to also consider the ability of the bidders (or regulated companies) and their investors to absorb the losses that a risk-sharing approach makes possible. Taking this into account, and to ensure the financeability of these companies, regulators and tenderers have sought to limit the revenue at risk.

In many regulatory regimes and infrastructure contracts, there are risk-sharing arrangements that operate on uncertainty around the cost estimate. A common form is through sharing factors, whereby the company is exposed to a percentage of any over/under spend against a target. These are included in many of the case studies set out in Appendix A.

In some cases, there are mechanisms in place that deal with extreme circumstances or significant changes in cost beyond a pre-determined threshold. Such mechanisms typically do not allow the company to recover full overspends, e.g. if additional expenditure is allowed, the sharing mechanism on the original overspend still applies (such as in TTT).

Lesson 6: Investors seek downside protection

We have discussed various ways in which downside protection can be included to better appeal to investors' risk appetites. Given the scale of the Heathrow capacity expansion, the CAA should carefully consider the level of risk that if HAL is willing and able (from a financeability perspective) to take on. We consider that a cap and floor mechanism might provide investors with a useful downside protection against 'extreme circumstances' while also limiting the potential upside that makes the project attractive. Sharing mechanisms then provide an ongoing incentive within the cap and floor.

[51] Ofwat (2015) "Explanatory memorandum to the Project Licence issued to Bazalgette Tunnel Limited" A.3.5 and NAO (2017) "Review of the Thames Tideway Tunnel" 3.21

Appendix B KEY CHALLENGES IN DESIGN OF EFFICIENCY INCENTIVES

There are some challenges to overcome in designing a well-functioning efficiency incentive mechanism including:

- When to set the cost allowance and associated delivery obligation.
- Level of granularity for cost categories and delivery obligations.
- Level of detail for setting delivery obligations.
- What costs are included as part of the incentive.
- How to set the incentive strength.

We discuss these in turn below.

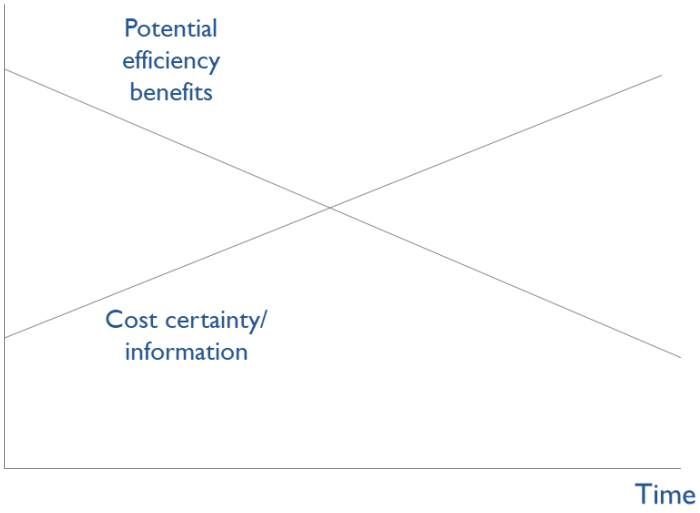
B.1. WHEN TO SET THE COST ALLOWANCE AND ASSOCIATED DELIVERY OBLIGATION

Issue

The CAA can have more confidence in setting an allowance and delivery obligation when they are in possession of more information. This typically happens as we move through the project development cycle e.g. there can be greater confidence in a cost estimate once the design has been finalised as opposed to a project where the design has not yet been finalised.

The potential efficiency benefits reduce as the project progresses through the development cycle e.g. more efficiency benefits are possible when you have multiple design options possible, relative to when the design is locked down.

Figure B.1: Trade-off on timing – stylised diagram



The slopes of both lines will vary with the type of work being completed e.g. repeatable, low-risk projects are likely to have flatter lines for efficiency benefits and for cost certainty. The different nature of work is particularly the case for Heathrow's expansion programme with the number and variety of projects. This scale also means collecting detailed information for each project will impose a significant resource burden on the CAA.

