

H7 Capital Efficiency

June 2021

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Executive Summary



The Scope

Jacobs has been engaged by Heathrow Airport Limited (Heathrow) to review CAA proposals and provide an independent assessment on how ex-ante can be implemented in the interest of consumers.

In preparing our analysis and recommendations, the list of key documents we reviewed were:

- Economic regulation of Heathrow Airport Limited: working paper on capital expenditure efficiency incentives (CAP 1951),
- Economic regulation of Heathrow Airport Limited: Consultation on the Way Forward (CAP2139),
- Appendices to Economic regulation of Heathrow Airport Limited: Consultation on the Way Forward (CAP2139A),
- Heathrow Interim H7 Price Control: Review of HAL's initial submission (CAP1769A).

Based on this review, we prepared an in principle recommendation of criteria that may be appropriate for the application of proposed CAA changes to capital incentives.



Our Analysis

In this paper, we have assessed the proposed changes to the capex incentive arrangements for the H7 capital programme and considered them against two main question sets:

- Is a full scale ex-ante approach appropriate for Heathrow given the diversity and complexity of the regulated asset base?
- What are the optimum criteria for applying an ex-ante approach in order to achieve desired regulatory/efficiency outcomes – and does Heathrow's circumstances provide a close enough fit to justify consideration of ex-ante?

Our analysis has also included comparisons (where appropriate) to other regulated markets that have different types of capital incentives in use.



Our Conclusions

For both CAA and Heathrow, it is important to consider what are the likely impacts on customers from adopting the proposed changes to the capex incentive arrangements:

- Following our assessment, we have concluded that a move to full scale ex-ante for H7 would drive unintended consequences that in turn would lead to poorer outcomes for customers;
- To avoid this, we recommend a mixed regulatory model that will use ex-ante incentives where appropriate, combined with some existing ex-post incentives;
- To assist both the CAA and Heathrow, we have identified a series of discussion points that can form the basis of a constructive dialogue in the development of the H7 regulatory framework and set these out in this report (section 5).

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1. Introduction & background

1. Introduction and background

The June 2020 Consultation set out the CAA criteria for developing new capex incentive arrangements and the broad approach that CAA intend to apply to the H7 capex programme. The August 2020 Working Paper set out further details of this approach. CAA proposed to retain key aspects of the current (Q6) arrangements, including the development and core framework, but also proposed some important changes including:

- clear ex ante (forward looking) incentives so that Heathrow would bear a pre-determined share of any under or overspend against the capex baselines CAA set,
- delivery obligations specified for each category of capex, to allow CAA to assess whether Heathrow has delivered the outputs agreed with airlines, and
- arrangements to allow capex baselines to be updated during the H7 period, provided that any changes are appropriate and efficient and are agreed by airlines.

Jacobs has been engaged by Heathrow Airport Limited (Heathrow) to review CAA proposals and provide an independent assessment on how ex-ante can be implemented in the interest of consumers and an in principle recommendation of criteria that may be appropriate for the application of these changes.

Pandemic Impacts

The COVID-19 pandemic has had significant and ongoing impact to air travel. In 2020, total passenger volume was down ~75% compared to 2019 and London Heathrow followed this decline with passengers down ~73%.¹ This is an unprecedented downturn in traffic volumes, with other major shock events such as 9/11 related disruptions insignificant in comparison (~6% reduction in traffic to Heathrow between 2001 and 2002).² Recovery to pre-pandemic air traffic activity remains uncertain and is dependent on multiple factors including but not limited to vaccination proliferation and efficacy, domestic and international travel policies, changing traveller habits and airline response to evolving market conditions.

The dramatic reduction in air traffic activity because of pandemic disruption is well documented and reflective globally. However, pandemic related disruption extends to all parts of the airport supply chain including the development of infrastructure and assets. In a large-scale survey of 900 contractors, ~63% of respondents noted that supply of materials, goods or services for construction has been disrupted.³ Additionally, ~42% of respondents noted that travel/transport restrictions were the biggest factor to disruption along with increased operating costs.⁴ Forecast Tender Price Index (TPI) illustrates volatility in prices because of supply chain disruption not only to materials supply chains but also to changing labour conditions.

Pandemic related emigration from the UK for construction resources exacerbates volatility in infrastructure development costs. Additionally, record high commodity prices (for example, iron ore and copper) is driving up cost of key building input costs such as steel.

