Issues Paper

2019 Determination of the Maximum level of Airport Charges at Dublin Airport

Commission Paper 7/2018

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Commission for Aviation Regulation

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Table of Contents

1. Executive Summary

1.1 In 2019, we will make a new determination on the maximum level of airport charges at Dublin Airport, for a period of 4 plus years, commencing on the 1 January 2020.[1] We last made a determination in 2014. This paper begins our process of engaging with stakeholders in preparation for that determination.

1.2 The forthcoming determination will be made against a backdrop of four years of extraordinary growth in aviation in Ireland. This year, in excess of 30m passenger are expected to travel through Dublin Airport. This is 10m more passengers than the year we last published an issues paper, 2013.

1.3 Dublin Airport is a major international airport, the eleventh busiest in the EU, with almost 200 destinations served by over 50 airlines. In 2017, the Irish Government reaffirmed the need for economic regulation of the airport. The National Policy on airport charges regulation confirms that Dublin Airport holds significant market power and that the appropriate remedy to this is a continuation of price regulation. The policy reaffirms that the objective of price regulation is the protection of the interests of current and future passengers at Dublin Airport. While the policy proposes some changes to the framework; legislation has yet to be enacted implementing these changes.

1.4 The growth has presented some challenges. Most notably, the airport is capacity constrained at certain times; for the 2018 Summer season, there is no daily slot available from 6am to 9pm. This is not in the interest of passengers as it will constrain both competition between airlines and connectivity developments.

1.5 This growth was not expected when we made the last determination. Our targets have all been surpassed. Between 2015 and 2017, Dublin Airport, has served 14.2m more passengers than forecast, collecting an additional €123m and €154.7m in aeronautical and commercial revenue respectively while incurring additional operating costs of €124.1m. In the period daa plc committed to dividend payments to the state of €85m. daa plc is currently rated A- by Standard and Poors, with a positive outlook.

1.6 The differences between targets and outturns are marked, but, in part, this is incentive-based regulation working as intended. Dublin Airport has a strong incentive to grow traffic beyond the targets set where the additional revenues this generates can be used by it to fund any additional costs. The aim of incentive-based regulation is to encourage competitive behaviour by the regulated firm, the targets we set are in effect the competition. This is in the interest of passengers. In the short term passengers benefit from additional connectivity. When the price cap is reset, passengers benefit from any scale effects and any improvements in commercial performance.

1.7 However, capital investment has not kept pace with the growth and this would suggest that the incentive to make long term investments which have not been part of a regulatory settlement is weak. Given the requirement to invest in infrastructure to cope with the additional growth, in 2016 we introduced a process for considering a supplementary capital allowance. We are in the process of considering amending the 2014 Determination to increase the capital expenditure allowance.[2]

[1] Airport charges are charges for taking-off, landing and parking aircraft, the use of airbridges, arriving and departing passengers, and the transportation of cargo.
[2] The Draft Decision is to increase the allowance by €267.5.
https://www.aviationreg.ie/_fileupload/PACE%20Draft%20Decision/2018-02-20%20Draft%20Decision%20final%20draft.pdf

1.8 The determination of airport charges is a significant undertaking, with consequences for the airport, passengers, airlines and national economic development. Decisions made in this process have the ability to affect the capabilities of the airport to deliver connectivity, but also the attractiveness of the airport to airlines. We will be considering revenues in the region of €2bn in the next regulatory period and an investment plan which has the potential to serve passengers for decades to come. In simple terms, if the price is too high airlines will reduce the number of flights offered and/or increase ticket prices, while if the price is too low the airport will not be able to invest sufficiently in a key piece of national infrastructure.

1.9 In making the next determination our statutory objectives will be the core principles which we will adhere to: to protect the reasonable interests of current and prospective users of Dublin Airport in relation to Dublin Airport, to facilitate the efficient and economic development of Dublin Airport which meets the requirements of current and prospective users of Dublin Airport and to enable daa to operate and develop Dublin Airport in a sustainable and financially viable manner.

1.10 We will also be guided by our 2017-2019 Strategic Plan, which includes our mission to protect the interest of air passengers, and our strategic goal to protect those interests by focusing on enabling the delivery of efficient, high-quality and safety conscious airport services.

1.11 We must learn lessons from the past and explore ways we can improve the regulatory framework to further advance our aims and objectives. This requires both an assessment of what worked well and what did not. A key theme here will be balancing the competing needs of a flexible regulatory model with one which has strong efficiency incentives.

1.12 A good regulatory outcome is best achieved with a deliberative process. We will aim to achieve this through our program of stakeholder engagement, our plan to encourage the engagement of passengers in the process and our formal consultations (including our consultation on this paper). We expect Dublin Airport to engage in extensive consultation, particularly on future capital investment plans. As in previous years, we intend to make the next determination transparently, publishing all relevant material including the financial model.

1.13 This paper explores the mechanics of price cap regulation, but there are also some key strategic questions which need to be considered. Some of these will be informed by Government policy. These include the desired quality level of the airport, the provision of differentiated services at differentiated prices and the level and timing of capacity investment.

1.14 This paper has two key objectives. First, it puts the next determination into context by exploring the current performance of the airport and second, it opens the debate on the issues, which we currently see as being relevant for the forthcoming determination.

Consultation Questions

1.15 This is a consultation paper. The following are the key questions identified in this paper. You can use these to guide your response but are not restricted by them, nor indeed by the contents of this paper.

Policy Development

1.16 We have identified two key Government policies which will be relevant when making the next determination. In 2015, the National Aviation Policy was published. This sets out a number of action items aimed at achieving the Government's aviation policy. Second, in 2017 the National Policy Statement on Airport Charges Regulation was published. This reaffirmed the need for price cap regulation at Dublin Airport and also outlines some planned changes to the regulatory framework.

Q1. Which elements of National and International policy should we have regard to and how?

Approach to Regulation

1.17 Our statutory remit is to specify the maximum level of revenue Dublin Airport can collect from airport charges. To date we have fulfilled this by setting a maximum per passenger cap. We have generally incentivised Dublin Airport to out-perform our various targets by assigning the risk of deviations from those targets to the airport. To date we have used a building blocks approach based on the Regulatory Asset Base (RAB), the rest of this document assumes this will continue and discusses each building block in detail. However, we are open to new approaches and innovations on the existing methodology.

Q2. What high level methodology should we use to arrive at a price cap? Should we continue with the building block Regulatory Asset Base approach?

Q3. How should risk be allocated in the regulatory model?

Q4. What duration should we set the price cap for (4+ years)?

Passenger Forecasts

1.18 Passenger numbers is the denominator in the price cap calculation and a determinant of other building blocks. Dublin Airport has experienced a high level of growth since 2014. Passenger numbers are expected to be over 30m this year. In addition to overall passenger number growth, the number of airlines operating and the destination served has also increased. We now need to examine how best to set our target for passenger numbers post 2020.

Q5. What methodology and data sources should we use to forecast passenger numbers?

Q6. Should we forecast an aggregate or disaggregate passenger forecast?

Operating Expenditure

1.19 In 2017, Dublin Airport incurred operating costs of €257m. This is €59m more than our target. There are two reasons for this, first passenger numbers were 6m ahead of target, but second, the elasticity of operating costs to passenger numbers has been much higher than we estimated. For the 2019 Determination we need to determine the efficient level of operating costs.

Q7. What methodology should we use to forecast operating costs? What are appropriate benchmarks?

Q8. If efficiencies are identified, how long should Dublin Airport have to achieve them?

Q9. Should we continue to use rolling schemes to maintain a consistent incentive to realise efficiency gains throughout the regulatory period?

Commercial Revenues

1.20 We use a single till where commercial revenues are netted off costs to establish the required aeronautical revenues and then set the price cap. Commercial revenues are performing well. On a per passenger basis the 2017 outturn was €7.56 compared to our target of €6.94. This combined with the increase in passenger numbers resulted in an aggregate outperformance of €61m. We now need to examine how best to set targets for the next period. In addition, we need to consider how best to incentivise Dublin Airport to realise commercial opportunities.

Q10. What methodology should we use to forecast commercial revenues? What are appropriate benchmarks?

Q11. Should Dublin Airport be incentivised to maximize revenue from all commercial activities?

Q12. Should we continue to use rolling schemes to maintain a consistent incentive to realise commercial opportunities throughout the regulatory period?

Capital Expenditure

1.21 Capital investment is less flexible than the other building blocks due to the longer time horizons for planning, delivery and remuneration. However, in 2016 we introduced a process to consider a supplementary capital allowance in situations where circumstances have changed substantially within a determination period. In 2019 we will need to consider what is the appropriate level of capital expenditure for the next regulatory period and how it should be remunerated.

Q13. How should we establish if a capital investment project should be given an allowance?

Q14. Should we continue to group projects together to allow flexibility?

Q15. How and when should we establish the efficient cost of a project?

Q16. How should we reconcile completed projects against the allowance?