Implications

A 'late' model, that has more certainty associated with it, risks limiting the efficiency benefits that could be delivered by adopting an ex-ante efficiency incentive mechanism. However, while an 'early' model would potentially lead to lower overall costs, the level of uncertainty could be such that setting an incentive based on information at that time would lead to significant risks that HAL could have windfall gains or losses and, in turn, potentially face financeability issues.

It is not necessarily the case that the potential efficiency benefits in the early model to users are greater. There are two main reasons for this:

- the greater confidence in setting a baseline in the late model could lead to application of a higher efficiency incentive strength; this means users may benefit more from a modest saving with a high incentive strength, rather than a larger saving with a weaker incentive strength.
- limited confidence in setting a baseline in the early model could lead to cost estimates that build in headroom to accommodate risks that may eventuate in the early model (for example due to concerns around financeability) or due to a greater information asymmetry, and this could increase charges.

Certain projects may face significant uncertainty until late in the project development cycle and so the most beneficial timing for setting an allowance is not necessarily the same for all projects across an overall portfolio.

In addition, monitoring and information gathering is an important role for the regulator in order to be able to set robust regulatory baselines and to implement the incentive mechanism well.

A key question in our models is the timing of setting a baseline and associated delivery obligations. This is a fundamental difference between our two main straw men options.

B.2. LEVEL OF GRANULARITY FOR COST CATEGORIES AND DELIVERY OBLIGATIONS

Issue

It is possible to consider different levels of cost disaggregation and delivery obligations for developing an efficiency incentive. At one extreme, a single allowance could be set for a high-level delivery obligation e.g. 'complete the expansion programme to accommodate a set number of annual passenger movements.' At the other end of the spectrum, you could look at all individual tasks and set very detailed obligations on what is required, associated with a number of individual cost allowances.

The advantages of the aggregated approach are that the model is simple, it places a limited burden on the CAA (and other stakeholders) and the approach is based on an overarching output that gives HAL flexibility to change design to best meet the needs of users.

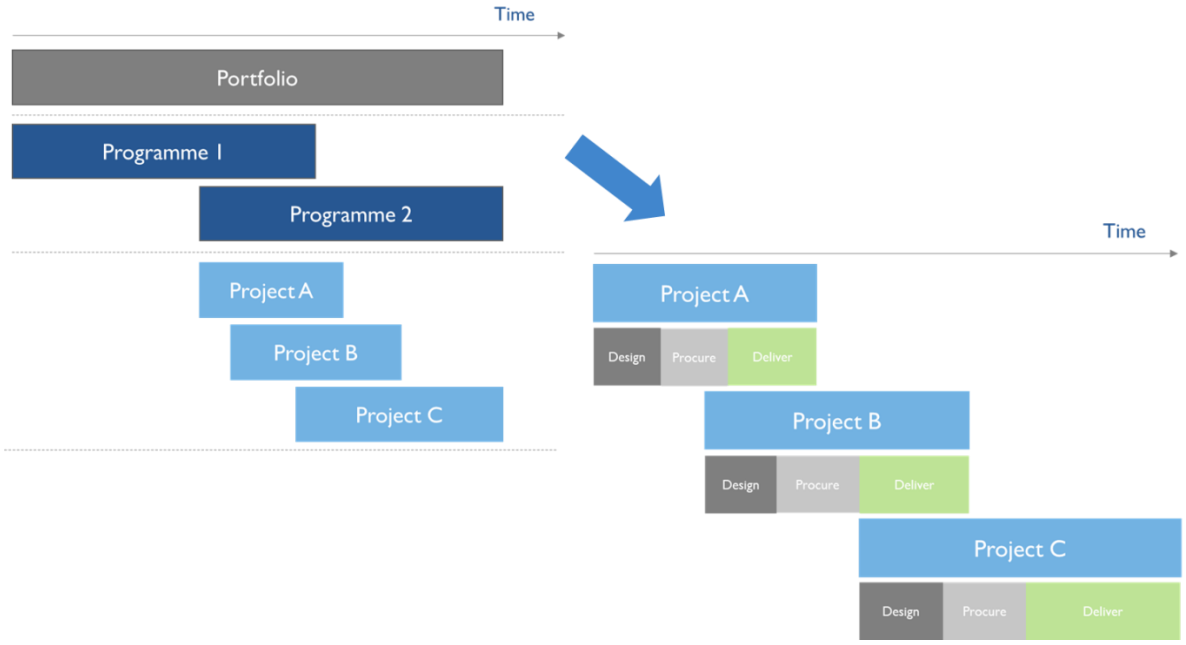
The disadvantages to this approach (if information is not available at a more disaggregated level) are that it has a higher scope for gaming with a lack of detail around delivery obligations, and there will be additional challenges around updating allowances/ the reconciliation process. It is also unlikely that you can set an accurate regulatory baseline without looking at a relatively granular level of costs.