This is within the context of a boom in overall infrastructure development, increasing pressure on construction inputs. Baseline forecast for tender price inflation for 2022 is 2.4% and 3.0% in 2023, however the volatility to inflation ranges from ~1.5% to ~5.0%.⁵

Pandemic Impact on Regulated Markets – UK Water Sector

The impact of the pandemic on the UK Water Sector has been felt across all aspects of companies' operations with Ofwat recognising that revenue, costs, service levels and company performance commitments would all be affected across the current price control period (2020-25). Ofwat reacted early to the impact of the pandemic and made it clear that staff shortages from social distancing and changing customer demand patterns from the national lockdowns would mean water companies having to prioritise core services over planned maintenance/enhancements in the period:

"...the sector is likely to face significant staff shortages and limitations to its ability to undertake some routine work because of social distancing requirements. This may make it difficult for every company to meet some of the performance commitments in the regulatory settlement. In planning for these constraints, companies are rightly looking to prioritise meeting their core service obligations. In this situation and for the avoidance of doubt, incentives and penalties in our regulatory regime should not get in the way of effective prioritisation in the interests of customers..... Please be assured that we will consider the need for any ex post adjustments to our regulatory system following an in-the-round assessment as part of our normal reconciliation process."

Rachel Fletcher. Chief Executive Ofwat (March 2020)

All regulated companies have subsequently provided data to Ofwat showing that they have had to either delay or re-prioritise their capital programmes for 2020-25. This has been driven by social distancing rules as well as, more recently, materials and resource shortages.

The original expectation was that delay impacts could be mitigated across the period however the second national lockdown and now the impact of supply chain shortages is increasing the likelihood of ex-post adjustments being required against both efficiency and delivery measures in the period.

¹Table 9 (Terminal and transit passengers) – Airport Data 2020, Civil Aviation Authority

²Table 9 (Terminal and transit passengers) – Airport Data 2002, Civil Aviation Authority

³The Impact of COVID-19 on the Construction Industry (According to Business Owners), CHAS

⁴Ibid.

⁵AECOM Tender Price Inflation, 2021

2. Appropriateness of *ex-ante* incentives

2. Appropriateness of *Ex-ante* incentives to Heathrow capital investments

Key Takeaways

- Investment types at airports are unique in comparison to other regulated infrastructure sectors.
- Airport infrastructure investments are more complex than other regulated businesses across UK/Europe.
- Cost controllability is a significant issue for Heathrow within the context of pandemic related impacts.
- Development costs face uncertainty with many complex Heathrow initiatives without a demonstrable track record to benchmark.

Airports are amongst the most complex infrastructure operations. The precinct incorporates and interfaces with multiple asset classes and stakeholders. As a brownfield site, Heathrow operates in a complex live environment that continually evolves with changes in the aviation market. The following section provides an assessment of airports in comparison to other regulated and unregulated infrastructure classes. The assessment is based on:

Asset diversity – the variety of asset types the infrastructure deploys. Asset diversity is viewed from the lens of core infrastructure assets and non-core assets. Core infrastructure assets with respect to this study are *the assets required to provide the specialised service provision of the infrastructure asset class*. For simplicity, for airports it is the aviation operations assets such as airfield, terminal, landside and associated technology assets.

Non-core assets are those assets that an infrastructure service provider deploys which *enable specialised services or improve consumer service levels*.

Asset knowledge – the level of knowledge infrastructure managers have of their assets. Asset knowledge is impacted by technical assessment of overall asset condition and lessons learned from repeated capital works.

Cost uncertainty – with respect to development, the level of uncertainty to capex. Cost uncertainty is related to multiple factors along the investment pathway. For example, the degree of latent conditions on a site can increase cost uncertainty. Similarly, evolving statutory requirements related to planning and environmental consents can increase cost uncertainty.

Stakeholders/Consumers – The number of parties that have an interest in infrastructure development and provision of customer service.

Investment governance – The level of scrutiny and associated investment administration requirements faced by infrastructure owner.

The infrastructure asset classes assessed in this framework include:

- Airports
- Rail
- Toll roads
- Maritime ports
- Water sector
- Electricity sector (wholesale networks)

2.1 Airport asset diversity and uniqueness

Developing infrastructure at a suitable service level for airport consumers is complex and unique with respect to other regulated infrastructure types. Airport precincts have most of the elements of a city with:

1. Various modes including roads, motorways, tunnels, rail and active transport,
2. Utilities and services that span high voltage, low voltage, switchgear, HVAC, gas, aviation fuels, chillers, boilers, stormwater, potable water, generation and transmission assets,
3. Commercial and industrial real estate including hotels, offices, car parks, logistics and warehousing facilities and,
4. Retail services ranging from quick service, food and beverage, specialty stores and duty free.

