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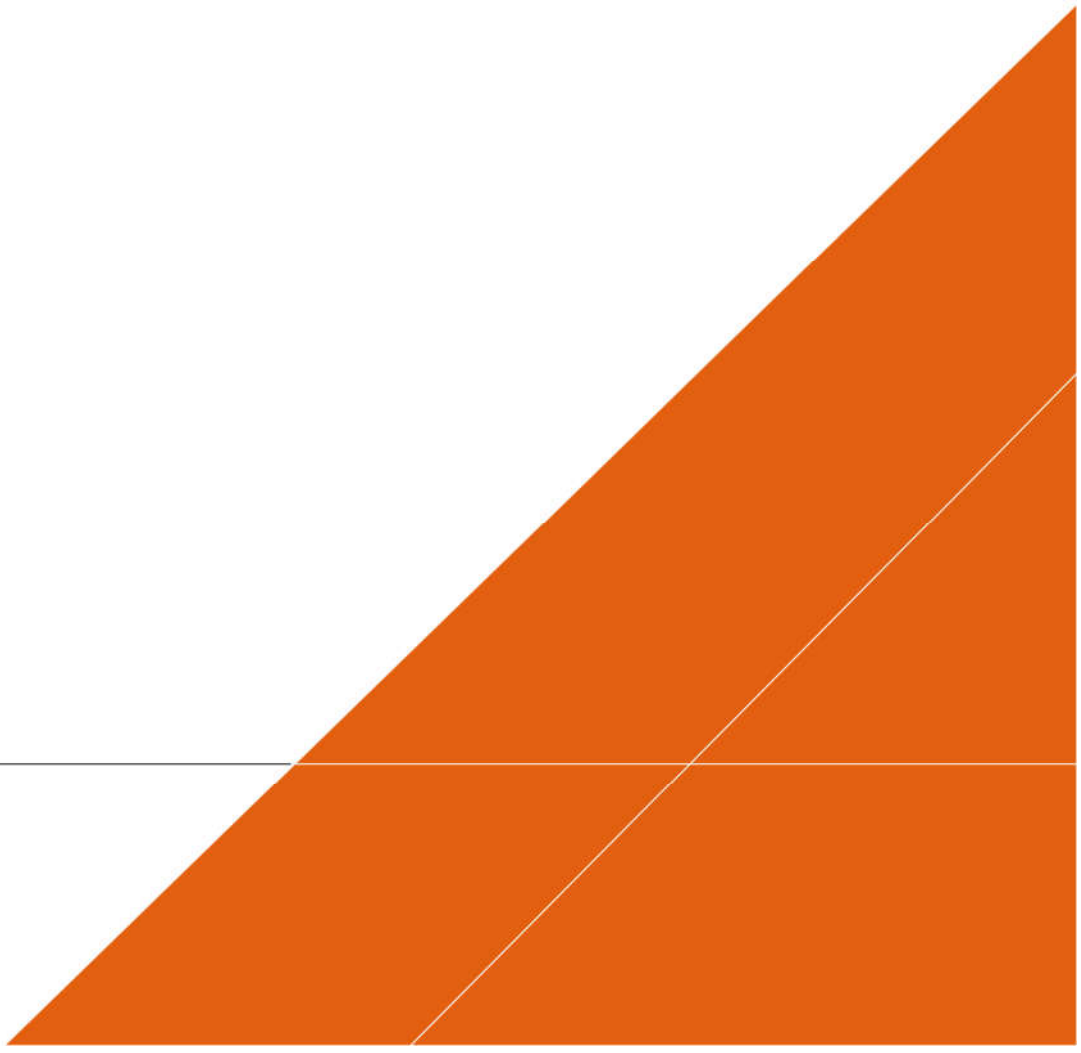
CAA REPORT

Heathrow Q6 Capex Efficiency Review

SEPTEMBER 2020



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EC HARRIS BUILT ASSET CONSULTANCY

Hyder

CONTACTS

JASON BUCKLAND
Aviation Business Consultancy
Director

m +44 (0)7818 525 930
e jason.buckland@arcadis.com

Arcadis.
Bernard Wetherill House
8 Mint Walk
Croydon CR0 1EA
United Kingdom

CAA Q6 Capex Efficiency Review Report

Author (s)	Gareth Thomas Jon Treece Nicky Jones Chris Mattock Piar Kahai
Checker	Theo Panayi
Approver	Jason Buckland
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Glossary

Abbreviation	Description
ALARP	As Low as Reasonably Possible
AOC	Airline Operators Committee
XXX	[redacted]
CAA	Civil Aviation Authority
CAPEX	Capital Expenditure
CCD	Cost Control Document
CEMAR	Contract Event Management and Reporting
DI	Delivery Integrators
EAC	Estimate at Completion
XXXX	XXXXXXXXX XXXXXXX XX
G3 G4	Governance Investment Decision Gateways
HAL	Heathrow Airport Limited
HLC	High-Level Controls
IDL	International Departures Lounge
IFS	Independent Fund Surveyor
ISG	Infrastructure Steering Group
L & L	Leadership and Logistics
MPR	Monthly Project Review
NCE's	Notified Compensation Events
NEC	New Engineering Contract
OHP	Overhead and Profit
PPR	Post Project Review
Q6	Heathrow Airport's 6th Regulatory Control Period (2014 – 2018)
QA	Quality Assurance
QSM	Quality Service Measure

RAB	Regulated Asset Base
SEB	Supplier Evaluation Board
T3IB	Terminal 3 Integrated Baggage
WBU	Western Baggage Upgrade
WI	Works Information

1 Introduction

Towards the end of each control period, the Civil Aviation Authority (CAA) carries out an assessment of Heathrow Airport Limited's (HAL's) performance in relation to the efficiency of its capital expenditure programme to support any decisions it makes relating to allowing or disallowing capital expenditure to be added to the RAB.

Arcadis has been asked by the CAA to advise on HAL's capital efficiency and in particular identify and estimate any inefficiency in a sample of HAL's capital projects during the Q6 regulatory control period.

The Q6 regulatory period at Heathrow ran from 2014 and was due to expire in December 2018. Following the Government's 2016 decision to support Heathrow expansion, the CAA extended the current Q6 regulatory period by one year, until 31 December 2019.

To ensure that the price control period remains aligned with the process of expansion, the CAA has since decided to further extend the Q6 period by two additional years, until 31 December 2021. The CAA is currently consulting on the methodology to be used for this further extension.

The CAA, in discussions with the airline community and HAL has selected ten projects to be reviewed as part of this process. It should be noted that Arcadis has not been involved in the selection process of the projects being assessed as part of the Q6 Capex Efficiency review.

The scope of this report is to test whether HAL has been efficient with their spending of CAPEX, on the selected projects, during the Q6 regulatory period to date. Arcadis has used its professional judgment to determine efficiency or inefficiency and our decisions will be based on the evidence and information that has been gathered and assessed as part of this review.

Arcadis' objectives were to engage with HAL, the IFS and Airlines, to review the projects identified by the CAA and, building on and furthering the work of the IFS, provide a transparent assessment of whether capital expenditure has been efficiently incurred.

Arcadis was asked to review the following projects identified by the CAA in three separate "Pots":

Pot 1a – IFS Assured Projects (completed)

- B051 - Terminal 3 Integrated Baggage (T3IB)
- B238 - Terminal 5 Western Baggage Upgrade (T5WBU)

Pot 1b – IFS Assured Projects (incomplete)

- B131 - Main Tunnel
- B131 - Cargo Tunnel

Pot 2 – Non-IFS Assured Projects

- B066 - Energy and Utilities Management – Supply
- B101 - Terminal 3 Pier 7 Main Roof Works
- B101 - Terminal 4 Rooflight Replacement
- B101 - Terminal 4 CPS1548 & CPS1918 -T4 Toilets & Finishes
- B316 - Terminal 3 Refurbishment & Enhancement – International Departures Lounge (IDL)
- B009 - Northern Perimeter Parking

The role of the Independent Fund Surveyor

During the Q6 period an Independent Fund Surveyor (IFS) has been employed on behalf of HAL and the Airlines to provide assurance on key capital projects. In its Capital Efficiency Handbook HAL states the objective of the IFS as being, "to provide an ongoing assessment of the reasonableness of all key decisions made on key projects and, in undertaking projects the capital is being used effectively to deliver the outcomes

determined by the business case". In carrying out its review of the specified projects Arcadis have proceeded, where applicable and appropriate, to build on and further the work already done by the IFS.

Note: The price base for the figures contained within this report are nominal and as reported at the time of undertaking the review. These numbers have not been adjusted to consider inflation or where there have been further updates to the prices based on subsequent amendments from HAL or where projects are still on-going.

2 Executive Summary

Arcadis has been asked by the CAA to advise on HAL's capital efficiency and in particular identify and estimate any inefficiency in a sample of HAL's capital projects during the Q6 regulatory control period. The scope of this report is to test whether HAL has been efficient with their spending of CAPEX, on the ten selected projects, during the Q6 regulatory period to date.

Key findings:

- Seven of the selected ten projects reviewed have been delivered efficiently.
- Potential inefficiency in two projects (B051: T3 Integrated Baggage and B238: T5 Western Baggage Upgrade) has been identified and HAL's actions may have contributed to this however this is hard to quantify or easily attribute.
- Potential inefficiency has been identified in one project (B131 – Cargo Tunnel). There is clear evidence that the actions of HAL may have directly contributed to a financial or benefits loss.

Towards the end of each price control period, the CAA carries out an assessment of HAL's performance in relation to the efficiency of its capital expenditure programme to support any decisions it makes relating to allowing or disallowing capital expenditure to be added to the RAB.

Arcadis has been appointed by the CAA to provide technical advice in support of their end of control period assessment of HAL's performance in relation to the efficiency of the capital expenditure programme. Arcadis' scope of work has been to capture and analyse data and information regarding the selected projects delivered as part of the Q6 regulatory period to provide assurance to the CAA that the use of capital expenditure by HAL through the Q6 regulatory control period has been efficient.

The CAA, in discussions with the airline community and HAL has selected ten projects to be reviewed as part of this process. It should be noted that Arcadis has not been involved in the selection process of the projects being assessed as part of the Q6 Capex Efficiency review.

In undertaking this review, Arcadis has assessed whether the selected projects have been delivered efficiently or potentially inefficiently and set out the reasoning behind these conclusions. This report does not set out to determine the quantum or value of any inefficiency however, it will support the CAA to focus any further analysis as part of the Q6 review workstream.

Arcadis process when undertaking review

2.1 Defining Efficiency

The starting point for the review was to set a definition of efficiency that could be used to assess HAL's Capex expenditure performance across the Q6 projects selected for review by the CAA. All well run projects will have a set of criteria (or factors) that, if managed appropriately, will usually result in a project being delivered efficiently. These are the project:

- Scope
- Time
- Cost

- Risk
- Gateway Process
- Procurement
- Programme Governance
- Development Process
- Stakeholder Engagement

HAL's Capital Efficiency Handbook (April 2015) is intended to act as a reference source providing detail and guidance to those involved in the Heathrow Gateway Lifecycle process. The Handbook has set out a clear definition of both efficient and inefficient Capex:

- **Efficient Capex** is the delivery of an asset in a manner which optimises and balances scope, time, cost, and risk, procured in an appropriate manner having followed a structured Development Process with appropriate decision points and governance.

- **Inefficient Capex** is the delivery of an asset in a manner which significantly fails to balance scope, time, cost, and risk, or which is procured in an inappropriate manner or has failed to follow a structured Development Process with appropriate decision points and governance; and which has directly resulted in a financial or benefit loss.

Arcadis has considered other examples of capital efficiency assessment and referenced HAL's approach against other examples of best practice including the work undertaken by the Transport Infrastructure Efficiency Taskforce in December 2017 in publishing its Transport Infrastructure Efficiency Strategy.

Arcadis has not constrained its view when assessing the capital efficiency of the selected projects on just the content of the HAL Capital Efficiency Handbook (April 2015) but concludes that definitions of efficiency and inefficiency contained within this document reflect the efficiency criteria required to effectively manage and govern projects.

2.2 Factors Impacted by efficiency

As part of this review, Arcadis has focused on the factors (levers) that influence the efficient delivery of a project. These factors, although not explicitly described are also used in HAL's own definition of efficiency set out in 2.1. These factors are the project:

- **Project Brief** that states the objectives and intended benefits of the project
- **Scope** that determines and documents the specific project goals, deliverables, tasks, costs and deadlines;
- **Time** where a timeline is developed for the completion of a project or deliverable;
- **Cost** that considers the total funds needed to complete the project or work that consists of both Direct Cost and Indirect Cost;
- **Risk** where an uncertain event or condition that, if it occurs, influences at least one project objective;
- **Procurement** which involves obtaining all of the materials and services that are required for the project ;
- **Development processes** which is the planning, organizing, coordinating, and controlling of the resources required to accomplish specific goals;
- **Gateway process** which is a project assurance methodology designed to support the effective development, planning, management and delivery of projects, services and programs;
- **Programme governance** that oversees multiple projects and includes approval gates at which viability is reviewed and approved; and
- **Stakeholder engagement** where interacting with and influencing project stakeholders to the overall benefit of the project takes place.

Arcadis, as part of its review, assessed how HAL has dealt with these factors across the selected Q6 projects and has sought to determine whether this has potentially resulted in any financial or benefits loss as an outcome of HAL's inefficient project delivery. There are factors within any project that may not be delivered 'as planned' however those in themselves may not result in an inefficiency at the end of the project. The key to this review was to consider how HAL has delivered these projects and to determine whether their actions are the cause of any potential inefficiency.

2.3 Understanding HAL's Actions

The first phase in understanding HAL's actions was to undertake a detailed review of the project and to run through the key documentation associated with its delivery. This supported the development of a chronology of events with key issues that potentially impacted on the project and set out HAL's actions in relation to the delivery of the project.

The second phase was to undertake interviews with the individual(s) involved in delivering the project or who had detailed knowledge of the project from HAL. In addition, where the IFS were involved, separate interviews were undertaken to ensure as much of the first phase information and understanding was validated and discussed.

Finally, a meeting was held with the representatives of the Airline community to understand their position on the delivery of the selected projects. The aim being to gather the Airline community perspective on how they thought the selected projects had been delivered.

2.4 Reviewing the Impact

Having gathered the evidence relating to the selected projects, Arcadis has reviewed this in relation to the definition of efficiency as set out in 2.1 above and used the information provided, both written and through the interview process, to assess whether HAL has delivered either an efficient or inefficient project.

Arcadis has shared its draft findings with HAL, the IFS and Airline community for comment and where any factual inaccuracies have occurred, Arcadis has then corrected these and reviewed the conclusions considering any changes. These have been incorporated into this final version of the report.

2.5 Summary of Project Costs

The table below sets out the last approved budget, the final or forecast cost and any variance between these two numbers. The last approved budget is the budget that has been agreed by HAL with the airline community. The final cost is the outturn cost of the completed projects. The forecast cost is used on projects that are yet to be completed at the time of this review.

Project	Last Approved Budget £m	Final Cost £m	Forecast Cost £m	Variance £m
B051: T3 Integrated Baggage	92.2	136.1	-	43.9
B238: T5 Western Baggage Upgrade	20.7	25.9	-	5.2
B131: Main Tunnel Refurbishment	86.0	-	146.3	60.3
B131: Cargo Tunnel Refurbishment	44.9	-	197.0	152.1
B066: Energy & Utilities Management	51.3	48.2	-	3.1
B101: T3 Pier 7 Roof Works	29.9	29.7	-	0.2

B101: T4 Rooflight Replacement	13.1	11.3	-	1.8
B101: T4 Toilets & Finishes	14.5	15.2	-	0.7
B316: T3 IDL Refurbishment & Enhancement	18.6	18.5	-	0.1
B009: T5 Northern Perimeter Parking	3.1	4.9	-	1.8

2.6 Efficiency Determination

The table below sets out Arcadis' determination on whether the project was delivered efficiently or inefficiently. Arcadis has set out the main conclusion it has drawn from its review in the table below, and there is a detailed analysis of every project set out in the review section of this report that explains Arcadis' determination.

Project Name	Delivered efficiently* or potential inefficiency identified?	Review Conclusion
B051 - Terminal 3 Integrated Baggage (T3IB)	Potential inefficiency identified	The lateness and content of the major variation on the project would lead us to consider there had been a degree of inefficiency on the part of HAL in dealing with the issue. Quantifying to any extent what HAL could have done, by way of earlier identification of scope, is extremely difficult. The unknown complexity of the project has made it difficult to appreciate when clarity of scope became obvious. Arcadis could not establish, definitively, whether any inefficiency on the part of HAL led to any capital inefficiency. It is difficult to demonstrate that HAL paid more for the works than they reasonably should have. There is insufficient evidence for a firm conclusion that the project was inefficient, however Arcadis has not been convinced that the project was delivered efficiently.
B238 – T5 Western Baggage Upgrade (T5WBU)	Potential inefficiency identified	On the first of the two stoppage issues on the project it would appear the underlying cause of the issue was supplier performance and XXXXXXXXXX's inability to adequately resource the project. Arcadis can find no evidence of HAL directly contributing to the cause of the issue. HAL's actions were in mitigation of the impacts. The circumstances and impacts surrounding the second postponement are not so clearly identifiable. It would appear the cause for the need to defer was an increase in risk to airline operations as a result of changes introduced by the airlines to their existing schedules and further complications with the delivery of the new baggage system. There is insufficient evidence for a firm conclusion that the project was inefficient, however Arcadis has not been convinced that the project was delivered efficiently.
B131 - Main Tunnel	Efficiently delivered	In reviewing HAL's procurement of XXX and the project's state of readiness to proceed, on the balance of the information reviewed, Arcadis consider it was fit to do so. In relation to XXX's poor performance throughout the period 2015 and early 2016, Arcadis would consider HAL did

		everything that could reasonably have been expected to mitigate the impacts. Arcadis considers the removal of the Cargo Tunnel scope and change in the form of contract to have been the correct course of action. The assessment of XXX's contract price at £XXXm for the Main Tunnel was appropriately calculated and is not considered inefficient. From the period post the Deed of Amendment HAL did everything that could reasonably have been expected to mitigate the impacts of the contractor's poor performance. In summary Arcadis would consider the project to have been properly and efficiently managed during the periods pre and post the Deed of Amendment and HAL did not contribute to capital inefficiency.
B131 - Cargo Tunnel	Potential inefficiency identified	In recommencing the project, and with reference to the significant variance between budget and solution, HAL made no attempt to gain any form of alignment. HAL progressed the project with little chance of making any meaningful savings and without setting any realistic cost limits for which the design team to work within. Throughout 2017 and early 2018, as the design progressed, there is still no evidence of HAL having introduced any form of structured, meaningful cost limits for the design team to work within. In addition to the budget, there appears to have been no ongoing review of the forecast schedule duration. In summary, Arcadis considers the project not to have been properly and efficiently managed post the period of re-commencement to stand-down and as a consequence there being an element of capital inefficiency that is likely attributable to HAL.
B066 - Energy and Utilities Management – Supply	Efficiently delivered	Due to safety concerns the project was commenced when levels of risk and uncertainty of scope were high. Despite this, it was delivered under budget and in accordance with the planned schedule. Management in all areas of project performance was shown to be good. Arcadis considers that value for money was achieved and that the project was well managed throughout and delivered efficiently.
B101 - Terminal 3 Pier 7 Main Roof Works	Efficiently delivered	Following commencement of the project it was ascertained that the roof structure was not as initially envisaged, and areas of paintwork contained asbestos. Both of these issues impacted on the cost of the project. Arcadis are satisfied that the late discovery of the above did not result from a lack of pre-work and that they were managed effectively. Management in all areas of project performance was shown to be good.