If cost categories face the same treatment as part of the incentive, it is likely that these will be aggregated together to form a baseline for presentation purposes, although individual cost estimates may be relevant for reconciliation.

Implications

A particular challenge for the CAA is the scale of the programme and number of projects to assess for the CAA. The current capex governance model for Heathrow involves projects moving through gateways that align with the project development cycle e.g. once design is finished for a project. If this were to be used as the basis for updating cost allowances as greater information is possessed then it would place a significant burden on the CAA and stakeholders to update allowances.

Figure B.2: Understanding differences in project development cycle in the context of incentives



An alternative is to 'chunk' up projects and look at cost categories at a more aggregated level. This creates a greater challenge for updating allowances at a set point in the project development cycle as if you were to look at the programme level rather than the project level, the individual projects within that will be at different stages of development. The CAA would then need to consider what the threshold is for design being finalised when a programme is a collection of different projects e.g. when [x]% of projects have gone through Gateway 3.

B.3. LEVEL OF DETAIL FOR SETTING DELIVERY OBLIGATIONS

Issue

Detailed delivery obligations reduce the ability for the regulated entity to 'game' the incentive by earning rewards for capex efficiency that are due to reductions in scope (either in volume or in quality).

However, there are two main issues around setting detailed delivery obligations: i) the resource burden of developing these detailed delivery obligations, and ii) the risk that by setting detailed delivery obligations, the CAA is constraining the flexibility of HAL to deliver the outputs that are most valuable to users ('ossifying the design'). It is also important that the CAA can utilise these detailed delivery obligations for the reconciliation process.

Implications

The CAA must use sufficient detail to reduce the likelihood of gaming (and getting away with such gaming), whilst being conscious of the risks of being overly prescriptive.

This question interacts with the timing around when an incentive is set. In models where the allowance is set once the design phase is complete, there is less risk around setting more detailed delivery obligations with respect to ossifying design.

B.4. WHAT COSTS ARE INCLUDED AS PART OF THE INCENTIVE

Issue

A view must be taken on what costs are included in the incentive. This choice will be based on the cost characteristics, which could include how separable these are, the ability for the CAA to set delivery obligations or due to the degree of control HAL has over this cost item for example.

By including all costs, it removes the ability to game through cost allocation, incentives to reduce all costs are maximised and it does not create incentives to focus on one part of the programme at the expense of the other.

However, the downside is that including all costs can lead to more windfall gains and losses if costs are included that HAL cannot control or cannot be estimated accurately, it places more burden on the CAA to look at all cost items on an ex-ante basis and it can pose a greater financeability challenge if the range of outcomes are more uncertain. In addition, if the difficulty in setting the baseline leads to a weak incentive being used, benefits to users are not necessarily maximised.

Implications

The CAA needs to consider what costs are most suitable to be included within an incentive and potential efficiency benefits relative to the potential to impact on delivery of the expansion programme.

Not all costs need to be treated in the same way – as such, models can exist that apply different incentives to different cost categories (although the issues of allocation and prioritisation arise).

There are also other tools available to the CAA to address some of the above issues e.g. cost allocation reviews, varying incentive strength and financeability protections. These issues are all considered as part of our straw men option development.