In addition to these common built environment assets, the nature of aviation assets are diverse:

Airfield – runways, taxiways, RPT apron, freight apron, ground support equipment areas, contact and remote aircraft stands, aircraft guidance equipment, aerobridges, air traffic control, rescue and firefighting and meteorological assets, etc,

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Terminal – check-in, security screening, departures, transfers and arrivals lounges, boarding lounges, emigration and immigration control, utilities services corridors, commercial and retail services, etc,

Baggage Handling Systems – Inbound and outbound baggage controls, automated bag drops, baggage screening equipment, etc.

Landside – pick up/drop off facilities for vehicles, railway stations, forecourts, at-grade, elevated and underground access routes, bussing infrastructure, airport supplier facilities, commercial vehicle facilities, taxi and rideshare facilities, etc.

Information communication and technology (ICT) – public and private networks, flight information systems, CCTV and security installations, airfield situational awareness systems, access systems, ground handling ICT infrastructure.

2.1.1 Railways

UK railway infrastructure providers have higher levels of homogeneity in its asset classes. Asset classes are primary core infrastructure such as:

- Track
- Signalling
- Civils (structures and earthworks)
- Buildings (stations and depots)
- Electrical power
- Drainage
- Telecommunications
- Mobile plant and fleet

Non-core assets may consist of offices, road mobile fleet and IT equipment. There are some commercial assets that reside within train stations.

2.1.2 Toll roads

Typical toll road assets beyond the road, bridge and tunnel networks is limited to infrastructure related to tolling, operations and maintenance. Similar but to a much smaller scale, there are some commercial asset provisions. This is related to vehicle services and amenities.

Tolling - toll plazas/toll gantries, offices for toll staff at plazas, etc.

Depots – maintenance vehicles, maintenance tools and equipment, workshops, vehicles, areas for energy services, etc.

Service areas – retail shops, restrooms, fuelling stations and vehicle parking, etc.

ICT – CCTV system, operations and tolling technology, communication networks, toll collection systems, etc.

Management facilities – control rooms, customer service centres, staff offices, etc.

2.1.3 Maritime ports

Port operating models vary considerably depending on the type of cargo and trade it handles. This can range from container traffic to passenger ferry traffic. The landlord model of ports (that is, port authorities typically provide the land for which other lessors and operators develop and operate), means that typically ports will have mainly core infrastructure assets to facilitate trade of seaborne goods. Additionally there may be some commercial ventures. Core port infrastructure assets range from quayside to landside.

Water/Quayside – breakwater, channels, wharves, piers, discharging and loading equipment (cranes, hoppers, grabs), yard infrastructure, passenger service infrastructure (ferries and cruise vessels), etc.

Access – road network, truck and vehicle routes, yard access, etc.

Utilities – shore to ship power and water supply, onsite grid and renewable power generation, etc.

Commercial – logistics, storage and industrial facilities. Depending on the type of port can range from dry to liquid bulk handling infrastructure to hardstand areas for general cargo. Typically, landlord port functions would allow for these provisions to an operator through a lease.

Mobile Plant – dredging vessels, tugs, trucks and motor vehicle fleets, etc.

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2.1.4 Water sector

The UK Water Sector has been regulated by Ofwat since privatisation of the industry in 1989 and is regarded as one of the most mature and stable of all regulated infrastructure markets. Water companies have built up their detailed asset knowledge over the past 30 years with the price control process itself now segmented across four separate wholesale areas:

Water Resources – long-life assets (raw water abstraction, transport and storage).

Water Network Plus – filtrations plants, storage reservoirs, pumping stations, trunk mains, reticulation mains, network sensors/meters.

WasteWater Network Plus – reticulation sewers, trunk sewers, sewage pumping stations, sewage treatment works.

Bioresources – Sludge treatment works, sludge transport, sludge disposal.

Key to the heart of these separate price controls is Ofwat's commitment to protect the interests of consumers through resilient and affordable services – the relative stability and maturity of the UK water market combined with the high degree of asset/service knowledge within the companies themselves makes this achievable.

2.1.5 Electricity sector (wholesale networks)

Like the Water Sector, network operators for gas and electricity have been regulated since privatisation for more than 30 years. The transmission and distribution operators have detailed knowledge of their asset bases and condition of assets (a requirement given the safety aspect of managing power and gas networks).

Electricity Transmission – HV Overhead lines, underground cables, substations.

Electricity Distribution – LV Overhead lines, underground cables, substations.

Gas Transmission – Gas Terminals, High Pressure Gas Pipelines.

