



A Second Runway for Gatwick

Appendix

A21

Programme Risk Management

London Gatwick Airport Expansion

Airport Commission

Programme Risk Management Report

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Executive Summary

This report documents the activities, inputs and outputs of the Risk Management process applied by Gatwick Airport Ltd (GAL) to support the Detailed Capital Cost Forecast for the assessment of the Airport Commission selected option, to provide additional runway and terminal capacity by 2030 at London Gatwick Airport. The option assessed by the Airports Commission will involve the creation of a new 3.4km runway, south of the existing runway utilizing the land within the safe guarded boundary of Gatwick Airport and new terminal building between the two runways to allow for passenger growth.

Process & Challenges

Turner & Townsend have facilitated all aspects of the risk management approach, which is aligned to a range of recognized best practice frameworks (including The Risk Management Standard ISO 31000 and the Office of Government Commerce's Management of Risk Guidance MoR). As part of this approach we have drawn upon a wealth of experience in carrying out similar exercises for large scale infrastructure programmes globally for clients such as Heathrow Airport, London Underground, Crossrail, ADAC (Abu Dhabi Airports Company), Dublin Airport Authority and Edinburgh Trams.

Key Risk Management activities included facilitated workshops, multiple 1-2-1 meetings, risk review sessions, quantitative risk analysis (QRA) and reporting. Representatives of all key stakeholders were engaged to maintain accuracy of the Risk Registers and quantified model outputs.

The Risk Management methodology and process adopted has set out to address a number of key challenges in line with the submission guidance set out by the Airport's Commission. The table below articulates these challenges and illustrates how the way in which the submission has been developed responds to each as well as the level of validation offered under the process that we have followed.

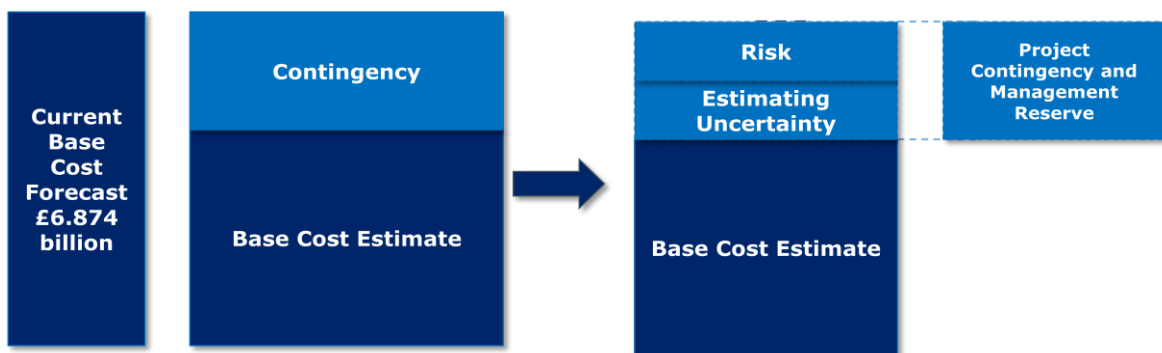
Challenge	Primary Response	Validation
<i>What level of confidence do Gatwick have in the overall capital cost estimate for the R2 Programme?</i>	Gatwick has developed a robust capital forecast for the R2 Project. Over 80% of the base construction cost has been benchmarked. The current contingency provision provides a P50 level of confidence of out turn costs and we have costed mitigation plans to set P80 by July 2019.	Conduct comprehensive Quantitative Cost Risk Analysis (QCRA) of base estimate and cost impact risks to establish if the identified level of contingency reserves in the estimate are sufficient
<i>What level of confidence do Gatwick have in their ability to meet key milestones set out by the Airports Commission?</i>	Our low risk phased approach makes us extremely confident we can meet the key objective of a new runway and associated infrastructure open by 2025. Our analysis shows a P80 confidence in achieving this.	Perform Quantitative Schedule Risk Analysis (QSRA) of the project schedule, duration uncertainties and schedule impact risks to understand confidence levels in achieving key milestones
<i>What are the significant risks being faced and what is GAL's ability to manage them?</i>	We have reviewed our risk profile against the Airport Commission concerns and our own experience - the key risks have been identified, mitigation plans prepared and a aggressive risk management plan put in place.	Identification of significant risks that the expansion project faces that are within GAL's control and develop and implement with mitigation action plans.
<i>What are the significant risks outside of GAL's control and what impact might these have on the delivery of the Programme?</i>	The D.C.O process and commission timeline represent the biggest risk outside our control. We can accommodate some slippage in both processes and still meet the 2025 opening.	Identification of the potential impact of risks out with GAL's control to allow for the expansion project to prepare a response action to reduce the impact on the project should it occur

Building the Contingency Profile

In the initial project budget a 'contingency' sum was set at 25% of the base cost. This was used to test the initial business case (and options within it) and provides a reference against which we can assess a more detailed analysis of risk and uncertainty for the project.

The overall risk profile for the project is built up by considering the inherent uncertainty within the cost estimate (Estimating Uncertainty) and identification of all potential threats (risks) that might impact upon the project.

The diagram below outlines this approach and illustrates how estimating uncertainty and risk are treated as discrete elements before being combined to provide an estimate of the overall contingency that the project might require.



Once identified both estimating uncertainty items and risks are quantified and modeled using statistical modeling tools that enable consideration of a range of confidence levels.

The modeling outputs allow the 'calculated' contingency estimate to be compared against the original budget to offer a view on the level of confidence that the original budget represents. The results of our analysis are presented in the following sections.

Qualitative Analysis

Once risks had been identified and evaluated by the Gatwick Management team, they were then categorized into groups as per their risk score. Prioritisation identified those risks that have the highest potential to threaten the success of the project and require priority action from the Gatwick Management Team to mitigate and control.

Overall Totals	
Risk Category	No of risks
Black	11
Red	69
Amber	67
Green	37
Total	184

Risks in the “Black” Category require priority action from the Gatwick project team and those within the “Red” Category require action in the imminent future.

Risks are grouped into one of five categories to align with what Gatwick consider the areas of concern for the Airports Commission and further analyzed to determine risks within GAL’s control and those not.

Airport Commission Category	No. of Risks	No. of Risks owned by Gatwick	No. of Risks out of Gatwick’s Control
Planning	36	12	24
Design	50	44	6
Delivery	42	33	9
Construction & Delivery	45	42	3
Transition	11	10	1
Total	184	141	43

The top two risks for each category (as set out by the Airport’s Commission) are detailed below.


Out of these only two are out of Gatwick's control and both sit within the planning stage of the project. Mitigation plans have been identified, where possible with a "target" score identified once mitigation plans have been implemented. The further eight risks are within Gatwick's control, mitigation plans have been identified along with a target score for the risk once all mitigation plans have been implemented. The target score shows the potential decrease in the risk exposure to each of the risks and project overall.

Risk ID	AC Group	Risk Description	Risk Score	Mitigation Plan	Target Score
RW 71	Planning	Levies and 106 agreement cannot be accommodated within the current cost plan	16	"1. Start the process asap 2. Appoint a single point of contact for Local authorities immediately if Gatwick are announced as winners 3. Cost out before July 2015 update 4. Costed list of mitigation and pledges"	9
RW 125	Planning	The DCO process gets delayed, jeopardising runway opening date	15	1. Early and continuous engagement 2. Monitor closely as deadline approaches 3. Identification of acceleration activities if required	9
RW 130	Design	Commercial facilities are developed with out supporting business case	20	1. Validate Commercial assumptions.	6
RW 139	Design	The briefed area for the terminal building is insufficient once bottom up functional brief is developed	20	1. Technical studies to validate floor plate layouts 2. Early engagement with stakeholders 3. Gatwick functional brief to be developed	15
RW 126	Delivery	The land assembly and relocation strategy delays commencement of R2 construction	15	1. identify problem areas 2. Acquire early where possible - at risk 3. Phased approach to understand	0
RW 156	Delivery	UKPNS scope and costs are not defined	20	1. Understand T&C's of agreement and add the relevant requirements to the constraints document	12
RW 160	Construction & Delivery	There is a risk of unidentified obstructions below ground	20	1. Site investigations 2. Transfer risk over to contractor	12
RW 90	Construction & Delivery	Airside space may be required on main construction site once a more detailed plan is developed	20	1. Confirm requirements for construction site as soon as possible 2. Adapt plans as soon as requirements confirmed	9
RW 181	Transition	Systems migration – The interface between old technology installations and newly installed technology does not function as required	20	1. Map critical systems 2. Establish migration plan 3. Build time into programme, aligned with system commissioning	12
RW 99	Transition	The volume of handovers proves onerous and difficult to manage	15	1. Detailed planning 2. Testing of process 3. Site Monitor of productivity 4. Best practice (Lessons Learnt) 5. Dedicated staff (operations)	6

Quantitative Analysis

The likelihood (%) and schedule impacts were used to develop assessments of likely risk exposure in cost terms and potential schedule delay by applying Quantitative Risk Analysis techniques. A summary of the key risk outputs are below:

Details of Cost Forecast, P50 and P80 results

	Base Estimate	Contingency		Grand Total	% Increase
		Estimating Uncertainty	Risk Only		
Forecast	£5.590	£1.284		£6.874	
P50	£5.590	£0.128	£1.161	£6.879	
P80	£5.590	£0.178	£1.325	£7.100	 3.2%

At this project stage, the current level of confidence associated with the current forecast is P50. The Gatwick Management Team are working towards achieving a P80 level of confidence with the current forecast by July 2019.

At this project stage, the analysis shows that the Gatwick Management Team are confident of delivering new runway capacity by 2025. Our risk model shows we have P80 levels of confidence in achieving this.

Details of Schedule Deterministic Date, P50 and P80 results without DCO Risk for Runway Opening

Key Milestone	Deterministic Date	P50 Date without DCO Risks	P80 Date without DCO Risks
Runway Opening (2025)	12/05/2025	23/10/2025	08/12/2025

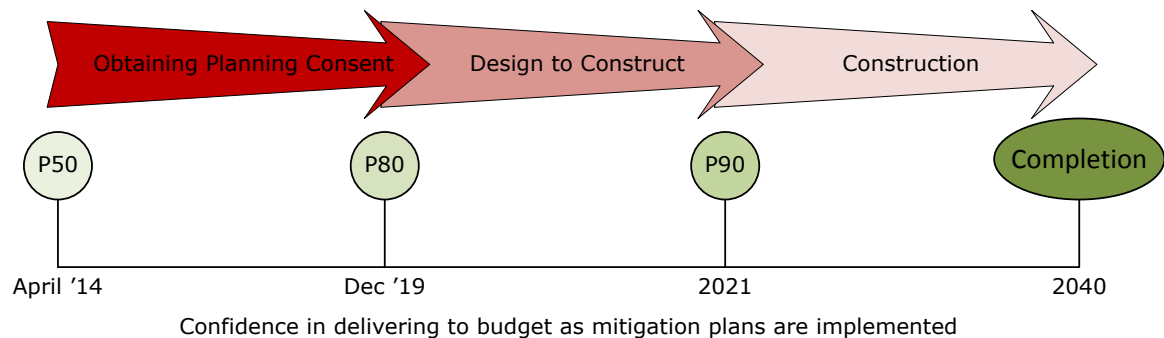
The further analysis also shows that the current project schedule has been sequenced in such a manner that if no mitigation plans were implemented and the project is delayed by the DCO process, there is still strong confidence that the Phase 1 Completion can be delivered by the Airport Commission's requirement of 2030.