B.5. HOW TO SET THE INCENTIVE STRENGTH

Issue

The strength of an incentive is clearly an important input in understanding the implications of adopting a particular incentive mechanism. However, the incentive strength is often an element that can be determined once the other features of an incentive scheme are known (both for the efficiency incentive itself and for the broader incentive package).

The key benefit of a more strongly powered incentive is that the regulated entity faces a larger share of any rewards or penalties, so the impact of the incentive on behaviour may be greater.

However, a higher sharing factor means that there is increased risk around the following topics:

- potential for greater windfall gains or losses, where cost movements are out of the control of HAL;
- increased incentive to pad cost estimates to game the incentive; and
- the impact of the incentive on financeability will necessarily be greater.

Implications

If the CAA has confidence in the setting of a baseline, has mechanisms in place to reduce the liking of padding of cost and does not increase financeability concerns by increasing the incentive strength, it can be more confident in setting a more powerful incentive strength.

The choices are the costs which will be subject to the incentive, the timing of setting the incentive and other features of an ex-ante incentive will need to be understood first before calibrating the incentive strength. This can be accompanied by financeability analysis and understanding the impact on investor returns from such a mechanism, as well as conducting further thinking on the full incentive package.

The exposure and likely outturn will impact on financing costs if this changes the risk profile, as well as impact on supplier relationships. We focus more on these spill-over issues further in the main report.

Calibrating a specific incentive strength is not in scope for this report, however we provide indicative sharing rates in our model given the interaction with other choices and based on the impact this would have.

Appendix C HEATHROW EXPANSION PROGRAMME WORK BREAKDOWN STRUCTURE

The information below has been provided to us by Arcadis, the CAA's technical advisers. This considers the illustrative work breakdown structure (WBS) with the high-level scope of work under each level of activity. This is based on HAL's Purple Book, version 0.63 (noting this is subject to change).

The information is provided to help readers understand the types of costs we are discussing in our description of delivery obligations and the costs faced under this incentive.

1	2	3	4	Scope
HEP Capex (HEP)				
	Airfield Expansion (EX)			
		Third Runway (R3)		
			Airfield Infrastructure (AI)	
				- Runway Code F compliant 3,500m long.
				- Engineered Material Arrestor System (EMAS) at either end of each runway.
				- Navigational equipment, weather instrumentation and approach lighting.
				- Redirection of the external aviation fuel pipeline and consolidated fuel facility.
				- Provision of noise/visual impact mitigation, consisting of landscaped bund/acoustic fencing.
				- Airside roads and associated tunnels.
				- Taxiway network.
				- Remote stands/apron at T6B.
				- Allowance for NATS fees associated with airspace changes.
				- Ancillary facilities: Fire station, snow base.
				- Serviced site to facilitate airside cargo development by a third party.
				- Two external control posts including 25 in-lanes of external security.
				- Restricted Zone (RZ) security fencing with vehicle protection to new perimeter.
				- Visual control tower.
				- De-icing pads and facility.
			Enabling (EN)	
				- Logistics centre, construction facilities and site security.
				- Demolition and site clearance, including hazardous materials decontamination.
				- Earthworks and site levelling.
	Campus Development (CD)			
		Cross Campus Connectivity (CC)		
			Passenger Infrastructure (PI)	
				- Baggage connectivity between new and existing terminals and associated facilities.
				- Ground handling offices (BA Facility replacement).