Cost of Capital

1.22 The cost of capital rewards investors (both equity and debt holders) for the risk they incur from investing in Dublin Airport. To date we have used the Weighted Average Cost of Capital (WACC) and Capital Asset Pricing Model (CAPM) approaches to estimate the appropriate return. In 2014, we estimated the (real) cost of capital to be 5.8%.

Q17. What methodology and data sources should we use to calculate an appropriate return on capital?

Financial Viability

1.23 One of our statutory objectives is to enable daa to operate and develop Dublin Airport in a sustainable and financially viable manner. In 2014, we considered if the price cap would enable Dublin Airport to achieve an investment grade credit rating.

Q18. How should we enable Dublin Airport to operate and develop in a sustainable and financially viable manner?

Q19. Is investment grade the appropriate benchmark to use?

Quality of Service

1.24 Dublin Airport is performing well across the suite of quality of service targets we set in 2014. This is despite the increase in passenger numbers. We now need to examine if the current targets accurately proxy for the full passenger experience at the airport.

Q20. Should the current scheme of Quality of Service targets and penalties be amended? What outcomes should be targeted and how?

Q21. What is an appropriate amount of revenue to put at risk?

Other Issues

Q22. How should incentive schemes be accounted for in the regulatory model?

Q23. How should we address imperfect pricing by the regulated entity (over and under collection)?

Q24. How should we treat costs related to Passengers of Reduced Mobility (PRM)?

2. Process for the 2019 Determination

2.1 A new determination on airport charges at Dublin Airport needs to be in place by the end of 2019. This paper begins our process of engagement with stakeholders, seeking submissions on how we should make the new determination and what issues should potentially influence it. Parties are invited to comment on the regulatory policies we should adopt, the methodologies we should apply and the data sources we should use.

2.2 We are keen to hear from all interested parties on these matters at an early stage. While this will not be the final opportunity for stakeholders to comment before the final determination, we strongly encourage parties to respond to this paper. This is because we will not adopt significant changes if we have not had the opportunity to understand their implications fully and afforded all interested parties an opportunity to comment.

Timeline for the 2019 Determination

2.3 We have made some adjustments to the timeline for the 2019 Determination compared to 2014. In particular, we are starting the engagement through this paper 3 months earlier and will publish the draft determination one month earlier than last time, April 2019.

2.4 We expect industry-led consultations on the passenger forecasts, quality of service regime and capital investment plan to take place in 2018. If parties wish to form working groups to discuss other aspects that might be relevant for the next Determination, we will consider requests to attend such meetings.

2.5 We expect Dublin Airport to publish its final Capital Investment Plan (CIP) following these consultations by December 2018.

2.6 We will publish the final determination in September 2019. This will allow sufficient time for parties adapt their plans for 2020 and Dublin Airport consult on the menu of airport charges for 2020.

How to Respond

2.7 We plan to allow parties two months to respond to consultation documents that we issue, whenever possible. The deadline for responses to this Issues Paper is **5:00 PM, Friday 29 June 2018**.

2.8 Responses should be titled "**Response to the Issues Paper CP7/2018**" and sent:

- By email to: Info@aviationreg.ie (preferable); or
- By post to: 3rd Floor, Alexandra House, Earlsfort Terrace, Dublin 2, D02 W773

2.9 We may correspond with interested parties who make submissions, seeking clarification or explanation of their submissions.

2.10 Respondents should be aware that we are subject to the provisions of the Freedom of

Information legislation. Ordinarily we place all submissions received on our website.[3] We may include the information contained in submissions in reports and elsewhere as required. If a submission contains confidential material, it should be clearly marked as confidential and a redacted version suitable for publication should also be provided.

2.11 We do not ordinarily edit submissions. Any party making a submission has sole responsibility for its contents and indemnifies us in relation to any loss or damage of whatever nature and howsoever arising suffered by us as a result of publishing or disseminating the information contained within the submission.

Structure of this Paper

2.12 The next section describes National and European policy developments since 2014 that we consider relevant to the 2019 Determination. At a national level we discuss current policies relating to aviation and airport charges regulation. At a European level, we refer to some recommendations of the Thessaloniki Forum, the ongoing evaluation of the Airport Charges Directive and Brexit.

2.13 In Section 4, we consider the high-level approach to regulation for the 2019 determination. We set out our statutory remit, basic definitions and the goals of regulation. We explain the key decisions that, in our view, need to be made before making decisions on the building blocks and other issues.

2.14 Sections 5 to 9 discuss the regulatory building blocks: Passenger forecasts, operating expenditure, commercial revenues, capital expenditure and the cost of capital. Each section explores the performance of Dublin Airport, with a particular focus on the current regulatory period, and discusses possible methodological and policy issues.

2.15 Section 10 assesses the results for relevant financial metrics of Dublin Airport and discusses our approach to meeting our statutory objective to enable the financial viability of the airport.

2.16 Section 11 discusses quality of service measures that we currently assess and some that we could potentially include in the next determination. We compare the current quality of service regime at Dublin Airport with that in some comparator airports in Europe.

2.17 Section 12 discusses some other topical issues, namely the regulatory treatment of incentive schemes, potential adjustments to the K Factor and the PRM charge formula.

2.18 Appendix 1 explains the methodology that we have used in past determinations to estimate the cost of capital for Dublin Airport. Appendix 2 states the recommendations issued in 2016 by the Thessaloniki Forum of airport charges regulators in relation to the estimation of the cost of capital. Appendix 3 summarises our previous decisions on cost of capital for Dublin Airport and those made by other regulators since 2015. Appendix 4 explains in detail the security queue audit that we carried out at Dublin Airport in 2016-2017.

[3] While we endeavour to ensure that information on our website is up to date and accurate, we accept no responsibility in relation to the accuracy or completeness of our website and expressly exclude any warranty or representations as to its accuracy or completeness.

3. Policy Developments since the 2014 Determination

3.1 This section explores relevant policy developments which have occurred since we last made a determination. One of the statutory factors we need to have regard to is Government policy which we have been notified of.

2015 National Aviation Policy

3.2 In making the 2014 Determination we had regard to the draft National Aviation Policy. In August 2015 the final National Aviation Policy (NAP) was published and we will have regard to it and its recommendations in making the 2019 Determination.[4] In 2014 our assessment was that when making the determination of maximum charges, it is sufficient to set a price cap which is consistent with Dublin Airport implementing the relevant elements of the NAP.

3.3 The NAP included an action item for the Department to conduct a high level strategic review of airport capacity in Ireland. This review is ongoing.

2017 National Policy Statement on Airport Charges Regulation

3.4 In the NAP the Government indicated its intention to conduct a review of the economic regulation of the state airports. In 2017, that review concluded with the publication of the National Policy Statement on Airport Charges Regulation.[5] Implementing legislation for the policy changes has yet to be enacted. If enacted prior to making the 2019 Determination, that determination may be made under the new legislative framework.

Chart 3.1: Key Policy Objectives of the Policy Statement on Airport Charges Regulation

The overriding strategic objective of the economic regulation of airport charges in Ireland is to ensure that current and future airport customers are presented with choice, value and quality services which also meet the highest international safety and security standards.

Customers' interests shall be the primary concern of price regulation.

Regulation policy also recognises the importance of the timely provision of capacity, enhanced connectivity, strong competition and the financial sustainability of the aviation sector more generally, each of which is key to ensuring that the primary interests of the customer are served and that national economic competitiveness is advanced.

Source: 2017 National Policy Statement on Airport Charges

3.5 The policy statement reached the conclusion that regulation of Dublin Airport will continue, in recognition of its significant market power. The policy proposes a number of changes to the existing regime in order to achieve the identified policy objectives (set out in Chart 3.1):

- We shall no longer be mandated to have specific regard to the financial viability of Dublin Airport in making a determination. This is intrinsic in the primary objective of protecting the interests of current and future users.
- The appeals process will be amended to provide for a single stage appeals process in the

[4] http://www.dttas.ie/sites/default/files/publications/aviation/english/national-aviation-policy-ireland/national-aviation-policy-ireland.pdf
[5] http://www.dttas.ie/sites/default/files/publications/aviation/english/national-policy-statement-airport-charges-regulation/nps-airport-charges-regulations-amended-oct-6.pdf

High Court or Commercial Court.

- The statutory basis for policy directions by the Minister for Transport, Tourism and Sport to the Commission will be repealed.
- There will be a statutory basis for the periodic review of the regulatory regime.
- It is intended that there will be an explicit reference to competition in the revised legislation.
- We will be required to have regard to Government policy on climate change and sustainability.

3.6 In addition, the policy proposes the establishment of a working group to examine ways in which additional flexibility can be introduced to the regulatory framework, in particular in relation to bilateral pricing contracts.

Government Policy on Dividends and Equity Injections

3.7 It is Government policy to seek a dividend of a minimum of 30% of normalised profit after tax from Dublin Airport. Return to shareholders is allowed for in the price cap via the return on equity component of the cost of capital, return can be realised through an increase in retained earnings or the payment of dividends. Payment of a dividend is contingent on the company being in a position to do so, for example, should payment of a dividend result in daa's credit rating dropping below investment grade it should not be expected to make the payment.