Details of Schedule Deterministic Date, P50 and P80 results with DCO Risk

Key Milestone	Deterministic Date	P50 Date	P80 Date
Phase 1 (2030)	07/01/2030	12/04/2030	13/05/2030
Phase 2 (2035)	16/02/2035	28/03/2035	20/04/2035
Phase 3 (2040)	10/02/2040	02/05/2040	06/06/2040

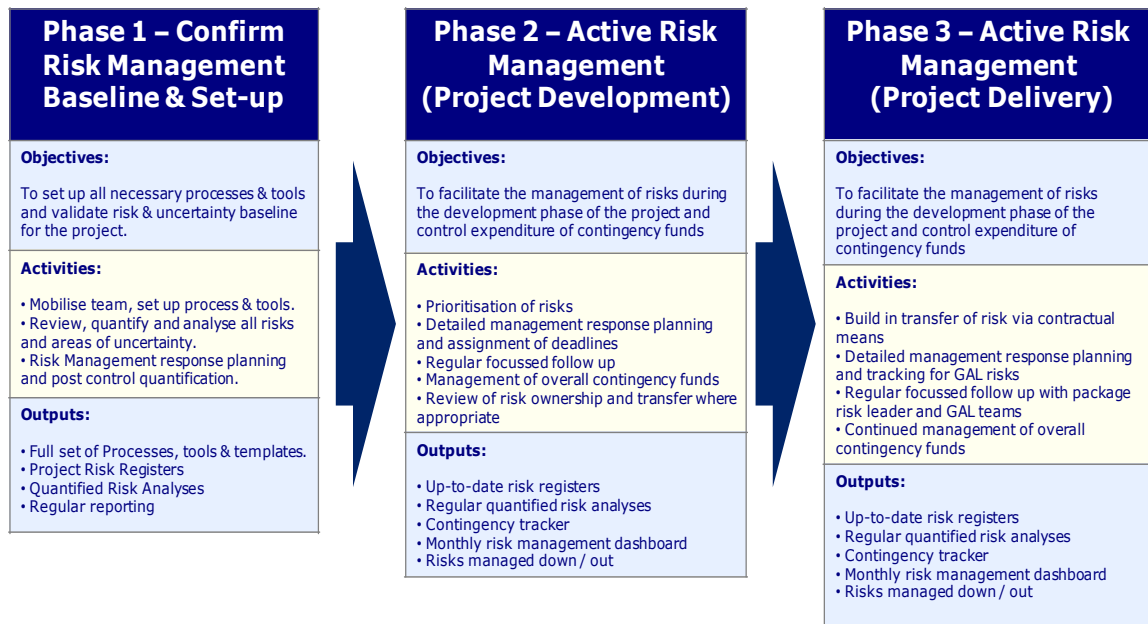
Next Steps

Initial mitigation plans have been developed for the Top 20 Risks. Further mitigation planning during the next phase of the project will help to increase the confidence we have that the scheme will be delivered on time and to budget in line with the targets set out in the diagram below.



The work carried out to date has focused on providing a robust view of the level of risk and uncertainty faced by the project. A baseline has been established and assessed against the original budget and will provide the basis from which all risk management activity will develop.

Proactive mitigation and management to drive down exposure and therefore increase the likelihood of completing the project on time and within the original budget will remain a focus of the project team throughout the determination period. Once the Airport's Commission have made their determination the level of risk management activity will step-up in line with the approach outlined in the diagram below.



1 Introduction

This report documents the activities, inputs and outputs of the Risk Management process applied by Gatwick Airport Ltd (GAL) to support the Detailed Capital Cost Forecast for the assessment of the Airport Commission selected option, to provide additional runway and terminal capacity by 2030 at London Gatwick Airport. The option assessed by the Airports Commission will involve the creation of a new 3.4km runway, south of the existing runway utilizing the land within the safe guarded boundary and New Terminal building between the two runways to allow for passenger growth.

Key questions that this assessment helps to answer include:

- What level of confidence do Gatwick have in the overall capital cost estimate for the R2 Programme?
- What level of confidence do Gatwick have in their ability to meet key milestones set out by the Airports Commission?
- What are the significant risks being faced and what is GAL's ability to manage them?
- What are the significant risks outside of GAL's control and what impact might these have on the delivery of the Programme?

Turner & Townsend have facilitated the production of the risk assessment outlined in this section of the report. Our approach aligns to a range of recognized best practice approaches (including The Risk Management Standard ISO 31000 and the OGC's Management of Risk Guidance MoR) and has drawn upon a wealth of experience in carrying out similar exercises for large scale infrastructure programmes globally for clients such as Heathrow Airport, London Underground, Crossrail, ADAC (Abu Dhabi Airports Company), Dublin Airport Authority and Edinburgh Trams.

Risk Management and modeling activities were carried out between November 2013 and March 2014 and involved a series of facilitated workshops, one-to-one meetings with key stakeholders, risk review sessions, quantitative risk analysis (QRA) and reporting. Across these activities, representatives of all key stakeholder groups have been engaged to allow us to build up a complete picture of where risks lie, what their likelihood and impact might be and how we might manage them. A list of dates of workshops and meetings can be found in Appendix A.

2 Objective

2.1 Risk Assessment for selected Airport Commission Option for Expansion

The following activities were required to be conducted to implement best practice risk management on the project:

- Develop a robust Risk Management Framework for Gatwick Airport Ltd (GAL) to govern and support the identification and analysis of potential risks to the expansion option
- Collate through complementary identification techniques a comprehensive project risk register in relation to the expansion option
- Assess all specific risks in risk register to conduct a full Quantitative Risk Analysis for both cost and schedule risk to provide Gatwick with a full understanding of risk exposure for selected option
- Produce a concise Risk Management report to detail risks, potential exposure and confidence levels in the cost estimate and schedule to be included in the final submission report from Gatwick to the Airport Commission
- Establish a robust forecast of risk exposure
- Drive mitigation planning into the thinking of delivery and design teams
- Establish a risk baseline to allow effective measurement against the project's mitigation plan

2.2 Outputs from Risk Assessment Activities

The outputs detailed in Figure 1 are the key activities required to be included in this Risk Management Report in the submission report from Gatwick to the Airport Commission.

Output	Reason
Project Risk Register (Created in MS Excel)	The risk register is a key deliverable in the risk management process. It is the 'live' database of all the risks identified, their assessment and mitigation plans where applicable. It is a central control point for risk which can be updated with new risks as they emerge and management of current risks. The risk register format is in line with current Gatwick procedures.
Top 20 Project Risks	Risks ranked on risk score to prioritise those risks that require immediate action to prevent potential risk arising.
Quantitative Cost Risk Analysis (QCRA) Risk Register	The QCRA modeling is conducted to calculate the potential impacts of risk in terms of cost to provide confidence levels of the allocated Risk Contingency for the project.
Quantitative Cost Risk Analysis (QCRA) Base Estimate	QCRA modeling is performed on the base estimate to assess estimating uncertainty to inform a more accurate contingency. As the base estimate is developed through "best available" information, analysis must be conducted to identify variances within the cost estimate.
Quantitative Schedule Risk Analysis (QSRA) Programme of works	QSRA modeling is conducted on the project schedule to calculate the confidence in meeting key completion dates for the project. The analysis also assesses the impacts of "what if" scenarios to determine impact to schedule should certain risks arise
Risk Report	The risk report is a collation and full analysis of outputs from all the activities conducted to provide an understanding of the projects cost and schedule risk

Figure 1 Risk Output

3 Risk Management

3.1 Definition of risk

A risk is an uncertain event or set of circumstances that, should occur, will have an effect (positive or negative) on the achievement of a project or business' objectives

Negative = Risk

Positive = Opportunity

Risk Management is the systematic process of identifying, analysing and responding to risk, maximising benefits and minimising threats. The risk management framework adopted by Gatwick allows for the understanding of the potential downside and upside of all those factors which could affect the runway expansion project. The implementation of the framework by Gatwick will increase the probability of success of the project, as well as reducing both the probability of failure and the uncertainty of achieving the projects overall objectives. Risk Management is a fundamental process for Gatwick's project delivery and its management of uncertainty, which will apply at every stage of the project lifecycle.

The benefits to Gatwick Airport for the adoption of a good risk management practice are detailed below;

- Realistic risk schedule and budgets for project delivery;
- Evaluation of uncertainty affecting the expansion project;
- A robust contingency fund that is calculated against identified risk; and
- Increased confidence in project delivery by focusing Gatwick's Management attention towards the proactive management of risk throughout the project lifecycle from start to finish.

3.2 Risk Methodology

The Risk Management Process has been created and developed to provide a robust framework for the identification and management of risk for Gatwick's Expansion Project. The framework was created to satisfy the key concerns raised by the Airports Commission as detailed below;

1. What level of confidence do Gatwick have in the overall capital cost estimate for the R2 Programme?
 - Conduct comprehensive Quantitative Cost Risk Analysis (QCRA) of base estimate and cost impact risks to establish if the identified level of contingency reserves in the estimate are sufficient
2. What level of confidence do Gatwick have in their ability to meet key milestones set out by the Airports Commission?
 - Perform Quantitative Schedule Risk Analysis (QSRA) of the project schedule, duration uncertainties and schedule impact risks to understand confidence levels in achieving key milestones
3. What are the significant risks being faced and what is Gatwick's ability to manage them?
 - Identification of significant risks that the expansion project faces that are within Gatwick's control and develop and implement with mitigation action plans.
4. What are the significant risks outside of Gatwick's control and what impact might these have on the delivery of the Programme?
 - Identification of the potential impact of risks out with Gatwick's control to allow for the expansion project to prepare a response action to reduce the impact on the project should it occur

3.3 Risk Management Process

Working alongside the Gatwick Management team, the Risk Manager agreed the project's risk requirements, scope and context. The risk process was then developed in line with ISO:31000 and existing corporate procedures at Gatwick Airport to provide a robust process for identification and analysis of risk to support the submission report for expansion at London Gatwick to the Airport Commission. Figure 2 below illustrates the process that was developed and adopted by the Gatwick Management Team. Following this process will allow the Gatwick Management team to manage risk effectively, as well as being able to have management plans to mitigate and respond to risk, improving the projects chance of success.