1	2	3	4	Scope
				- Provision of container handling systems and stillage.
			Passenger Connectivity (PC)	
				- APM - T2E Basement & Station Box (Safeguarded).
				- APM maintenance facilities and rolling stock.
				- APM station boxes, including fit out and VCC's.
				- Cut and cover tunnels including TTS line equipment and tunnel fit out.
				- Cut and cover tunnels between T2A and Satellite 2B, 2C, 2D, 2E and 5C.
		Operational Improvement (OI)		
			Airfield Infrastructure (AI)	
				- Reconfiguration of existing cargo facility, including new sheds, stands and external works.
				- Relocation and expansion of fuel storage and supply facilities.
				- Airfield noise, blast and visual impact mitigation including north-east landscaped bund.
				- Rapid Exit Taxiways (RET's) from Northern Runway to Taxiway Alpha.
			Campus Sustainability (CS)	
				- Works to improve the sustainability of the current airport campus.
			Landside Infrastructure (LI)	
				- Serviced site for hotel development by a third party.
				- New Hatton Cross Eastside concrete batching plant.
				- T4 southside lorry call forward parking.
				- Eastern Maintenance Base (EMB) ancillary facilities relocation.
				- Airport offices, support and logistics facilities (Hatton Cross and north-east corner)
				- Reconfiguration of T4 southside staff car parking to increase operational efficiency.
				- Provision of new car hire, taxi and staff coaching facilities.
		T2A & CTA & Associated Development (2A)		
			Passenger Infrastructure (PI)	
				- Expansion of baggage processing capability.
				- Fixed link stubs for stands 201 and 205 for future connection to T2A and 2nr Airbridges.
				- Information Communication Systems (ICS) to T2A
				- Operational Readiness and Training (ORAT).
				- T2A.
			Airfield Infrastructure (AI)	
				- Perimeter fencing and new external control posts.
				- Contact stands.
			Enabling (EN)	
				- Demolition of existing assets.
				- Utility upgrades.

1	2	3	4	Scope
				- Modifications to existing baggage connector.
				- Modifications to existing Pier 6 connector.
				- T1 apron reconfiguration.
				- Additional Pier 4a VCCs, nodes and airbridges, including gate room modifications.
			Landside Infrastructure (LI)	
				- Extension of Eastern Campus Energy Centre to facilitate the construction of T2C.
				- Upgrade and replace existing utility distribution networks.
				- Reconfiguration of CTA road network and safeguarding for southern road tunnel.
				- Utility and road reconfiguration to allow third party hotel development.
				- Relocation of existing and provision of new CTA bus station to facilitate T2 expansion.
				- Provision of a link to HEX from the reprovided bus station.
				- Reconfiguration and extension of T2 MSCP.
		T2C & Associated Development (2C)		
			Passenger Infrastructure (PI)	
				- T2C.
			Airfield Infrastructure (AI)	
				- Construction of a replacement BA EAA Ground Services Engineering Building.
				- Relocation of existing fire training ground.
				- Control post at the EMB.
				- Double A380 Hangar and associated office and maintenance space.
				- Relocation of Surface Movement Radar (SMR) during T2C construction.
				- Contact stands.
				- Reconfiguration of Taxiways A and B to facilitate the space for T2C.
				- Eastern Airfield Access Road (EAAR) including cut and cover tunnel.
			Enabling (EN)	
				- Services diversions, including moving HV cables and relocating AGL substations.
				- Cooling station extension.
				- Contractors' compound.
				- Landscape maintenance.
				- Decants and demolitions.
			Landside Infrastructure (LI)	
				- Power and heat generation energy centre extension.
				- Diversion of Eastchurch road related to EMB expansion.
				- Redevelopment of the Hatton Cross Roundabout.
		T2D, T2E & Associated Development (DE)		

1	2	3	4	Scope
				Passenger Infrastructure (PI)
				- T2D.
				Airfield Infrastructure (AI)
				- Removal and reprovision of western campus fire station.
				- Control post alterations and provision of additional lanes to facilitate T2D construction.
				- New section of southern airside link road in cut and cover tunnel.
				- Southern Airside link road including cut and cover tunnel.
				- PBBs, nodes, VCCs and fixed links.
				- Contact stands to T2 D & E.
				- Alterations of taxiways E and F to facilitate construction of T2D / T2E.
				Enabling (EN)
				- Services diversions.
				- Demolitions.
				Western Campus & Associated Development (WC)
				Passenger Infrastructure (PI)
				- Additional ICS infrastructure to T5C south extension.
				- Extension of T5C to the south.
				- Construction of T5X/T6A new terminal building.
				- Construction of new vertical circulation cores (VCC's) to HEX and LUL stations.
				- ORAT for T5X/T6A.
				- T6B.
				Airfield Infrastructure (AI)
				- Specialist airfield vehicles including snow moving equipment and fire engines.
				- Airside operational maintenance and motor transport facilities.
				- Drainage.
				- Contact stands (T6B North and South).
				- General service hardstanding area.
				Landside Infrastructure (LI)
				- Energy and waste facilities, including new Energy Centre.
				- Inner campus and service roads around southern car park area.
				- Campus roads and roundabouts to Business Park West T6 campus.
				- Site preparation of areas for warehouse use within T6 commercial zone by third parties.
				- Automated and electric vehicle infrastructure for green campus connectivity.
				- Passenger transport interchange taxi and bus coaching facility.
				- Landside roads, forecourts at grade, elevated forecourts and car park ramps.