		Ultimately the project was delivered under budget but several months late. Arcadis considers that value for money was achieved and that the project was well managed throughout and delivered efficiently.
B101 -Terminal 4 Rooflight Replacement	Efficiently delivered	Management in all areas of project performance was shown to be good. The project was ultimately delivered under budget and slightly early. Arcadis considers that value for money was achieved and that the project was well managed throughout and delivered efficiently.
B101 - Terminal 4 CPS1548 & CPS1918 -T4 Toilet & Finishes	Efficiently delivered	Two issues had a detrimental effect on the final outturn costs; IT scope that had not been identified, and a specification change that was discovered late in the project. The latter led to a need to change fittings (not sanitary ware) extending the handover. Management in all other areas of project performance was shown to be reasonable. The overall project was ultimately delivered slightly over budget with the Toilets slightly late. Arcadis view the issues with IT and specification changes were foreseeable. The element of extra work involved with the change of fittings although abortive, the value of the works would not categorise the overall project as being inefficient.
B316 - Terminal 3 Refurbishment & Enhancement – IDL	Efficiently delivered	The discovery of asbestos and issues with the floor both impacted on the project. However, due to limited opportunity to conduct intrusive surveys in an operational area it is not a reflection of inefficient management of the project. Management in all areas of project performance was shown to be good. The project was ultimately delivered under budget and slightly late. Arcadis consider that value for money was provided and that the project was well managed throughout and delivered efficiently.
B009 – Northern Perimeter Parking	Efficiently delivered	Unforeseen ground conditions had a significant cost impact on the project as only a visual survey was carried out prior to the commencement of the works. The reason for this is understandable under the circumstances and HAL have taken this on board as learning. Due to scheduling issues with the Contractor the contract was amended to a fixed price form which benefited the project by way of providing cost certainty. Management in all areas of project performance was shown to be reasonable. The project was ultimately delivered over budget and later than initially planned, however Arcadis consider that value for money was achieved and that the project was adequately managed throughout.

*Based on the definition of efficiency contained within the Capital Efficiency Handbook (April 2015)

2.7 Common Issues

From our review of the projects the following factors were seen to have negatively contributed to their outcomes:

Lacking Clarity of Scope

For all of the four major projects in Pot 1 and three of the Pot 2 projects there would appear to have been a lack of definition of scope at the time of HAL entering into contract with its contractor. This may have contributed to the cost and time overruns on these projects. There is evidence of significant extra scope having been required to be instructed into these projects by HAL which, had more detailed development work been carried out, would have been known about earlier in the project lifecycle and initially budgeted for in the project brief and business case.

Inappropriate Contract Model

Across the majority of the projects reviewed, HAL's chosen form of contract has been the Target Cost Option C form with a Contractor favourable pain/gain mechanism. In the case of T3IB, An Option E Cost Reimbursable type of contract was used for part of the delivery. In its adopted form it is clear that the contracts used did not incentivise the Contractors to the degree required, and, other forms, or different pain/gain structures, might have been better suited. Proof of this is self-evident from three of the projects, B238 – T5 Western Baggage Upgrade, B131 – Main Tunnel and B009 - Northern Perimeter Parking reviewed which had their contracting basis changed during the course of the works. There is clearly a need for a more considered approach to contract selection based more around project maturity and levels of risk.

2.8 Next Steps / Further Considerations

Arcadis' review can assign the ten projects assessed as part of this review into three categories:

- Delivered efficiently;
- Potentially delivered inefficiently but inefficiency difficult to quantify or easily attribute; and
- Potentially delivered inefficiently with clear evidence that HAL's actions have directly led to this outcome.

Arcadis has determined that seven of the ten projects have been delivered efficiently. This is not to say that there were no delays, over-runs or issues within these projects but the impact of these is not considered substantial enough to have delivered a financial or benefits loss to customers due to the actions of HAL.

Arcadis does not recommend that any further analysis or investigation is required on these projects.

Potential inefficiency in two projects (B051: T3 Integrated Baggage and B238: T5 Western Baggage Upgrade) has been identified. Arcadis considers that HAL's actions may have contributed to this however this is hard to quantify or easily attribute. The issues surrounding this determination are set out more fully within the individual project reviews contained in section 4 of this report.

Potential inefficiency has been identified in one project (B131 – Cargo Tunnel). There is clear evidence that the actions of HAL may have directly contributed to a financial or benefits loss. Arcadis is aware that a further report has been produce by the IFS (December 2019) relating to this project however the main findings of this report do not alter with regard to the determination on efficiency.

Arcadis considers the work carried out on this project between Q2 2017 to Q2 2018 as inefficient. The £12.25m identified for design and on-costs associated with the design should be included within the inefficiency range.

In addition, the Stand Back Review cost of £0.49m, should also be considered within the context of any inefficiency range. We consider the £12.25m to be the main element of inefficient spend and the inclusion of the Stand Back Review of £0.49m as an additional inefficiency spend to create a value at the high end of the inefficiency range of £12.74m.

Where Arcadis has highlighted potential inefficiency, the CAA will need to undertake further analysis of these projects to determine the quantum and value of this inefficiency to take into account the range of inefficiency identified. This analysis will require a more detailed and potentially forensic financial analysis of the projects to assign a cost value to this inefficiency.

A further consideration outside of this review and looking beyond the Q6 regulatory period is whether the CAA develops its own definition of efficiency (and therefore inefficiency) which it can then assess and test HAL's CAPEX spend against. Although HAL did produce its own Q6 Capital Efficiency Handbook in April 2015, in consultation with the airline community, there may be merit in the CAA developing its own definition and 'tests' in line with industry best practice for the future.

3 Assessment Methodology

Arcadis has been asked by the CAA to advise as to whether HAL has been efficient in how it has spent Capital Expenditure (CAPEX) during the Q6 regulatory control period. The first element of this advice is to set out a clear definition of efficiency so that, when examining the projects given to Arcadis to assess by the CAA, Arcadis has a definition it is assessing these against.

3.1 Defining Efficiency

The starting point for the review was to set a definition of efficiency that could be used to assess HAL's Capex expenditure performance across the Q6 projects selected for review by the CAA. All well run projects will have a set of criteria (or factors) that, if managed appropriately, will usually result in a project being delivered efficiently. These are the project:

- Scope
- Risk
- Gateway Process
- Time
- Procurement
- Programme Governance
- Cost
- Development Process
- Stakeholder Engagement

HAL has produced the Capital Efficiency Handbook (April 2015). The Handbook is intended to act as a reference source providing detail and guidance to those involved in the Heathrow Gateway Lifecycle process and is a companion document to both the Q6 Capital Investment Triggers Handbook, and the Capital Protocol. The vision of the Handbook was to '*Optimise the use of capital to create valued benefits, making Heathrow successful for all, through visible and measurable improvements*'.

The Handbook has set out a clear definition of both efficient and inefficient Capex:

- **Efficient Capex** is the delivery of an asset in a manner which **optimises and balances** scope, time, cost, and risk, procured in an appropriate manner having followed a structured Development process with appropriate decision points and governance

- **Inefficient Capex** is the delivery of an asset in a manner which significantly **fails to balance s**cope, time, cost, and risk, or which is procured in an inappropriate manner or has failed to follow a structured Development process with appropriate decision points and governance; and which has directly resulted in a **financial or benefit loss**

Arcadis has considered other examples of capital efficiency and referenced HAL's approach against other examples of best practice including the work undertaken by the Transport Infrastructure Efficiency Taskforce in December 2017 in publishing its Transport Infrastructure Efficiency Strategy.

Arcadis has not constrained its view when assessing the capital efficiency of the selected projects on just the content of the HAL Capital Efficiency Handbook (April 2015) but concludes that definitions of efficiency and inefficiency contained within this document reflect the efficiency criteria required to effectively manage and govern projects.

3.2 Factors Impacted by efficiency

As part of this review, Arcadis has focused on the factors (levers) that influence the efficient delivery of a project. These factors are also set out in HAL's own definition of efficiency and are scope, time, cost, risk, procurement, development processes, gateway process, programme governance and stakeholder engagement.

It is Arcadis' view that there is no project, even the most meticulously planned, that does not experience some form of issue that can influence the efficient delivery of a project. The purpose of the review was to identify the factors being influenced within each of the projects and to determine whether HAL dealt with these factors appropriately so as to limit or remove their influence in the efficient delivery of the project. There will have been some influences on a project that were outside of HAL's control and these have been taken into account when concluding the review.

In assessing how HAL has dealt with these factors across the projects, Arcadis has sought to determine whether this has resulted in any financial or benefits loss, an outcome of inefficient project delivery.

3.3 Information and data gathering

Arcadis has sought to gather information from HAL and the IFS where appropriate and it should be noted that both HAL and the IFS have been cooperative in supplying the information requested by Arcadis.

Aligned to the scope of the Q6 Capex Efficiency Review, Arcadis submitted formal information requests to HAL and the IFS to gather data and supporting evidence necessary to inform our analysis and to advise the CAA.

A summary of the information requested is as follows:

- Business case and supporting documents presented at Gateway reviews;
- Main Contractor contract documentation;
- Deeds of Amendment to above;
- Specified Project Team Monthly Progress Reports;
- Latest published Benefits Realisation Plans;
- IFS Project Monthly and Commissioned Reports;
- Various subject specific documents.

Full details of documentation requested is included in Appendix A.

Arcadis notes that whilst the majority of the information has been provided, some documents remain outstanding and have not formed part of our analysis and assessment. In addition, the date and timing of this information becoming available, in places, has imposed constraints on the level and depth of the Arcadis review.

Arcadis' report seeks to provide an appropriate review and analysis of the information that was made available and Arcadis has referenced those documents reviewed throughout this review. For the benefit of familiarisation and context other publicly available documents on both HAL's and the CAA's websites have also been reviewed.

3.4 Stakeholder Engagement

In addition to the review of documentation, Arcadis has initiated ongoing engagement and meetings with HAL, the IFS and the Airline Operator Committee (AOC) IFS Co-ordinators.

These meetings were undertaken to obtain further relevant information and to gain a clearer understanding of how each project progressed through its lifecycle and to understand the changes to the planned deliverables which took place during that time. Where relevant, comment received from those meetings has been used in the preparation of this report.

The following meetings and workshops were held with HAL, the IFS and the AOC:

Date	Description	Attendees
3 June 2019	HAL Introduction: • Confirmation of scope • Information gathering • Methodology	• CAA • HAL • HAL • Arcadis • Arcadis
24 July 2019	Pot 1a IFS review • T3IB	• Arcadis • Arcadis • IFS
29 July 2019	Pot 1a IFS review • T5WBU	• Arcadis • Arcadis • IFS
18 July 2019	Pot 1b IFS review • Main Tunnel • Cargo Tunnel	• Arcadis • Arcadis • IFS
13 August 2019	Pot 1a HAL review • T3IB	• Arcadis • Arcadis • HAL • HAL
15 August 2019	Pot 1a HAL review • T5WBU	• Arcadis • Arcadis • HAL • HAL • HAL
6 September 2019	Pot 1b HAL review • Main Tunnel	• Arcadis • Arcadis • HAL • HAL • HAL
6 September 2019	Pot 1b HAL review • Cargo Tunnel	• Arcadis • Arcadis • HAL • HAL • HAL
8 August 2019	Pot 1 Airlines review	• Arcadis • Arcadis

		• Airlines • Airlines
1 August 2019	Pot 2 HAL review • Energy & Utilities Management	• Arcadis • Arcadis • HAL • HAL • HAL
30 July 2019	Pot 2 HAL review • T3 Pier 7 Main Roof works	• Arcadis • Arcadis • HAL • HAL
8 August 2019	Pot 2 HAL review • T4 Rooflight Replacement	• Arcadis • Arcadis • HAL • HAL • HAL
8 August 2019	Pot 2 HAL review • T4 Toilets & Finishes	• Arcadis • Arcadis • HAL • HAL • HAL
7 August 2019	Pot 2 HAL review • T3 Refurbishment & Enhancement - IDL	• Arcadis • Arcadis • HAL • HAL • HAL
15 August 2019	Pot 2 HAL review • Northern Perimeter Parking	• Arcadis • Arcadis • HAL • HAL • HAL

Arcadis would note that the meetings with HAL, the Airlines and the IFS have been of a productive nature and the exchange of information and response to queries direct and forthcoming.

4 Q6 Selected Project Reviews

4.1 Approach

4.1.1 IFS Assured Projects (Pots 1a & 1b)

For those IFS monitored projects Arcadis' approach in reaching a view on efficiency has been to build on the work already undertaken by the IFS. In their assurance of capital delivery against the Capital Efficiency Handbook the IFS has prepared reports both on a periodic, generally monthly basis, and also specifically to cover areas of particular concern.

Having reviewed these reports, Arcadis considers them to sufficiently cover those aspects of performance that would be expected in relation to capital efficiency, they are well founded and thorough. There would be no justification for Arcadis carrying out additional work to verify the findings made by the IFS in these reports.

Within their reports the IFS has identified and discussed specific issues relating to the non-delivery of planned project outcomes, amongst these being programme overruns, cost increases and non-delivery of benefits. Whilst explanations are to a large degree provided for these diversions from plan, it is within these specific areas that Arcadis has focussed our attention and interrogated more closely for the purposes of this review.

Arcadis has set out its findings in the following chapters:

- Overview;
- IFS work to date;
- Chronology (Where appropriate);
- Commentary on information, and;
- Conclusion.

4.1.2 Non-IFS Assured Projects (Pot 2)

The principal source of information used for reviewing the Pot 2 Projects was HAL's 'Post Project Review' (PPR) document. In addition to this, Arcadis requested and has used other documents including the relevant business case and gateway documents.

The purpose of the PPR is to evaluate how the project has performed against delivering its objectives and its performance in key areas of control e.g. safety, cost, time, quality, etc. it also captures key areas of learning for the business to take forward on delivery of future projects.

Arcadis considers the PPR document to provide considerable benefit and the output report has been a good source of information for our review. Having reviewed the above documents, project specific queries were scheduled and issued to HAL in advance of project specific review meetings.

At our meetings with HAL, Arcadis reviewed and discussed responses to queries including further documentation provided in support of these.

In addition to our queries a review was carried out on how the project had performed against recognised areas of project control, and documentary evidence to demonstrate compliance with good practice was requested to be available for inspection at the meetings. The key areas of focus and the format in which Arcadis has presented its findings in this report comprise the following:

- **Scope definition, procurement and contract strategy** - to include the scope presented at Governance Investment Decision Gateway (G3) (Cost plan or benchmarking report) and the Project Procurement Plan
- **Schedule management** – to include the schedule narrative report issued in response to the Contractor's submitted monthly schedules for acceptance

- **Contract management** - administration of the contract to include extracted schedules from the Contract Event Management and Reporting (CEMAR) system of the Contractor's compensation events, early warnings, notifications of compensation events, submitted quotations and accepted compensation events
- **Risk and Opportunities management** – to include examples of the status of the register at the project start, middle and end
- **Change management** (Client and Contract) – to include Client Change Request Sheet (CCRS) register and Monthly Progress Review (MPR) or other report
- **Commercial management**:
  - Benchmarking – to include G3 Gateway Cost Plan, G3 Should Cost Estimate, G3 Value for Money Report;
  - Estimating / Cost forecasting – To include reference to Monthly Progress Review reports (or other equivalent);
  - Value engineering examples where available;
  - Cashflow management – To include reference to Monthly Project Review reports (or other equivalent); and
  - Final account agreement – To include the Summary of Final Account and signed Statement.
- **Benefits management** – Planned v Delivered with explanation for variance
- **Stakeholder management** – To include the Stakeholder Management Plan
- **Governance**
- **Conclusion**

4.2 Pot 1a: Terminal 3 Integrated Baggage System (T3IB)

4.2.1 Project Overview

Project Background:	The T3 Integrated Baggage Project has been in process for a number of years and commenced on site in 2012. It was included within the Q5 CIP at £234m. At the start of Q6 the budget had increased to £435m and shortly afterwards the Project reported a £43.8m increase in cost and 3-month delay.
Q5 Overview:	
Business Case	Designed to provide a modern, highly automated baggage system for T3 carriers, which integrates with T5 to provide quick and reliable baggage transfers.
Project Scope (Q5 & Q6)	Construction of a new 'Main Building' incorporating baggage sortation, screening and make up capability. T3 cut in works to enable connection of the new baggage feed lines from the new Integrated Baggage Facility into the existing operational system. All Transfer bag feed lines into and out of the systems including the T5 Baggage System.
Development Budget and EAC: Q5 - Q6	Included within the Q5 CIP at £234m. In March 2012 the Estimate at Completion (EAC) increased to £360m, and in June 2013 increased to £435m.
Project Manager	HAL
Designer	Main Building: XXXX Baggage: XXXXXXXXX XXXXXXXXX
MSP	XXXXX
Main Contractors	Main Building: XXXXXXXXX XXXXXXX Baggage: XXXXXXXXX XXXXXXXXX
Q6 Overview (Remaining works):	
Project Scope: (Q6)	Completion of Main Building T3 cut in works to enable connection of the new baggage feed lines to the new Integrated Baggage Facility. All transfer bag feed lines into and out of the systems including the T5 Baggage System and other terminals via the WIB.
Development Budget and EAC: Q6	£92.2m (out of £435m EAC at end of Q5) remaining spend at start of Q6. In December 2014 the remaining spend increased by £43.9m £136.1m (EAC increasing to £478.9m).
Project Manager	HAL
Designer	Baggage: XXXXXXXXX XXXXXXXX
MSP	XXXXXX

Main Contractors	Baggage: XXXXXXXXX XXXXXXXXX Minor & Existing Building Works: XXXX
Building Contracts	Heathrow Works Contract (NEC) with Main Option C - Target Cost
Main Contract Sums	Progressively increased
Construction Programme	Main Building is November 2014, cut in works to existing T3 baggage hall (principal work for Q6) is December 2015, and overall Completion is May 2016

4.2.2 IFS Work to Date

Governance for the T3IB project took place during the early part of the Q5 regulatory period with works commencing during 2012. At the start of the IFS' involvement on the project at the beginning of the Q6 the works had substantially progressed.

The IFS's role commenced with the preparation of an 'Initial Review' (Ref. 10000-XX-EC-XXX-000TBC) dated 19 September 2014. This commented on the then current status of the project and its readiness for delivering the remaining scope in Q6.