3.8 It is also Government policy not to provide additional equity to Dublin Airport. This means retained earnings is the only source of equity funding available.

3.9 Both policies are discussed further in the cost of capital and financial viability sections.

EU Policy developments

3.10 The Thessaloniki forum on airport charges has issued a number of sets of recommendations since the 2014 Determination. The most relevant set for the 2019 Determination is the recommendations on setting the cost of capital which we discuss in more detail in Section 9.

3.11 In 2017, the European Commission (EC) conducted an evaluation of the Airport Charges Directive (ACD) (2009/12/EC). Following the initial evaluation, the EC has commenced the process of evaluating the impact of reforming the Directive. The focus of the inception impact assessment is not inconsistent with the regulatory regime in place for Dublin Airport. Given the likely timelines we do not expect the reform of the ACD to impact the 2019 Determination.

UK Decision to exit the European Union (Brexit)

3.12 The UKs decision to leave the European Union is another European development which is likely to have an impact, but as of yet we are unable to judge its magnitude. In 2017, one third of traffic at Dublin Airport was to or from the UK. The implication of Brexit could be far reaching for the period post 2020, or could be minimal. This will largely depend on what transitional arrangements are agreed and the shape of the future relationship between the UK and the EU. As the timetable for the 2019 Determination progresses there may be more clarity on the outcomes of Brexit. The passenger forecast section shows the current expected timeline for Brexit, the IATA Calendar and the 2019 Determination.

High-level Consultation Question

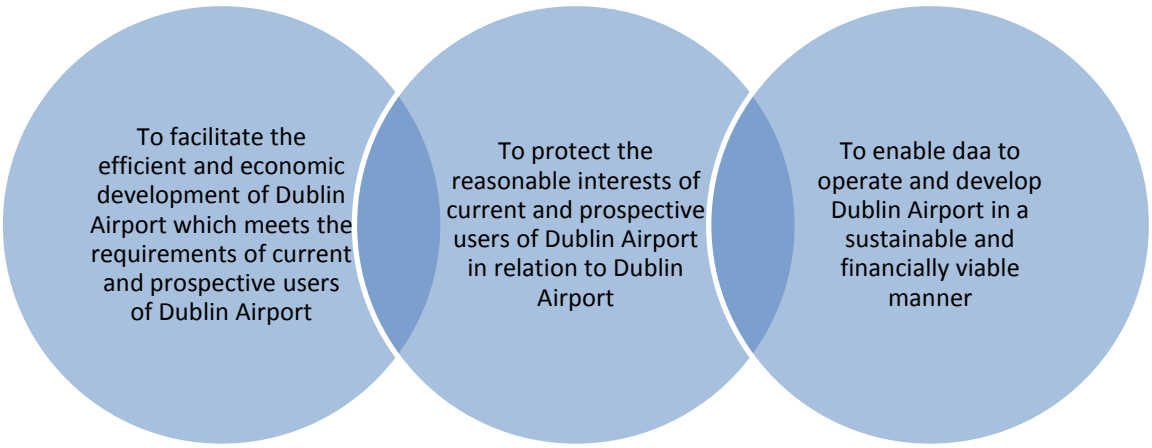
Q1. Which elements of National and International policy should we have regard to and how?

4. Approach to Regulation

Statutory Remit

4.1 Our statutory remit is to specify the maximum level of revenue Dublin Airport can collect from airport charges. This can be an overall limit or limits to particular categories of charges or both. To date we have fulfilled this with a per passenger limit on airport charges.

Chart 4.1: In setting airport charges, we have three statutory objectives

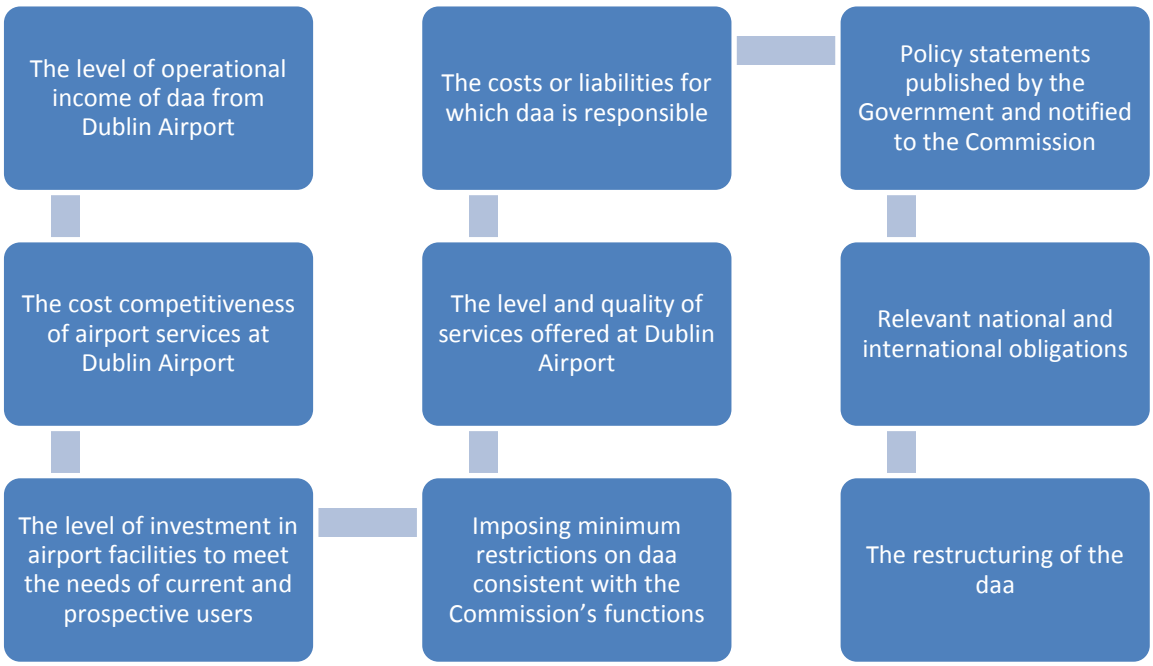


Source: State Airports Act, 2004.

4.2 Currently, we consider these objectives to have equal weighting, to be read together and in light of each other.

4.3 In addition to our statutory objectives there are nine statutory factors to which we must have regard:

Chart 4.2: In setting airport charges, we have nine statutory factors



Source: State Airports Act, 2004.

What are airport charges?

- Charges levied in respect of landing, parking or take-off of aircraft at an aerodrome including charges for airbridge usage but excluding charges in respect of air navigation and aeronautical communications services levied under Section 43 of the Irish Aviation Authority Act of 1993;
- Charges levied in respect of the arrival or departure from an airport by air of passengers; or
- Charges levied in respect of the transportation by air of cargo, to or from an airport.

Charges with Special Treatment

- Charges to use US Preclearance - currently these charges are not regulated and forecasts of the revenue from the charge are included in Commercial Revenues
- Fast Track - the revenue from fast track is split between airport charges and commercial revenues.
- ATI Fees - Fees for accessing installations (e.g. check-in desks) are approved by use under a separate framework. These fees are not airport charges, but forecasts for them are included in commercial revenues. Additionally, in 2009 and 2014 we set a cap on the amount the airport could collect from ATI fees.

Who is a user?

- Any person
  - for whom any services or facilities the subject of airport charges are provided at Dublin Airport;
  - using any of the services for the carriage by air of passengers or cargo provided at Dublin Airport; or
  - Otherwise providing goods or services at Dublin Airport.
- This definition includes more than just airline carriers, so is broader than sometimes used in other settings.

4.4 We have interpreted our statutory remit as being consistent with setting price caps that promote economic efficiency. Our aim is to simulate the effects of competition.

Our Goal

- We have interpreted our statutory remit as being consistent with setting price caps that promote economic efficiency. There are three concepts of economic efficiency: productive (i.e. providing a given level of service at minimum cost), allocative (i.e. all users willing to pay for the service have access to it subject to the producer recovering efficiently incurred costs) and dynamic (investment decisions have regard to both current and future demand and costs).

Economic Efficiency through Competition

- Competition is generally seen as promoting such outcomes, giving firms an incentive to continually strive to identify more efficient production methods than their rivals. If they can become more efficient than their rivals, they will be able to profit by undercutting their rivals to attract additional customers. As rival firms realise similar efficiency savings, the prices they all charge will be bid down until all the gains from an efficiency saving are enjoyed by customers.

Incentive regulation as an Alternative

- We have used incentive regulation, an approach often used by regulators when dealing with a company subject to muted or no competition. A price cap is set for a number of years at a level sufficient to allow the firm to recover what the regulator forecasts would be an efficient level of costs. Rather than having an incentive to become more efficient than competitors, the regulated firm's incentive is to outperform the efficiencies the regulator assumed when setting the price cap.

How users Benefit

- The opportunity for users to benefit materialises when the price cap is reset. At that time the regulator will be able to consider any efficiency savings that the regulated firm has realised and will set a revised cap accordingly. In this way, the firm's incentives to outperform the targets in a price cap lead ultimately to lower prices. Incentive regulation requires that the cap only be revised occasionally, and that otherwise the regulated firm retains any profits and incurs any losses if outturns do not correspond to the target.