Gas Distribution – Low pressure gas pipeline, Operations Depots.

Both the power and gas network operators have mature and well resourced supply chains that allow for a high degree of price and schedule certainty when contracting.

Asset diversity: Why does this matter?

- Heathrow requires expertise in the development and management of assets that are common to other regulated infrastructure. Exhibit 1 below shows this diversity of capex delivered in Q6. Given this variation capex, a flexible approach to capex regulation is required. Additionally, given the distribution of capex by £ value is skewed heavily towards smaller expenditure (Exhibit 2) there is limited ability for the Airport to meaningfully bundle and sequence projects. This is exacerbated by the diversity of airport assets requiring attention and expertise in many infrastructure and operational aspects in contrast to the standardised approach that can be applied in other sectors.
- Given the level of diversity in asset types developed, managed and operated, there may be difficulty in reconciling projects at this scale. Q6 delivered 733 projects. This is likely to result in higher costs and resource requirements.
- Approximately 18% of projects delivered in Q6 was in relation to commercial developments. This presents a particular uniqueness to the airport business.
- Overall, Heathrow has most of the features of a functional city. This level of diversity presents significant challenges in delivering capex that requires diverse levels of management expertise.
- Taken together, the relative diversity and complexity of the asset base managed and maintained by Heathrow will lead to capital programmes that can vastly differ from period to period. This will make it more difficult (relative to other regulated markets) to apply ex-ante across the whole capital programme and in turn will likely lead to higher risk allowances being attached to projects (limiting throughput and efficiency of projects in the regulatory period).

Exhibit 1: Distribution of projects by asset type

Description	Airside	Baggage	Commercial	CRS	Engineering	HAC	Security	Technology	Other
Number of projects	79	69	132	63	218	1	46	120	5
Proportion of projects	11%	9%	18%	9%	30%	0%	6%	16%	1%

Exhibit 2: Distribution of projects by capex (£)

Description	£50m+	£10m-50m	£5m-10m	£2m-5m	<£2m
Proportion of projects	1%	9%	10%	23%	56%

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2.2. Asset knowledge

Heathrow is an ISO 55000 certified organisation. This ensures that international best practice asset management processes and systems are enshrined in airport operations. From a systems perspective, the Airport manages and monitors ~500,000 assets within ~30 separate asset management strategies.

The Airport has varying levels of asset knowledge in a highly complex and asset rich environment. For example, on the airfield there are over 30,000 manholes, pits and chambers that are essential to the routing of and access to a large number of services and utilities including those related to surface water, foul and potable water, fire mains, gas, airfield ground lighting power and controls, NAVAIDS, telephone and data links, etc. In total there are thirteen different service types, some of which are unique to the airport environment, with over 50 different owners.

- 72 miles of high pressure fire main network;
- 81 miles of aviation fuel network ranging between 1.5" to 20" in diameter and between 3 and 115-bar in pressure;
- Intermediate and medium pressure gas mains;
- Power cables ranging from 9V up to 400 KVa, both AC & DC.

It is estimated that the accuracy of location of over 70% of these services are known to within 500mm whereas the location of the remaining is only approximate or unknown. Crucially the unknown depth of services is a significant risk factor for excavations.

The regularity of condition assessments conducted at the airport is dependent on the type of asset and criticality. For example, the LV network, there are currently 23 asset types inspected with frequencies between 3 months and 5 years. For the airfield:

- Level 1 Inspection – 3 times daily – All movement areas and grass areas adjacent to hard surfaces,
- Level 2 Inspection – monthly (32 days cycle) – All movement areas,
- Level 3 Inspection – 4 times a year – Management Inspection/Audit of Level 1/2 inspections.

This helps to better manage the balance between proactive and reactive maintenance which is broadly split 70%/30%. Reactive maintenance is largely a component of best practice asset management ensuring that the appropriate level of utilisation is achieved before replacement.

Asset knowledge impacting application of ex-ante approach

- Ex-ante may be appropriate for projects that deliver the replacement of assets. This is primarily because airports have detailed knowledge of most assets. This is a result of prior repeated and demonstrated experience of delivering these types of projects. Airports are likely to have detailed benchmarking (for both cost and delivery approach) of these types of projects as it is within the regular course of business.
- Furthermore, airports have more confidence in its ability to contract efficiently with a higher level of certainty. Airports has a better understanding of suppliers and vendors for repeated and demonstrated projects which allows for more efficient contracting.
- Ex-ante approach may not be appropriate for capacity related and complex projects. Capacity projects are inherently 'new' in nature and has more risk of deviation in scope, programme, cost and quality. The scope of projects has a higher likelihood to deviate post G3 and into the detailed design and delivery phases. These potential changes in scope can result in changes in cost and timescales.
- Complex projects (replacement or capacity) have similar issues to capacity projects as there are greater unknown factors in its delivery which makes ex-ante initial forecasting more difficult (and can again lead to higher risk allowances being attached to projects).