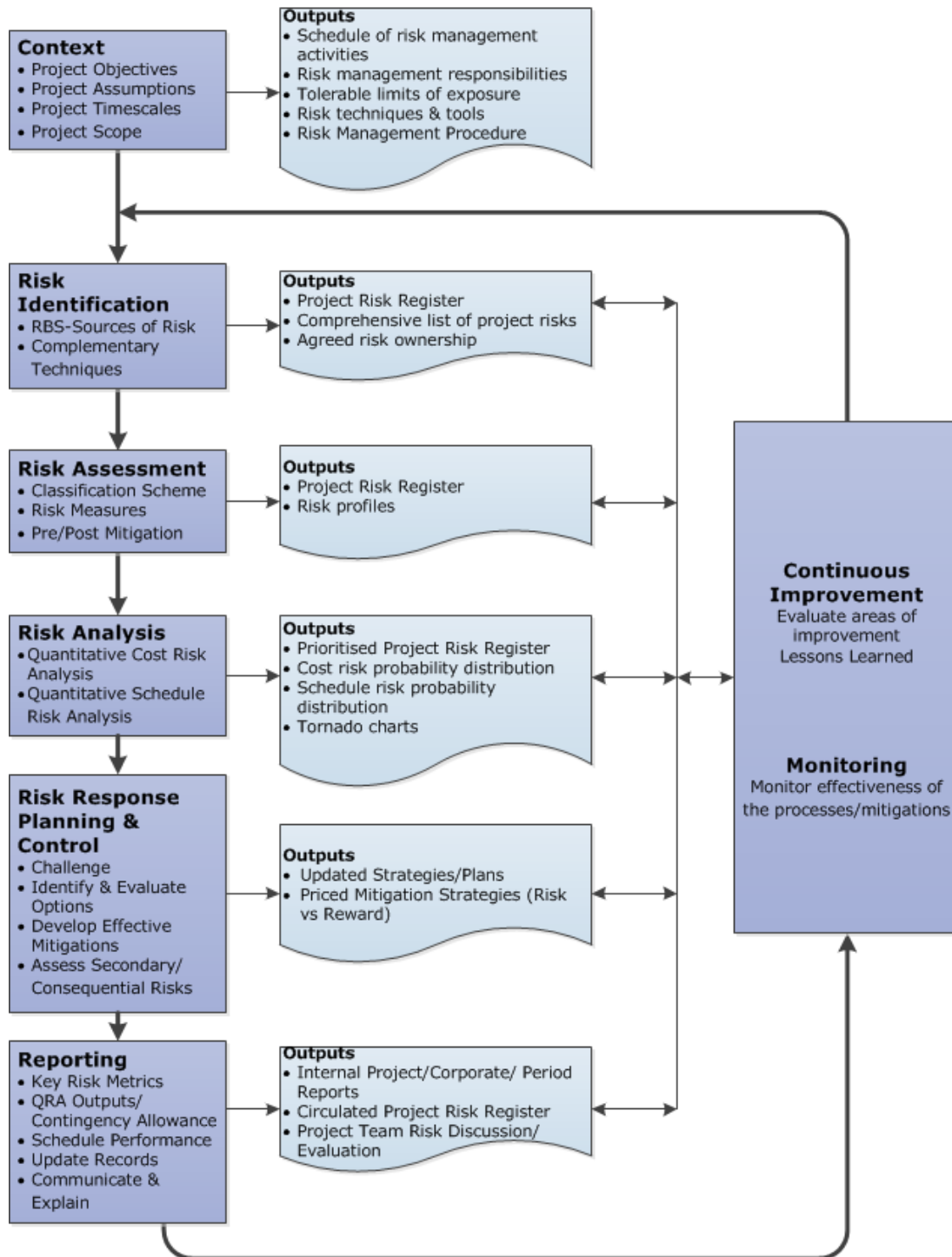


Figure 2 Risk Management Process

3.4 Risk Identification

In conjunction with the Gatwick Management team, the Risk Manager facilitated the identification of risks associated with the Airport Commissions selected option for the expansion project. The identification of these risks was critical to understanding the uncertainties and potential risk events that may impact the achievement of the project objectives.

Risk identification is an iterative process that was undertaken, developed and refined through a series of one-to-one sessions and risk review workshops with the key stakeholders from December 2013 through March 2014. A list of workshops and meetings can be found in Appendix A. These risks were then populated to establish the initial Gatwick Runway 2 Risk Register.

As the process was implemented, the risk register remained a “live” document that was continually reviewed and updated by the Gatwick Management team and the Risk Manager following risk workshops and review meetings.

Initial mitigation plans were developed once all risks had been identified, evaluated and the Top 20 Risks had been prioritized and confirmed with the Gatwick Management Team. The Top 20 Risks can be found in Section 5.

To help guide the initial risk identification process, common risk groups were identified and categorized using the Risk Breakdown Structure as detailed in Figure 3. Each of the categories were discussed and relevant risks identified in accordance. After a risk had been identified it was then defined and described in detail, including its root cause(s) and potential impacts to the project.

GAL Risk Breakdown Structure		
Stakeholder	Statutory Authorities	Design
Cost	Procurement	Construction
Interface	Operations	Programme & Integration

Figure 3 Gatwick Risk Breakdown Structure

The next stage of the process involved the assignment of each risk to a suitable owner within the Gatwick Management team. The specified owner was then responsible for the development, implementation and delegation of proactive mitigation plans. If a named person could not be identified at this stage in the project the risk was then allocated under the title “RW2 Programme Manager” until the time it can be allocated to a specific Gatwick employee.

Once all risks had been evaluated, each risk was grouped into the following categories shown in Figure 4 below;

Airport Commission Risk Breakdown Structure	
Planning	Design
Delivery	Construction and Delivery
Transition	

Figure 4 Airport Commission Risk Breakdown Structure

These categories were aligned with the key areas of concern outlined within the Airport Commissions Framework Document. This demonstrated that the Gatwick Management Team acknowledged and understood the Airport Commissions concerns and highlighted that the project team had considered all of these areas.

Results can be found in Section 5.

3.5 Risk Evaluation

The Risk Manager together with the project team developed a bespoke probability and impact matrix to be used for the quantification and the prioritization of the risks. The matrix is based on industry standard methods used on other large infrastructure projects to align with best practice, while has also being tailored to fit the specific expansion option project parameters (project duration, expected cost). The scoring matrix provides a risk score for each risk within the register, through the evaluation of the probability of the risk occurring and the subsequent impact it would have on the project. The matrix then allows risks to be prioritized to detail the most serious threats to successful project completion, and direct the teams focus and risk treatment efforts. The risks with the highest score are the risks that the Gatwick Management team should focus their attention on to mitigate to reduce the potential impact on the expansion project.

Using the scoring matrix each risk was first scored on the % probability of it occurring and then on its potential impact on cost and schedule should it occur. A scale of 1 – 5 is been used with 1 being “very low” or “minor” and 5 being “very high” or “major” for probability and impact respectively.

Assessments were made initially on each risk’s pre-mitigated (current) exposure. Once identified, an additional assessment was then conducted by the risk manager and the Gatwick project team on the Top 20 risks to the project to establish, where possible, any mitigation actions that could be carried out to potentially reduce its risk score.

The respective probability and impact matrices are found in Figure 5 and Figure 6.

The complete Probability/ Impact Matrix can be found in Appendix B.

Probability Matrix			
Description	Score	Minimum	Maximum
Very High	5	80%	100%
High	4	50%	80%
Medium	3	30%	50%
Low	2	10%	30%
Very Low	1	0%	10%

Figure 5 Probability Matrix

Impact Matrix					
Classification		Cost Impact (£'s)		Schedule Impact (Months)	
Score	Category	Min	Max	Min	Max
5	Very High	> £50,000,000		> 1 Year	
4	High	£20,000,000	£50,000,000	6	12
3	Medium	£5,000,000	£20,000,000	3	6
2	Low	£1,000,000	£5,000,000	1	3
1	Very Low	£0	£1,000,000	0	1

Figure 6 Impact Matrix

3.6 Risk Impact Score

In order to determine the key risks to the project a risk score is required to be established for each risk. The probability and impact matrix was used to calculate a Risk Score for each risk on the register. The risk score is calculated by multiplying the probability score by the impact score.

$$\text{Risk Score} = \text{Probability Score} \times \text{Impact Score}$$

Probability	Very High	5	10	15	20	25
	High	4	8	12	16	20
	Medium	3	6	9	12	15
	Low	2	4	6	8	10
	Very Low	1	2	3	4	5
		Minor	Small	Significant	Large	Major
		Impact				

Once all of the risks on the register had been evaluated and scored, they were then categorized into the following groups as per their risk score:

- **Black** - Critical Risk / Requires immediate attention
- **Red** - Significant risk / Requires attention imminently
- **Amber** - Minor Risk / Requires to be monitored closely
- **Green** - Risk is manageable/ controlled to be monitored

The purpose of grouping and prioritizing risks was to identify those risks that had the highest potential to threaten the success of the project and to highlight risks that required urgent attention by the Gatwick Management Team.

Risks scored between 16 and 25 were placed in "Black" Category and require immediate action from the Gatwick project team to control and to reduce the likelihood or impact of. Those within the "Red" Category require action in the imminent future.

The table below details the number of risks as per each category

Overall Totals	
Risk Category	No of risks
Black	11
Red	69
Amber	67
Green	37
Total	184

3.7 Risk Mitigation

Mitigation actions for each risk are required to be defined to demonstrate how the project team plans to reduce the chances of risk materializing or reduce the impact should a risk occur.

Mitigation actions for each risk were identified, where possible, during the series of one-to-one meetings held with the risk owners and at the risk review workshop with the Gatwick Management Team.

Mitigation actions were either assigned to the risk owner or to someone who would be responsible for carrying out any actions deemed necessary to drive the risk score down to an acceptable level. Mitigation action owners were notified of actions they had been assigned and of any deadlines that were attached.

All risks within the risk register have been assessed at the “Current” position. This is the probability and impact of the risk as it stands at the time of assessment. Where mitigation plans have been identified for a risk a “Target” score has been identified to show the potential risk score if all mitigation actions are adopted, carried out and successfully completed. A full analysis to get a true Post Mitigated score is required to be conducted at the next stage of the project lifecycle.

Identifying a “Target” score at this project stage, demonstrates that proactive risk management is being implemented on the expansion plan project and provides confidence to all of its stakeholders and to the Airport Commission.

3.8 Risk Review

The risk register has been continuously reviewed throughout the process by the Risk Manager and Gatwick expansion project team. In addition, as stated previously, one-to-one meetings were conducted to update and reassess the data in the risk register to assure risks were correct and up to date. The review process enabled the project team to re-evaluate risks and validate cost and time impacts. During the process the risk register was peer reviewed by members of Turner & Townsend, to validate the data collated was correct and relevant to the project and to confirm that all potential risks to the expansion project had been captured. This peer review allowed Gatwick Management team to be confident that all areas of risk had been covered and assessed correctly.

Top 20 Risks can be found in Section 5.

4 Quantitative Risk Analysis

4.1 Introduction

Quantitative Risk Analysis (QRA) modelling is a critical process to inform the project of their potential risk exposure and potential required contingency levels.

The QRA modelling uses Risk Analysis techniques to simulate the combined effect of risk on the project. The model ran the simulation using @Risk software, where ten thousand iterations were run, each time using different randomly selected sets of values for the risks that have been identified.

The following QRA's have been conducted for the Runway 2 Master Plan:

- Quantitative Cost Risk Analysis (QCRA)
- Estimating Uncertainty
- Quantitative Schedule Risk Analysis (QSRA)

Once the QCRA and the Estimating Uncertainty analysis had been completed the outturn values were added together to identify the potential project contingency and management reserves. Detailed below and shown in Figure 7 is how the Base Cost Forecast is built with result of the QCRA process.