Monthly reports commenced in August 2014 the content on these focussing on key aspects determining the project's state of health.

In October 2014 the project reported a 3-month delay to programme and a £43.8m cost increase. As a consequence, the IFS were instructed to carry out a review of the schedule and cost increases. This was subsequently reported in their 'Variation Review' (Ref. 10000-XX-RP-XXX-003104) dated 7 October 2015.

On the 15 June 2017 the IFS published their 'Project Close out Report – T3 Integrated Baggage - Q6 Scope'. This provides a summary of the project's performance against key areas of control throughout the Q6 delivery period.

4.2.3 Commentary on Issues Identified

As of March 2014, the T3IB project was reporting an EAC of £434.2m against a budget of £435m. Of this total the value of works to be completed in Q6 amounted to £92.3m, with the project forecasted to be complete in December 2015. The works comprised:

- Completion of the 'Main Building', a new separate facility containing the baggage sortation, screening and make up capability;
- Delivery of the cut in works for the existing Terminal 3 baggage hall connecting the new system to the existing check in;
- All transfer bag inputs into and out of the systems including the Terminal 5 baggage system and tunnel via the Western Interface Building.

In beginning to review the efficiency of the project during the Q6 period Arcadis has considered those major issues, below, known to have impacted the project:

October 2014 'Variation'
At the October 2014 Capital Programme Board (CPB) meeting HAL advised of an increase of £43.8m, (subsequently reduced to £43.3m due to error) to the project EAC and a delay to the delivery stage of

approximately 3 months. Reference to the event as a 'variation' is somewhat misleading as it is made up of a number of separate issues that relate to both existing and new scope.

From information provided by HAL the IFS in its 'Variation' review has analysed the costs under the following four categories:

- £12.3m Prolongation: costs associated with the 3-month delay to completion,
- £14.3m Price growth: relates to price increases for existing scope,
- £16.3m Product Robustness Activities (Risk Reduction): additional testing and commissioning and operational support in order to assure the product as it was taken into operation,
- £0.4m Enhanced Scope: costs associated with additional scope.

Prolongation
Whilst more than one issue affected the schedule in causing the delay, by far the main source lies in the extended duration taken by [redacted] to develop and install the software. This had a consequential impact on the rest of the schedule. This was a supplier performance issue and would appear to be generally accepted as such. HAL have confirmed that this is not a scope change.

Price Growth
Making up the majority of the increase under this heading is the [redacted] High Level Controls scope at £[redacted]m. It is understood that HAL had been aware of the increase for some time but had not reported figures until they had a more reliable assessment of cost. A further £[redacted]m is set against [redacted] 'design development costs' and 'additional constraints' work within the existing baggage Hall. The balance is made up of [redacted] works and HAL direct costs.

Product Robustness Activities
Of the product robustness costs circa £[redacted]m relates to increased scope for [redacted] in order to reduce risk on transition to operations. This includes £[redacted]m of additional scope added to safeguard operations, £3.5m of additional testing activity to enhance security of operational transition, and £[redacted]m for [redacted] 'Hyper-care' transition support resources. Other costs include HAL direct costs at circa £1.3m and HAL IT costs at £1.8m. The balance is made up of other additional works, risk and consultant fees. Arcadis would note the view of the IFS on this category of increases whereby, in their 'Variation Review' report (referenced above), they state;

"these product robustness activities and related costs should have been identified earlier allowing more time to plan integration with existing scope and achieve commercial agreement of impacts".

Enhanced Scope
Whilst at a summary level the increase in cost is shown as £0.4m, the total value is £4.8m which is offset by £4.4m of risk and the cost of scope - journaled out of the project. The larger element of cost increase under this heading is a sum of £[redacted]m for additional [redacted] scope in the Existing Baggage Hall in order to improve the baggage system design. Arcadis would consider that this type of activity could have also been identified earlier in the project.

Commentary
In reviewing the extent to which the above 'variation' may be considered inefficient it is worth reflecting on the overall size of the change and its timing in relation to being introduced into the project scope.

The £43.3m represents some 47% of the total Q6 spend. This is a considerable amount of work not to have been known about until circa 6 months before the works were due to be completed. Reference to the above commentary, on the build up to the costs, points to Arcadis's and the IFS's view that a significant amount of this work should have been known of well in advance of the variation and planned for and delivered in a more organised and efficient manner.

At a meeting with HAL and the IFS the complexity of the project was discussed at length. It was explained that the development and introduction of the software was extremely pioneering and little experience, if any, of how it was to be delivered actually existed. Reference was also made to the fact that the work proved extremely difficult even for HAL's highly recognised baggage designer. Counter to this, the implications of this could have been allowed for by way of risk provisions earlier on in the project programme.

Also discussed with HAL was the requirement for additional product robustness activities relating to additional testing and commissioning and operational support. HAL view the requirements as having arisen for two reasons;

- The need to integrate a much more complex system into the operation,
- A general raised awareness by HAL and the airlines of the risk to the business surrounding the integration of new baggage systems into the existing operation.

It is noted from the build up to the variation estimate that the costs are very much high-level budget figures based on limited scope information. Arcadis is also aware that as the project progressed the scope associated with the estimate reduced whilst additional scope was identified. The cost of this additional scope was then covered by way of savings made from the £43.3m. It would appear that HAL developed and deployed the estimate in parallel with the continued delivery of the project, as opposed to having a structured definition of scope and procurement route. Arcadis considers that had the works been identified earlier it would have allowed more time for their integration into the project at a potentially lower cost.

It is generally recognised that the work proved to be a great deal more difficult than was initially anticipated. The extent to which this should have been known of in advance and planned for, and therefore the extent to which the three-month delay might have been lessened, is extremely difficult to assess.

Further Impacts
Subsequent to the above variation the project progressed in line with the target March 2016 completion date up until February 2016. At this point it became clear that further issues had come into play combining to drive a further circa 8 weeks delay. The completion date then moved from March to June 2016. In their Project Close Out Report the IFS notes the following as two examples of these further issues:

- Changes to the airline handler mix in the T3IB Facility
- Risk profile for phased delivery of works in existing areas

In relation to the airline handler mix, two airlines changed handlers at the start of 2016. Whilst it is common for airlines to do this the lateness of the change caused more of an impact than it would have had it occurred earlier in the programme. As a result of this change in handlers there was a need to change the physical layout of the floor space and a need for additional time to train the associated staff. The issues were reported to have caused a 3.5-week delay.

The risk profile for the phased delivery of the works relates to the restriction of access to existing occupied areas. The works were planned to be completed in five distinct consecutive phases, with access to a following area not permitted until completion of the former. In the event of any issues being encountered this limited the extent of any recovery action. An example of an issue encountered was the late discovery of a manhole that had to be dealt with before the works could proceed.

The cost implications of these later issues were compensated for by way of savings made against the budgeted costs contained within the major variation above. However, this has prevented realised savings from being returned to the business at least in part due to the actions of the airlines involved.

It is difficult for Arcadis to assess the degree to which issues such as the above could have been allowed for by way of risk allowances.

It is relevant to note that the basis of the main contracts was Target Cost Option C. This is a cost reimbursable form of contract employing a pain/gain mechanism dependant on whether the contractor's actual cost falls over or under the Target. On this particular contract the Contractor's pain threshold was limited to [redacted]% of the target cost up to [redacted]% above the target. This is extremely low Contractor but high Employer risk. Irrespective of their performance, to a contractual degree, the Contractors would always have been entitled to their costs incurred.

4.2.4 Findings/Conclusions

The lateness and content of the major variation above would lead one to consider there had been a degree of inefficiency on the part of HAL in dealing with this issue. It would appear that HAL were not proactively looking ahead at potential issues early enough in the project. Whilst supplier performance, subject to mitigating action having been taken, is not always controllable, the identification of additional scope and time delay is controllable. Even at the time of advising the variation, late in the project, it would appear there remained an element of uncertainty around the scope required to complete the works.

In trying to quantify to any extent what HAL could have done, by way of earlier identification of scope, is extremely difficult. Bearing in mind the unknown complexity of the project it is difficult to appreciate when clarity of scope actually became obvious.

A further difficulty also arises in establishing whether any inefficiency on the part of HAL led to any capital inefficiency. A possible lack of forward planning and late identification of scope does not necessarily lead to extra costs having to be paid to contractors. It would be extremely difficult to demonstrate that HAL paid more for the works than they reasonably should have.

As noted above, the basis of the two main contracts being cost reimbursable, all costs incurred by the contractors, subject to specific contractual exclusions, would be payable. Therefore, HAL had no option but to pay the Contractors even if they were underperforming.

With respect to HAL's direct costs, these are to a very large extent linked to the duration of the project, which as noted above was a consequence of supplier performance.

In consideration of the above Arcadis concludes that it has seen no supportive evidence to demonstrate there being capital inefficiency on the project.

4.3 Pot 1a: Western Baggage Upgrade (WBU)

4.3.1 Project Overview

Project History:	The project was suspended in March 2014, part way through delivery, for the purpose of prioritising critical resources to T3 integrated Baggage. It was re-started in February 2015. It was again suspended in March 2016 to reduce the risk of impacting the summer peak in 2016.
Q5 Overview:	
Business Case	To provide asset replacement for life expired IT infrastructure and to align the baggage solution in T5 with the other Western Campus baggage solution.
Project Scope (Q5 & Q6)	Upgrading of T5 High-Level Controls (HLC) system.
Development Budget: Q5 - Q6	Included within the Q5 CIP at £25.8m.
Project Manager	HAL
Designer	Baggage: XXXXXXXXXX XXXXXXXX
MSP	XXXXXX
Main Contractors	Baggage: XXXXXXXXXX XXXXXXXXX
Building Contracts	Heathrow Works Contract (NEC) with Main Option C - Target Cost
Main Contract Sums	£X.XXm (original)
Construction Programme	60 weeks (original)
Q6 Overview (Remaining works):	
Project Scope (Q6)	Phase 5 of 5 plus additional scope to improve certainty of delivery
Development Budget and EAC: Q6	£25.9m
Project Manager	HAL
Designer	Baggage: XXXXXXXXXX XXXXXXXXX
MSP	XXXXXX
Main Contractors	Baggage: XXXXXXXXXX XXXXXXXXX
Building Contract/s	Heathrow Works Contract (NEC) with Main Option C - Target Cost

4.3.2 IFS Work to Date

The T5 Western Baggage Upgrade (T5WBU) project originated in Q5, with works commencing on site in October 2012. In March 2014 the project was temporarily suspended in order to divert critical resources to the T3IB project. The resources being those employed by the baggage design and delivery contractor, [redacted], who were engaged on both projects. The project was re-started in February 2015 and, due to the introduction of new scope was the subject of a mid-delivery G3 (Investment Decision Gateway) event in the forthcoming July.

The IFS's role on the project commenced with the preparation of a 'Mid-Delivery Gateway: G3 Report' (Ref. 10000-XX-RG-XX-001458) dated 9 September 2016. The report was based on a review of the status of the project following the introduction of the above additional scope, with associated costs, in order to improve certainty of delivery.

The first IFS monthly report was prepared based on August 2016 data, and final report based on January 2017 data.

In June 2017 the IFS published their 'Project Close out Report – BC 238 Western Baggage Upgrade' (Ref 10000-XX-RG-XXX-001660). This provides a summary and analysis of the project's performance post the mid-delivery G3 review.

4.3.3 Commentary on Issues Identified

Commencing on site in October 2012 the original scope of the project comprised the upgrading of the T5 high level controls system. This would provide enhanced control and resilience to the T5 baggage system together with additional capacity to accommodate future growth. The upgraded system would also integrate with other terminal facilities, including T3IB, and Heathrow's airport-wide HIBS systems. The project was to have been delivered over five consecutive phases.

In March 2014, on completion of four of the above phases, the project was temporarily suspended in order to divert critical resources to T3IB. Due to the baggage supplier's inability to cope with increased complexity and scope issues, HAL no longer considered it possible to achieve the planned completion dates on both projects, as they were currently resourced. The decision was therefore taken to prioritise T3IB over T5WBU. It should be noted that the decision to divert resources was in complete agreement with [redacted], and that there was no expectation for HAL to incur cost from the supplier as a consequence of this.

During the deferment period the project took the opportunity to incorporate lessons learned from T3IB, resulting in the need for significant changes to the way in which the remaining phase of the project was to be delivered. The principal purpose of the changes was to ensure greater certainty over the successful commissioning and handover of the system and mitigate risk to airport operations.

Changes to Delivery, February 2015
The project re-started in February 2015. The learning captured from T3IB and incorporated into T5WBU comprised an enhanced set of systems integration and operational readiness activities. Within their 'Mid-delivery G3' report the IFS lists out fourteen additional activities/phases that were required. It was noted that the benefits outlined in the original project business case were to remain unchanged.

In order to gain stakeholder agreement to implementing the above changes and associated costs a 'Mid-Delivery G3' event was held in July 2015. At that event HAL set out the revised requirements for the project and advised an increase in cost of £12.7m.

The build up to the £12.7m extra cost is set out in HAL's 'Additional Funding – Cost Plan' dated 30 June 2015 and has been reviewed by the IFS and discussed in their Mid G3 report above. The costs can be summarised as follows:

Ref	G3 Cost Plan	Amount
1	Base Costs	£7.7m
2	Internal & External On-Costs	£3.1m
3	Risk	£0.3m
4	Inflation	£0.6m
5	Capex Q6 Challenge	£1.0m
	Total	**£12.7m**

The base costs being made up from quotations and estimates provided by the various service providers, the largest of these being:

- £[redacted]m – [redacted]
- £[redacted]m – [redacted]
- £[redacted]m – [redacted]

The larger of the On-Costs comprise the following:

- £1.4m – HAL Leadership & Logistics
- £0.9m - System Integration
- £[redacted]m – [redacted]

Within the total On-costs figure is an amount of £1.7m relating to prolongation costs a result of the postponement.

The Capex Q6 Challenge cost relates to extended monitoring by HAL Programme Management Office.

In their review of the cost plan the IFS noted that the methodology adopted by HAL in its preparation was considered appropriate.

In reviewing the extent to which the above postponement might have led to inefficiency Arcadis have considered the options open to HAL and decisions made at that time. A further view has then been made on the entitlement and correctness of the costs added to the overall project cost.

At the time prior to the postponement both T3IB and T5 WBU were continuing to fall further and further behind programme and both were in danger of not achieving key dates. The reasons behind the T3IB delays have been described earlier in that section of the report and for much the same reasons, unforeseen complexities of scope, the same can be said for T5WBU.

At the centre of the issue and playing a major role in its cause and resolution, was HAL's baggage design and delivery supplier, [redacted]. It was [redacted]'s inability to secure additional resources for the projects that led to HAL's decision to divert resources from T5WBU, and postpone the project, for the benefit of T3IB. The decision for HAL at the time was one of either maintaining schedule on T3IB, at the expense of T5WBU, or to continue falling behind on both.

There is a need to consider the financial implications for the projects had HAL not made the decision to prioritise T3IB and continued to progress with both projects.

The basis of [redacted]'s contract on T5WBU was the same as that on T3IB, i.e. Target Cost Option C - cost reimbursable, therefore, on the same basis as that described earlier on T3IB, irrespective of their performance, to a contractual degree, they would always have been entitled to their costs incurred. The decision on a postponement from a cost point of view was whether it was costing more to have two projects not performing or just one, with the other on hold.

With respect to the decision to postpone the T5WBU project HAL have advised that this led to an indirect benefit. It provided the project team with the opportunity to take on board the learning from T3IB and identify and resolve issues it had not considered during its earlier development. It could be argued that had HAL not put the project on hold it could have resulted in additional costs over and above those for which HAL are now responsible. The introduction of scope into a project generally proves far more costly when unplanned.

The heads of cost set out in the 'Additional Funding – Cost Plan' would all appear appropriate. Arcadis note that the costs correctly exclude any amounts for [redacted] in relation to the stoppage. This being on the basis that they were largely responsible for and party to the agreement for the stoppage.

Deferred June 2016 Go-Live Date

In March 2016 HAL took the decision to defer the planned June 2016 Go-Live date. This second postponement of the project was a mitigation response to reduce the risk of interrupting the summer peak in 2016. At the time it was considered that the risk and consequences of any interruption would be too great.

Arcadis queried HAL on what had changed to cause this decision as they would always have been aware of the summer peak and Arcadis would have expected this to have been accounted for in their planning. HAL advised that changes introduced by the airlines to their existing schedules and further project delivery complexity had added risk to the process and that, consequently, the decision had been made, in agreement with the airlines, to defer the go-live date.

In their Project Close Out report the IFS notes the cost impact of the delay to be in the order of £5.2 m. No build up to the figure is given. With respect to [redacted] Arcadis have been advised that the costs formed part of the negotiated final account settlement.

4.3.4 Findings/Conclusions

From a review of the circumstances surrounding the first postponement it would appear the underlying cause of the issue was supplier performance and [redacted]'s inability to adequately resource the project. Arcadis can find no evidence of HAL directly contributing to the cause of the issue. HAL's actions were in mitigation of the impacts.

In deciding upon what course of action to take HAL opted for the postponement of T5WBU, which from what Arcadis are aware, was considered the more appropriate and supported by the airlines.

In considering the financial impact of the delay, it is difficult to see how this might in any way have been mitigated. The entitlement under each of the heads of cost appear valid and there appears to have been a proper review of the quantum of cost.

The circumstances and impacts surrounding the second postponement are not so clearly identifiable. It would appear the cause for the need to defer was an increase in risk to airline operations as a result of changes introduced by the airlines to their existing schedules and further complications with the delivery of the new baggage system. From the information available it is difficult to comprehend how such an event could not have been foreseen earlier and its impacts mitigated. Within the IFS' 'Project Close Out report' they do however comment that the action taken was a positive step by the project team.

The details of the financial impact, £5.2m, are not readily available. Whilst the figure is reported in the IFS's 'Project Close Out Report' there is no detail to this. Arcadis understands the costs for the larger element of this, [redacted], are included as part of the negotiated final account agreement for that supplier. It is therefore not possible to judge whether the full £5.2m had a valid entitlement or whether the level of cost was correct.

Again, with reference the IFS Close Out report, the IFS note the project team engaged effectively with [redacted] (on the commercial settlement) ensuring they were held accountable for their contributions to delay and project over-run.

In consideration of the above Arcadis concludes that it has not seen supportive evidence to demonstrate there being capital inefficiency on the project.

4.4 Pot 1b: Main and Cargo Tunnels

4.4.1 Overview

The Pot 1b projects consists of the refurbishment of the Main Tunnel Project and the Cargo Tunnel Project. Initially these were progressed as a single project and sought to incorporate the efficiencies associated with delivery by a single contractor. The 'Design & Build' contract was awarded to [redacted] on 17 January 2014.

Subsequently, due to performance issues with [redacted] the Cargo Tunnel scope was taken out of the contract by way of a Deed of Amendment signed on 5 December 2016. The Cargo Tunnel works were subsequently awarded to [redacted], to initially support a design review and provide constructability support, and to be completed as a separate project.