Strategic Considerations

4.5 Stakeholders need to consider some core strategic choices when engaging in the determination process. Dublin Airport has experienced high levels of growth in recent years. Capacity is now scarce. The quality of services delivered to passengers overall has remained high (as measured by passenger surveys). When making a determination the time horizon for the price is relatively short but decisions made have long term consequences. While some strategic options are informed by national policy, the timing and scale of delivery are generally

not. Other strategic options are not informed by policy and the deliberations of stakeholders are required to inform our process.

Quality

4.6 There is a trade-off between quality and cost. The relationship between quality and price is less obvious, as lower quality services may lead to reduced volume, and given the high level of fixed costs at an airport could lead to an increased price cap. In any case, the desired quality level is a choice but one which has consequences for the regulatory building blocks.

Differentiated Services

4.7 There are in the region of 50 airlines operating at Dublin Airport. There are a range of different business models. There are ten five-star airlines in the world (skytrax ranking) and five of them operate at Dublin Airport. Europe's largest low-cost carrier, Ryanair, operates a major base at Dublin Airport with 13m point to point passengers (43% of Dublin's passengers). Significant hub operations are a relatively new and growing feature of the airport. In 2013 0.5m passengers transferred through Dublin Airport, in 2017 this had increased to 1.6m. This diverse range of airlines results in a diverse level of requirements for infrastructure and for quality levels. When considering infrastructure and quality there is a choice between one standard for the airport as a whole or varying standards throughout.

4.8 The follow-on question is, should you have differentiated prices for differentiated services or a one airport one price policy. Currently at Dublin Airport there is some price differentiation generated largely from the type of stand used, but the passenger charge is the same in each terminal.

Delivery of Capacity

4.9 When considering investments in capacity, a key strategic choice is the amount of headroom you should allow. In a perfect world, infrastructure (and the associated cost) would be delivered as needed. But the timelines for delivery of airport infrastructure projects and the ability of airlines to deliver capacity are not aligned. Airlines can move capacity quickly (within months), whereas it takes years to design, obtain planning permission and deliver a significant piece of airport infrastructure. This can result in periods of time when the airport is capacity constrained. If you over provide infrastructure the risk of being constrained is lower, but users may be paying for infrastructure they do not need at a particular point in time. While just in time delivery is not practical, just in time remuneration is a possible option.

4.10 Related to this, when an airport is approaching capacity, it should be enjoying economies of scale which can benefit users through lower airport charges. When at capacity the economies of scale may remain (although operating at capacity can be inefficient), but there will be scarcity rents available. In other words, passenger will pay higher prices in order to use the scarce capacity. If the airport is unregulated the scarcity rents will be collected by the airport. However, in a price regulated constrained airport the scarcity rents will be collected by the airlines (airlines retain grandfather rights to historic slots). Passengers welfare is not well served by a capacity constrained airport.

Long Term Planning

4.11 Many of these long term strategic questions should be considered as part of long term planning which engages all stakeholders in a deliberative process.

Fundamental Decisions

4.12 When making a determination there are a number of key decisions which need to be made before considering the individual components to arrive at the price cap.

Form of Cap

4.13 Our statutory remit is to make a determination "specifying the maximum levels of airport charges that may be levied by an airport authority." We have discretion on the form and operation of the cap. To date we have set a maximum average charge per passenger.

Allocation of Risk

4.14 To date, within a period most of the risk in the regulatory model has been assigned to Dublin Airport, on the basis that it is the party best able to manage and/or control it.[6] The combined effect of different elements of risk results in high powered incentives, not only to beat the various targets we set, but also to respond appropriately to changing circumstances, as demonstrated in Chart 4.3 below. Between periods, the results of materialised risks are then transferred to users (in some case with a delay due to rolling schemes).

4.15 The risks that we need to allocate primarily relate to outturns deviating from forecasts. Risks exist in relation to passenger numbers, Opex , Capex allowances, commercial revenues and the cost of capital. Possibilities for risk allocation and their implications relating to specific building blocks is discussed further in the various sections.

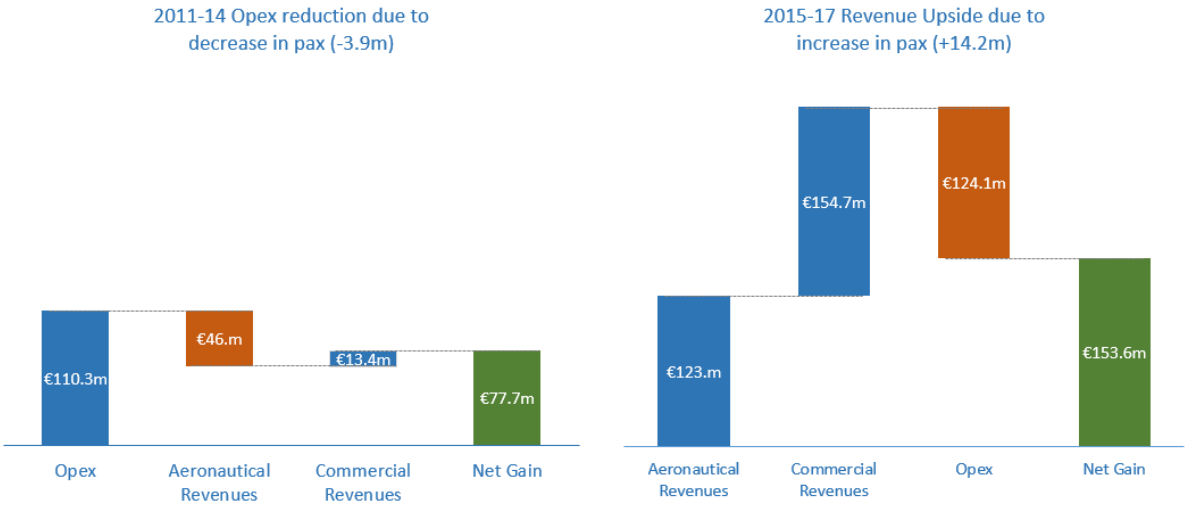
4.16 When allocating risks, we need to carefully consider the implications on incentives and outcomes for passengers. The current risk allocation is intended to result in an efficient airport motivated to grow traffic, which benefits passengers.

4.17 There are two key mechanisms which currently allocate risk to the airport; firstly, the per passenger price cap allocates the volume risk to the airport and secondly, there are no *ex post* adjustments for outturn operating costs, commercial revenues or cost of capital. While the airport carries a lot of risk, it does so only for a time limited period.

4.18 Chart 4.3 shows that Dublin Airport responded to lower than expected traffic between 2011 and 2014 by ensuring that Operating Expenditure (Opex) were also lower than the allowance. The lost revenue was more than matched by the reduction in Opex. Between 2015 and 2017, traffic was higher than forecast. This resulted in higher Opex to deal with the additional traffic, but Dublin Airport more than met this from the additional revenue (both aeronautical and commercial) it generated. While in both cases Dublin Airport exceeded what they needed to do and gained overall, if it did not hold the risk relating to these building blocks, in 2011-2014 it would not have been as strongly incentivised to adjust Opex, and in 2015-2017 it would not have been as incentivised to facilitate the additional traffic (and incur the associated costs).

[6] One exception is that the volume risk on the North Runway triggers is assigned to the users.

Chart 4.3: Airport Takes the Risks, and Responds Accordingly



Source: Dublin Airport Regulatory Accounts, CAR Calculations. Data in nominal prices.

Duration of Cap

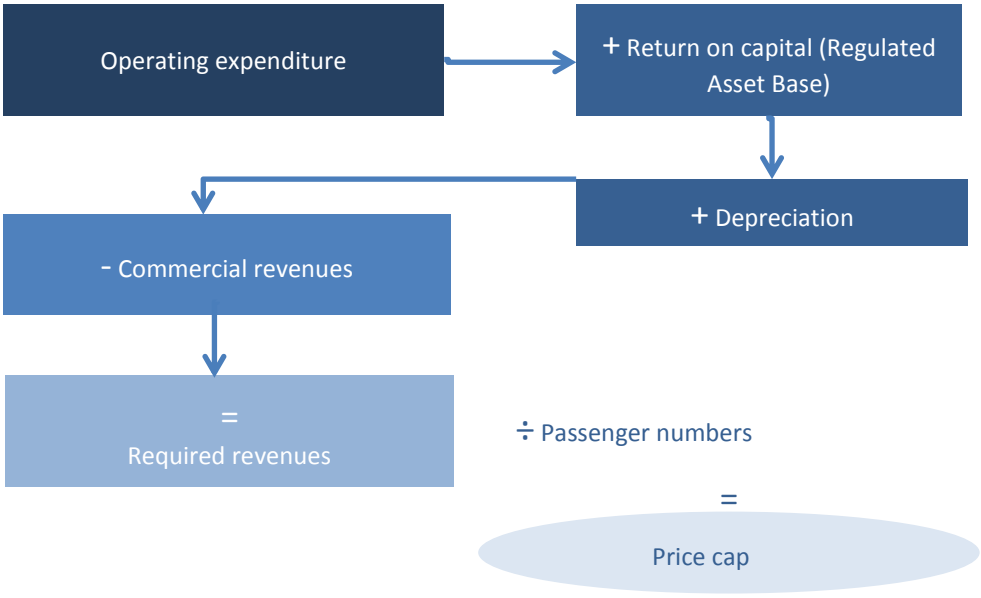
4.19 The Determination must last for a minimum of four years. The 2014 Determination lasts five years. In general, a longer period results in stronger incentives for the airport to achieve efficiencies. A shorter period allows for a quicker reset (transfer of efficiencies to users) and also allows for reassessment in the event of unexpected or unpredictable circumstances (for example, the effect of Brexit).