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2.3 Cost uncertainty

Airport development face numerous cost uncertainties. Heathrow as a historical and significant brownfield site is encumbered by some key themes such as:

Live Environment – Projects undertaken within a live airport environment must consider project phasing and overall approach to mitigate impacting the existing airport operation. Live developments may also be phased for convenience surrounding asset replacement, to avoid additional costly terminal disruptions.

Landside Interaction – New areas must be accessible for them to be used. Where terminal expansions have taken place, considerations must be made for the surrounding access and how this could impact the existing airport's passenger flow.

Temporary Emplacements – Non-permanent facilities may be required to re-provision temporarily lost services, adding to the overall cost of the development.

Utilities Impact – Alterations to existing, or expansions to new areas require utilities to serve both passengers and airlines within these facilities.

Apron / Taxiway Works – Complexity in this area may coincide with an airport's airside spatial constraints.

Cost uncertainty: so what?

- The impacts of the pandemic has increased the forecasting challenge. This ranges from the whole delivery supply chain from airport planners through to construction contractors. A live environment exacerbates this challenge with more uncontrollable factors. Uncertainty is likely to result in larger contingency requirements for all parties.
- Risk transfer is a likely outcome of the inherent uncertainties during and post pandemic airport environment. This is likely to result in additional costs for projects which may be borne by Heathrow or its suppliers. Cost risk transfer is likely to therefore occur between Heathrow and its stakeholders. A reset mechanism is required to ensure that fair and equitable risks are borne by parties in the airport value chain.

2.4 Stakeholders/consumers & investment governance

Heathrow has over 76,000 colleagues and 400 organisations working across the airport precinct. This ranges from:

This ranges from security providers such as Metropolitan Police, Civil Aviation Authority and the Government to baggage handling providers, ground handlers, air traffic controllers, border force and of course, the airlines.

Passengers and cargo owners are the consumers which Heathrow serves which requires the airport to ensure an adequate level of service. This has touchpoints for the movement of passengers and cargo from the point of entry to the campus and exit.

Airlines play a vital role in the coordinated effort to provide the level of service required by passengers and cargo owners. Engagement with airlines forms a key uniqueness for Heathrow as the airline community are a key influencer in capex development. Typically, other regulated sectors do not have this additional element as the relationship between the infrastructure owner is directly with the consumer (except for cases such as rail which has train and freight operating companies in addition to the passenger).

Investment governance for capex at Heathrow with its partners is an ongoing and high quality process. Where forums such as Constructive Engagement is periodical, IFS and airline engagement with respect to project delivery is ongoing.

Stakeholders/consumers & investment governance: so what?

- The additional layer of airlines in both stakeholder engagement and investment governance is unique to the airport sector. Other regulated infrastructure sectors have limited involvement in the way in which capex is delivered with management benefitting from a higher degree of control and autonomy once a regulatory capital allowance is set for a given period.
- In Jacobs view, relative to other sectors, Heathrow also faces a situation where the identification and definition of projects can sometimes be outside of the control of management – applying ex-ante incentives to this area of the capital programme will again increase the overall risk facing Heathrow in H7 which in turn may result in either higher risk allowances in project estimates or, in extremis, an appeal to the CMA should Heathrow management/shareholders not accept the overall risk position.

2. Appropriateness of *Ex-ante* incentives to Heathrow capital investments

This report prepared a high level assessment of the nature of airport development and management in comparison to other typically regulated sectors. Exhibit 3 presents a RAG (red, amber, green) approach to comparing infrastructure asset classes by its relative asset diversity and knowledge, cost uncertainty in developing projects (capex), complexity of stakeholders and investment governance. Exhibit 4 compares the diversity of asset types for airports against other infrastructure asset classes.

The aim of these tables is to demonstrate Jacobs analysis that airport development is relatively complex and diverse and the mechanisms for capex regulations needs to be proportionate to these factors.