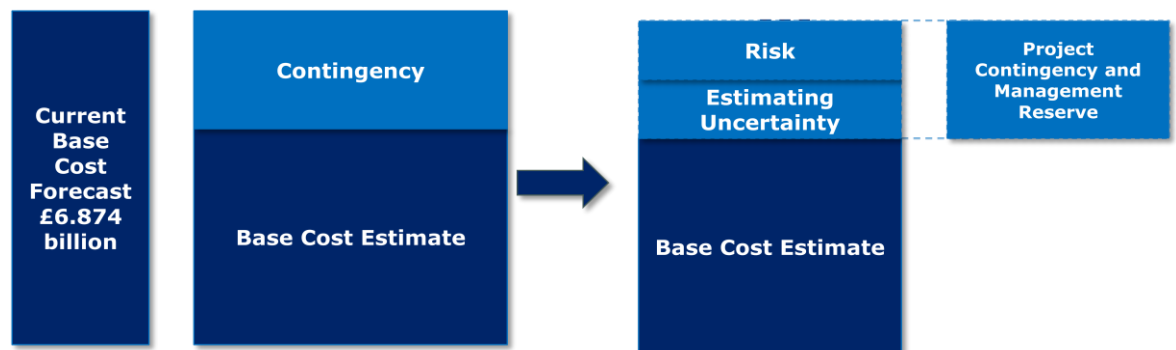


Figure 7 Base Cost Estimate and Contingency

4.1.1 Definitions

- Cost Impact Risk – potential cost risk impacts if an identified risk should occur
 - Estimating Uncertainty – quantifying the variance of potential costs within the base cost estimate
 - Project Contingency & Management Reserve – robust project contingency built up of the two aspects above

4.2 Quantitative Cost Risk Analysis

Once the initial identification, assessment and prioritisation of risks had been completed, a QCRA was run on the project risk register. Understanding the potential cost risk exposure to the project will help to advise suitable contingency levels for the project as well as driving proactive risk mitigation on those risks with high cost impacts.

The QCRA process used the risk's probability as a percentage and potential cost impacts in terms of minimum, most likely and maximum impacts. This information was then inputted into the QCRA model to identify the likely project outturn cost of risk. Figure 8 below is an example of a risk being used for analysis.

Risk Definition					
Risk ID	Description	Probability	Min Cost	Most Likely Cost	Max Cost
AB12	Discovery of Unexploded Ordinance (UXB)	60%	£10,000	£20,000	£30,000

Figure 8 Example Risk to be assessed

The model calculates the value of the risk multiple times within the range identified and produces a distribution of possible outcomes. The process is repeated for all risks identified on the risk register and all the individual values for each risk are added together to produce a Cumulative Probability Curve or "S-Curve". The "S-Curve" shows the range of possible outcomes on the project. From the graph the P50 and P80 confidence point is identified. The confidence point shows the total amount advised for project contingency and how confident it will not exceed that value. The outputs from the QCRA produce P50 and P80 values.

4.2.1 Definitions

- **P50:** the 50% confidence level of the value that the project will not exceed (based on the current Risks identified).
- **P80:** the 80% confidence level of the value that the project the project will not exceed (based on the current Risks identified).

4.3 Sensitivity Analysis

In addition to the S-Curve, the software produces a “Sensitivity Analysis” as part of the modeling results. By analyzing the relationship between risks and the outturn costs it establishes which risks the project is most sensitive to i.e. which of the risk model inputs had the biggest influence on the output. The results of the sensitivity analysis identify the most influential risks. These are detailed in the table below.

Risk ID	Risk Title
RW 83	Selected procurement route fails to deliver value for money
RW 141	The land and property development valuations are incorrect leading to overspend + protracted negotiation
RW 129	Assumption that Additional commercial facilities will be self funding prove incorrect
RW139	The briefed area for the terminal building is insufficient once bottom up functional brief is developed
RW 31	Gatwick maybe expected to contribute a higher percentage of the cost of rebuilding the London Gatwick station to Network Rail
RW123	Airport land take demands relocation of Thames Water treatment plant
RW 149	Key suppliers are overstretched, leading to poor performance and inflated cost base
RW 91	Existing Gatwick practices and procedures are not validated for Major Programme delivery, leading to inefficient working practices

4.4 Estimating Uncertainty

In order for the Gatwick Management Team to build a more accurate contingency “Estimating Uncertainty” was assessed on the base cost estimate. This was required as the baseline cost forecast is based on “best available” information and there is a potential for variance on these base (most likely) figures.

Estimating Uncertainty was applied to each relevant component within the base cost estimate capturing the best case (minimum) and worst case (maximum) values, alongside the base case (most likely). A clear Work Breakdown Structure was identified within the base cost estimate to allow the cost risk model to be built in this way. As the activities are definitely being undertaken there is no probability element of the model.

Figure 9 below is an example of an activity on the estimate being analysed.

Cost Estimate – Airfield				
Ref	Item	Min	Most Likely	Max
1.1	Runway	£44,000,000	£46,907,208	£51,000,000

Figure 9 Example of Base Cost Estimate “Uncertainty”

4.5 QCRA Results

As detailed in section 4.1 the results from the QCRA and the Estimating Uncertainty analysis are combined with the Base Cost Plan to give a confidence level, at this project stage, that the total cost of the project will not exceed £6.9 billion.

Figure 10 below shows the P50 and P80 QCRA results from the Project Risk Register. The analysis identifies that, at this project stage, the Gatwick Management team can be 50% confident that the required risk contingency figure will not exceed £1.161 billion and 80% confident that it will not exceed £1.325 billion.

Confidence Level	Risk Value
P50	£1.161 billion
P80	£1.325 billion

Figure 10 P50 and P80 QCRA outputs from the Project Risk Register

Figure 11 below shows the P50 and P80 results from the QCRA on Estimating Uncertainty.

The analysis identifies that, at this project stage, the Gatwick Management team can be 50% confident that the base cost forecast value will not exceed £5.718 billion and 80% confident that it will not exceed £5.768 billion.

To arrive at the Estimate Uncertainty Value this P50 or P80 figure is then subtracted from the Base Plan figure to give difference between the Base Plan and the QCRA output.

Confidence Level	Analysis Value	Base Cost Plan	Estimate Uncertainty
P50	£5.718 billion	£5.590 billion	£0.128 billion
P80	£5.768 billion		£0.178 billion

Figure 11 P50 and P80 QCRA outputs from the Base Cost Plan

To arrive at the final required P50 or P80 contingency total each set of results for the risk and estimate uncertainty are added together to give an overall total.

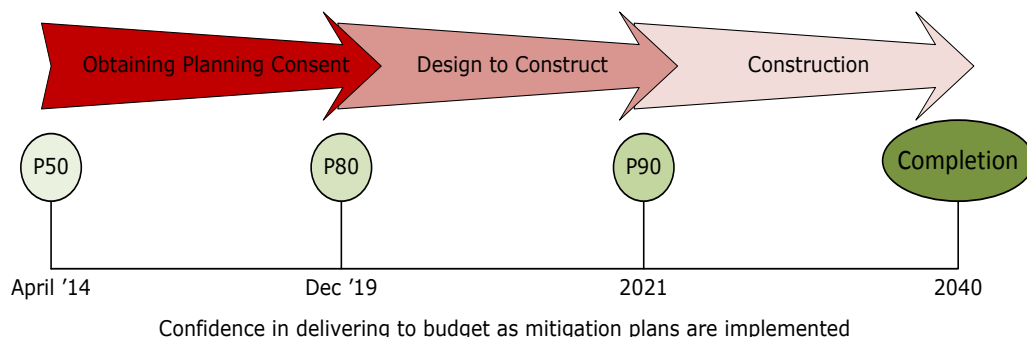
Figure 12 below details the results of both QCRA models combined to give confidence levels P50 and P80 for the overall project value.

At this project stage, the analysis shows that the Gatwick Management Team has a 50% confidence level in the project not exceeding the current £6.882 billion forecast. The % difference between the current forecast and P50 value is 0.5% and the % difference between the current forecast and P80 value is 3.2%.

	Base Estimate	Contingency		Grand Total	% Increase
		Estimating Uncertainty	Risk Only		
Forecast	£5.590	£1.284		£6.874	
P50	£5.590	£0.128	£1.161	£6.879	↑ 0.5%
P80	£5.590	£0.178	£1.325	£7.100	↑ 3.2%

Figure 12 Combined P50 and P80 QCRA output

Initial mitigation plans have been developed for the Top 20 Risks as confirmed with the Gatwick Management Team. The next stage for the project going forward is to identify proactive mitigation plans that provide growing confidence and assurance within the project that the forecast/budget can be delivered to, as greater certainty is gained. As progress is made towards the summary milestones shown in the graphic below, the expansion project strongly anticipates that confidence will rapidly increase once planning consent is achieved and then gradually increasing to P90 for the start of construction.



4.6 Quantitative Schedule Analysis

Quantitative Schedule Risk Analysis (QSRA) modeling has been used to indicate confidence in meeting the completion date of key milestones for the project. We used impact distributions, in relation to extension (threat) or acceleration (opportunity) of durations. Additionally, the project risks identified were then attributed to specific activities within the schedule that the risks could potentially impact.

Primavera Risk Analysis was used to simulate the QSRA with 10,000 iterations run each time using different randomly selected sets of values for the risks that have been identified. The model uses “Monte Carlo” Risk Analysis techniques (a random number generator process) to simulate the combined effect of risk on the project.

The individual values for each risk are added up, enabling a Cumulative Probability Curve or “S-Curve” for the project to be produced (included in the Appendices). The Cumulative Probability Curve shows the range of possible outcomes on the project. The minimum value, or 0% confidence point, states that the project delivery date will not be earlier than this date, based on the risks and uncertainty identified. The maximum value, or 100% confidence point, states that the project delivery date should not exceed this date. There are also intermediate levels used to determine contingency at levels which suits the project’s willingness to accept risk.

4.7 Inputs Required

In order to run the QSRA for the project the following were developed by the project team:

- Logic linked schedule
- Duration uncertainties established for key activities in the schedule
- Risk register scored for minimum, most likely and maximum impact durations, and likelihood of occurrence.
- Assignment of Risks to specific schedule activities for modeling

4.7.1 Definitions

- **P50:** the 50% confidence level is the date that the project can be 50% confident that the project will not exceed (based on the Risks identified).
- **P80:** the 80% confidence level is the date that the project can be 80% confident that the project will not exceed (based on the Risks identified).

4.8 Duration Uncertainty

There is a need to take account of “Duration Uncertainty” to build a more accurate Schedule Risk model. The difference between these elements is noted below:

- **Discrete Risk** – An uncertain event that, if it occurs, will have an impact on the achievement of project objectives (negative threats, or positive opportunities). Measured in terms of both impact and likelihood.
- **Duration Uncertainty** – The baseline schedule is based on “best available” information. However, as an estimate there is potential variance from these “most likely” figures.

With the duration uncertainty, we can apply the same Monte Carlo analysis techniques, but with no likelihood. This allows us to determine a more robust schedule model, taking account of both discrete risk and any inherent duration variance.

4.9 Output Statistics

The summary QSRA outputs of the key phased milestones are detailed in Figure 13. The analysis has shown that the current project schedule has been sequenced in such a manner that if no mitigation plans were implemented, there is still strong confidence that the key milestones of Phase 1 completion can be delivered by the Airport Commission's requirement of 2030.

The QSRA was also run removing all risks concerned with delays in the DCO process, to highlight that if Gatwick were to manage their risks and the DCO theirs there would be further improvement in the project schedule. The re-run analysis demonstrated that there would be approximately a 5 months improvement at P80 in the schedule for Runway Opening prior to Gatwick initiating mitigations if the DCO process is managed accordingly.

Key Milestone	Deterministic Date	P50 Date	P80 Date
Runway Opening No DCO Risk (2025)	12/05/2025	23/10/2025	08/12/2025
Runway Opening (2025)	12/05/2025	02/03/2026	13/05/2026
Phase 1 (2030)	07/01/2030	12/04/2030	13/05/2030
Phase 2 (2035)	16/02/2035	28/03/2035	20/04/2035
Phase 3 (2040)	10/02/2040	02/05/2040	06/06/2040

Figure 13 QSRA Results

5 Top 20 Risks – Airport Commission Grouping

As stated in Section 3.5, once a risk had been identified it was then required to be evaluated and scored. Risks were grouped into one of five categories to align with what Gatwick considered the areas of concern for the Airports Commission. The evaluation process was completed on all risks in the register to prioritize and direct the Gatwick project team to the most serious threats to the project and focus the attention to the identification of mitigation plans to reduce the probability or impact of the risk.