4.20 In 2016 we formalised a process for assessing a request for a supplementary capital expenditure allowance within a regulatory period. This removes one risk of a longer determination, that the airport would provide insufficient infrastructure to deal with presenting demand.

High Level Methodology

4.21 To date we have used the building blocks approach to RAB based regulation to arrive at the price cap. The approach, illustrated in Chart 4.4, is consistent with our statutory objectives and factors we must have regard to. This is not the only possible methodology and we are open to representations on innovations to this approach, or alternative methodologies. That being said, significant moves away from the building blocks approach would require careful consideration and deliberation with all interested parties.

Chart 4.4: The Building Blocks Approach – Deriving a Price Cap



4.22 The calculations of the building blocks approach require forecasts of future operating expenditures, commercial revenues and passenger numbers. They also require decisions on amounts to allow for a return on capital and for depreciation.

4.23 Since 2009, we have set quality standards to help ensure that the cost efficiencies achieved by the airport are not made at the expense of the quality of service delivered to passengers.

4.24 When arriving at a price cap, we enable the financial viability of Dublin Airport by checking that, when all the building blocks are taken together, Dublin Airport is able to raise debt at an investment grade credit rating.

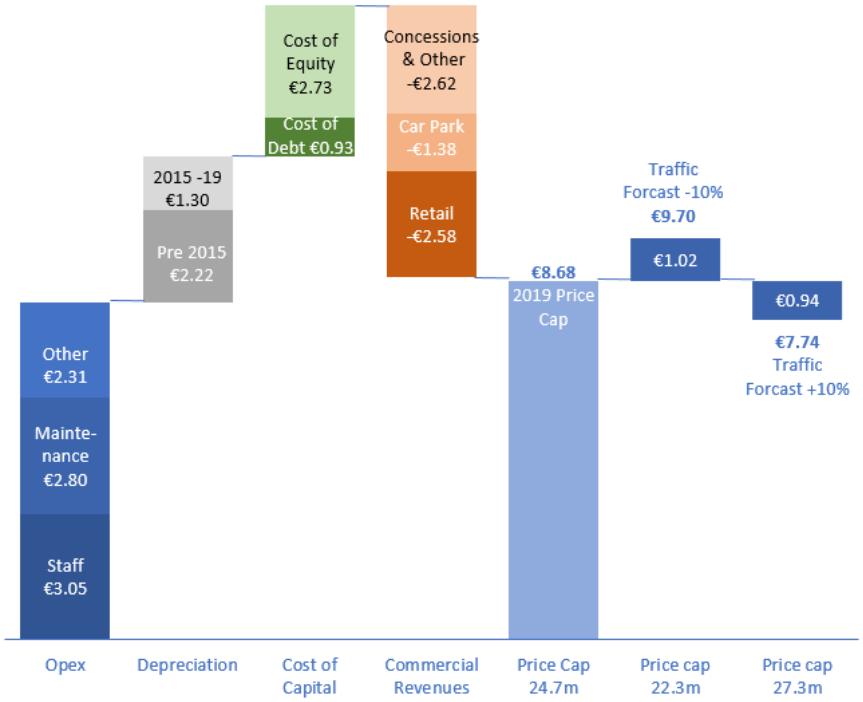
4.25 We use a single till, which means we include commercial revenues (e.g. retail, car parking) and also costs associated with providing these non-aeronautical services in the calculations. We have a process to remove items from the regulatory till. Dublin Airport has concluded one till exit, exiting the land and buildings associated with Dublin Airport City (since renamed Dublin Airport Central).[7]

4.26 We have used a RAB-based approach when considering capital costs. The return on capital and depreciation allowances will depend on capital expenditure allowances in both the current and previous determinations. The return on capital depends on the cost of capital (interest rate) that we allow.

4.27 The building blocks method arrived at a price of €8.68 for 2019 (excluding Quality of Service, K Factor and trigger project related adjustments). Chart 4.5 shows the relevant importance of each of the building blocks and some of the larger components of those. It also shows that the price would have been €1.02 higher if our passenger traffic forecast had been 10% lower.

[7] https://www.aviationreg.ie/_fileupload/2014-12-10%20CP3%20Dublin%20Airport%20City%20valuation%20and%20till%20exit.pdf

Chart 4.5: Importance of each Building Block and some larger components in the 2019 Price Cap



Source: 2014 Determination, CAR Calculations

Interaction between Building Blocks

4.28 There is interaction between the building blocks. It is important to consider these interactions when commenting on methodologies used in each. Two key interactions are facilitation and risk. A forecast in one must be facilitated by an appropriate forecast in another. For example, if we are forecasting passenger numbers and quality of service to reach a certain level then the capital allowances we make should be sufficient to facilitate this. Similarly, forecasts in commercial revenue require appropriate operating and capital costs.

4.29 When we set the cost of capital, we assess the risk held by the regulated entity and set an appropriate return. Therefore, changes to risk in other building blocks (for example, our approach to reconciling outturn expenditure on capital projects) would change the underlying risk profile of the regulated entity and therefore would influence the cost of capital building block.

High-level Consultation Questions

Q2. What high level methodology should we use to arrive at a price cap? Should we continue with the building block Regulatory Asset Base approach?

Q3. How should risk be allocated in the regulatory model?

Q4. What duration should we set the price cap for (4+ years)?

5. Passenger Forecasts

5.1 Passenger forecasts are a central element in calculating the price cap. They affect various components of the regulatory building blocks simultaneously; they also act as the denominator when setting a per passenger price cap.

Volume Risk Allocation

5.2 One of the key risks set out in Section 4 is the volume risk, i.e. the risk of passenger numbers deviating from the forecasts. In previous determinations, we have assigned symmetric (upside and downside) volume risk to Dublin Airport, setting the price cap at a per passenger level. We did this on the grounds that overall, Dublin Airport is best placed to influence passenger numbers and/or respond to changing levels of demand. Assigning the volume risk in this way incentivises Dublin Airport to increase passenger traffic in order to increase revenue. Previously stakeholders have supported this risk allocation, we are now interested in the current thinking.

5.3 Traffic at Dublin Airport also depends on the decisions of airlines, other stakeholders and a range of other factors. It could be argued that the allocation of volume risk could change. This could be done by:

- Setting the cap on overall airport charges, rather than charges per passenger. This would entirely remove the volume risk from Dublin Airport. When traffic is growing, adjusting the risk allocation could reward airlines by effectively generating volume discounts, thus creating an incentive for airlines to grow traffic. However, when traffic is falling the price cap would increase, which is counterintuitive from a supply demand perspective, and could generate a longer lasting negative feedback loop. A potential downside are charges which are procyclical, high when demand is low and low when demand is high.

- Maintaining a per-passenger cap, but applying one or more bands to the forecasts such that provision is made for adjusting the risk allocation in the event of outturns deviating from forecasts by a stated percentage. For example, Dublin Airport might be assigned the volume risk for deviations up to 10%, with the results of any greater deviations being shared with users according to a stated percentage. Such adjustments could be made at the end of the regulatory period, or on an ongoing basis throughout it.

5.4 Moving away from the current approach would weaken the incentive for Dublin Airport to grow traffic; the extent would depend on the degree of risk sharing provided for.

Forecast Methodologies

5.5 We also seek views on what type of forecast methodology and variables we should use, considering their advantages and disadvantages. For the next determination, we could use one or potentially more of the following forecast methodologies:

- Extrapolation: simple, backwards looking time-series forecasts (such as linear forecasts)
- Causal forecasts: complex forecasts that look at causal relationships between variables,
- Judgment-based forecasts: done by experts and not necessarily based on data.

5.6 Extrapolation and univariate causal forecasts for overall passenger numbers tend to be simple and transparent, if they use publicly available data. Judgment-based forecasts and causal forecasts with great level of disaggregation and using many variables tend to be complex and use confidential information.

5.7 In 2009 and 2014, we estimated forecasts of passenger numbers, using a simple causal forecast based on a single explanatory variable (changes in Irish GDP) and time-series trends. The positive relationship between per capita income and the propensity to travel has been shown by empirical data of many European countries.[8]

5.8 The method employed by Dublin Airport is a combination of causal and judgment-based forecasts. The causal forecast uses monthly historical data by route (origin and destination) and the GDP of Ireland and up to other 5 countries. The forecast is then adjusted using judgement based on customer input and local market intelligence. Dublin Airport calibrates its forecasting models by comparing them with external forecast by Airbus and Boeing.