In reviewing the Pot 1b projects Arcadis has split our review into the following headings:

- Pre-Deed of Amendment, Main and Cargo Tunnels;
- Deed of Amendment;
- Post Deed of Amendment, Main Tunnel;
- Post Deed of Amendment, Cargo Tunnel.

In order to provide context around the budget challenges throughout the projects Arcadis has provided a summary of the Project forecasted final cost (Estimate at Completion (EAC)) and tender / contract sums:

Stage	£m	Comments
Pre-Deed of Amendment		
G3 EAC	£191.3m	For both Main & Cargo Tunnels
G4 EAC	£141.9m	For both Main & Cargo Tunnels; includes £22.3m of earlier completed Pre and High Priority Works
[redacted] Tender	[redacted]	For both Main & Cargo Tunnels (Increased by compensation events up to time of Deed of Amendment)
Post Deed of Amendment: Main Tunnel		
Development Budget	£86m	Main Tunnel
XXX agreed fixed price	[redacted]	Main Tunnel
Total Project EAC August 2019	£146.3m	Main Tunnel; includes HAL's and others direct costs
Post Deed of Amendment: Cargo Tunnel		
Development Budget	£44.9m	Cargo Tunnel
Project Estimate to Complete	£73.6m - £78.2m	Cargo Tunnel (EAC range advised by HAL at December 2016 CPB)

G2 Cost Estimate presented May 2017	£119m	Cargo Tunnel (EAC advised by HAL May 2017)

4.4.2 IFS Work to Date

The IFS' reporting on the Project commenced with the issue of their 'Tunnels Refurbishment - Initial Review Post G4' report (Ref. 1000-XX-EC-XXX-000127), issued on the 20th March 2014. The report sets out the IFS' observations across a number of aspects considered essential to a project's state of well-being. Along with their observations a significant number of recommendations were made.

Post the Initial Review reports were then issued on a monthly basis, the contents of the reports again focussing on those key aspects determining the project's state of health. Up until November 2016 the reports covered both the Main and Cargo Tunnels. Following the execution of the Deed of Amendment in December 2016 and separation of the Cargo Tunnel they were reported separately.

In October 2017 the IFS was commissioned to prepare a report on the Deed of Amendment. The 'Deed of Amendment (Contract No IC0001444)' report (Ref. 10000-XX-RP-XXX-003262) reviewed the basis of the agreement and the commercial status of the project at the time of the agreement.

Then in August 2018 the IFS prepared their 'Review of Tunnels Chronology' report (Ref 10000-XX-RG-237-000008) covering key events and milestones across both tunnel projects.

The IFS has also delivered two reports specific to the Cargo Tunnel:

- 'Cargo Tunnel Refurbishment 'Should Take' Programme Review' (Ref. 10000-XX-RG-XXX-001815) issued in July 2018. This was an assessment of HAL's 'Should Take' assessment of for the Cargo Tunnel issued in March 2018,

- 'Review of Cargo Tunnel ("Why" Report) – Factors Leading to HAL's Decision to Initiate a Stand Back Review (Ref. 10000-XX-RG-XXX-001836). Commissioned in August 2018 the report was approved for issue in July 2019.

4.4.3 Pre-Deed of Amendment, Main and Cargo Tunnels

4.4.3.1 Project Details

Headline details of the project are set out below:

Project Background:	Refurbishment of Main and Cargo Tunnels as a combined project to replace life expired assets, comply with legal requirements and mitigate existing life safety risks. Subsequently split into two separate contracts.
Pre-Deed of Amendment:	

Business Case	1) Mitigate existing life safety risk; 2) Reduce business risk; 3) Replace life-expired assets meeting the appropriate legal requirements.
Project scope	The refurbishment of the Cargo Tunnel (830m) and the Main Vehicular Tunnels (630m) at Heathrow Airport. The works incorporate design, building, civils and services elements with the primary objective of reducing the life safety risk to 'As Low as Reasonably Possible' (ALARP).
Development Budget	G4: £141.9m – Both Main & Cargo Tunnels (Includes £22.3m of earlier completed Pre and High Priority Works)
Project Manager	HAL
Designer	XXXXXX was lead designer to conclusion of the Scheme Design Stage - G4 (Note the G4 gateway in Q5 became the equivalent to the G3 in Q6). Following G4 and the execution of the works contract, XXX became the lead designer.
Managed Service Provider	XXXX XXXXXXXX
Main Contractor	XXX
Building Contract	Heathrow Works Contract (NEC) with Main Option C - Target Cost (with Contractor's design) executed 17 January 2014.
Main Contract Sum	Accepted tender price offer of XXXXXXXX for both tunnels.
Original Contract Construction Programme	Start 17 January 2014, Completion 10 February 2016.

4.4.3.2 Chronology

To understand the timeline of events a high-level chronology of the project's progress is set out below:

Date	Event
Q5: March 2008	
28-Mar-13	Revised Scheme Design (Solutions Development) Report for Main Tunnel Issued by [redacted]
10-May-13	G3 Gateway Review & Approval
31-May-13	ITT Documents Issued
06-Dec-13	G4 Gateway & Approval

17-Jan-14	Tunnels Refurbishment Contract (both Main & Cargo) between HAL and BAM executed
Q6 March 2014	
11-Nov-14	Commencement of Site Works
Apr-15	Supplemental resource introduced within [redacted]'s team with specific responsibility for reviewing, streamlining and ensuring compliance with HAL processes.
Feb-16	An Executive Director from [redacted] engaged on the project plus delivery team supplemented with senior support from [redacted]'s major projects division – both part of BAM's wider plan for positive change.
19-May-16	Decision taken to de-scope Cargo Tunnel Refurbishment from [redacted]'s contract via a Deed of Amendment.
05-Dec-16	Deed of Amendment to the Tunnels Refurbishment Contract between HAL and [redacted] executed.

4.4.3.3 Commentary on Issues Identified

Project Readiness

The earliest 'baseline' figures for the project are the total project estimated costs (EAC) at the G3 and G4 gateways (under the Q5 process). These are noted in HAL's November 2013 G4 Business Case (Ref. 19341-XX-RG-400-000003) Report as follows:

- EAC at G3 - £191,331,638
- EAC at G4 - £141,982,845

Between the two gateways the project was competitively tendered, and a contract agreed with [redacted] in the sum of [redacted] for delivery of the works to both tunnels. The above EAC's at G4 incorporate [redacted]'s price from the competitively tendered process and account for a proportion of the approximate £50m reduction between G3 and G4.

Of the agreed contract sum the approximate split in the cost of the works between Cargo and Main Tunnel was £30m and £55m respectively. Completion of the whole of the works was contractually set at 10 February 2016 (109 weeks).

As a starting point in assessing the performance of the project and its impact on cost, Arcadis has considered the adequacy of the original G4 budget and schedule to deliver the defined scope and the readiness of the project team to efficiently manage the work. As a basis for this Arcadis have examined the IFS' Initial Review Post G4 report which covered the progress and status of the project up to and including the above G4 Gateway.

Scope Definition

Reference is made in the report to the degree to which solutions have been developed and co-ordinated. It would appear from the comments included that this was to some degree lacking. Arcadis view the following comments of particular note:

- There is not a current brief however it is assumed that the project objectives have been fully and clearly stated in the Business Case and other related project documentation.

- There have been a number of scope reductions significantly in response to budget challenges. It is unclear to the IFS how compliance with mandatory requirements has been sustained and assured throughout this process.

- The [redacted] Solutions Development Report, dated April 2013, contains the following qualification in relation to the design stage output;

- "*This updated Scheme Design was prepared in a very short period, in order to meet HAL procurement programme for the refurbishment. It must be recognised that the reduced period available for proving and developing these updated solutions has had an adverse impact on the depth to which the indicative solutions have been developed and co-ordinated*"."

- There is a current exercise by the HAL Tunnels Manager to collate a report which captures the final procured project solution.

A review of the above comments suggests that the degree to which the design on the project had been taken was not exactly satisfactory. Bearing in mind the project works had at this stage been tendered and a contract signed, the question to be asked is whether the HAL project Team knew what scope was reflected in the contract documentation.

When procuring construction works there is a need to ensure that the project requirements are clear and not left open for the contractor to make assumptions. Progressing a project based on an inadequately defined brief leads to assumed solutions and possible redesign should they be deemed to be unacceptable. Ultimately leading to both cost and schedule increases.

The above said, it is important to note that the HAL/[redacted] contract was let on a 'Design and Build' basis, and that the contractor was deemed to have allowed in his tender for developing the design from the detail provided at tender and constructing the works in accordance with this. Providing he met with the requirements of the performance specifications there should have been no need for redesign, unless HAL instructed a change to requirements.

Budget

In reviewing the budget cost, the IFS has analysed the tendered [redacted] costs in the following ways:

- Comparison against external benchmarks,
- Consideration of the level of HAL's on-costs (Consultant fees, direct staff costs, logistics, etc.), risk and other elements of cost to be delivered directly by HAL.

Their findings were:

- Elements of the Contractor's measured works tender had costs which fully aligned to benchmarks whilst in other areas they were significantly apart.
- Where lump sums were included it was not possible for the IFS to make reasonable assessments, and their comments needed to be qualified by way of further investigation being required.
- Regarding the Contractor's Preliminaries costs and Overheads and Profit, the IFS viewed these to be marginally high.
- The contract provision for inflation was also commented on suggesting this to be insufficient and requiring review.

- Outside of the Contractor's figures the project risk provision was considered to be marginally low, with HAL's on-costs high.
- A complete lack of budget for HAL's own Information and Communication Systems was queried.

For the purpose of using the report as a way of gauging the adequacy and reliability of [redacted]'s tender, and also the same with respect to its contribution as part of the G4 budget, the IFS' review appears inconclusive.

In their conclusion to their review of the budget the IFS listed twelve recommendations aimed at increasing confidence in the figures. No overall general view is provided on the adequacy of the £141,982,845 budget.

Arcadis questioned how HAL had satisfied themselves that the accepted tender from [redacted] was not in any way deficient in cost. In response HAL provided extracts from the Supplier Evaluation Board report (i.e. tender report) showing the submitted tenders from the 4 bidding contractors to be within a margin of [redacted]% of each other. The prices submitted, following a reconciliation of issues, ranged between £[redacted]m - £[redacted]m. HAL's reason for the offered cost being considered acceptable was that it's alignment with the other tenders demonstrated it was. Arcadis would comment that it has been known for every tender to be understated, especially if based on poor tender documentation.

A reconciliation of the difference between the G3 and G4 estimates had been carried out noting the major difference being the preliminaries costs. This was put down to the different project durations being allowed for in the [redacted] tender and the G3 estimate. An approximate 25 – 30% reduction.

Schedule

The basis for the IFS' review of the schedule was the client's January 2014 (G4) pre-contract issue, the Contractor's schedule having not been agreed. Of note in their findings was a 25-30% reduction to the overall construction durations for both Main and Cargo Tunnel works from those noted in the May 2013 (G3) schedules. HAL's explanation for the reduction was based on the removal of delivery constraints.

Whilst the IFS' comments did not raise any fundamental concerns with the schedule, it is noted within their recommendations that a review of productivity assumptions was required in order to substantiate the above, significant, reduction in construction duration.

Risk

A review of the Project's principal risks had been undertaken and observations and recommendations provided with the following being significant:

- A concern over the Contractor's phasing of the works and methodology for carrying it out.
- A large amount of critical survey work remained undone. Of note was the red 'RAG' status identified for surveys required in relation to the existence of asbestos.
- Unresolved design stage risk. There were a large number of design issues carried forward from the design stage into the main contract.

Selection of the Main Contractor

The IFS report notes the contractor selection process followed by HAL in the appointment of [redacted] as being correct. Having reviewed the Supplier Evaluation Board (SEB) tender report Arcadis would also consider the process to have been appropriately managed.

In common with other HAL projects the form of contract on which [redacted] was engaged is the Heathrow Works Contract (based upon the NEC form of contract) with Main Option C – Target Cost. As noted above this also included a contractor's design requirement. This is a cost reimbursable form of contract employing a pain/gain mechanism dependant on whether the contractor's actual costs fall over or under the Target.

The HAL/BAM contract provides that the Contractor bears [redacted]% of the pain/gain up to [redacted]% of the costs running over/under the Target Price. Above [redacted]% the Contractor is exempt from all further pain/gain and the Employer (HAL) bears all the increase or savings in cost.

Arcadis would consider the above parameters to effect a low Contractor but extremely high Employer risk. Whilst the Employer stands to gain considerably from any underspend, the corresponding costs on an overspend, and everything over [redacted]% of the target, is borne by the Employer. This provides little incentive for the Contractor to control costs once the threshold pain level has been reached. The maximum possible 'pain' to which the Contractor can be subject to is [redacted]% of the Target.

Progress January 2014 – December 2016

Following the execution of the contract in January 2014 [redacted] progressed with the development of the design and overall project execution plan leading to the commencement of the works on site on 11 November 2014.

Having reviewed the IFS reports over this period there is evidence of there having been significant issues with [redacted]'s performance. Reference is made to poor design, schedule, cost and risk management. The IFS October 2014 monthly report notes a delay to production design of 3 months and a 5-week delay to Completion.

Throughout 2015 and early 2016 reports of continuing lack of performance are recorded with respect to progress on both the Main and Cargo Tunnels. At the March 2015 Tunnels Board HAL advised that they had decided to prioritise the design of the Main Tunnel over the Cargo Tunnel until confidence in the team's ability to deliver had been restored.

The tender recommendation report with respect to [redacted]'s appointment refers to [redacted] being a new supplier to HAL and therefore requiring support. Arcadis queried HAL on the extent to which this had been afforded and the extent to which any other action had been taken in order to mitigate the impacts resulting from inadequate performance. In response HAL have provided their document, 'Tunnels Refurbishment Project - Heathrow Leadership Interventions' (Ref. 19341-XX-ME-XXX-000055). The document logs references to numerous events held and actions taken on the part of HAL in supporting [redacted]. It also lists actions taken independently by HAL for the purpose of mitigating the issues and impacts. Other actions Arcadis is aware of having been taken include supplementing [redacted]'s team with HAL expertise and the introduction of more senior [redacted] resource.

From information currently available it is difficult to gauge the impact these measures might have had on the performance of the project at those specific points in time.

Whilst checks can be made on a Contractor's appropriateness, and readiness for carrying out a project, there is no guarantee of delivery going exactly as planned. The client's assurance of delivery is by way of proactive support and intervention by his own team and administration of the contract. The question to be asked is did HAL do all in their powers to support and intervene and administer the contract as it was intended.

4.4.4 Deed of Amendment

General

In May 2016 HAL took the decision to remove the Cargo Tunnel Workstream from [redacted]'s contracted scope and negotiate a revised contractual agreement.

On the 12 October 2016 the main changes revising the original contract between [redacted] and HAL were agreed under a Heads of Terms Agreement. This was later formalised by the execution of a Deed of Amendment

executed on the 5 December 2016. The Deed of Amendment had the effect of changing the original contract from a target cost reimbursable (Option C) to a fixed price (Option A) contract.

In their Deed of Amendment Report the IFS note their engagement with HAL during the course of 2016 on the proposed change in contracting strategy and heads of terms for the revised agreement. The IFS subsequently confirmed their support for the strategy and basis of the agreement within their October 2016 monthly report, noting the following:

- The Heads of Terms appear reasonable
- There are broad positive indicators surrounding the commercial agreement, including the reduction of client risk and the overall reduction of the EAC for the project.

Further endorsement by the IFS of the decision to de-scope the Cargo Tunnel works and agree a fixed price for completion of the Main Tunnel refurbishment was presented at the Capital Portfolio Board meeting on the 17 November 2016.

The basis for making the decision revolves around the financial impact [redacted]'s poor performance was having on the project as a consequence of the contractual relationship. As described earlier, the form of contract under which [redacted] were engaged is a cost reimbursable form incorporating a target cost mechanism to incentivise contractor performance. Under the basis of the mechanism included in [redacted]'s contract HAL were obliged to pay [redacted]% of any increase in cost up to a margin of [redacted]% above the target; and from there on were obliged to pay a full [redacted]%.

At the point in time the decision was made to remove the Cargo Tunnel out of the existing contract actual costs on the project had exceeded the [redacted]% margin and HAL were paying the full [redacted]% extra cost. Effectively, [redacted]'s poor performance was translating directly into increased cost for HAL.

The decision on whether it was right to amend the form of contract comes down to whether the revised option had commercial advantages over the existing. HAL would contend that at the end of the day they would have paid more under the existing Option C than they would under an Option A. They would also contend that the Option A form would have provided a much better level of cost certainty.

Scope
In addition to a number of agreed changes in scope the Deed of Amendment included for the removal of the remaining works to the Cargo Tunnel.

Cost
Based upon the terms and status of the original Option C contract all costs being incurred by [redacted] would become chargeable to HAL as a result of the threshold for applying the 'pain share' having been exceeded.

In order to arrive at a figure for negotiation HAL carried out modelling on what they would have eventually paid [redacted] had the Option C contract remained in place. Forming the basis of this was [redacted]'s submitted monthly programme for acceptance in August 2016 [redacted]. Based on the programme HAL assessed the impact to planned Completion as being in the region of six to eight months late on that currently identified. Calculating a forecast outturn cost based on the eight-month delay gave HAL a figure around which to form a basis for negotiation.

Based upon the output of their modelling HAL agreed a value of [redacted] with [redacted].

A detailed explanation to HAL's modelling of the anticipated outturn cost and calculation of a fixed price contract sum is set out in the IFS's Deed of Amendment report. The IFS have acknowledged the outcome of the modelling carried out by HAL and the improved projected final cost to be achieved by converting from an Option C contract to an Option A.

From figures extracted from the IFS's Deed of Amendment report (Figure 1 – Main Tunnel Heads of Terms Agreement - Revised Total of the Prices (at 07-Nov-16)) the following table notes the change in Target Cost across both the Main and Cargo Tunnels up to the time of the Heads of Terms Agreement:

	Cargo £m	Main £m	Total £m
Original Contract Target	XXX	XXX	XXX
Instructed Changes	XXX	XXX	XXX
Revised Target	XXX	XXX	XXXX

From an original target cost of [redacted], for both tunnels, Compensation Events had been issued amounting to an increase of [redacted]

Whilst not completely unusual this increase highlights a considerable change in scope having been introduced into the contract by HAL. The implications for capital efficiency are that had this scope been identified at the outset and bought in competition at the time of tender then a more favourable price may have been achieved against that eventually negotiated at the time.

In reaching the agreed [redacted] fixed price contract sum the following further adjustments are made to the Revised Target Cost (The above £[redacted] was adjusted slightly downwards to a figure of [redacted] between the time of the Heads of Terms Agreement and agreement of the Deed of Amendment):

Revised Target Cost	XXXXXX
Compensation Events still to be Implemented	XXXX
Agreed Adjustment for Omission of Remaining work on Cargo Tunnel	XXXX
Settlement of all other Matters in Relation to the Deed of Amendment	XXXX
Agreed Fixed Price Contract Sum	XXXX

The [redacted] can be regarded as a further increase in scope and therefore adjustment to the Target Cost.