Initial mitigation plans have been developed, where possible, for the Top 20 Risks and a “Target” risk score identified. This is to show that once a mitigation plan has been implemented the risk score should reduce providing confidence and assurance within the project that the forecast/budget can be delivered to.

The table below details the Top 20 Risks, (grouped by airport category) as agreed by the Gatwick Management Team, along with current risk score and target risk score once mitigation plan has been implanted.

5.1 Planning Risks

ID	Airport Commission Category	Risk Breakdown Structure	Risk Description	Risk Score	Mitigation Plan	Target Risk Score
RW 71	Planning	Stakeholder	Levies and 106 agreement cannot be accommodated within current cost plan	16	1. Start the process as soon as possible 2. Appoint a single point of contact for Local authorities immediately if Gatwick are announced as winners 3. Cost out before July Update 4. Costed list of mitigation and pledges	9
RW 125	Planning	Statutory Bodies	The DCO process gets delayed, jeopardising runway opening date	15	1. Early and continuous engagement 2. Monitor closely as deadline approaches 3. Identification of acceleration activities if required	9

5.2 Design Risks

ID	Airport Commission Category	Risk Breakdown Structure	Risk Description	Risk Score	Mitigation Plan	Target Risk Score
RW 130	Design	Commercial	The commercial brief is not fully aligned with the cost plan assumptions	20	1. Conduct exercise to realign plans for internal use to show how all elements existing along side each other.	6
RW 139	Design	Design	The briefed area for the terminal building is insufficient once bottom up functional brief is developed	15	1. Technical studies to validate floor plate layouts 2. Early engagement 3. Gatwick functional brief to be developed	12
RW 94	Design	Design	Failure to agree technology solution according to schedule	15	1. What can we fix early 2. What is the point where we have to lock it down (Design) 3. Knowing the impact if it happens	8
RW 129	Design	Commercial	Additional commercial facilities will be required that are not included in the base case cost	15	1. Conduct more stakeholder engagement 2. Further understanding of what requirements have and have not been included 3. Readjustments where required early as possible 4. Sit down with commercial team and ARUP's Team	4
RW 122	Design	Cost	Thames Water can not cope with the additional waste water from Gatwick facilities	15	1. Assessment currently being undertaken March 14 2. Should know scope April 14	12

5.3 Delivery Risks

ID	Airport Commission Category	Risk Breakdown Structure	Risk Description	Risk Score	Mitigation Plan	Target Risk Score
RW 126	Delivery	Commercial	The land assembly and relocation strategy delays commencement of R2 construction	20	1. Identify problem areas 2. Acquire early where possible - at risk 3. Phased approach to understand	9
RW 156	Delivery	Design	UKPNS scope and costs are not defined	20	1. Understand T&C's of agreement and add the relevant requirements to the constraints document	12
RW 141	Delivery	Cost	The development valuations are incorrect	15	1. Identification of potential areas of error 2. Early negotiation where possible	9
RW 36	Delivery	Stakeholders	There is a risk of potential disruption from lobby groups (anti airport expansion)	12	1. Active monitoring of the group (GACC) 2. Identify groups who have protested at other airports e.g. Heathrow 3. Early engagement with groups where possible 4. Consultation taking place	6

5.4 Construction and Delivery Risks

ID	Airport Commission Category	Risk Breakdown Structure	Risk Description	Risk Score	Mitigation Plan	Target Risk Score
RW 90	Construction & Delivery	Construction	Airside space may be required on main construction site once a more detailed plan is developed	20	1. Confirm requirements for construction site as soon as possible 2. Adapt plans as soon as requirements confirmed	9
RW 160	Construction & Delivery	Construction	There is a risk of unidentified obstructions below ground	20	1. Site investigations 2. Transfer risk over to contractor	12
RW 69	Construction & Delivery	Construction	Unidentified below ground services are found on site once construction has commenced	20	1. Survey land where possible 2. Gather all data 3. Validate data and check where there may be discrepancies 4. Engagement with utility companies as early as possible	12
RW 98	Construction & Delivery	Construction	Third parties fail to deliver essential works according to our schedule	20	1. Engagement and communication of programme schedule 2. Engagement with third party before and during works 3. Good Project Management during construction 4. HA - do construction on own 5. Energy highest risk 6. EA - Risk 7. Taking as much control of the works as possible - Bring in house	12
RW 119	Construction & Delivery	Construction	The current landside APM is in poorer condition than first anticipated and can't accommodate expected extension & increased movements	16	1. Survey of current asset condition 2. Compare design with asset to assess if upgrade is required	12
RW 108	Construction & Delivery	Construction	A phased approach of construction may lead to inefficient working	15	1. Early establishment of phased working plan	6

5.5 Transition Risks

ID	Airport Commission Category	Risk Breakdown Structure	Risk Description	Risk Score	Mitigation Plan	Target Risk Score
RW 181	Transition	Technology	Systems migration – The interface between old technology installations and newly installed technology does not function as required	20	1. Map critical systems 2. Establish migration plan 3. Build time into programme, aligned with system commissioning	12
RW 99	Transition	Handover & Integration	The volume of handovers proves onerous and difficult to manage	15	1. Detailed planning 2. Testing of process 3. Site Monitor of productivity 4. Best practice (Lessons Learnt) 5. Dedicated staff (operations)	6
RW 182	Transition	Stakeholder	Aerodrome Licensing including safety case is delayed preventing airport opening	15	1. Engage with CAA to establish requirements 2. Establish process map to license approval 3. Reflect above in Stakeholder comms plan & Delivery Programme	6

The table below details the number of risks that fall into each category. As with any large infrastructure project it is to be expected that the majority of the risks fall into the Construction and Delivery phase as this is one of the most critical parts of any project.

Airport Commission Category	No. of Risks
Planning	36
Design	50
Delivery	42
Construction and Delivery	45
Transition	11
Total	184

Further analysis was conducted on the risks identified to highlight those risks that were owned by Gatwick and those that were out of Gatwick's control. This allows for the project team to identify those risks that they have control over to mitigate and respond to and those risks that they would have to accept and plan actions as best as possible to assure that if those risks did occur they would not seriously jeopardize the success of the project.

The table below shows an example of a risk owned by Gatwick and a risk out with Gatwick's control.

Risk ID	Owned by GAL	Risk Description
RW98	NO	Third parties fail to deliver essential works according to our schedule
RW90	YES	Airside space may be required on main construction site once a more detailed plan is developed

The table below details the number of risks owned by Gatwick and those that are not.

	No. of Risks
Owned by Gatwick	141
Out of Gatwick's Control	43
Total	184

For the risks that have been identified out of Gatwick's control mitigation plans can still be identified and put into place. This will allow Gatwick to have limited control over the impact of the risk should it occur.

6 Summary and Next Steps

The activities, inputs and outputs of the Risk Management process that has been adopted and applied by Gatwick are detailed in this report. The purpose of this risk assessment is to support the Detailed Capital Cost Forecast for the Airport Commissions selected option for expansion at London Gatwick Airport.

The expansion project is the creation of a new 3.4km runway, south of the existing runway utilizing the land within the safe guarded boundary of Gatwick Airport and new terminal building between the two runways to allow for passenger growth. The total value of this project is forecasted at £6.874 billion.

In order to complete the assessment of this option a Risk Management methodology and process was adopted by the Gatwick Project Team to answer the following questions that had been identified as key to the project:

1. What level of confidence do Gatwick have in the overall capital cost estimate for the R2 Programme?
 - Conduct comprehensive Quantitative Cost Risk Analysis (QCRA) of base estimate and cost impact risks to establish if the identified level of contingency reserves in the estimate are sufficient
2. What level of confidence do Gatwick have in their ability to meet key milestones set out by the Airports Commission?
 - Perform Quantitative Schedule Risk Analysis (QSRA) of the project schedule, duration uncertainties and schedule impact risks to understand confidence levels in achieving key milestones
3. What are the significant risks being faced and what is Gatwick's ability to manage them?
 - Identification of significant risks that the expansion project faces that are within Gatwick's control and develop and implement with mitigation action plans.

4. What are the significant risks outside of Gatwick's control and what impact might these have on the delivery of the Programme?
 - Identification of the potential impact of risks out with Gatwick's control to allow for the expansion project to prepare a response action to reduce the impact on the project should it occur

Risk Management and modeling activities were carried out and involved a series of facilitated workshops, one-to-one meetings with key stakeholders, risk review sessions, quantitative risk analysis (QRA) and reporting. Through these activities a complete picture of where risks lie and the impact may be should any occur.

Through the detailed analysis of the risk register and of the base cost plan the Gatwick Management team, at this project stage, has a P50 confidence level in the project not exceeding the current £6.874 billion forecast.

As initial mitigation plans have only been developed for the Top 20 Risks as confirmed with the Gatwick Management Team, the next stage for the project going forward is to identify proactive mitigation plans that provide growing confidence and assurance within the project that the forecast/budget can be delivered to, as greater certainty is gained. As progress is made towards the project milestones, the expansion option project strongly anticipates that confidence will rapidly increase once planning consent is achieved and then gradually increasing to P90 prior to construction commencement

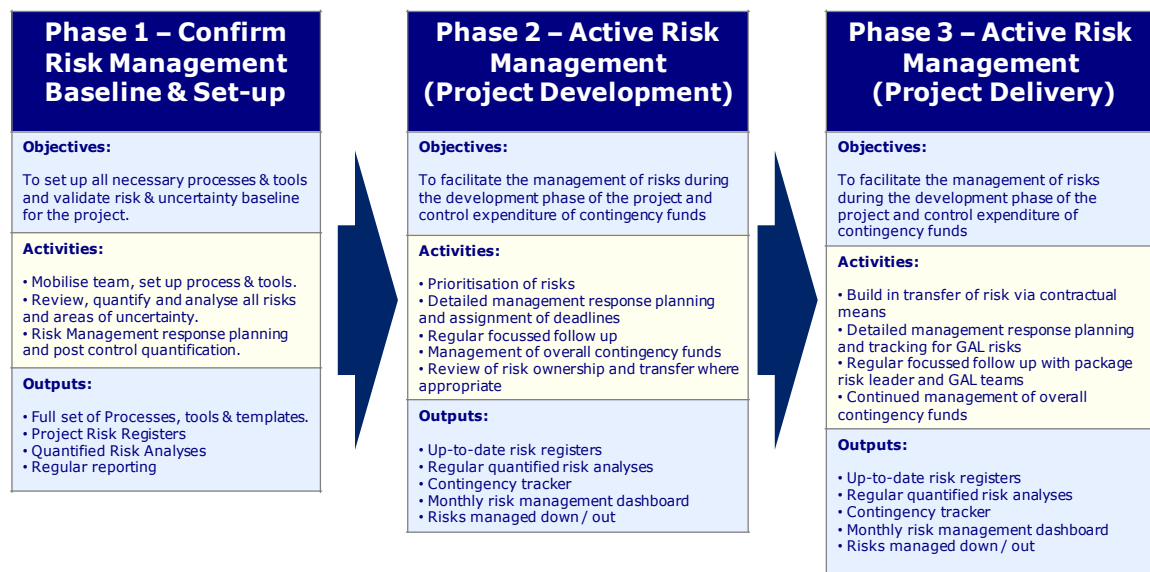
Through the detailed analysis of the programme schedule, it has shown that the current project schedule has been sequenced in such a manner that if no mitigation plans were implemented, there is still strong confidence that the key milestones of Runway Opening and Phase 1 Completion can be delivered before the Airport Commission's requirement of 2030.