1	2	3	4	Scope
				- Car park facilities for T2, T4 and T5/6.
	Create the Space (CS)			
		Displaced Uses (DU)		
			Infrastructure Relocation (IR)	
				- Reprovision of water and drainage infrastructure.
				- Increased capacity to the existing sewage treatment facility.
		Natural Environment & Water Courses (NE)		
			Flood Defence (FM)	
				- Reconfiguration of flood mitigation measures.
				- Ecological mitigation and habitat creation.
				- Flood storage.
			Landscape & Public Realm (LS)	
				- Reprovision of public rights of way and open spaces.
				- Tree planting for screening purposes.
				- Landscaping and public realm improvements to Western Campus.
				- Footbridges over new watercourses.
				- Public footpaths to the River Colne valley.
			River Diversions (RD)	
				- Modification and re-routing of watercourses.
				- Creation of a major culvert under new runway for River Wraysbury and Colne Brook.
		Primary / Off Airport Utilities (UT)		
			Primary / Off Airport Utilities	
				- Rerouting of any network distribution.
		Surface Access (SA)		
			Motorway (MW)	
				- Junction modifications to the M24/M25 and provision of new collector/distributor roads.
				- Runway box structure for realigned M25.
				- Realigned M25.
			Rail (RA)	
				- Western campus station fit out.
				- Moving existing rail head to the north.
			Roads & Highways (RH)	
				- Reprovision of local authority road and highway infrastructure.
	Design & Development (DD)			
		Engineering & Surveys (ES)		

1	2	3	4	Scope
				Surveys (SS)
				- Ground investigations and below ground services surveys.
				Obtain Consents (OC)
				Consents (CO)
				Development Consent Order (DCO)
				- Relocation of facilities.
				Procure the Space (PS)
				Community & Heritage (CH)
				Conditions, Commitments & Levies (CL)
				- Listed Building decants / relocations - Provisions for impacts related to Listed Building
				- Relocation of Heathrow Special Needs Centre and Farm.
				Educational Facilities (EF)
				- Allowance for the creation of an educational facility (Academy School).
				Heritage (HE)
				- Listed Building decants / relocations - Provisions for impacts related to Listed Building
				Noise Insulation (NI)
				- Community Infrastructure Levy.
				Conditions, Commitments & Levies (CL)
				Expansion Commitments (CM)
				- Creation of Regional Consolidation Centres.
				Levies – Expansion (LV)
				- Wider domestic property zone acquisition allowance.
				- Allowance for purchase of BA Land holding at the Eastern Maintenance Base (EMB).
				Property Purchases (PP)
				Compulsory Purchases
				Compulsory purchase of all property.

Appendix D HIGH-LEVEL AND DETAILED DELIVERY OBLIGATIONS

Using the illustrative work breakdown structure (WBS) presented in Appendix C, Arcadis have provided examples of potential high-level delivery obligations and detailed delivery obligations for three of the "pots" set out in Figure 6.4:

- Western Campus passenger infrastructure.
- Western Campus landside infrastructure.
- Operational improvements.

These are presented in Boxes D.1, D.2, and D.3 below, demonstrating the different level of detail between the two types of delivery obligation.

We discuss in the main body of the report the trade-offs between high-level and detailed delivery obligations.