With respect to the Cargo Tunnel, the explanation provided by HAL is that the [redacted] adjustment was the value agreed between the parties.

HAL's modelling of an estimated final outturn cost (for the Main Tunnel only) formed an offer price of [redacted]. The [redacted] is, therefore, the residual amount between the revised Target Cost, Compensation Events to be Implemented and omission of the remaining works to the Cargo Tunnel.

The [redacted] is [redacted]'s overspend on their target cost, made up of [redacted] actual to date plus [redacted] forecasted. This is due to under-pricing and/or poor performance (both payable under the terms of the original contract), together with the cost of securing certainty of price.

With respect to the [redacted] forecasted, Arcadis notes that the actual cost to date at the time was £107.8m. From a forecasting viewpoint Arcadis would consider that at that stage of the contract HAL would have had enough information on the remaining project scope to have been able to reach a reasonably accurate forecast of the cost to completion.

Arcadis notes that within the calculation of the above [redacted] there is a reduction of [redacted] equating to the Contractor's liability under the pain/gain share mechanism of the original contract. This is a direct loss for the Contractor.

Schedule
The agreed programme included in the Deed of Amendment, Programme Ref. [redacted] notes the following Contract Key Dates and Milestones:

- 31-Mar-17 – Planned Completion / Works Complete
- 30-Apr-17 – Contract Completion

4.4.5 Post Deed of Amendment, Main Tunnel

4.4.5.1 Project Details

Headline details of the project are set out below:

Project Background:	Refurbishment of Main Tunnel to replace life expired assets, comply with legal requirements and mitigate existing life safety risks. Subsequently split into two separate contracts.
Post Deed of Amendment:	
Project Scope	Main Tunnel refurbishment
Development Budget	£86m – Main Tunnel only (Dec 2016)
Project Manager	HAL
Designer	XXXXXXX
Cost and Controls	XXXXXXXXXXX
Main Contractor	XXXXXXXXXX
Building Contract	Heathrow Works Contract (NEC) with Main Option A - Fixed Price (with Contractor's design) executed 5 December 2016.
Main Contract Sum	Fixed price at XXXXXX

Construction Programme	Deed of Amendment (Contract) Completion 30 April 2017. Current Planned Completion not available.

4.4.5.2 Chronology

A high-level chronology of the project's progress, extracted from the IFS 'Why Report' is set out below:

Date	Event
Post Deed of Amendment	
16-Dec-16	Stakeholder Event held with representatives of the Infrastructure Steering Group (ISG) and IFS at which the commercial history of the Tunnel Project as a whole was outlined and the rationale for the termination of the [redacted] contract explained. Stakeholders advised that the EAC for the Cargo Tunnel could reach c£75m when all risks considered.
Jan-17	Additional experienced Heathrow resource introduced to strengthen HAL Team with specific focus on safety & quality.
Feb-17	[redacted] requested at Director Level to present to HAL their plan to complete the project – due 21-Apr-17.
Feb-17	Decision taken not to pay the [redacted] EAC reserved for the payment of bonuses to [redacted]
Apr-17	Site progress reported as being affected by breakdown in relationship between [redacted] and [redacted]. [redacted] attempting to mitigate this by de-scoping elements of the work from [redacted].
13-Apr-17	[redacted] notified of defects raised in relation to Reflective Wall Cladding (DEF-3) and Power & Comms Cables (DEF-4).
May-17	Complete Quality Audit of the project, including Design, initiated by HAL – estimated to take 8 to 12 weeks.
Jun-18	[redacted]
Jun-18	3 Project Engineers introduced to HAL Project Team aligned to specific systems and to provide appropriate installation Quality Assurance (QA).
Jun-18	[redacted]
Nov-18	[redacted]
Dec-18	[redacted]
19	[redacted]

4.4.5.3 Commentary on Issues Identified

General

Following the signing of the Deed of Amendment the Project has suffered from the effects of a number of issues resulting in overall major delay to Completion.

In late December 2016 an 'electrical flashover' occurred resulting from a serious breach of safety regulations. The outcome of this was an immediate stoppage on all electrical works lasting 101 days and the imposition of greatly stricter working practices in order to ensure compliance with HAL standards. HAL consider the event has resulted in an overall delay of around 6 months to the Project Completion Date. They also claim that liability for the incident lies totally with [redacted].

[redacted]

Also, around this time evidence began to emerge of serious defects within major elements of the works. The two most notable of these being:

- Tunnel wall cladding specification
- Cabling installations.

[redacted]

In relation to the above issues of mal-practice, major defects and main subcontractor failure, Arcadis questioned the adequacy of HAL's management and assurance surrounding these, and how they allowed this to happen. The degree of the issues and their impact on the project are and have been significant.

In our discussions with HAL explanations were provided as to the process for providing assurance around design and installation of the works. From a design point of view, it would appear that an adequate review and approval process existed. However, Arcadis are still unclear as to how the cladding came to be wrongly specified and are aware there is a dispute currently ongoing with respect to this issue.

Regarding the malpractice and defects associated with the installation of the works, Arcadis notes that in June 2017 HAL introduced three project engineers to provide quality monitoring. In addition to the engineer's other changes were made to the HAL senior team and a more proactive approach given to provide support on site. At a higher level, regular meetings between senior directors were put in place.

Throughout 2017 and into 2018 progress on both remaining contract works and the rectification of defective work was extremely slow.

In August 2018 the Project, instigated by [redacted], went into an 'Optimisation Period' with the works being put on hold. The purpose of this was to review outstanding design issues and reach agreement on a way forward to complete the project. The original period, planned for 3 months, is now (at September 2019) approaching 13 months.

Budget

The current price for the works stands at [redacted] an increase of [redacted] over the over the Deed of Amendment contract sum.

The current overall Project Estimated Final Cost is £146.3m. The balance of cost on top of the £[redacted] being for HAL's and others direct costs.

4.4.6 Post Deed of Amendment, Cargo Tunnel

4.4.6.1 Project Details

As noted previously, following the execution of the Deed of Amendment the Cargo Tunnel project progressed as a separate distinct project.

Headline details of the project are set out below:

Project History:	Refurbishment of Cargo Tunnel to replace life expired assets, comply with legal requirements and mitigate existing life safety risks. Was formerly part of a single project.
Post Deed of Amendment:	
Project Re-start	On the 21 March 2017 XXXXXXX were appointed DI for the Pre-Construction Services including design management, surveys etc. for the refurbishment of the Cargo Tunnel.
Development Budget	£44.9m
Project Manager	HAL
Designer	XXXXXXX
Cost & Controls	XXXXXXX
Main Contractors	XXXXXXX
Post Stand-back Review:	
Project Scope	Following consideration of a budget costing exercise and the results of a 'Should Take' programme assessment HAL took the decision in May 2018 to stop developing the scope of works as defined in the original Works Information and to temporarily stand-down both XXXXXXX and the HAL Design Team. A Development 'Stand Back' Review of the Project was carried out and then a full Business Case review instigated which is still underway.

4.4.6.2 Chronology

To understand the timeline of events a high-level chronology of the project's progress is set out below:

Date	Event
Post Deed of Amendment	

Mar-17	Review of XXXXXXX design complete. Assessed as "predominantly 70 – 90% complete across all design packages."
Apr-17	Contract executed with XXXXXXX for the design phase.
May-17	Revised G2 Cost Estimate (c£119m) presented to IFS and ISG.
Dec-17	XXXXXXX engaged by HAL to provide a 'Should Cost' and 'Should Take' estimates – drafts due by 28-Jan-18.
Jan-18	Budget costing exercise completed by XXXXXXX – decision taken to withhold reporting until 'Should Take' assessment completed – target end of February 2018.
Mar-18	'Stand Back' Review process initiated for scope and user requirements for detailed design.
Apr-18	Development 'Stand Back' Review completed – decision taken that full Business Case review should be undertaken.
Apr-18	All works associated with current tunnel solution deferred – existing delivery team XXXXXXX stood down.
Post 'Stand Back' Review	It is our understanding that as at the time of our review the Business Case Review was still ongoing.

4.4.6.3 Commentary on Issues Identified

Overview

At the December 2016 CPB review, following the execution of the Deed of Amendment with [redacted] and separation of the Cargo and Main Tunnel works, HAL advised the following as the planned way forward for the Cargo Tunnel:

- The budget of £130.9m was to be split between the Main Tunnel (£86.0m) and the Cargo Tunnel (£44.9m).
- A review of the completeness of the Cargo Tunnel design package was being undertaken with the aim to have a 'G3' (Solution Development Gateway) in name but not an 'Investment Decision' in February 2017.
- The EAC was currently £73.6 - £78.2m but there would be no request for Core (additional funding) and HAL would deal with the cost pressure

Design

In relation to the completeness of design, [redacted] were appointed to carry out a due diligence review of the design package work carried out by [redacted], and [redacted] appointed to carry out a buildability review. [redacted] provided IT input.

Output from the review was available some 3 – 4 months later with the status of the design package considered to be "predominantly 70 – 90% complete across all design packages."

Following completion of the design and buildability review in March 2017 both [redacted] and [redacted] were appointed as Lead Designer and Principal Contractor respectively.

The appropriateness of appointing [redacted] has been the subject of discussion within the IFS' reports due to issues with the design team's performance throughout the original two tunnel design phase. Arcadis have queried HAL on their basis for appointing them, and in response HAL provided the following:

- In April 2017 when [redacted] were appointed for the detailed design they had successfully completed for HAL, within budget and time, the Design Review phase.
- [redacted] significant knowledge of the project is would be of great benefit.

Arcadis raised the question with HAL over the cost of the design work, which was also raised by the IFS. The original order value being [redacted], as of February 2019, rose to [redacted]. HAL's explanation for the increase was that the design had been taken to a significantly high level of detail and that the design cost now related to a project of circa £200m in value as opposed to circa £100m.

Throughout the remainder of 2017 and up to early March 2018 the design progressed to a relatively high level of detail. Whilst performance issues were raised by the IFS these were addressed and responded to by HAL.

Cost

From the above basis on which the Cargo Tunnel was commenced as a single project, it is noticeable there is no reference to any form of revised budget or any figure setting a limit within which the project was to be developed. Mention is only made to a split of the original, leaving the Cargo Tunnel with £44.9m. With a current EAC of between £73.6 - £78.2m, Arcadis must therefore assume that HAL was prepared to continue with the project on the basis of a circa £30m overspend on the budget.

In May 2017 HAL presented their G2 (Options Development) cost estimate amounting £119m. As noted above, in March 2016 both [redacted] and [redacted] had been instructed to progress with the design.

At this stage of the project Arcadis would question the basis upon which HAL is progressing. The cost estimate of £119m is circa £45m over the previous estimate (£73.6 - £78.2m) and £75m over the original budget (£44.9). There is still no reference to a figure being considered as an approved budget on which to work to going forward.

In addition to the above updated financial position, Arcadis would have expected the project at this stage to be in possession of updated information with respect to scheduling, buildability, access constraints, construction methodology, risk issues, etc.

Arcadis notes from a review of the Project's Business Case document (Ref. 19341-XX-RG-400-000003) the last recorded update being in November 2013, some 3 years earlier. By its own stated requirements *"It is essential that the Business Case is seen to be a living document and through regular review with micro and macro stakeholders a common understanding of the project objectives, risks, efficiencies and overall project execution".*

Whilst the business case may in some form or another have been updated, Arcadis would question whether the information available at the time was appropriately considered and used to inform and update the higher-level plan for moving the project forward? On consideration of the factors surrounding the project at this stage, it would appear the project was progressing without having any form of defined plan in place as a basis for going forward.

It is noted in the above IFS' "Why" Report that in April 2017 the IFS recommended that the existing business case should be validated or redefined, if considered appropriate, in light of the reported budgetary pressure.

In Arcadis' queries to HAL the following questions were put regarding the reported cost increase and requirement for a business case review:

- How was the £75m increase reported going forward and what action was decided upon as a consequence of the increase?
- Was consideration given to a stand-back review and if so the reasons for not doing so?

HAL's response to the queries was as follows:

- The increased EAC was reported but not formally. At the time of identifying the increase the detailed design was commencing with the expectation that this would identify opportunities to reduce the overall cost.
- As the updated Risk Assessment, completed during the Design Review phase, had concluded that the business needs remained unchanged the decision was made to progress the design with the aim of reducing the total known project costs at the time.

At face value Arcadis find it difficult to understand the above reasons given by HAL for not considering a review of the Business Case.

On the basis that the design was considered so well advanced, as noted above 70 – 90% complete, the opportunity for reducing cost would have been relatively low.

HAL refers to a Risk Assessment previously undertaken by [redacted] Ref. Heathrow Cargo Tunnel Safety Risk Assessment, version 2, dated 6 October 2016, as providing a basis for progressing with the design. The reasoning behind this is not clear. The purpose of this document was to present an assessment of operational safety risk at various levels of refurbishment and compare those risk levels to the required reference level of risk judged to be as low as reasonably practicable. Having reviewed this document, Arcadis cannot see how it provides justification for not holding a review. The purpose of the risk assessment was to inform the delivery of the current solution, it was not to dictate what the solution should be nor the method of delivery.

In their October 2017 monthly report, the IFS made the following recommendation:

"The IFS has previously expressed concern over the fact that a budget has not been set for the design team to work within and continues to recommend a Client Cost Plan for the works to be established as a priority. The project team should confirm whether the approach currently being followed is in compliance with HAL's procedures relating to budget setting and cost planning".

In December 2017 the Project Team advised that it was planning on issuing an "Indicative (budget) Cost Plan" by the end of January 2018 ahead of a 'Should Take' (construction duration) estimate at the end of February 2018.

In relation to the above the following questions were put to HAL:

- Is this the first update on Project Cost since the G2 Estimate in May (7 months ago)?
- Did the Monthly Project Review reports not give any form of update with regard to what progress was being made in removing the £75m overspend?
- What action was being taken as a consequence of the increase, which was known to HAL at the time?

HAL's response to the queries was as follows;

- Yes. The development of the Should Take and cost plan was the first documented update to cost and Programme since the start of the detailed design phase in May 17. The preparation of these documents commenced in December 2017 – once the design was sufficiently developed.
- Design changes/challenges were reported at Monthly Project reviews, however without a developed design the project team were not in a position to provide a revised robust EAC.

- The project commenced the preparation of the Independent Should Take in December 2017 this activity was initiated in response to the indicative increase in construction duration being advised by [redacted]

Arcadis questions HAL's judgement in having continued to progress the design without providing any steer on financial limits or having a plan for the imposition of any throughout the design stage.

In the normal course of events on a project of this nature regular design reviews would have been held and drawing issues made in order to update the project's commercial team on how and in what way the design was evolving. From these reviews cost advice on design options would be provided to ensure compliance with the cost plan. Also, regular updates on forecasted total cost would be prepared to ensure compliance with the overall budget.

Estimates on project cost can be and are made on designs developed to very limited degrees, and it is not necessary or the norm to take a design to near completion before estimating its cost. Arcadis can see no reason why more regular updates on the project's anticipated total cost could not have been provided.

HAL's responses above would indicate that there was little or no awareness of the forecast total project cost for a period of 7 months, or if they were, Arcadis would question why they allowed the design to continue with costs escalating.

Schedule

Together with reviewing a project's evolving design, is a requirement to review its schedule, both being interconnected with its cost. From HAL's comments above it appears that a review of the schedule was not considered until December 2017. A further query was issued to HAL on this:

- In view of the significant increase in programme duration, why was the requirement for a review of the schedule not identified earlier?

HAL's response to the query was as follows:

- Until the design was sufficiently developed there was no value in undertaking the Should Take as the Programme would have needed continual updating to align with the project team's knowledge.

Whilst the complexity of the project might have hindered the accuracy of any schedule forecast, it remains to be said that this should still have been carried out. From the information reviewed Arcadis are not aware of any client reviewed and recognised project schedule having been in existence since 2014.

The outcome of the 'Should Take' estimate, completed by HAL in March 2018, identified a 534 working day increase on the August 2014 Programme. It is difficult to see how such an increase in the required project duration could have gone unnoticed and the schedule not considered worthy of earlier review.

Stand Down

In March 2018, following the outcome of the budget costing exercise and 'Should Take' assessment, HAL took the decision to stand down both [redacted] and the HAL Design Team ([redacted])The output from the above cost and schedule exercise, whilst not published at the time, was subsequently issued to the IFS in May 2018. The output identifying 3 priced schemes relating to 3 separate project durations is shown below:

2 Yr Schedule	3 Yr Schedule	4 Yr schedule
£179,979,000	£196,970,000	£210,597,000

4.4.7 Findings/Conclusion

4.4.7.1 Main and Cargo Tunnels

As a starting point in assessing the efficiency of the project and the related efficiency of spend Arcadis have reviewed the basis on which the project was commenced. The premise of this being that to start a project in a state of incomplete readiness generally results in a need for additional, unplanned, disruptive and abortive work, all leading to implications for cost, schedule and quality on the project.

The combined G3 Gateway budget for both Main and Cargo Tunnels stood at £191,331,638. Further to the receipt of tenders and the agreement of a contract sum the budget was reduced by circa £50m to £141,982,845. The reduction from the original budget being based on the level of pricing from the tenders received.

As a means of demonstrating the adequacy of the tender sum HAL have referred to the consistency in the pricing of the work across all four tenderers. With tenders received ranging between [redacted]. Arcadis would agree that this would indicate a common understanding of the scope of the works by the contractors and provide assurance around the completeness of the tenders.

The degree to which the project scope was developed prior to tender, and upon which [redacted]'s contract subsequently based, was raised as a cause for concern by the IFS. From the evidence provided it does appear that a significant amount of design and development work was left to the Contractor to take forward. However, based on the contract having been let as 'Design and Build, and subject to HAL changing any of the project requirements, the contractor would have been deemed to have allowed for such work.

As noted in our comments above, Arcadis would consider the process followed by HAL in the procurement and selection of the Contractor to have been robust and acceptable.

In relation to the adequacy of the overall budget one further aspect for consideration was the allowed provision for risk. Whilst the closeness of the tender returns may have provided a level of confidence in the contractor's figures, issues still existed around the level of design on which the contractors prices was based, the lack of survey information, and the use of [redacted] as a new contractor to the airport. Arcadis have also made reference above to the mechanism of the contract pain share being very much in favour of the Contractor rather than the Client. Arcadis would therefore question the appropriateness of the risk provision included.

With respect to the Project's overall state of readiness to progress at the time in question, on the balance of the information reviewed, Arcadis considers it was fit to do so.

Throughout 2015 and early 2016 issues arose with [redacted] performance. Reference was made to poor design, schedule and cost management. Whilst checks can be made on the appropriateness of a contractor prior to award these are by no means failsafe. Arcadis has reviewed, as far as possible, HAL's response in mitigating impacts arising from these issues and would consider a great deal of effort was made on the part of HAL to help [redacted] However, it is difficult to gauge the impact these measures might have had on the project at that point in time.