Exhibit 3: Comparison of infrastructure asset class by investment implications

Infrastructure type	Airports	Rail	Toll Roads	Ports	Water	Electricity
Asset diversity	High	High	Low	Medium	Low	Low
Asset knowledge	Medium	Low	High	Low	High	Medium
Cost uncertainty	High	Medium	Medium	Low	Low	Medium
Stakeholders	High	High	Low	Medium	Low	Low
Investment governance	High	Medium	Low	Low	Low	Low

Exhibit 4: Comparison of asset types by infrastructure assets

Asset types	Airports	Rail	Toll Roads	Ports	Water	Electricity
Core infrastructure assets	Yes	Yes	Yes	Yes	Yes	Yes
Retail	Yes	Yes	Yes	No	No	No
Commercial property	Yes	Yes	No	Yes	No	No
Multi-modal assets	Yes	No	No	Yes	No	No
Public vehicle storage	Yes	Yes	No	No	No	No
Utilities	Yes	Yes	Yes	Yes	Yes	Yes
ICT	Yes	Yes	Yes	Yes	Yes	Yes

Airport development is the most complex of assets to deliver.

- The 'city' nature of an airport results in the highest level of asset diversity. The rail sector in comparison has a similar level of asset diversity. In contrast, the electricity, water and toll roads sector have higher levels of homogeneity of asset types. This presents increasing challenges in monitoring, managing and developing the precinct for airports.
- Airports have a strong understanding of its existing assets but do not have complete knowledge of its assets on the campus. This is closely related to both the brownfield nature of assets as well as its uniqueness which requires greater intervention to gather detailed benchmarking.
- Airports have more robust investment governance with more stakeholders than other regulated sectors. The role of airlines play an important part in this robustness. This is a particular uniqueness that enhances the quality of governance on investment decisions.

Airport asset types are unlike any other regulated sector.

- Airports have wide ranging asset types ranging from its core business of providing aviation services through to interfacing with multimodal assets and commercial property. This requires a fit for purpose regulatory regime that factors in these complexities.
- Where the ex-ante regulatory approach may be appropriate to sectors such as water and electricity, these infrastructure types do not exhibit relative variation to its assets. This presents greater challenges to airports as development can be highly changeable (relative to other infrastructure sectors).
- The wide range of asset types managed by Heathrow can make supply chain engagement more difficult which limits management ability to share the cost efficiency burden (through work bundling, work packaging, tendered efficiency factors for repeatable work).

3. Ex-ante criteria

3. On balance of the analysis, we propose the following criteria for the application of *ex-ante* methodology:

No.	Criteria	Rationale	Example
1	<i>Ex-ante</i> should be considered for capex where Heathrow has regular and repeated experience in development.	Asset classes with a renewal cycle of up to 5-10 years allow regulated companies to build detailed benchmarks and project briefs that can support ex-ante capex forecasting.	<ul style="list-style-type: none"> Vertical transport (lifts/escalators) refurbishment Apron resurfacing (Taxiway and Runway) Retail shell and core fitout Asset Refurbishments (under £5m value e.g. toilets)
2	<i>Ex-ante</i> should be considered for capex that can be efficiently contracted with a high degree of certainty.	Regulated companies can use procurement methods such as work packaging and bundling to achieve enhanced cost control with their supply chains – but only where projects can be efficiently grouped and contracted.	<ul style="list-style-type: none"> IT Networks Airfield Ground Lighting
3	<i>Ex-ante</i> should be considered for capex that can be sequenced with a high degree of certainty without reducing benefits to consumer.	Projects that have to be delivered in limited time frames (such as possession windows) are inherently more risky and difficult to forecast – this is the case for certain aviation and rail capital interventions.	<ul style="list-style-type: none"> Automation: Self-Service Bag Drops, Self Boarding Gates. EV Charging
4	<i>Ex-ante</i> should not be considered for generational renewals .	Regulators are using 'conditional allowances' to allow for the efficient development and delivery of large scale 'once in a generation' capital solutions that cannot be assessed in line with more standardised maintenance renewals.	<ul style="list-style-type: none"> Heathrow Expansion Security Transformation
5	<i>Ex-ante</i> should not be considered for complex capex .	Complex projects require detailed development and inherently are not part of standard asset management plans during a regulatory period. Ex-ante forecasting is not appropriate for projects facing these increased complexities and challenges.	<ul style="list-style-type: none"> Baggage systems project Multiple asset types being delivered in one project (E.g. Kilo Apron Development)
6	<i>Ex-ante</i> should be considered for capex that has limited customer impact .	Applying ex-ante forecasting requirements to a suite of projects with elongated approvals pathways and limited historic benchmarks will result in increased risk allowances and by extension increased costs to end customers.	<ul style="list-style-type: none"> Back of house projects Commercial and office scope
7	<i>Ex-ante</i> should not be considered for capex that does not have sufficient Heathrow management control .	A determined management cannot reasonably be held accountable for ex-ante forecasting of projects that are subject to significant third party influence.	<ul style="list-style-type: none"> Baggage Handling Systems Technology projects (3rd Party e.g. NATS) UKPNS and HhOPCO
8	<i>Ex-ante</i> should not be considered for capex that exhibits unobservable risks .	Heathrow will be required to invest in some projects that will by their nature uncover additional scope/compliance requirements during the project lifecycle.	<ul style="list-style-type: none"> Contaminated soil (PFAS) Hydrocarbons Known Asbestos and Legionella