5.9 Complex causal or judgemental-based forecast may be more accurate but at the cost of transparency. The complexity of origin-destination models may not be justified for the purposes of estimating overall passenger numbers.

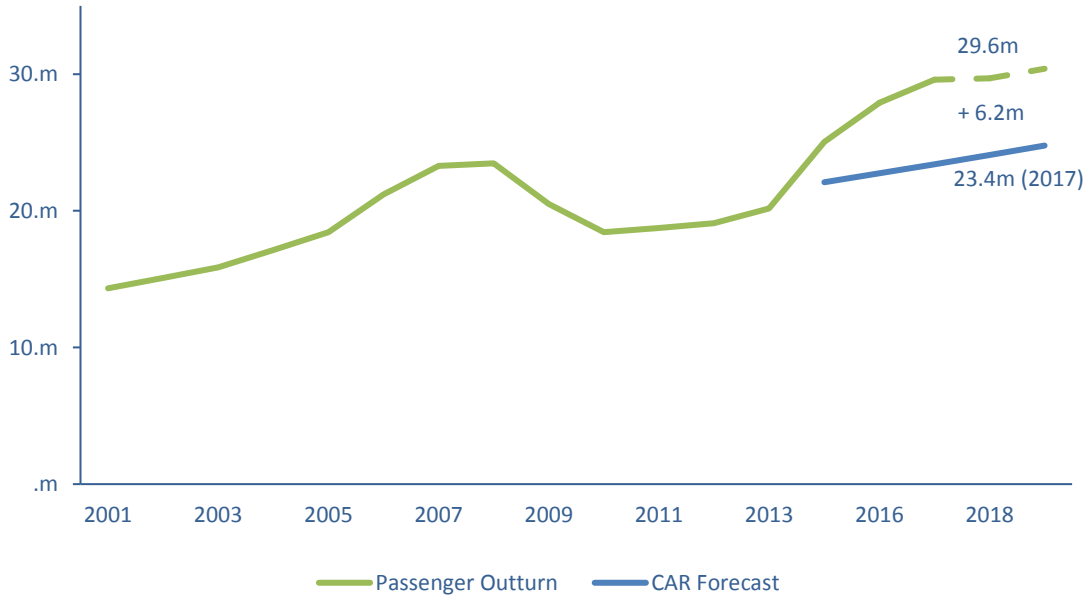
5.10 In previous determinations, stakeholders have pointed out that the model used by the Commission did not account for the effect of airfares on passenger numbers or for the effect of the GDP of partner countries. We found that taking account of other countries' GDPs reduced the accuracy of the model because of multicollinearity problems, and the effect of airfares did not appear to be material for small changes.

5.11 In the next regulatory period, passenger levels at the airport will possibly approach the current planning permission limit of 32m. This limit refers to the maximum combined capacity of Terminals 1 and 2, as established in the planning permission for Terminal 2 granted by An Board Pleanala in 2007.

Outturns v 2014 Forecast

5.12 During the current regulatory period 2015-2019, Dublin Airport has reached record traffic levels. In 2015, the airport handled over 25mppa, and for 2019, it estimates a centreline traffic forecast of 30.4m passengers.[9]

Chart 5.1: Record traffic levels at Dublin Airport during the current regulatory period 2015-2019



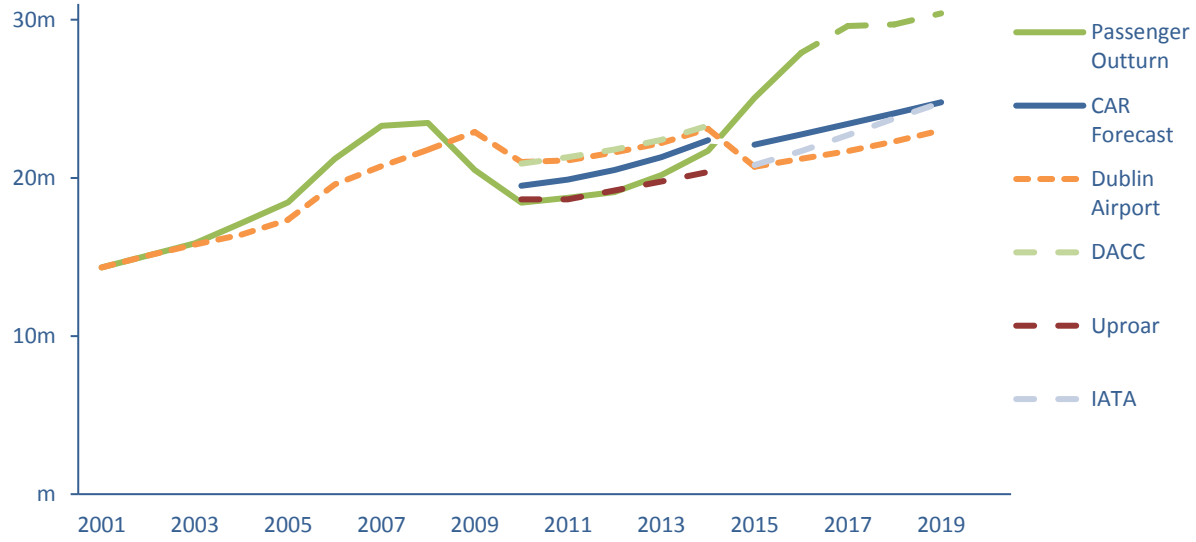
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, PACE Document

[8] Goodbody, European Airlines "Summertime, and the livin' is easy". 2017
[9] https://www.aviationreg.ie/_fileupload/PACE/17-10-5%20DUB-%20PACE%20Document.pdf

5.13 Passengers at Dublin Airport grew by 15.4% and 11.4% in 2015 and 2016 respectively. Our forecast in 2014 estimated annual growth of 3%, from 22.1m in 2015 to 24.8m in 2019.

5.14 When drafting the 2014 Determination, no party anticipated the rapid growth that would be experienced from 2015. In 2013, Dublin Airport estimated passengers would grow by 3% per annum from 21.2m in 2015 to 23.6m in 2019.[10] Aer Lingus and Ryanair expected a growth rate of 3.3%, while the IATA forecast was most ambitious at 4.4%. Selected forecasts from different parties in previous determinations are shown in Chart 5.2.

Chart 5.2: Outturn Traffic v Past Forecasts from Various Parties



Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, Submissions to 2014 Determination

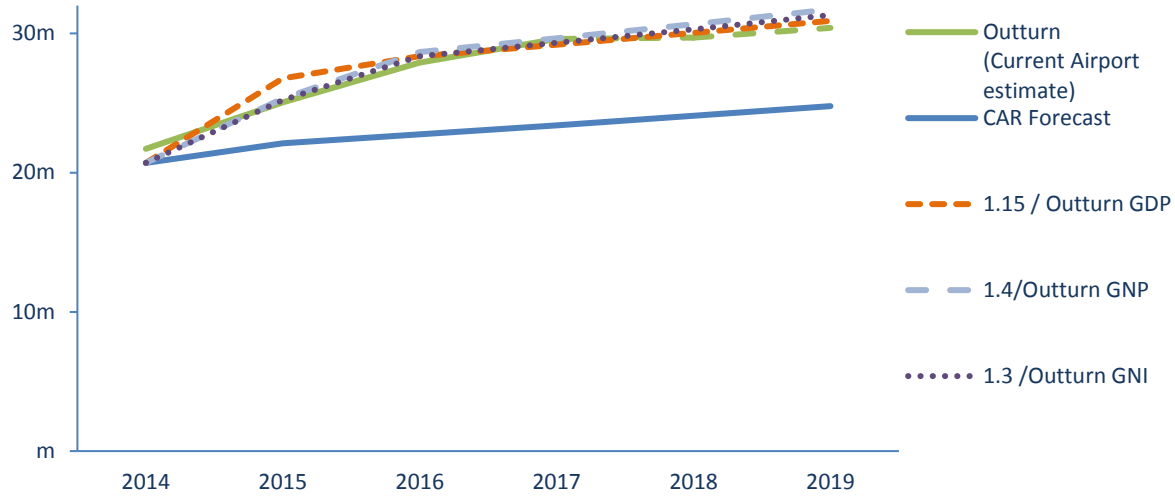
5.15 In 2014, we estimated passenger numbers using the Irish GDP growth forecast from the IMF and an elasticity of 1.15 based on data between 1997 and 2013. The IMF forecast annual GDP growth of 2.5%. However, outturn GDP growth in 2015 was 25.6%, and 5.1% in 2016. No other GDP forecast predicted growth rates of this scale.