In May 2016, as a result of [redacted] poor performance, HAL took the decision to remove the Cargo Tunnel Workstream from [redacted] contracted scope.

HAL's strategy behind this has been discussed above. The decision on whether it was right to de-scope and change the form of contract comes down to commercial advantage. Would HAL under the revised option pay less to complete the remaining works than they would continuing under the existing set up? Arcadis believes both the removal of scope and change in form of contract for the works remaining had commercial advantages over the existing set up and was the right thing to do.

As an overall view on the efficiency of the project up to the time of the Deed of Amendment we would comment as follows:

- In reviewing the HAL's procurement of [redacted] and the project's state of readiness to proceed, on the balance of the information reviewed, Arcadis considers it was fit to do so.

- In relation to [redacted] poor performance throughout the period 2015 and early 2016 Arcadis considers that HAL did everything that could reasonably have been expected to mitigate impacts.

- Arcadis considers the removal of the Cargo Tunnel scope and change in the form of contract to have been the correct course of action.

In summary Arcadis would consider the project to have been properly and efficiently managed up to the time of the Deed of Amendment and HAL did not contribute to any capital inefficiency.

4.4.7.2 Main Tunnel

In amending the basis of the Main Tunnel [redacted] contract sum increased from [redacted], based on a split of the original [redacted] for both tunnels, to [redacted]. From a cost efficiency perspective, it is worth considering the components making up the increase.

Of the [redacted] total increase there has been an increase in the original Target Cost of [redacted]. This increase is a result of changes in scope instructed by HAL and cannot, therefore, be considered inefficient.

The value of work agreed between the parties as having been completed by [redacted] on the Cargo Tunnel is [redacted] .This is actual cost of work carried out against the Target Cost and therefore cannot be considered inefficient.

A further [redacted] increase is included for [redacted] current [redacted] and forecast [redacted] overspend on the Target Cost. These costs being due to [redacted] under-pricing or poor performance. As previously explained, under the terms of the original Option C cost reimbursable contract this money would always have been payable to [redacted]. The amounts cannot therefore be considered inefficient.

Post the change in contract no entitlement existed for [redacted] to claim additional costs for non-instructed changes, and the issues around slow progress and malpractice had no cost impact. However, these issues would have impacted on HAL's direct costs. It is noted that HAL took action to mitigate the impact of the issues and Arcadis therefore do not consider HAL could be held to account for any loss of capital efficiency during this period.

In August 2018 the Project went into an Optimisation Period. The subject matter and output from this have not been considered within this review.

As an overall view on the efficiency of the project up to and including the Deed of Amendment Arcadis would comment as follows:

- The assessment of [redacted] contract price at [redacted] for the Main Tunnel was appropriately calculated and is not considered inefficient.
- From the period post the Deed of Amendment HAL did everything that could reasonably have been expected to mitigate the impacts of the suppliers' poor performance.

In summary Arcadis considers the project to have been properly and efficiently managed during the period post the Deed of Amendment and HAL did not contribute to any capital inefficiency.

4.4.7.3 Cargo Tunnel

In recommencing work on the Cargo tunnel at the beginning of 2017 HAL instigated a detailed review of the design to date, as completed by [redacted], together with a buildability review. The review completed some 3 – 4 months later, generally concluded that the design was 70 – 90% complete.

In addition to the design output, HAL, at this time, were also in receipt of an updated project estimate amounting to £119m. This being some £74m above the declared budget at that time (£44.9m advised by HAL at December 2016 CPB). On the basis that opportunities for reductions existed, HAL progressed with the design and planning of the works. Despite the significant variance in budget and forecast cost, it would appear no formal review of the budget took place.

In addition to the budget, and again in consideration of the budget v forecast variance, no consideration appears to have been given to a review of the current project objectives as outlined in the Business Case. With respect to the budget and solution Arcadis can see no attempt having been made to gain any form of alignment. HAL continued to progress the project with little chance of making any meaningful savings, and without setting realistic cost limits for which the design team to work within.

Arcadis would consider HAL's decision to progress with the project on the above basis as being out of process and not best industry practice. The project was not in an appropriate state to proceed and action should have been taken to re-define the project's objectives.

Throughout 2017 and early 2018 the design of the project, together with its delivery plan was allowed to progress. During this period there is still no evidence of HAL having introduced any form of structured, meaningful cost limits for the design team to work within. Also apparent is a lack of regular and meaningful reporting of final cost. Again, this is not good practice as it is an important tool in to facilitating decision making at higher levels.

In a similar way to the setting and management of the budget, there appears to have been no ongoing review of the schedule. This would have been essential for informing the cost and also compliance against the business case requirements.

Informing the schedule would have been the methodology of how the works were to be carried out. With the Contractor, [redacted] engaged on the project, Arcadis sees no reason for this information not to have been available.

In assessing to what extent, if any, the project has been inefficient Arcadis has considered the timeline of the project from its recommencement to the point of stand-down.

As indicated from its comments above, Arcadis believes that it was not best practice for the project to have progressed on the basis that it did, following the April 2017 cost increase to £119m. nor in the way HAL did during the period up to the point of standing down the project team.

As an overall view on the efficiency of the project post the Deed of Amendment, Arcadis would comment as follows:

- In recommencing the project, and with respect to the budget and solution, HAL made no attempt to gain any form of alignment. HAL progressed the project with little chance of making any meaningful savings and without setting any realistic cost limits for which the design team to work within.
- Throughout 2017 and early 2018, as the design progressed, there is still no evidence of HAL having introduced any form of structured, meaningful cost limits for the design team to work within.
- In addition to the budget there appears to have been no ongoing review of the forecast schedule duration.

In summary Arcadis considers the project not to have been properly and efficiently managed post the period of re-commencement to the time of stand-down.

In quantifying the value of any inefficiency, the following two aspects require consideration:

- The cost expended on the project from the time of recommencement to the point of stand-down
- The value, if any, that may have been gained from the work carried out during the period.

The balance between the two can be taken to represent the cost of inefficiency.

HAL's document 'Cargo Tunnel ACWP (Actual Cost of Work Performed) review for CPB, v5' dated 28th April 2019 sets out the total cost incurred on the project up to that date. The costs have been categorised as follows covering four time periods:

Stage	Period	Cost
Historic Costs	Quarter 2 (Q2) 2014 to Quarter 4 (Q4) 2016	£24.01m
Design Review	Quarter 1 (Q1) 2017	£1.16m
Surveys, Design & Planning	Quarter 2 (Q2) 2017 to Quarter 2 (Q2) 2018	£12.25m
Stand-back Review	Quarter 3 (Q3) 2018 to Quarter 4 (Q4) 2018	£0.49m
Total		**£37.91**

Arcadis considers the work carried out between Q2 2017 to Q2 2018 to relate to the period of inefficiency described in the section of the report above. The £12.25m identified for design and on-costs associated with the design should be included within the inefficiency range.

In addition, the Stand Back Review cost of £0.49m, should also be considered within the context of any inefficiency range. It is our opinion that, if the project was being delivered efficiently without any issues, the need to stop the project and undertake the stand back review would not have been necessary and this could also be included in the pot for inefficient spend. That is not to say that HAL may have undertaken any review at this point in the process in any case, but it may not have been as intensive (or costly).

We consider the £12.25m to be the main element of inefficient spend and the inclusion of the Stand Back Review of £0.49m as an additional inefficiency spend to create a value at the high end of the inefficiency range of **£12.74m**.

The value, if any, that has and can in the future be gained from the work carried out was not readily available at the time of the Arcadis review. This would require a detailed breakdown of the figures identifying those works which have been taken forward to provide a benefit against those works now considered to be abortive. Until such a stage has been reached it would not be possible to develop any meaningful assessment of the quantum of any inefficiency.

4.5 Pot 2: B066: Energy and Utilities Management – Supply

4.5.1 Project Overview

Business Case:	To alleviate safety concerns and operational risk held in connection with the life expired High Temperature Hot Water System. There was also a need to reduce carbon emissions as a result of new legislative requirements and Heathrow's own carbon emissions reduction target.
Project Scope:	The replacement of the existing High Temperature Hot Water System with a new low carbon Low Temperature Hot Water system including the replacement of the existing pipework infrastructure from the Heathrow Energy Centre.
Development Budget v Total Project Cost:	£51.3m at G3 (core) v £48.2 Final Outturn.
Project Manager:	HAL
Designer:	XXXXXXX up to scheme design with production design undertaken by the two Delivery Integrators (DI) XXXXXXX
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX for the scope in T3. XXXXXXX responsible for the service subways, external and boiler house works. Other non-DI specialist works.
Building Contract:	Heathrow Works Contract (NEC) with Main Option C - Target Cost executed on the 30 March 2015 and 16 April 2015 (XXXXXXX). Contract provide that the Contractor bears XXXXXXX of the pain/gain up to XXXXXXX of the costs running over/under the Target Price.
Main Contract Final Accounts:	XXXXXXX (Works let in progressive tranches) XXXXXXX (Works let in progressive tranches)
Construction Programme Planned v Actual:	The works were delivered, as planned, over three successive summers while the heating systems were on their annual shut down between 2015 and 2017
Benefits Planned v Delivered:	Planned: Safer system More reliable system Reduced energy consumption and carbon emissions Reduced OPEX costs through more efficient system and reduced maintenance Delivered: All the above have been delivered

4.5.2 Project Specific Issues

The Energy and Utilities PPR report (Ref. 13000-XX-KN-XXX-000052) dated 9 May 2019 refers to the works having proceeded despite the knowledge of emerging scope and there being a need for design development. The reason for this decision being that there was a strong enough safety case to warrant the risk to cost and schedule.

From a review of the procurement strategy it was explained how the overall project scope had been broken down into tranches and stages. The progression of each stage on site was not to occur until the scope of design had been developed to an appropriate state and there being a robust cost plan in place.

A schedule of Client's Change Request Sheets exists which evidences there being an audit trail in place sanctioning change in project budget relative to the development of the various stages.

During the course of the project an overpayment was made of £1.129m for head office charges. An investigation revealed that this was due to those charged being billed on a provisional basis, but when these costs were audited it was found that they were significantly lower than billed – a Project Manager's instruction was issued to rectify this overpayment. This process was in line with the standard way in which the DI framework operated.

4.5.3 Performance Against Areas of Control

Scope Definition, Procurement and Contracting Strategy:

In line with the staged development of the works described above separate procurement strategies were prepared and signed off by the HAL Procurement Leadership Team. An example of these was reviewed with the Project Team which was shown to be well considered covering scope, time, cost and risk and incorporated the 'Commercial Principles' set out in the Q6 Delivery Integrators Framework Agreement.

In accordance with the Q6 delivery strategy the works in Terminal 3 were allocated to the DI, [redacted], for that area and the External Airside/Landside works were allocated to [redacted].

Schedule Management:

The works were delivered in tranches over three successive summers from 2015 to 2017 while the heating systems were on annual shut-down. Overall schedule management was controlled by the Project Team with input from the two DI's.

Of vital importance was the achievement each year of the 'heat on' date of 1st September, which was achieved. The consideration given to the overall planning of the project is worthy of note.

Contract Administration:

The form of contract employed by HAL requires action by various people/parties at specific points in the project. These relate to issues such as compensation events, schedule acceptance, payments, defects, early warnings, etc. It is essential that these are dealt with and on a timely basis as the contract demands.

As an aid to ensuring proper management of the Contract HAL has adopted the use of the contract management system CEMAR. This is widely used in the industry and Arcadis would consider it to add considerable benefit to ensuring contracts are properly administered.

Arcadis reviewed various fields of the Project's CEMAR account. This identified that the required contractual activities on the project had been appropriately carried out.

Risk and Opportunities Management:

It was explained by the team that through the mechanism of the contract all risks identified by way of early warning notices were dealt with via weekly meetings with the Contractor. Again, using CEMAR this would have ensured the process was enforced and recorded.

Evidence of the project risk register was provided and reviewed. The format, development and management of the register is consistent with that used throughout the construction industry. Management of the register was carried out by HAL's Cost and Controls Consultant. The register was shown to have been formally reviewed and reported by the Team on a monthly basis.

Opportunities were identified and realised on the project. The approach to the management of these was on a similar basis to that for risks.

Change Management:

Client project change was managed through the HAL 'Client Change Record Sheet' process. Evidence of this having been appropriately administered is included in the PPR report.

Contract change (i.e. to the Main Contractor's works) is managed through administration of the contract compensation event mechanism. Evidence of this having been administered is also included in the PPR report and again with the use of CEMAR this was shown to have been enforced and the process recorded.

Commercial Management:

At Arcadis's meeting with the Project Team various aspects of commercial management were discussed and evidenced, and our comments on these are as follows:

- A detailed G3 cost plan was not available for review, however, Arcadis did review a G3 benchmarking report which demonstrated the G3 (core) capex figure provided value for money.

- An example of the monthly Cost Control Document used on the project was reviewed by Arcadis. Regular, consistent cost control was evidenced, and the forecasting and cash-flowing of costs was viewed to have been properly managed.

- As a means of demonstrating commercial challenge in their management of the main contract works the team were requested to provide evidence of variance between submitted quotations, from the Contractor, and the agreed values of compensation events. From figures provided for a list of compensation events the team demonstrated a reduction of [redacted] from quotations submitted by the contractor.

- Arcadis also reviewed a summary of the total project outturn cost. No contentious items were apparent in the build-up.

Stakeholder Management:

A stakeholder management plan had been developed in line with HAL's standard format and effected accordingly. In addition to this a weekly report was issued to all stakeholders and an update provided at the monthly Infrastructure steering Group (ISG).

Governance:

Arcadis undertook a review of one of the project's monthly Cost Control Documents. This was found to include metrics and reports on all the above aspects of the project. The report was rolled up with other related projects into a summary Monthly Project Review report and was reviewed at the monthly Projects Progress Board Meeting.

Conclusion:

The project was commenced, when levels of risk and uncertainty behind scope were high, due to safety concerns. Despite this it was delivered under budget and in accordance with the planned schedule.

The procurement strategy was developed in accordance with HAL processes and procedures and was in line with industry best practice.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project.

A suitable risk and opportunity register was established and updated throughout the project life cycle, with some of the opportunities being realised.

Cost control was evidenced, cash flow was forecast, and compensation event pricing was effectively challenged.

With the above in mind Arcadis considers that value for money was provided and the project was well managed throughout and delivered efficiently.

4.6 Pot 2: B101 T3 Pier 7 Main Roof Works

4.6.1 Project Overview

Business Case:	The project forms part of the wider B101 Engineering Asset Replacement business case. The aim of this was to target the replacement or refurbishment of HAL assets in order to remain safe, compliant and operational. The project was prioritised due to the asset being past its design life and failing (the roof leaking) in both passenger facing and non-passenger facing areas. The project was also amalgamated with another project for the replacement of life expired mechanical plant located on the roof.
Project Scope:	To ensure the cessation of water ingress throughout T3 pier 7 and enhance the access and maintainability of those assets. The replacement of life expired heating, ventilation and air conditioning plant, and other services to provide new infrastructure that was compliant, energy efficient and provided Opex benefits.
Development Budget v Total Project Cost:	£29.9m at G3 (core) v £29.7m Final Outturn
Project Manager:	HAL
Designer:	Roof replacement, steel plant structure and general enabling works: XXXXXXX up to scheme design then taken on by XXXXXXX for production design. Chiller and air handling unit replacement and general M&E works: XXXXXXX up to production design.
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX
Building Contract:	Heathrow Works Contract (NEC) with Main Option C - Target Cost, executed on 26 November 2015
Main Contract Sum v Final Account:	XXXXXXX increasing to XXXXXXX
Construction Programme Planned v Actual:	Start on site 7 January 2016 with a Contract Completion Date of 21 February 2017. Actual Completion 21 June 2017.
Benefits Planned v Delivered	Planned: Elimination of water ingress leading to disruption and damage to the existing structure Improved passenger experience Reduction in Opex costs for inspection, maintenance and energy efficient plant. Delivered: All the above have been delivered

4.6.2 Project Specific Issues

Under the heading of Project Scope Changes, the PPR refers to two major changes.

The first of these relates to the connection of new steel stub columns onto the existing steel roof structure. As the existing roof coverings were removed it became apparent that the developed design for this detail would not work as the existing roof structure was not as expected.

Arcadis queried the Project Team as to why the details of the existing structure were not ascertained beforehand by way of reviewing existing drawings or site surveys. In response Arcadis were advised that the existing drawings did not go down to the level of detail required and that it was not possible to carry out a full 'intrusive' survey of the area due the location and volume of services running along the roof. After being shown photographic records of the area Arcadis agrees that carrying out an intrusive survey would have been very difficult.

The second change in scope resulted from the discovery of asbestos fibres within the paintwork finish to the plant rooms. Arcadis were advised that earlier sampling for asbestos in various areas had proved negative. It was eventually established that when the pier was originally painted asbestos fibres had been added to the paint randomly which meant that the presence of asbestos in any area was unpredictable. The earlier tests had not included those areas which would have given a positive reading.

Due to the nature of where the asbestos was located Arcadis would consider it reasonable that they could have been missed.

The resulting additional costs to the project for these two compensation events was [redacted]. Whilst these issues did have time impacts this was mitigated by the project team.

4.6.3 Performance Against Areas of Control

Scope Definition, Procurement and Contracting Strategy:

Evidence was provided of a signed off procurement strategy in compliance with HAL's governance requirements. This was shown to cover scope, time, cost and risk and incorporated the 'Commercial Principles' set out in the Q6 Delivery Integrators Framework Agreement. In accordance with the Q6 project delivery strategy the works being in Terminal 3 were allocated to [redacted] the DI for that area.

A well detailed cost plan for the project was also reviewed and, subject to some explanation, was found to align to the G3 (core) figure.

Schedule Management:

Initial concerns were raised over the quality of the DI's submitted monthly schedules and the HAL team were proactive [redacted]. A significant amount of the planning work was put into the project by the HAL team and they are largely credited with the project succeeding in achieving its defined trigger date.

Contract Administration:

Arcadis reviewed the Project's CEMAR account covering two separate months. This identified that the required contractual activities on the project such as the management of change, compensation events, early warnings, schedule, defects, etc had been appropriately carried out.

Risk and Opportunities Management:

It was explained by the team that through administration of the contract all risks identified by way of early warning notices were dealt with via weekly meetings with the Contractor. Again, with the use of CEMAR this process was shown to have been enforced and recorded.

Evidence of a project risk register having been maintained was provided and reviewed by Arcadis. The format, development and management of the register is consistent with industry best practice. Management of the register was carried out by HAL's Cost and Controls Consultant and the register reviewed on a monthly basis by the Project Team.

Several opportunities were identified and realised on the project, an example being the coordination with other projects in the area in order to share space and logistics items.

A further, significant opportunity was realised from the prefabrication of the roof top steel plant structure and services within it. This solution resulted in a cost saving of £149k and schedule saving of 4 weeks.