4. Case Study: Thames Tideway Tunnel

4. Thames Tideway Tunnel

At 25KM long and 65m below ground, Thames Tideway Tunnel (TTT) is one of the largest water infrastructure projects ever undertaken in the UK. Its size and scale has required Ofwat and the UK Government to develop/implement specific legislation to enable the development, delivery and operation of this critical infrastructure asset. It was determined that the size and complexity of TTT threatened Thames Water's ability to provide services for existing customers and that better value for money could be achieved by designating TTT as a 'Specified Infrastructure Project' (under the 2013 SIP Regulations).

Following a tender process, Bazalgette Tunnel Limited were selected by Thames Water as the preferred bidder to deliver the design, construction, ownership, financing and operation of TTT. Ofwat subsequently appointed Bazalgette as a 'Infrastructure Provider' for TTT which in effect brought Bazalgette (and TTT) within the regulatory net of the Water Industry Act 1991.

TTT Regulatory Model

As a designated Infrastructure Provider (IP), Bazalgette have become a regulated entity subject to licence. This provides Ofwat with the power to monitor costs during the construction phase and take enforcement against Bazalgette if it fails to deliver the project in line with licence conditions.

To account for the long and complex nature of the construction phase, Ofwat has included a series of measures in the TTT regulatory framework to protect the interests of customers whilst also ensuring the ongoing financeability of Bazalgette. Of particular relevance to Heathrow, and the regulatory treatment of any future major capital projects, is Ofwat's treatment/assessment of 'Additional Allowable Project Spend' during the construction phase of TTT:

"Where the IP (Bazalgette) forecasts that a Predicted Overrun may occur (that is, project expenditure is likely to exceed the level of the Threshold Outturn), the IP is obliged under the terms of the Liaison Agreement to put in place a Mitigation Plan. The IP will discuss this plan with stakeholders, identify the potential scope of any Predicted Overrun and describe the measures that will be taken to mitigate that Predicted Overrun. Where it is apparent that, notwithstanding the implementation of the Mitigation Plan, a Predicted Overrun is expected to occur, the IP may request an increase in Allowed Revenue (an IAR) under the terms of the Project Licence.

In considering the IP's IAR application, Ofwat is required, subject to its statutory duties, and the terms of the Project Licence, to determine various aspects that affect the revenue that the IP will receive in relation to the additional expenditure above the Threshold Outturn i.e. the Additional Allowable Project Spend."

Ofwat Guidance on Economic Regulation for TTT (August 2015)

Cost increases that are deemed to be 'allowable' will be capitalised and added to the Regulated Capital Value (RCV) at the end of the construction phase (latest cost estimates provided by Bazalgette have revised the cost forecast to completion up to £3.9bn from the original regulatory baseline of £3.4bn – some of this increased cost will be deemed as 'excluded cost' and not added to the RCV).

Ofwat uses an Independent Technical Assessor to assess the annual expenditure report of Bazalgette which in turn determines the annual 'actual project spend' that is added to the RCV. This in effect creates an ex-post adjustment mechanism each year provided Bazalgette can demonstrate that any cost overrun has been outside of management control.

Is Ex-Ante appropriate for large scale 'generational projects'?

Large scale expansion of Heathrow (such as the proposed third runway) would potentially be subject to any new ex-ante incentive scheme should the decision be made to apply it to all aspects of Heathrow capital investment.

It has been suggested that ex-ante has been well used in other sectors for similar 'generational' projects that sit way outside the normal capital programme limits of regulated entities and so it would also be appropriate to use it for Heathrow expansion projects.

The proceeding discussion has shown that even though Thames Tideway Tunnel has used an ex-ante approach to initial target price setting (the £3.4bn), Ofwat have included enough ex-post adjustment tools to ensure an appropriate balance of risk sharing between all stakeholders whilst still incentivising Bazalgette to deliver efficiently and on time.