Through the risk management process and risk analysis adopted by Gatwick the key questions set out at the start of this report can now be answered:

1. What level of confidence do Gatwick have in the overall capital cost estimate for the R2 Programme?
 - GAL has developed a robust capital forecast for the R2 Expansion Project. Over 70% of the base cost has been benchmarked and market tested. The current contingency provision provides a P50 level of confidence of out turn costs and we have costed mitigation plans to set P80 by July 2019.
2. What level of confidence do Gatwick have in their ability to meet key milestones set out by the Airports Commission?
 - Our low risk phased approach makes us extremely confident we can meet the key objective of a new runway and associated infrastructure open by 2030. Our analysis shows a P80 confidence in achieving this.
3. What are the significant risks being faced and what is Gatwick's ability to manage them?
 - We have reviewed our risk profile against the Airport Commission concerns and our own experience - the key risks have been identified, mitigation plans prepared and a aggressive risk management plan put in place.
4. What are the significant risks outside of Gatwick's control and what impact might these have on the delivery of the Programme?
 - The D.C.O process and commission timeline represent the biggest risk outside our control. We can accommodate significant slippage in both processes and still meet the 2030 opening.

The work carried out to date has focused on providing a robust view of the level of risk and uncertainty faced by the project. A baseline has been established and assessed against the original budget and will provide the basis from which all risk management activity will develop.

Proactive mitigation and management to drive down exposure and therefore increase the likelihood of completing the project on time and within the original budget will remain a focus of the project team throughout the determination period. Once the Airport's Commission have made their determination the level of risk management activity will step-up in line with the approach outlined in the diagram below.



Appendix A Workshops, Meetings and Reviews

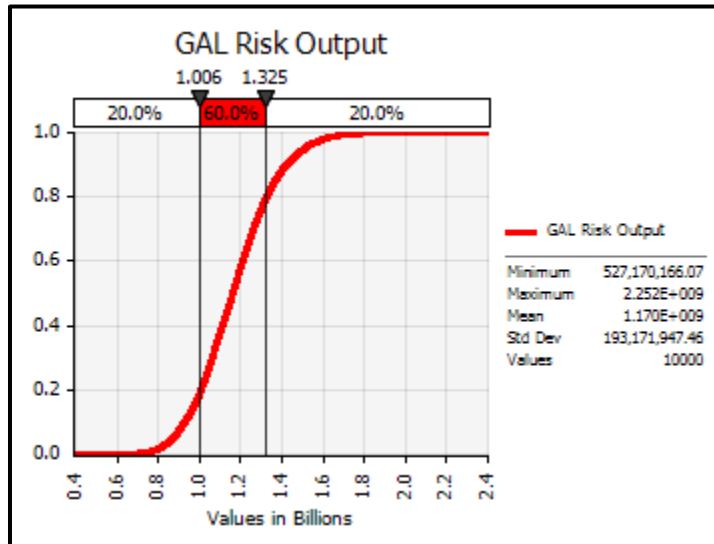
Activity	Date Conducted
Confirm scope of work Develop Risk Register Framework Develop Risk Register Template	November 2013
Risk Identification Workshop #1	10 th December 2013
Construction Risk Workshop	20 th January 2014
Risk Identification Workshop #2	5 th February 2014
1-2-1 Meetings with Identified Risk Owners	15 th January 2014 – 28 th February 2014
Risk Evaluation and Quantification	1 st March 2014 – 12 th March 2014
Risk Review Workshop #1	13 th March 2014
Risk Review Workshop #2	17 th March 2014

Appendix B Probability and Impact Matrix

		Threats							
Probability	>80%	VH	5	5	10	15	20	25	Probably will occur
	51% to 80%	H	4	4	8	12	16	20	More likely to occur than not
	31% to 50%	M	3	3	6	9	12	15	Fairly likely to occur
	11% to 30%	L	2	2	4	6	8	10	Low but not impossible
	0% to 10%	VL	1	1	2	3	4	5	Virtually impossible
			1	2	3	4	5		
			VL	L	M	H	VH		
Impacts	Cost (£)		0 - 1m	1m - 5m	5m -20m	20m-50m	>50m	* Upper bound assigned individually for each risk where it is applicable	
	Cost (£)		Minor effect on project cost	Small increase	Significant increase	Large increase	Major increase		
	Time (months)		0 - 1 month	1 month - 3 months	3 months - 6 months	6 months - 1 year	>1 year		

Appendix C Quantitative Cost Risk Analysis Results

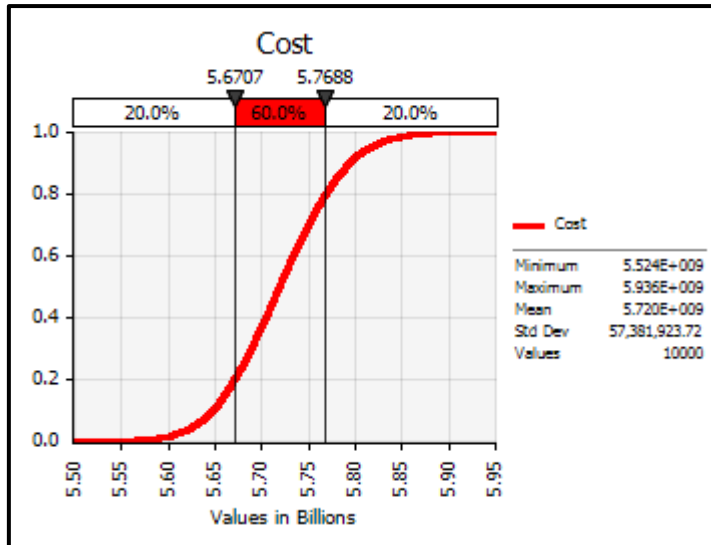
Quantitative Cost Risk Analysis Results – Risk Register



Statistics	
Minimum	£527,170,166
Maximum	£2,252,104,921
Mean	£1,170,272,909

% Confidence Level	Cost £'s	% Confidence Level	Cost £'s billions
5%	£869,566,713	50%	£1,161,743,044
10%	£929,283,872	55%	£1,184,550,777
15%	£974,099,588	60%	£1,208,578,935
20%	£1,006,476,380	65%	£1,235,564,087
25%	£1,036,135,616	70%	£1,262,628,177
30%	£1,062,953,986	75%	£1,292,393,617
35%	£1,086,4833,382	80%	£1,324,741,597
40%	£1,111,210,548	85%	£1,365,880,183
45%	£1,137,917,348	90%	£1,423,039,910

Appendix D Estimating Uncertainty Results



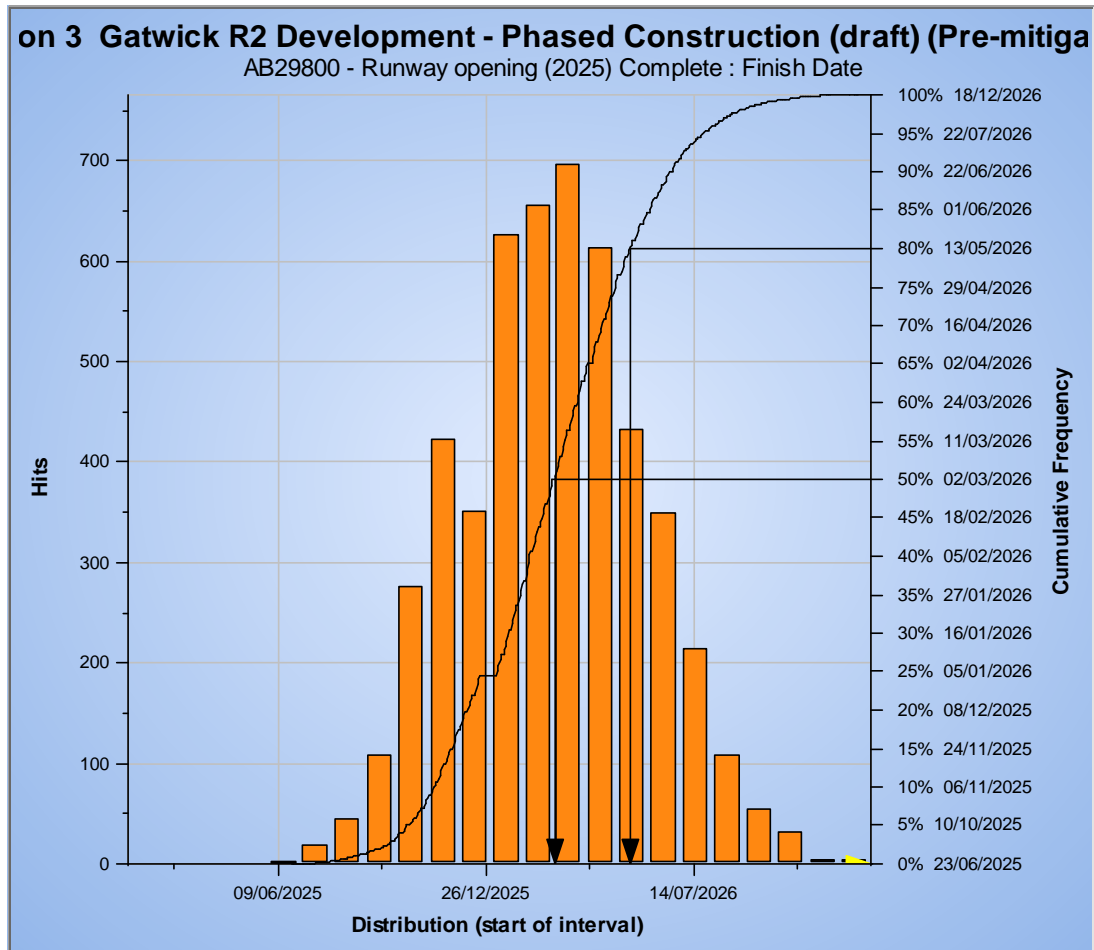
Statistics	
Minimum	£5,523,850,210
Maximum	£5,935,838,164
Mean	£5,719,909,483

% Confidence Level	Cost £'s	% Confidence Level	Cost £'s billions
5%	£5,628,216,795	50%	£5,718,776,122
10%	£5,647,192,237	55%	£5,726,021,329
15%	£5,660,128,557	60%	£5,733,281,749
20%	£5,670,689,290	65%	£5,741,421,941
25%	£5,680,298,616	70%	£5,749,944,816
30%	£5,688,669,330	75%	£5,758,654,863
35%	£5,696,561,760	80%	£5,768,815,488
40%	£5,704,216,531	85%	£5,779,693,436
45%	£5,711,848,400	90%	£5,793,037,055

Appendix E Quantitative Schedule Risk Analysis Results

Results with all risks captured

Key Milestone – Runway Opening Programme (2025)