5.16 We have investigated the extent to which forecast passenger numbers were lower than the outturns because of the inaccuracy of the GDP forecast used, relative to the assumed elasticity of 1.15. We estimated passenger numbers using the same 1.15 elasticity but replaced the IMF forecast with the outturn GDP growth rates in 2015 and 2016. As shown in Chart 5.3, if the GDP forecast had been correct, the forecast passenger level is very close, albeit slightly overshooting in 2015, to the outturns. Therefore, the inaccuracy of the passenger forecasts is largely explained by the inaccuracy of the GDP forecasts used. Brexit may increase the uncertainty of GDP forecasts used for the future regulatory period.

5.17 We investigated whether Gross National Product (GNP) would have been a better predictor of passenger numbers, given that it is less sensitive to corporate restructuring by multinationals than GDP. To check our hypothesis, we estimated the elasticity between passenger numbers and GNP for the period 1997-2013, and used the 2015-16 GNP outturns. We obtained a more accurate passenger forecast by using GNP. We carried out a similar exercise using Gross National Income, and again found that the historic elasticity has largely been maintained in this regulatory period.

[10] Dublin Airport, PACE Document, 2017

Chart 5.3: Outturn Traffic v 2014 Forecasts, 2014 forecast with revised GDP, forecast with GNP



Source: CSO Statistics, CAR Calculations.

5.18 If we continue with a similar overall approach, we must decide on an appropriate predictor variable or variables, based not only on predictive value, but forecasts which are available for the full regulatory period. A range of forecasts are available, however depending on the duration of the next determination, GNP forecasts may not be available, and GNI will not be. The longer term of the forecast, the less accurately it is likely to reflect short term economic cycles. Table 5.2 shows available GDP/GNP forecasts by Irish and international economic organisations.

Table 5.2: Selection of Recent Irish GDP / GNP Growth Forecasts

Source		2018	2019	2020	2021	2022	2023
OECD Long-term baseline projection up to [11]	GDP	3%	2.8%	2.8%	2.9%	2.9%	3.0%
International Monetary Fund (IMF) October [12]	GDP	3.4%	3%	2.9%	2.8%	2.8%	
Department of Finance[13] 2017	GDP GNP	3.5% 3.3%	3.2% 3.0%	2.8% 2.5%	2.6% 2.3%		
Standard and Poor's (S&P)[14] 2 June 2017	GDP	3.7%	3.0%	3.0%			
European Union (EU) Winter 2018[15] Winter 2017[16]	GDP GNI	4.4% 2.9%	3.1%				
Central Bank of Ireland[17] 12 October 2017	GDP GNP	3.9% 4.2%					
Economic and Social Research Institute (ESRI)[18] 27 Nov 17	GDP GNP	4.2% 4.2%					
Irish Business and Employers Confederation (IBEC)[19] January 2018	GDP	4.2%					

Source: ESRI, EU, IBEC, OECD, S&P, Central Bank of Ireland, IMF and Department of Finance.

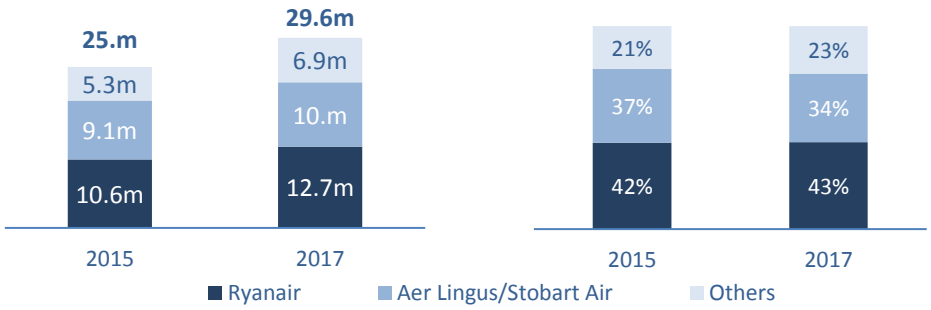
[11] https://data.oecd.org/gdp/gdp-long-term-forecast.htm#indicator-chart
[12] http://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD/IRL
[13] http://www.budget.gov.ie/Budgets/2018/Documents/Budget_2018_Economic_and_Fiscal_Outlook.pdf
[14] https://www.capitaliq.com/CIQDotNet/CreditResearch/RenderArticle.aspx?articleId=1861212&SctArtId=427289&from=CM&nsl_code=LIME&sourceObjectId=20028564&sourceRevId=101&fee_ind=N&exp_date=20270605-13:33:18
[15] https://ec.europa.eu/info/node/10182
[16] https://ec.europa.eu/info/sites/info/files/ecfin_forecast_winter_1317_ie_en_0.pdf
[17] https://www.centralbank.ie/docs/default-source/publications/quarterly-bulletins/quarterly-bulletin---no-4-2017.pdf?sfvrsn=6
[18] http://www.esri.ie/pubs/QEC2017WIN.pdf
[19] http://www.ibec.ie/IBEC/Publications.nsf/vPages/Economic_Outlook~economic-outlook---january-2018-08-01-2018/$File/IBEC_Q4_2017.pdf

Overall or Disaggregated Forecast

5.19 We need to decide whether to continue using an overall passenger forecast rather than disaggregated into different categories of passengers. In previous determinations we have used an overall passenger forecast. It is our view that there has not been a substantial change in the composition of traffic at Dublin Airport that would warrant a more disaggregated forecast.

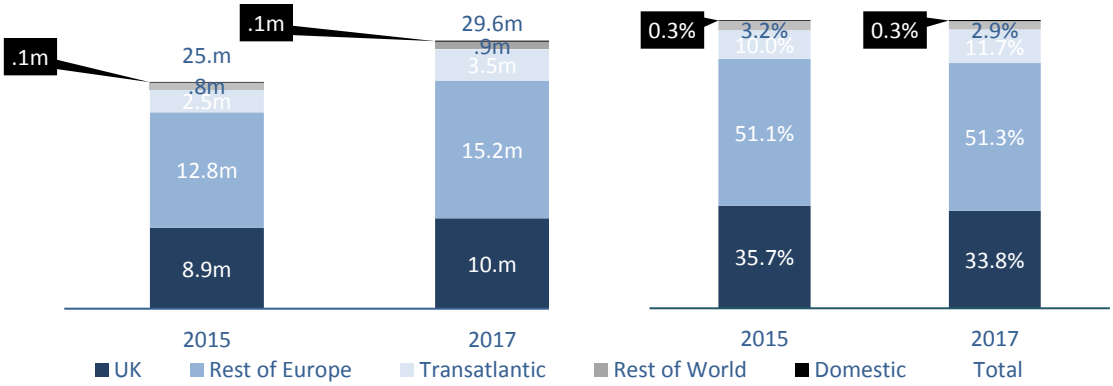
5.20 Charts 5.4 and 5.5 show that the growth between 2015 and 2017 has not materially changed the broad composition of traffic by airline, nor traffic by region.

Chart 5.4: Shares by airline have materially not changed



Source: Dublin Airport

Charts 5.5: The Composition of traffic by region has also not materially changed.



Source: Dublin Airport

Short-term or Long-term Passenger Forecast

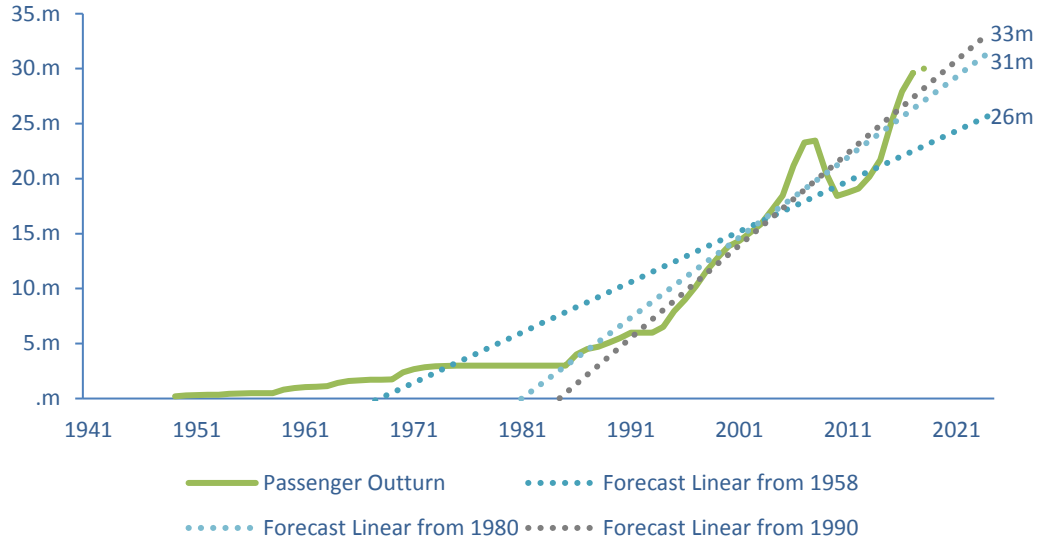
5.21 Another key question is whether we should focus on a short term or long term forecast. In previous determinations, we have estimated a short-term passenger forecast, focused only on the regulatory period in question. However, the 2014 forecast highlights the difficulty of accurately forecasting passenger numbers, given the short-term volatility of GDP.