Further, Ofwat have now begun to use 'conditional allowances' for major resilience schemes in the UK water sector to help companies identify and develop the right solutions as opposed to just applying a blanked ex-ante efficiency challenge. These resilience projects involve new technologies and new environmental solutions (such as desalination plants, reuse facilities and large-scale conveyance projects) and as such Ofwat has shown strong leadership in the sector by ensuring an appropriate risk sharing approach between all stakeholders.

5. Discussion

5. Discussion – capital incentives should be calibrated for the best interest of consumers.

When assessing any proposed change to an existing regulatory framework, both the Regulator and the Regulated entity should be mindful of the likely impacts any such changes (intended or unintended) will have on the wider stakeholder group. In this case, it is important for both the CAA and Heathrow to consider what are the likely impacts on customers from adopting the proposed changes to the capex incentive arrangements and will these lead to a less optimal outcome for all interested stakeholders.

In this paper, we have assessed the proposed changes to the capex incentive arrangements for the H7 capital programme and considered them against two main question sets:

- (i) Is a full scale ex-ante approach appropriate for Heathrow given the diversity and complexity of the regulated asset base?
- (ii) What are the optimum criteria for applying an ex-ante approach in order to achieve desired regulatory/efficiency outcomes – and does Heathrow's circumstances provide a close enough fit to justify consideration of ex-ante?

Following our assessment, we have concluded that a move to full scale ex-ante for H7 would likely drive unintended consequences that in turn would lead to poorer outcomes for customers as cost uncertainty and risk aversion would result in less maintenance/enhancement projects being delivered in the regulatory period. To avoid this, we recommend a mixed regulatory model where those elements of the capital programme that have available historic benchmarks (and higher degrees of scope certainty) be subject to ex-ante incentives whereas other aspects of the capital programme remain under the existing ex-post arrangements as used in Q6.

To further the dialogue around appropriate capex incentives for H7, we invite both Heathrow, CAA and key parties to consider the following discussion points that have surfaced in our assessment:

- **Price Discovery & Efficiency** – Ex-ante approaches are expected to drive efficiency as the risk of cost/scope increases will sit wholly with the regulated entity who are in turn incentivised to manage this risk. The complex nature of Heathrow's asset base limit their ability to make use of all risk mitigation tools that are otherwise available to other regulated entities and so ex-post may remain the most appropriate approach for certain elements of the capital programme.
- **Optimum Criteria for Applying Ex-Ante** – In section 3 we have set out a range of criteria where ex-ante approach would be the most appropriate to drive efficiency and regulatory outcomes. It was clear from our assessment of Heathrow that Heathrow does not meet enough of these criteria and so an ex-ante application would likely result in sub-optimal outcomes for all stakeholders.

- **Cost/Scope Control on Complex Projects** – Heathrow have identified that a portion of the capital programme in H7 will be complex projects that do not have sufficient historic benchmarks. Ex-ante application itself will not remove the risk of these projects increasing in cost/scope but will instead transfer this risk wholly to Heathrow management.
- **Ex-ante may result in less delivered outcomes** – As noted above, application of ex-ante forecasting to complex projects will most likely result in higher risk allowances being 'priced' in to initial estimates and project scope definitions. In aggregate, this will lead to less throughput of projects in a set regulatory period and potentially higher costs when compared to previous ex-post regulatory periods.
- **Mixed regulatory model may result in more benefits to consumers** – maintaining a mixed approach where both ex-ante and ex-post assessments are applied may result in superior outcomes for customers as risk allowances in projects may be reduced and the overall risk of an H7 appeal to the CMA is lessened (we note that 4 major water utilities have appealed to CMA following the publication of PR19 final determinations).
- **Reconciliation of projects unknown and creates additional uncertainty** – Heathrow are currently unclear of what the reconciliation process will be for H7 and so this increases the risk associated with ex-ante forecasting (which in turn may lead to increased risk allowances being priced into initial estimates to provide a degree of control for Heathrow management).
- **Lack of uncertainty on the change process** – When compared to other regulated markets, Heathrow face a much more uncertain change process with higher levels of stakeholder influence over capital projects during the regulatory period. This again increases the relative risk faced by Heathrow management if ex-ante is fully adopted across all aspects of the capital programme.
- **Exposure to compounding risk factors** – Heathrow management have identified the potential that they will have to analyse and explain a compounding of risk factors to their own shareholders for the H7 capital programme that will be further exacerbated if ex-ante is applied to all capex areas. The combination of financeability concerns with initial ex-ante forecasting risks and the potential for further negative ex-post adjustments creates a compounding risk problem for Heathrow management and may limit outcomes for customers in the period.

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