Box D.1: Indicative high-level and detailed delivery obligations for Western Campus passenger infrastructure

Western Campus Passenger Infrastructure

High-level delivery obligation:

Provision of new terminal fully fitted out including all fixed links, loading bridges and VCC's. Fully trialled and tested and ready for use.

Excludes the provision of baggage equipment which is included elsewhere.

Detailed delivery obligations:

- Provision of **x** number of contact stands fully provisioned with airbridges and connecting structures Vertical Circulation Cores (VCC) and Fixed Links and Nodes (FLAN).
- Additional terminal capacity with **x** number of departure gates.
- Additional passenger terminal capacity. With **x** number of check-in desks provision.
- Additional terminal capacity with **x** m^2 of airline lounges.
- Additional terminal capacity with **x** number of security lanes.
- Additional terminal capacity with **x** m^2 of international departures lounge.
- Additional terminal capacity with **x** number of border gates.
- Additional terminal capacity, with **x** number of baggage reclaim belts.
- Associated office and support functions to deliver the above capacity.
- Additional terminal capacity connected to existing public transport interfaces.
- Carry out full testing and operational readiness and acceptance trials to ensure compliance of the above facility.

Box D.2: Example high-level and detailed delivery obligations for Western Campus landside infrastructure

Western Campus Landside Infrastructure

High-level delivery obligation:

Works to facilitate operation of T6; supporting multi storey, business parking and surface carparking, forecourt, coach park, car hire taxi holding. Provision of energy centre and waste facility to support T6. Access roads to T6 and associated carparking, commercial areas, passenger interchange and inner campus roads. Provision of sites for ancillary facilities by others

Detailed delivery obligations:

- Additional x number of car parking provision linked to the new terminal capacity.
- Additional public transport coach / bus provision, x number / x m length of bus lanes.
- Additional x m2 of passenger drop off zone in support of the new terminal capacity.
- Provide reconfigured road access to new terminal capacity while maintaining full access to the existing assets (Terminal 5).
- Provide additional public transport interface, linked to existing provisions.
- Provide additional x m2 of taxi parking capacity.
- Provide additional x m2 of buses and coach parking capacity.
- Provide electric vehicle support infrastructure.
- Provide x number additional short access business parking.
- Provide additional energy centre support to provide resilience to the new capacity.
- Provide additional waste processing facility in support of the additional capacity.
- Testing and proving of the above capacity to ensure operational readiness at the point of opening.
- Provide additional surface water management system to support additional hardstanding areas.
- Provide support to additional commercial enterprise zones around the new terminal area. i.e. hotel or commercial office space.

Box D.3: Example high-level and detailed delivery obligations for operational improvements

Operational Improvements

High-level delivery obligation:

Works across the whole campus to improve the airport operations. These include works such as Southern Road Tunnel; reconfiguration of cargo facilities including new sheds and stands; improvements to existing fuel tanks, additional RET's to existing northern runway; improvements to maintenance base, review of airport support facilities including staff and coach parking and improvements to inner road layouts

Detailed delivery obligations:

- Deliver new road access from the southern area of the Heathrow campus into the Central Terminal Area (CTA). In the form of additional tunnel access. Including the construction and fitting out of the tunnel. Including connection to the existing road system at the south and within the CTA.
- Reconfigure the existing CTA road system to connect with the new southern access tunnel.
- Reconfigure the existing cargo processing facility to enable a **X** % increase in cargo handling capacity.
- Upgrade existing fuel farm capacity to provide resilience and match requirements to additional airfield capacity.
- Provide **x** number of additional Rapid Exit Taxiways (RET) to the existing northern runway areas to provide resilience in operations and flexibility and harmonisation with operation of the new 3rd runway.
- Reconfigure existing maintenance facilities to provide **x** % increased capacity, or efficiency in operation.
- Provide additional x number of staff parking capacity.
- Provide additional **x** m2 of staff coaching capacity.
- Reconfigure existing campus road system to remove bottlenecks or inefficiencies in traffic flows.

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