Change Management:

The Project Team confirmed that there had been no requirement for any Client changes on the project and hence there was no evidence of any 'Client Change Record Sheets'.

Evidence of contract change having been administered is included in the PPR report (Ref. 13301-XX-PD-212-000008) dated 1 May 2019 and once again the use of CEMAR was shown to have enforced and recorded the process.

Commercial Management:

Various aspects of commercial management were discussed with the Project Team and our comments on these follows:

- The baseline, G3 (core) cost plan (Ref. 13301-XX-CP-XXX-000008) dated was evidenced and reviewed by Arcadis. The summary figure was shown to align to the acknowledged G3 figure and the basis and build up to the figure was seen to be appropriately detailed. A further 'Value for Money' report (Ref. 13301-XX-CP-XXX-000007) dated 8 October 2015 had been prepared supporting the scope and basis of costs in the G3 cost plan.

- Arcadis reviewed a copy of the Monthly Project Review Report. Ongoing cost control was evidenced, and the forecasting and cash-flowing of costs was viewed to have been properly managed.

- From Arcadis's review of the CEMAR report it could be seen that a number of the Contractor's Notified Compensation Events (NCE's) had not been accepted by the team and that a number of submitted quotations for changes to scope had been rejected. This evidences that there had been appropriate commercial challenge on the project.

- Arcadis also reviewed a summary of the agreed main contract final account together with the signed statement of agreement. No contentious items were apparent. The summary figure aligned to that included within the build up to the Project Final Outturn Cost.

Stakeholder Management:

A Stakeholder Management Plan (Ref. 13000-XX-PD-212-000006) dated 22 May 2015 was reviewed and the level of consultation was shown to be extremely good. In addition to this a weekly update on progress was issued.

Governance:

Arcadis undertook a review of one of the project's Monthly Project Review reports. This was found to include metrics and reports on all the above aspects of the project and was reviewed at the monthly Projects Progress Board Meetings.

Conclusion:

Following commencement of the project it was ascertained that the roof structure was not as initially envisaged and some of the paintwork contained asbestos. Both of these issues impacted on the cost of the project, Arcadis considers the team took reasonable measures to identify the risks beforehand, however their nature made them very difficult to identify.

The procurement strategy was developed in accordance with HAL processes and procedures and was in line with industry best practice. A detailed cost plan had been produced.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project.

A suitable risk and opportunity register were established and updated throughout the project life cycle, with several significant opportunities being realised. This helped to offset the impacts of the asbestos and roof structure issues noted above.

Cost control was evidenced including cash flow forecast.

Stakeholder management was shown to be extremely good with consultations and weekly progress updates.

Ultimately the project was delivered under budget but several months late. With the above in mind Arcadis feels that value for money was provided and that the project was well managed throughout and delivered efficiently.

4.7 Pot 2: B101 T4 Rooflight Replacement

4.7.1 Project Overview

Business Case:	The project forms part of the wider B101 Engineering Asset Replacement business case the aim of which was to target the replacement or refurbishment of HAL assets in order to remain safe, compliant and operational. The project was prioritised due to the asset being past its design life and failing in a number of critical areas. This resulted in disruption to both operational and retail activities together with there being a safety hazard.
Project Scope:	The replacement of existing double-glazed roof-lights within Terminal 4 check-in which were at end of life and beginning to fail.
Development Budget v Total Project Cost:	£13.1m at G3 (core) v £11.3m Final Outturn
Project Manager:	HAL
Designer:	XXXXXXX up to G2 Options Report then taken on XXXXXXX production design.
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX
Building Contract:	Heathrow Works Contract (NEC) with Main Option C - Target Cost, executed on 11 December 2017
Main Contract Sum v Final Account:	XXXXXXX
Construction Programme Planned v Actual:	Start on site 3 February 2018 with a Contract Completion Date of 12 December 2018. Actual Completion 3 December 2018
Benefits Planned v Delivered:	Planned: Elimination of health and safety risks associated with the failure of the roof system Elimination of water ingress leading to disruption and damage to the existing structure Improved passenger experience Reduction in Opex costs for inspection and maintenance Delivered: All the above have been delivered

4.7.2 Project Specific Issues

From Arcadis's review of the PPR report (Ref.14401-XX-KN-212-000003) dated 25 December 2018, subject to minor clarifications and adjustments for errors, no particular issues of concern were identified.

4.7.3 Performance Against areas of Control

Scope Definition, Procurement and Contracting Strategy:

The PPR report identifies early design and enabling works packages as having been single sourced in advance of the main works packages in order to achieve an earlier start on site. Having reviewed the nature of the packages; surveys, prefabrication, etc., Arcadis would not consider this to be unusual or less efficient.

Evidence was provided of a signed off procurement and contracting strategy in compliance with HAL's governance and procedures. This was shown to cover scope, time, cost and risk and incorporated the 'Commercial Principles' set out in the Q6 Delivery Integrators Framework Agreement. In accordance with the Q6 project delivery strategy the works being in Terminal 4 were allocated to [redacted], the designated DI for that area.

A detailed cost plan for the project was reviewed by Arcadis and subject to some explanation found to align to the G3 (core) figure.

Schedule Management:

An example of one of [redacted] submitted monthly programmes for acceptance was reviewed, the programme being one that was accepted by the HAL Project Team. HAL's process for reviewing the programmes was discussed and found to be sufficiently robust.

Contract Administration:

Arcadis reviewed the Project's CEMAR account. This identified that the required contractual activities on the project such as management of change, early warnings, schedule, defects, etc had been appropriately carried out.

Risk and Opportunities Management:

In accordance with the contract all risks identified by way of early warning notices were dealt with via regular meetings with the Contractor. Again, using CEMAR this process was enforced and recorded.

The status of the project risk register was reviewed at both the middle and end stages of the project. The format, development and management of the register is consistent with that used on other HAL projects and Arcadis considers it to align to good practice.

The make-up of the project final outturn cost shown in the PPR report identifies the total risk allowance of £921K as being handed back. This is not a completely true reflection of what happened. Certain risks did materialise, and parts of the risk budget were used. The resultant overall saving included contributions from realised opportunities.

Change Management:

The Project Team confirmed that there had been no requirement for any Client changes on the project and hence there was no evidence of any 'Client Change Record Sheets'.

Contract change (i.e. changes to the Main Contractor's works) was managed through administration of the contract compensation event mechanism. Evidence of this as having been administered is included in the PPR report and the use of CEMAR shown to have enforced and recorded the process.

Commercial Management:

The baseline, G3 (core) cost plan was evidenced and reviewed by Arcadis. The summary figure was shown to align to the acknowledged G3 figure and the basis and build up to the figure was seen to be appropriately detailed.

A copy of the project cost report for September 2018 was reviewed. Good practice project cost control was evidenced by Arcadis and the forecasting and cash-flowing of costs was viewed to have been properly managed.

A section of the CEMAR report was presented which identified a value of [redacted] submitted as quotations for compensation events. Against this an amount of [redacted] had been accepted by the team. The resulting [redacted] reduction evidences there having been appropriate commercial challenge on the project.

A summary of the agreed main contract final account was reviewed together with the signed statement of agreement. No contentious items were apparent. The summary figure aligned to that included within the build up to the Project Final Outturn Cost.

Stakeholder Management:

No stakeholder management plan existed for the project. Engagement was formalised by way of low and high-level stakeholder integration meetings and the T4 Stakeholder Project Group meetings. In addition to these a weekly report was issued to all stakeholders. Arcadis would consider this to have been appropriate.

Governance:

A review was undertaken of one of the project's Monthly Project Review reports. This was found to include metrics and reports on all the above aspects of project management and had been reviewed at the monthly Projects Progress Board Meetings.

Conclusion:

The procurement strategy was developed in accordance with HAL processes and procedures and was in line with industry best practice. A detailed cost plan had been produced. Direct procurement of enabling works and design was utilised to enable an early start on site.

A construction programme was produced and updated monthly, then reviewed sufficiently by HAL.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project.

A suitable risk and opportunity register were established and updated throughout the project life cycle, with some opportunities being realised. This helped to offset some issues that were encountered.

Cost control was evidenced, cash flow was forecast, and compensation events were successfully challenged.

Whilst no stakeholder management plan was created, meetings with relevant parties were held and reports issued regularly to stakeholders.

The project was ultimately delivered under budget and slightly early. Arcadis considers that value for money was provided and that the project was well managed throughout and delivered efficiently.

4.8 Pot 2: B101 T4 CPS1548 & CPS1918 -T4 Toilets & Finishes

4.8.1 Project Overview

Business Case:	The project forms part of the wider B101 Engineering Asset Replacement business case. The aim of this was to target the replacement or refurbishment of HAL assets in order to remain safe, compliant and operational. The T4 Toilets and Finishes projects were prioritised due to them being identified as being below HAL standards.
Project Scope:	The refurbishment of 4 passenger toilet blocks together with passenger-facing areas within T4.
Development Budget v Total Project Cost:	Toilets: £3.9m at G3 (core) v £3.5 Final Outturn Finishes: £10.6m at G3 (core) v £11.7m Final Outturn Total: £14.5m at G3 (core) v £15.2m Final Outturn
Project Manager:	HAL
Designer:	XXXXXXX progressing earlier design work completed by HAL in Q5.
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX
Building Contract:	Toilets: Heathrow Works Contract (NEC) with Main Option C - Target Cost executed on the 22 June 2016 Finishes: Heathrow Works Contract (NEC) with Main Option C - Target Cost executed on the 21 August 2016
Main Contract Sum v Final Account:	XXXXXXX XXXXXXX XXXXXXX XXXXXXX
Construction Programme Planned v Actual:	Toilets: Start on site 16 December 2016 with a Contract Completion Date of 31 March 2017. Actual Completion 21 June 2017 Finishes: Start on site 1 September 2016 with a Contract Completion Date of 30 November 2017. Actual Completion 28 November 2017
Benefits Planned v Delivered:	Planned: Improved passenger experience. Delivered: Delivered with evidence of QSM scores provided.

4.8.2 Project Specific Issues

A comparison of the G3 (core) budget against Final Outturn costs provided in the PPR's (Toilets Ref. 14401-XX-KN-XXX-000079 and Finishes Ref. 14401-XX-KN-X224-000002) both dated 2 January 2019 highlights an exclusion of £845,484 for HAL IT costs. This cost had to be covered by savings made elsewhere. Had such significant savings not been achieved then the overall project outturn cost would not have been brought in below budget. HAL have put the omission of budget down to a lack of alignment between HAL IT solutions design and the main works design. This is not best practice design co-ordination.

Under the Lessons Learned section there is reference to the project scope being different to key stakeholder expectations. Arcadis queried this with the Project Team who explained that HAL's standards for some of the toilet fittings had changed during the design and construction period and that this had not been identified. It was not until handover of the Project that this was identified leading to a required change of fittings and delay in handover. The additional cost of the changes was covered from savings realised through opportunities.

Arcadis would have expected there to be a process in place for capturing changes to standards and specifications of this nature.

4.8.3 Performance against Areas of Control

Scope Definition, Procurement and Contracting Strategy:

The PPR report identifies early design and survey works packages as having been single sourced in advance of the main works packages in order to achieve an earlier start on site. Arcadis would not consider this out of place.

Whilst no specific project procurement plan was seen to have been prepared for either the Toilets or the Finishes project the PPR report itself provides a detailed description of the process followed. [redacted] being the Q6 Delivery Integrator for T1, T2 and T4 were allocated the main works contracts.

The G3 cost plans were reviewed for both projects and shown to align to the G3 (core) figures stated in the PPR report.

Schedule Management:

[redacted] submitted monthly programme for acceptance for September 2017 for both Toilets and Finishes was reviewed. The programmes were accepted by the HAL Project Team. The process for reviewing the programmes was discussed and found to be sufficiently robust.

Contract Administration:

Copies of the Project CEMAR reports were reviewed. These identified that the required contractual activities on the project such as the management of change, early warnings, schedule, defects, etc had been appropriately carried out.

Risk and Opportunities Management:

In accordance with the contract all risks identified by way of early warning notices were dealt with via regular meetings with the Contractor. Again, using CEMAR this process was enforced and recorded.

Examples of early project risk registers were reviewed. The format, development and management of the registers is consistent with that used on other HAL projects and Arcadis consider them to align to good practice.

The make-up of the project final outturn cost shown in the PPR report identifies all the risk monies of £274K (Toilets) and £504K (Finishes) as being handed back. Whilst this might have been the case for those risks identified further risks were identified and did materialise. The cost of these were covered from opportunities realised.

There is sound evidence of opportunities being pursed and realised specifically around the use of the Main Contractor's preliminaries resources, facilities and plant being used across more than on the project.

Change Management:

The Project Team confirmed that there had been no requirement for any Client changes on the projects and hence there was no evidence of any 'Client Change Record Sheets'.

Contract change had been managed through administration of the contract compensation event mechanism. Extracts from the CEMAR accounts listing all the compensation events raised and administered on the projects was evidenced.

Commercial Management:

The baseline G3 (core) cost plans for both the Toilets and the Finishes were evidenced and reviewed. The summary figures were shown to align to the acknowledged G3 figures and the basis and build ups to the figures were seen to be appropriately detailed. A worthwhile benchmarking exercise had been carried out in the case of the Toilets project. This demonstrated the DI's submission was consistent with other projects of a similar nature.

Arcadis reviewed a copy of the July 2017 Monthly Progress Review report. Good practice project cost control was evidenced, and the forecasting and cash-flowing of costs was viewed to have been properly managed.

Evidence of commercial challenge was presented by way of a [redacted] reduction against a value of [redacted] submitted as quotations for compensation events (taking both projects together).

Summaries of the agreed main contract final accounts were reviewed together with signed statements of agreement. No contentious items were apparent. The summary figure aligned to that included within the build up to the Project Final Outturn Cost.

Stakeholder Management:

Stakeholder management plans were reviewed for both projects. The plans had been developed in line with HAL's standard format and were shown to have been affected accordingly. The main engagement forums included low- and high-level integration meetings and a weekly report issued to all stakeholders. Overall Arcadis would consider stakeholder management to have been reasonably good.

Governance:

A review of the July 2017 Monthly Progress Review report was undertaken. This was found to include metrics and reports on all the above aspects of project management and had been reviewed at the monthly Projects Progress Board Meeting.

Conclusion:

Two significant issues had a detrimental effect on the final outturn costs. IT scope that had not been identified and a specification change that was discovered late in the project. The latter led to the need to change fittings and delaying the handover. Whilst the cost of both of these issues was covered by savings elsewhere, they

should not have arisen in the first place. Due to the relatively low value of the issue Arcadis would not consider this to categorise the project as being inefficient.

No specific procurement strategy was produced for the project, however the PPR detailed the process adequately.

A construction programme was produced and updated monthly, then reviewed sufficiently by HAL.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project.

A suitable risk and opportunity register were established and updated throughout the project life cycle, with some opportunities being realised. This helped to offset the issues that were encountered.

Cost control was evidenced, cash flow was forecast, and compensation events were successfully challenged.

Stakeholder management plans were in place, meetings with relevant parties were held and reports issued regularly to stakeholders.

The project was ultimately delivered slightly over budget and with the Toilets slightly late. Arcadis considers that the issues with IT and specification changes were foreseeable. The element of extra work involved with the change of toilet fittings must be considered inefficient.

4.9 Pot 2: B316 T3 Refurbishment & Enhancement – IDL

4.9.1 Project Overview

Business Case:	To increase the number of seats together with an improvement in ambience in the international departures lounge (IDL) in T3. Enhance passenger experience along the transfer passenger connection corridor from the Flight Connection Centre and increase the retail area where the old ticketing area had become redundant. Delivery of the benefits were to improve QSM scores and achieve an increase in revenue as a result of the increased retail area.
Project Scope:	The upgrading and refurbishment of the IDL concourse in T3, provision of additional 311 seats, creation of 4 additional retail units and the integration of the new FCC corridor entrance into the IDL with the introduction of specialist lighting.
Development Budget v Total Project Cost:	£18.6m at G3 (core) v £18.5 Final Outturn.
Project Manager:	HAL
Designer:	XXXXXXX took the design through the G2 Options Report and completed the Stage E issue. From this XXXXXXX progressed the design through G3 and G4 to production.
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX
Building Contract:	Heathrow Works Contract (NEC) with Main Option C - Target Cost.
Main Contract Sum v Final Account:	XXXXXXX XXXXXXX
Construction Programme Planned v Actual:	Start on site October 2016 with a Contract Completion Date of 2 November 2017. Actual Completion 19 February 2018.
Benefits Planned v Delivered:	Planned: Expanded footprint and better use of floor space Improved ambience within IDL and increase in number of seats Better utilised space and increased number of retail units Improve the passenger experience within the FCC to IDL walkway Delivered: All the above have been delivered.

4.9.2 Project Specific Issues

Under the heading of 'Developments post G4' (start on site), the PPR (Ref.13127-XX-KN-XXX-000065) report dated 2 May 2019 identifies five items as being introduced into the project which were "not allowed for" within the G3 Cost Plan.

On review with the Project Team Arcadis was advised that the costs had not been excluded completely but only to the extent that they did not allow for the higher degree of specification eventually required. It was pointed out that the level of specification was not 100% clear at tender stage but allowances for development of the design had been included within the risk register and that these were drawn down in order to cover the spend. Arcadis would not consider this unreasonable if at the time of tender there was a partial lack of clarity on the specification.

Within the section of the report dealing with schedule reference is made to two compensation events which had an impact on the Project Completion Date. The original completion date written into the contract being 2 November 2017 had to be moved back to 8 February 2018. It was unclear from the report as to the reasons for the additional scope and to what the financial implications were because of the extended project duration. The two events causing this prolongation were:

- Installation of the In-Seating Power, additional work was required due to the discovery of unrecorded asbestos along the proposed conduit routes.
- Defects discovered within the existing flooring substrate planned for reuse. This was then required to be replaced / repaired.

The Project Team explained that there was little opportunity to carry out pre-construction intrusive surveys due to the impact on operations. The team also referred to mitigation plans put in place to reduce periods of disruption. The cost of the works and extended contract period was in the order of [redacted]. The Project Team pointed out that throughout the duration of the works the Quality Service Metrics (QSM) scores had remained unchanged.

Arcadis would consider the issues discovered to have not been totally foreseeable and the actions taken to mitigate impacts to have been reasonable.

4.9.3 Performance Against Areas of Control

Scope Definition, Procurement and Contracting Strategy:

Evidence was provided of a signed off procurement and contracting strategy in compliance with HAL's governance and procedures. In accordance with the Q6 project delivery strategy the works being in Terminal 3 were allocated to [redacted]

In addition to the above evidence of competitive tendering across second tier suppliers was provided.

The G3 cost plan for the project was reviewed and shown to align to the G3 (core) figure stated in the PPR report.

Schedule Management:

Monthly programmes for acceptance were submitted by the Contractor and reviewed by the project team as required by the contract. The quality of the programmes submitted was viewed to be good on the basis of the majority of them having been accepted.