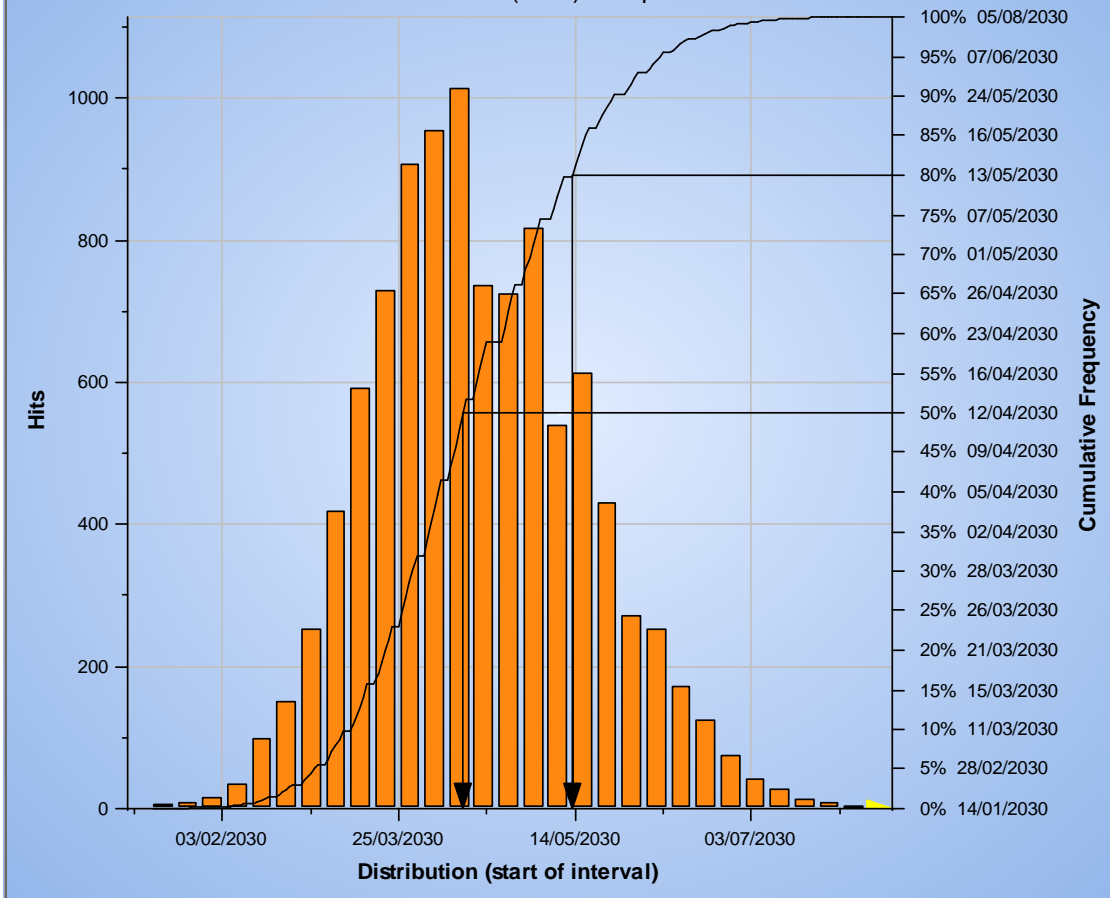


	Milestone Completion Date
Deterministic Date	12/05/2025
Schedule P50	02/03/2026
Schedule P80	13/05/2026

Key Milestone- Phase 1 Programme (2030)

on 3 Gatwick R2 Development - Phased Construction (draft) (Pre-mitiga

AB30170 - Phase 1 (2030) Complete : Finish Date

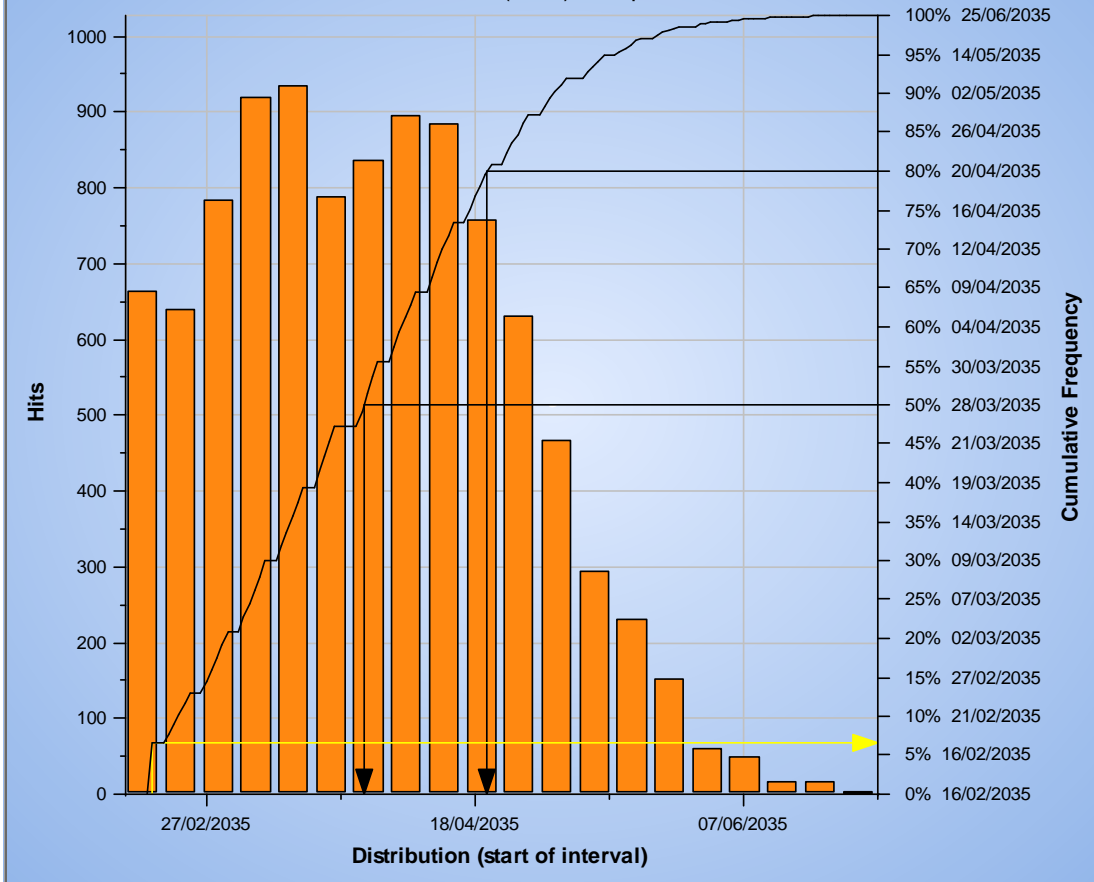


	Milestone Completion Date
Deterministic Date	07/01/2030
Schedule P50	12/04/2030
Schedule P80	13/05/2030

Key Milestone- Phase 2 Programme (2035)

on 3 Gatwick R2 Development - Phased Construction (draft) (Pre-mitiga

AB30180 - Phase 2 (2035) Complete : Finish Date

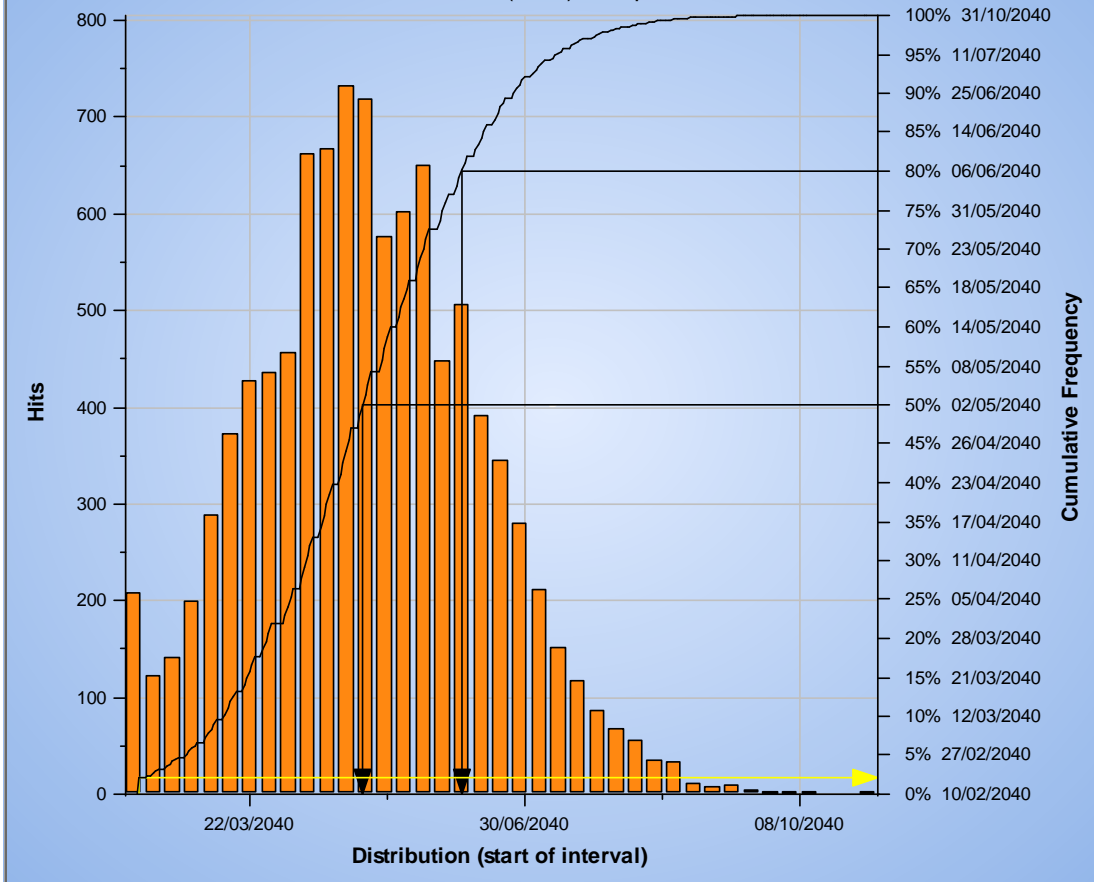


	Milestone Completion Date
Deterministic Date	16/02/2035 (7% chance of success)
Schedule P50	28/03/2035
Schedule P80	20/04/2035