Contract Administration:

Whilst the CEMAR account for this particular project was not available for review, from evidence within the PPR report in relation to the management of change, schedule and risk and the adopted use of CEMAR Arcadis would consider the contract to have been appropriately administered.

Risk and Opportunities Management:

Through the mechanism of the contract all risks identified by way of early warning notices were dealt with via weekly meetings with the Contractor. Again, using CEMAR this process would have been enforced and recorded.

Evidence of the project risk register was provided and reviewed. The format, development and management of the register is consistent with that used on other HAL projects and throughout the construction industry.

Although evidence of pursuing opportunities is identified in the PPR no evidence of anything having been realised could be provided.

Change Management:

Client change was managed through the HAL 'Client Change Record Sheet' process. Evidence of this having been administered is included in the PPR report.

Contract change was managed through administration of the contract compensation event mechanism. Evidence of this being administered is also included in the PPR report and once again the use of CEMAR would have enforced and recorded the process.

Commercial Management:

The baseline G3 (core) cost plan was evidenced and reviewed. The summary figure was shown to align to the acknowledged G3 figure and the basis and build up to the figure was seen to be appropriately detailed.

From a review of the Monthly Project Review report ongoing cost control was evidenced and the forecasting and cash-flowing of costs was viewed to have been properly managed.

As a way of demonstrating commercial challenge in their management of the main contract works Arcadis requested the project team identify differences between submitted quotations, from the main Contractor, and agreed values of compensation events. From a submitted amount of [redacted] the HAL team agreed a [redacted] reduction. I.e. [redacted] This is a significant reduction which would demonstrate commercial challenge having taken place.

A summary of the agreed main contract final account was reviewed together with the signed statement of agreement. No contentious items were apparent. The summary figure aligned to that included within the build up to the project final outturn cost.

Stakeholder Management:

A stakeholder management plan had been developed in line with HAL's standard format and effected accordingly. In addition to this a weekly report had been issued to all stakeholders advising them of the activities to be carried out in the forthcoming week.

Governance:

A review of one of the project's Monthly Progress Review reports was undertaken. This was found to include metrics and reports on all the above aspects of project management and had been reviewed at the monthly Projects Progress Board Meeting.

Conclusion:

The discovery of asbestos and issues with the floor both impacted on the project, however due to limited opportunity to conduct intrusive surveys in an operational area it is not a reflection of inefficient management of the project.

The procurement strategy was developed in accordance with HAL processes and procedures and was in line with industry best practice. A detailed cost plan had been produced.

A construction programme was produced and updated monthly, then reviewed sufficiently by HAL.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project.

A suitable risk and opportunity register were established and updated throughout the project life cycle, with some opportunities being identified. However, no opportunities appear to have been realised.

Cost control was evidenced, cash flow was forecasted, and compensation events were successfully challenged.

A stakeholder management plan was in place, and reports issued regularly to stakeholders.

The project was ultimately delivered under budget and slightly late, Arcadis feels that value for money was provided and the project was well managed throughout and delivered efficiently.

4.10 Pot 2: B009 Northern Perimeter Parking

4.10.1 Project Overview

Business Case:	To provide additional car parking to satisfy the increase in demand forecasted for the 2014 to 2019 Regulatory Period (Q6). If the capacity was not provided, then this would lead to a negative impact on both passenger experience and airport resilience due to congestion on the Terminal 5 forecourt.
Project Scope:	The redevelopment of the existing N2 Car Park to provide a higher value product including the making good of areas previously used as storage compounds in order to create more spaces.
Development Budget v Total Project Cost:	£3.1m at G3 (core) v £4.9 Final Outturn
Project Manager:	HAL
Designer:	XXXXXXX
Cost and Controls:	XXXXXXX
Main Contractor:	XXXXXXX
Building Contract:	Heathrow Works Contract (NEC) with Main Option C - Target Cost subsequently amended to a fixed price Option A by way of a contract deed of amendment.
Main Contract Sum v Final Account:	XXXXXXX
Construction Programme Planned v Actual:	Start on site 1 August 2014 with a Contract Completion Date of 9 February 2015 subsequently amended to 13 March 2015 by way of a contract deed of amendment. Actual Completion 12 February 2015.
Benefits Planned v Delivered:	Planned: Improved passenger experience demonstrated by an increase in the QSM scores. Delivered: Delivered with evidence of QSM scores provided.

4.10.2 Project Specific Issues

The PPR (Ref.19465-XX-KN-XXX-000008) report dated May 2019 identifies an increase in cost from the G3 (core) budget of circa £1.5m. It was explained that £700K of this resulted from poor ground conditions. Only a visual survey of the car park surface had been carried out on the basis that as it was an existing car park then the existing subsurface should have been satisfactory and they would only need to make repairs and not

completely renew. As a consequence of the poor ground conditions found under the old compound areas complete replacement of the base material was required. A further increase of £436K resulted from an increase in the HAL Leadership and Logistics costs. This is a percentage add-on to every project. The project being planned in Q5 had only a 7% allowance included against the required percentage of 15.5% for Q6. Whilst this was possibly foreseeable it would not have led to inefficiency. A further increase occurred as a result of striking live underground cables. Responsibility for this was undetermined with HAL claiming the contractor failed to follow correct procedures and the Contractor claiming the services were live when they were shown to have been dead.

The learning from all the above have been carried forward by HAL.

4.10.3 Performance Against Areas of Control

Scope Definition, Procurement and Contracting Strategy:

As suggested in the commentary above, the development of the project scope prior to entering into contract was in some areas incomplete, due to a lack of adequate pre-contract survey information. The PPR report includes a reference to capturing lessons learnt against these issues.

There is no evidence of a detailed project procurement plan having been prepared. In view of the simplicity of scope this is not unexpected. In accordance with the Q6 project delivery strategy the works being landside civil engineering in nature were allocated to the Delivery Integrator, [redacted], for that category.

Schedule Management:

During the project issues arose with the quality of the DI's submitted monthly schedules for acceptance. In order to encourage the Contractor to work to a more fixed time frame and cost, and therefore lower client risk, the form of contract was renegotiated to a fixed price NEC Option A form.

Contract Administration:

A review was undertaken of the Project's CEMAR account. This identified that the required contractual activities on the project such as the management of change, early warnings, schedule, defects, etc had been appropriately carried out. The change in form of contract provided certainty of cost.

Risk and Opportunities Management:

The Team advised that following the change in contract to a fixed price option the risk register was discontinued. This was justified on the basis that all the works were in the ground and the risk for this lay with the Contractor. Arcadis are not aligned to this view as not all risks are readily definable and they cannot therefore be totally dismissed.

No evidence of Opportunities management was provided.

Change Management:

There were no client project changes instructed on the Project.

Contract change (i.e. changes to the main Contractor's works) was managed through administration of the contract Compensation Event mechanism. Evidence of this having been administered was provided by way of a review of the project's CEMAR account. This would have also enforced and recorded the process.

Commercial Management:

A detailed G3 cost plan was not available for review. However, a G3 benchmarking report was reviewed and demonstrated the G3 (core) capex figure provided value for money.

Due to the relatively low value of the project a less comprehensive monthly cost report, Project Cost Control Document (CCD) had been used on the project in lieu of a full Monthly Project Review (MPR) report. Ongoing cost control was evidenced, and the forecasting and cash-flowing of costs was viewed to have been properly managed.

As a way of demonstrating commercial challenge in their management of the main contract works the team were requested to identify differences between submitted quotations (from the main Contractor) and agreed values of compensation events. From the figures provided for two major variations the value of the agreed compensation events was on average circa [redacted] lower than the submitted quotations.

A summary of the total project outturn cost was reviewed. The main contractor's final account sum was seen to reconcile with the renegotiated Fixed Price Deed Contract Sum. No contentious items were apparent in the build-up.

Stakeholder Management:

A stakeholder management plan was developed in line with HAL's standard format and effected accordingly. In addition to this a weekly report was issued to all stakeholders.

Governance:

A review of one of the project's Monthly Cost Control Document was undertaken. This was found to include metrics and reports on all the above aspects of project management. The report had been rolled up with other lower value projects into a summary Monthly Progress Review report and was reviewed at the monthly Projects Progress Board Meetings.

Conclusion:

Unforeseen ground conditions had a significant cost impact on the project, caused by having only a visual survey carried out prior to the commencement of the works. The reason for this is understandable under the circumstances and HAL have taken this on board as learning. Additionally, HAL's Leadership and Logistics costs rose considerably causing cost to the project through no fault of the delivery team. This would not have led to inefficient costs.

No procurement strategy was prepared, however due to the simplicity of the scope this is not unexpected.

Construction programmes were produced but there were issues with the quality.

The contract was effectively administered using appropriate contract management software, with changes being recorded and managed well throughout the project. The change in form of contract benefited the project by way of providing cost certainty.

A risk register was initially established but discontinued following the move to a fixed price contract.

Cost control was evidenced, cash flow was forecast, and compensation events were successfully challenged.

A stakeholder management plan was in place and reports issued regularly to stakeholders.

The project was ultimately delivered over budget and later than initially planned, however Arcadis feels that value for money was provided and the project was adequately managed throughout.

5 Appendices

5.1 Appendix A – Documents Requested and Reviewed

A summary of information received from HAL and IFS is provided below.

Information Requested	Received
Pot 1a	
• T3IB	
IFS Monthly reports 2014	18 June 2019
IFS Monthly reports 2015	18 June 2019
IFS Monthly reports 2016	18 June 2019
T3IB [redacted] contract £1.2m - Mar13 - 10000-XX-LD-XXX-004341	18 June 2019
10000-XX-RP-XXX-003104	18 June 2019
IFS Initial Review July 2014 rev 2 Final - 10000-XX-RP-XXX-002966	18 June 2019
[redacted] Deed of Amendment Rev 4 Terms 13 June 2014	18 June 2019
Plan D cost plan timeline for change	18 June 2019
T3 Integrated Baggage Report - 15-6-17	01 March 2019
T3IB benefits - 9 months review - December 2016	19 August 2019
T3IB Benefits Realisation Plan October 2014 v4	18 June 2019
• WBU	
Monthly Reports 2016	11 April 2019
Monthly Reports 2017	18 June 2019
10000-XX-RG-XXX-001458	18 June 2019
T5WBU Benefits 15000-XX-ME-XXX-000105 -	21 June 2019
T5WBU Business Case 15000-XX-RG-371-000003	18 June 2019
B238 Western Baggage Upgrade Business Benefits PPM 110517	21 June 2019
Project Status Report By Business Case	21 June 2019
Mid-delivery G3 Review	
Restart_Project_Scope_Definition 01399-410-00004-en-A06_T5WBU_	04 July 2019

Integrated Programme - 21-May-15 Version 150521 T5WBU	04 July 2019
T5WBU Project G3 Event 20th July 2015 V2.0	04 July 2019
T5WBU Register - July 2015 IFS	04 July 2019
WBU detailed cost plan (4.8.15)	04 July 2019
Pot 2b	
• Main Tunnel	
IFS Monthly Reports 2014	18 June 2019
IFS Monthly Reports 2015	18 June 2019
IFS Monthly Reports 2016	18 June 2019
IFS Monthly Reports 2017	18 June 2019
IFS Monthly Reports 2018	18 June 2019
IFS Monthly Reports 2019	18 June 2019
(AL73) Main Tunnel PfA assessment + MPR Narrative Aug 16 - Jul 17	04 October 2019
2018-11-28_BC 131 - MT Refurb_DoA - IFS Review_Rev 3.0 (10000-XX-RP-XXX-003262)	03 April 2019
Main Tunnel Refurb_Nov 2018_FINAL 10000-XX-RP-XXX-002922_	03 April 2019
Gateway 4 docs - 19341-XX-RG-400-000003	18 June 2019
CAA Main Tunnel Position - Sep 2019 v0.3	20 September 2019
Commentary on process of establishing £122m	20 June 2019
Doc 09 P4 - ACWP Spend	20 September 2019
Doc 10 P5 - DOA Executed 5th December - Price & Payment	20 September 2019
IC 000 144 - [redacted] - Tunnels Refurbishment - executed 17jan14	18 June 2019
IC 000 144 - [redacted] - Tunnels Refurbishment Deed of Amendment - executed 05dec16	18 June 2019
Tunnel Refurbishment Benefits Map v1.1	18 June 2019
Tunnels - understanding the Price & EAC & HoT - 11nov16	18 June 2019
G3 Gateway Papers	
Acquisition Strategy 19341-XX-PT-XXX-000011	04 July 2019

Business Case - 19341-XX-RG-400-000003 -	04 July 2019
Quantitative Risk Assessment Report - 19341-XX-RO-400-000009	04 July 2019
Project Risk and Opportunities Register - 19341-XX-RO-400-000010	04 July 2019
Project Schedule - 19341-XX-TS-400-000016 -	04 July 2019
Cost Estimate - MOT_19341-XX-CD-400-000001_V5p0_P2 -	04 July 2019
• Cargo	
IFS Monthly Reports 2014	18 June 2019
IFS Monthly Reports 2015	18 June 2019
IFS Monthly Reports 2016	18 June 2019
IFS Monthly Reports 2017	18 June 2019
IFS Monthly Reports 2018	18 June 2019
IFS Monthly Reports 2019	18 June 2019
Management Interventions (AL60) 19341-XX-ME-XXX-000055 -	20 September 2019
Cargo Tunnel 'Should Take' Review Report_v3.0 2018-07-17_10000-XX-RG-XXX-001815_	03 April 2019
IFS Initial Review Post-G4 Report Rev. 3.0 10000-XX-EC-XXX-000127 -	18 June 2019
Cargo Tunnel WHY Report_v2.0 10000-XX-RG-XXX-001836 -	24 July 2019
Tunnels Chronology - Cargo Tunnel WHY Report_v1.1 – DRAFT 10000-XX-RG-XXX-001836_	03 April 2019
Tunnels Chronology - Cargo Tunnel WHY Report_v1.3 10000-XX-RG-XXX-001836	18 April 2019
_Cargo Tunnel Refurb_Nov 2018_FINAL10000-XX-RP-XXX-003199	03 April 2019
[redacted] Deed of Amendment Review - 10000-XX-RP-XXX-003262	18 June 2019
Procurement strategy paper for Cargo Tunnel - nov16 – signed 19226-XX-PD-237-000002	04 July 2019
Heathrow Cargo Tunnel Risk Assessment 19226-XX-RO-400-000006	11 October 2019
Benefits Map - Cargo Tunnel 19341-XX-BM-XXX-000004	18 June 2019
19341-XX-PT-XXX-000053	18 June 2019
19341-XX-RG-400-000003	18 June 2019
ACWP Reconciliation - v4 - 28 April 2019	20 September 2019
CAA Capex Review - Cargo Tunnel Plan for Review (HAL Rev 1)	20 September 2019

Cargo Tunnel - ACWP update to CPB - v5 - 28apr19	20 September 2019
Cargo Tunnel CAA Response Viewing	20 September 2019
[redacted] - Tunnels Refurbishment Deed of Amendment - executed 05dec16 IC 000 144 -	18 June 2019
Tunnels IFS Project Review - Feb 16 - GMP	18 June 2019
Pot 2	
• Energy & Utilities Management	
B066 Benefits Realisation Plan 10000-XX-BM-XXX-000248 -	19 June 2019
B066 Business Case 10000-XX-RG-XXX-000867 -	19 June 2019
160211 Gateway Management Plan (10000-XX-GM-XXX-000206)	20 September 2019
BC066 Procurement Strategy - Combined DG2 - v3	20 September 2019
BC66 Post Project Review V2.0 09.05.19	19 June 2019
• T3 Pier 7 Roof Works	
13000-XX-CD-212-000001	19 August 2019
13301-XX-BM-XXX-000005 0 B101 Benefits Realisation Plan	19 June 2019
13301-XX-PD-212-000008 - BC101 T3 Pier 7 Roof Replacement PPR	19 June 2019
B101 PROG-20 Pier 7 Main Roof Schedule Scorecard- 16-10-20 Cover P1	19 August 2019
B101 PROG-20 Pier 7 Main Roof Schedule Scorecard- 16-10-20 SC	19 August 2019
MPR Key Project B101(710) T3 Pier 7 Roof - Dec16 rev1	19 August 2019
Pier 7 - Risk Register 13301-XX-RO-212-000003 (Final)	19 August 2019
Pier 7 Roof Meeting minutes 20 12 16 docx (002)	19 August 2019
Quotation No. 08 - Advanced Purchase of AHU's for Permanent M & E Installation (AHU Impact)	19 August 2019
T3 pier 7 design progress minutes 160216	19 August 2019
T3 Pier 7 Roof – Contract Status Report	19 August 2019
T3 Pier 7 Roof - EW-5_Response (AHU Impact)	19 August 2019
T3 Pier 7 Roof - Gateway Report and Cost Plan 13301-XX-GM-XXX-000007	19 August 2019
T3 Pier 7 Roof - PMI-45_Instruction - AHU Impact	19 August 2019

T3 Pier 7 Roof - Value for Money Report 13301-XX-CP-XXX-000007	19 August 2019
T3 Pier 7 Roof EW-5_Notification (AHU Impact)	19 August 2019
T3 Pier 7 Roof G3 Cost Plan 13301-XX-CP-XXX-000008	19 August 2019
T3 Pier 7 Roof PMIR_Detailed_Sheet	19 August 2019
T3 Pier 7 Roof Stakeholder management Plan - 13000-XX-PD-212-000006	19 August 2019
T3 Pier 7 Roof VFM Report 13301-XX-CP-XXX-000006	19 August 2019
• T3 Refurbishment & Enhancement - IDL	
B316_IDL_Retail & Seating_PPR_FINAL	19 June 2019
Benefits - B101 Engineering Asset Replacement - OPPM Extract	04 July 2019
CAA Audit Slides_B316-1-2 IDL Retail & Seating_Q&A's	19 August 2019
• T4 CPS 1548 & CPS 1918 – T4 Toilets & Finishes	
DG2 CPS-1548 T4 Toilets (Final) Rev 2 (Omit Prov Sum)	20 September 2019
DG2 T4 Finishes - Implementation Works (Final)	20 September 2019
rptCE_QTE_Tracker T4 Finishes	20 September 2019
rptCE_QTE_Tracker- value for money T4 toilets	20 September 2019
T4 finishes Post project Review	19 June 2019
T4 Toilets Post project Review	19 June 2019
• T4 Roof	
HAL Q6 Capex Review - Review Areas (Pot 2) T4 Rooflight Replacement	19 August 2019
Post_Project_Review_Detailed - T4 Rooflights	20 September 2019
rptCE_QTE_Tracker value for money T4 rooflights	19 August 2019
T4 rooflights Post project Review	19 June 2019

• T5 Parking	
B041 T5 Parking - Benefits Realisation Plan 16278-XX-GM-XXX-000003 -	19 June 2019
B041 T5 Parking - Business Case 19220-XX-RG-XXX-000001 -	19 June 2019
N2 Car Park G8 Certificate 19465-XX-GM-XXX-000014	19 August 2019
B009 NPP N2 Post Project Review Low Complexity v1.0 FINAL	19 June 2019