Key Milestone- Phase 3 Programme (2040)

on 3 Gatwick R2 Development - Phased Construction (draft) (Pre-mitiga

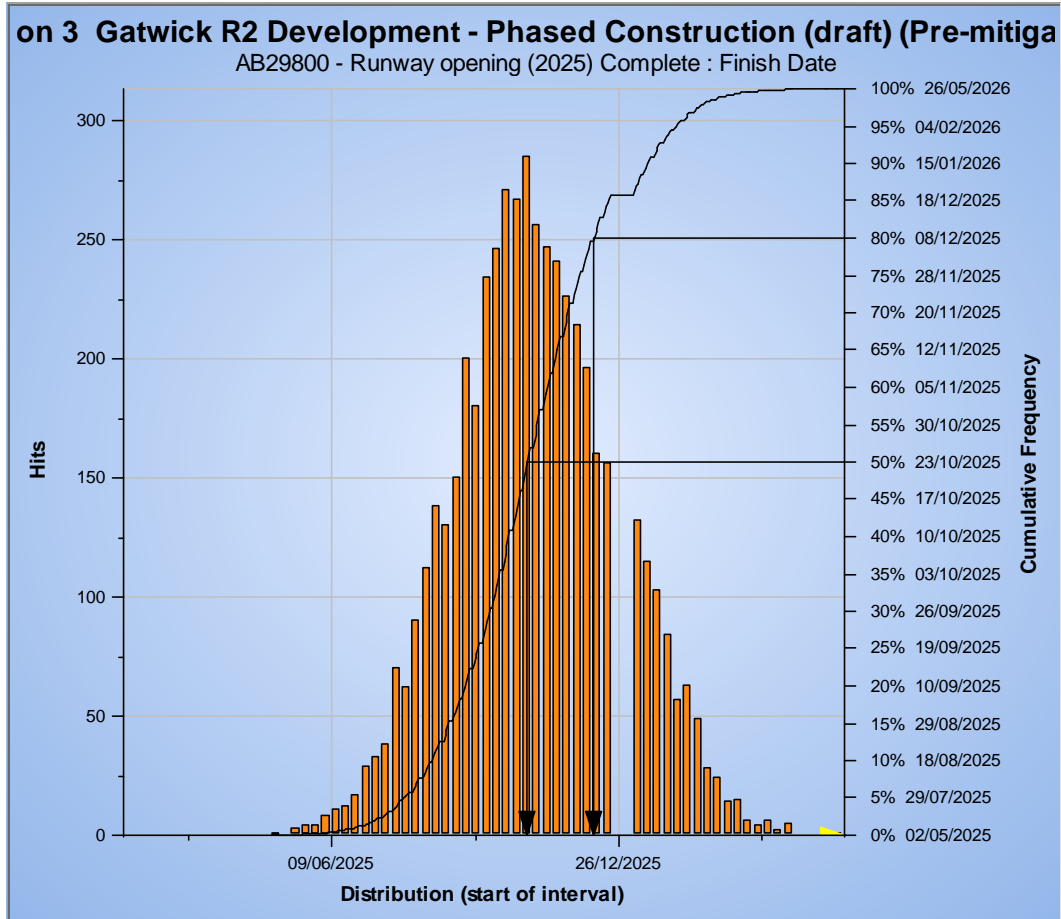
AB30190 - Phase 3 (2040) Complete : Finish Date



	Milestone Completion Date
Deterministic Date	10/02/2040 (2% chance of success)
Schedule P50	02/05/2040
Schedule P80	06/06/2040

Results with DCO delay risks removed

Key Milestone – Runway Opening Programme (2025)



	Milestone Completion Date
Deterministic Date	12/05/2025
Schedule P50	23/10/2025
Schedule P80	08/12/2025

Appendix F Optimism Bias

The technique of Optimism Bias has become associated with the assessment of risks on publicly funded infrastructure projects in the last decade.

*"Optimism bias is the demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters." **HM Treasury Green Book (2003)***

However, in recent times the need and reliance for the use of Optimism Bias has started to be replaced by a more proactive and mature risk management approach. Optimism Bias, while acknowledging the risk of under-assessment, has now become a technique that driven by the use of rigid calculations provides a project with over-inflated contingencies that are difficult to fully legislate, especially at early project conception.

Optimism Bias not been used for the Runway 2 Master Plan Base Estimate as result of the project's mature risk management framework and processes. The project, at master planning stage, has developed a framework that matches or exceeds that of other infrastructure projects at this lifecycle stage. The implemented project risk management process outlines clear risk scoring schemes, responsibilities and a comprehensively developed and quantified project risk register with proactive mitigation strategies for the critical risks. As a consequence of the process, best practice quantification techniques have been initiated to assess uncertainty within the base estimate, potential cost impact of project risks and the potential schedule delay should certain risks materialise. These three techniques collectively contribute to the project's overall assessment of contingency and provides the Runway 2 Master Plan project of far greater granularity, assurance and confidence at this stage of the project that all uncertainty and risks have been considered and quantified where possible.

Appendix G Estimate Uncertainty (Model)

Ref	Item	Min	Most Likely	Max	Dist Type	Comments	Low	High
A	Client Management							
A1	GAL Management (Staffing and commercial)							
1.1	GAL Programme Management and associated Consultants	173,500,000	192,681,829	220,000,000	Triangular	Min - Out-source all planning, procurement & management to EPC. Max assumes packaged route(10%)	-10%	14%
1.2	GAL Management - Support Functions and associated consultants	104,000,000	115,609,097	125,000,000	Triangular	Min - assumes current staffing levels sufficient for HR, IT, Finance, only specialists recruited. (10%)	-10%	8%
B	Design							
B1	Design Consultants							
1.1	Design from RIBA work stage B to Completion	289,022,743	346,827,292	400,000,000	Triangular	% based on recent airport schemes - assume minimum 6% (based on performance spec and D&B,) maximum 12 % based on full client design for all elements	-17%	15%
C	Base Construction Costs							
C1	Enabling works							
1.1	Site preparation comprising topsoil strip and breaking out existing landside roads and parking areas	40,000,000	43,011,505	52,000,000	Triangular	Measure - mainly from plans/images, qty's could vary +/- Min - reduction in rates and minor change in qty Max - increase in disposal rate and volume	-7%	21%
1.2	Demolitions - within GAL boundary	9,000,000	11,621,750	15,000,000	Triangular	Qty - based on rough areas Rates - main issue is diversion of utilities	-23%	29%
1.3	Demolitions - outside of GAL boundary	22,500,000	25,451,000	32,000,000	Triangular	as above	-12%	26%
C2	AIRFIELD							
2.1	Runway	44,000,000	48,746,934	55,000,000	Triangular	Pavement areas have been checked, variance is within 5% Main runway is fairly fixed as are the shoulders, issue on rate for extending the existing	-10%	13%
2.2	Aprons	310,000,000	365,293,753	400,000,000	Triangular	Possible reduction in benchmarking rate due to earthworks, drainage network being elsewhere	-15%	10%
2.3	Stands	140,000,000	146,450,367	160,000,000	Triangular	Possible reduction in benchmarking rate due to earthworks, drainage network and fuel being elsewhere	-4%	9%
2.4	Airfield instrumentation	20,000,000	22,520,000	45,000,000	Triangular	Increase in cost due to technology changes	-11%	100%
2.5	Airfield other	52,280,940	59,113,750	68,280,949	Triangular	Increase in stabilisation thickness, and/or powder ratios	-12%	16%
C3	AIRSIDE SUPPORT FACILITIES (TTS, ATC, HANGARS, CARGO, SURFACE WATER)							
3.1	Facilities	65,000,000	70,979,000	80,000,000	Triangular	rate variances and area changes	-8%	13%
3.2	Reprovision of removed facilities	25,000,000	30,150,000	40,000,000	Triangular	rate variances and area changes	-17%	33%
3.3	Airside APM / TTS	180,000,000	189,671,900	225,000,000	Triangular	rate variances, change to tunnel size	-5%	19%
3.4	Roads	11,000,000	13,905,000	16,000,000	Triangular	perimeter road rate changes, other airside road reduction in qty	-21%	15%
3.5	Noise control	15,000,000	16,842,287	20,000,000	Triangular	qty based on drawings, rate for wall may vary	-11%	19%
3.6	Security	4,500,000	5,365,830	7,000,000	Triangular	qty from plans, possible rate saving on fence and increase in control post costs	-16%	30%
3.7	Surface water	26,282,438	30,876,655	40,282,438	Triangular	possible increase in drainage network rate, possible increase in ponds and material not deposited but disposed. Reduction in excavation and pumping station costs	-15%	30%
C4	TERMINALS AND PIERS							
4.1	Terminals	780,000,000	799,347,500	880,000,000	Triangular	Max assumes benchmark rate inadequate, briefed area not covering all required functions - plant / circulation space / enhanced public area fitout.	-2%	10%
4.2	Piers	739,768,968	779,605,540	860,000,000	Triangular	Max assumes benchmark basis incorrect & pier becomes Departures above arrivals.	-5%	10%
4.3	Baggage Handling Systems	192,000,000	195,000,000	220,000,000	Triangular	Max assumes GAL brief develops to include remote make up, remote bag drop, EBS	-2%	13%
4.4	Energy Centre	70,000,000	80,000,000	95,000,000	Triangular	reduction in tunnels, increase in building and M&E works	-13%	19%
C5	SURFACE ACCESS INCLUDING; CAR PARKS, LANDSIDE TTS, HIGHWAY WORKS AND STATION UPGRADE							
5.1	Landside APM / TTS - Continuous system from NT to MFT	150,000,000	166,727,007	190,000,000	Triangular	changes to technology and incorrect assumption in utilising existing	-10%	14%
5.2	Car parks	145,000,000	151,935,000	175,000,000	Triangular	benchmark rates too low, more decked spaces reducing surface spaces	-5%	15%
5.3	Highways and Surface Access (Highways Agency/DfT)	414,125,000	424,125,000	480,000,000	Triangular	changes to railway station, highway work include more structures	-2%	13%
5.4	Airport Roads (GAL)	2,500,000	10,240,000	12,500,000	Triangular	reduced NT forecourt as part of Q6, increased MFT Basement	-76%	22%
5.5	Facilities	26,100,000	29,780,000	36,100,000	Triangular	reduction in facilities as combined, increase in PTI as 'gateway' enhanced	-12%	21%
C6	UTILITIES							
6.1	Provision of new by Utility providers	39,000,000	39,200,000	50,000,000	Triangular	major service diversion works off-airfield	-1%	28%
C7	OPERATIONAL COMMISSIONING							
7.1	M&E services	4,500,000	5,000,000	10,000,000	Triangular	major service diversion works off-airfield	-10%	100%
7.2	Airfield	900,000	1,000,000	5,000,000	Triangular		-10%	400%
7.3	Baggage	450,000	500,000	1,000,000	Triangular		-10%	100%
7.4	TTS	450,000	500,000	1,000,000	Triangular		-10%	100%
7.5	Passenger flow and security	900,000	1,000,000	2,000,000	Triangular		-10%	100%
7.6	Flight systems	4,500,000	5,000,000	10,000,000	Triangular		-10%	100%
C8	OPERATIONAL HANDOVER	8,000,000	£10,000,000	15,000,000	Triangular		-20%	50%
D	Project specifics							
D1	Pre Construction							
1.1	Land Purchase (assumed risk not included)	767,000,000	804,204,496	850,000,000	Triangular	incorrect assumptions in property/land costs. Specific risks identified in rr	-5%	6%
1.2	Compensation/Blight	22,000,000	24,201,680	40,000,000	Triangular	incorrect assumptions in compensation and blight costs	-9%	65%
1.3	Levies & 106 Agreements	45,000,000	50,338,727	100,000,000	Triangular	Some covered in risk register (contingency)	-11%	99%
1.4	Equipment	6,000,000	8,800,000	12,000,000	Triangular	quantity changes for snow clearing equipment	-32%	36%
1.5	Principle Water Course Permanent Diversions	50,000,000	52,300,298	67,000,000	Triangular	increased watercourse width, planting, etc. increased Ifield lake contribution	-4%	28%
1.6	Obstacle clearances	17,000,000	17,396,250	23,000,000	Triangular	incorrect rate/qty assumptions	-2%	32%
1.7	Archaeology/ Ecology / Heritage	5,000,000	5,500,000	10,000,000	Triangular	incorrect assumptions in costs	-9%	82%
1.8	Construction Logistics	100,000,000	115,609,097	135,000,000	Triangular		-14%	17%
E	General / other project costs							
E1	Insurances							
1.2	Insurances	65,000,000	78,054,268 5,590,482.812	105,000,000	Triangular	Phased nature prevents commercial deal	-17%	35%