5.22 We could switch the focus of the forecast to a long-term trend that would not fluctuate with the economic cycle. Traffic growth may be subject to more stable long run income elasticities relating passenger numbers to GDP growth. If we combine a long run approach to forecasting, the significance of short term economic cycles on the outcome of our determinations should be more limited.

5.23 Chart 5.6 shows outturn traffic volume at Dublin Airport between 1940 and 2017 (2018 and

2019 values are Dublin Airport's estimates).[20] As an example of a long-term forecast, we have calculated 3 linear forecasts. The use of different starting points (in our case 1950, 1980 and 1990) yields different forecast traffic volumes for 2024.

Chart 5.6: Examples of Linear Long-term Forecasts Using Different Starting Points



Source: daa Annual Reports, Dublin Airport Regulatory Accounts, CAR Calculations

Brexit

5.24 The outcome of Brexit, the conditions for the transition period and their potential implications for our traffic forecast are unknown. We will follow these developments carefully. Table 5.3 shows the current timelines for Brexit, the IATA Calendar for Slot Coordination and the 2019 Determination.

Table 5.3: Brexit – Timeline v 2019 Determination

Timeline	Brexit[21]	IATA Calendar[22]	2019 Determination
March 2018		Airlines start selling tickets for Summer 19.	
April 2018			Issues Paper **Q2 2018:** Dublin Airport consults on passenger forecast and Quality of Service.
May/June 2018	UK Parliament passes the EU (Withdrawal) Bill.		
Oct 2018	Exit deal agreed within 18 months of Article 50 being triggered (end March 2017).	Initial Submission Deadline for S19	**Q3 2018:** Dublin Airport Consults on Capital Investment Plan (CIP)
Nov 2018	**Late 2018:** UK Parliament votes, prior to the EU Parliament vote, on Brexit agreement.	IATA Slot Conference for S19	**Q4 2018** Dublin Airport Final CIP
March 2019	UK expected to leave the EU. 29 March 2019-2021 Potential 2-year transition period	Start of S19	
April 2019			Draft Determination
Sept 2019			Final Determination

Source: CAR Timeline, IATA Coordination Calendar, and UK Parliament, Research Briefings 2017.

[20] https://www.aviationreg.ie/_fileupload/PACE/17-10-5%20DUB-%20PACE%20Document.pdf
[21] https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7960#fullreport
[22] https://www.iata.org/policy/slots/Documents/calendar-coordination-activities.pdf

Dublin Airport's Forecasts

5.25 Dublin Airport will estimate its own passenger forecast which will directly affect its proposed Capital Investment Programme (CIP). Therefore, Dublin Airport is expected to consult airline users in Q2 2018 on its own passenger forecast for the next regulatory period. The airport's forecast will be consulted on ahead of the CIP consultations later in 2018.

5.26 Dublin Airport's forecast is also likely to feed into our own forecasts or be used as a sense check. An alternative to doing our own forecasts would be to use Dublin Airport's. The Civil Aviation Authority (CAA) in the UK has taken account of stakeholders' input to correct for over or under estimation in the traffic forecast of Gatwick and Heathrow airports.

5.27 There are mixed incentives for stakeholders regarding traffic forecasts in relation to the price cap. The airport may wish to understate expected traffic growth, which would lead to a higher price cap, all else being equal. On the other hand, it may set out ambitious traffic forecasts to seek higher allowances for capital and operating expenditure. Airlines may seek high forecasts to reduce the per passenger cap, but may also want reduced cost allowances, arguing against further expenditure on the grounds of lower passenger forecasts.

High-level Consultation Questions

Q5. What methodology and data sources should we use to forecast passenger numbers?
Q6. Should we forecast an aggregate or disaggregate passenger forecast?

6. Operating Expenditure

6.1 This section seeks to explore the key issues relating to the level of Operating Expenditure (Opex) to be allowed for as part of the 2019 Determination. We assess the recent performance of Dublin Airport relative to previous forecasts, and consider some reasons for variation from these. We then discuss some potential approaches which we could rely on to set the Opex allowances.

6.2 Our objective is to set Opex targets which are challenging, yet achievable, to feed into the price cap. Dublin Airport then has discretion to spend on Opex as it sees fit; the Commission will only assess compliance with the overall price cap.

6.3 In order to set these targets, we need to take a view on the following key questions:

- How efficient is Dublin Airport? What is the scope for Dublin Airport to become more efficient in the next regulatory period, from the outset and/or over the period?
- How are the costs of efficiently running an airport such as Dublin expected to evolve over the regulatory period?
- Should targets be set having regard to efficiency in current levels of Opex, forecast passenger numbers, and the aforementioned questions only? Are there other factors which we should consider?

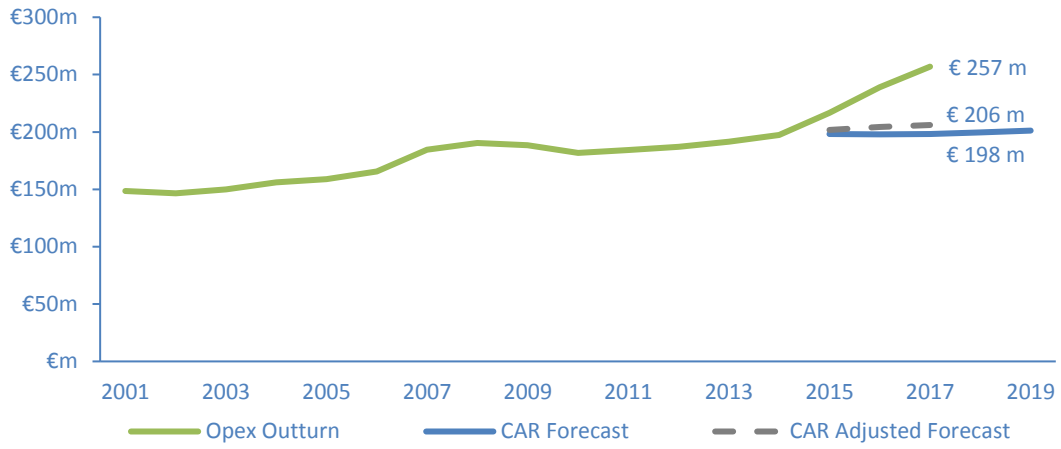
6.4 Separately, we must decide how to allocate the risk of actual expenditure deviating from these targets; that is, who loses out if Dublin Airport spends more than the target, and who gains if Dublin Airport underspends.

6.5 Rolling schemes are intended to standardise incentives throughout the period and are discussed at the end of this section.

Operating Costs - Forecasts and Outturns

6.6 Chart 6.1 compares Opex outturns and our 2014 forecasts. Overall Opex at Dublin Airport has increased since the 2014 Determination, from €198m in 2014 to €239m in 2016 and €257m in 2017. Taking 2016 as an example, Opex is approximately €41m higher than the 2014 Determination forecast. Outturn passenger numbers for 2016 were 27.9m, 5m above our forecast of 22.7m. Based on the implicit elasticity of Opex with regard to passenger numbers in the 2014 Determination, and using 2016 outturn passenger numbers, the difference between outturn versus forecast Opex is approximately €35m. This means that, had outturn passenger numbers for 2016 been perfectly predicted, the Opex allowance would have increased by €6m only. This assumed inelastic response of Opex to passenger numbers is one of the core elements of the 2014 Opex forecasts and is examined in detail below.

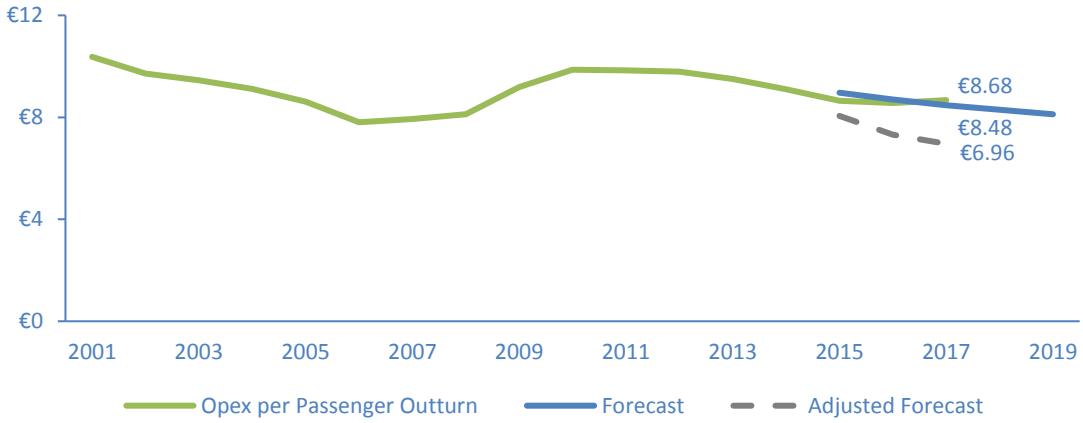
Chart 6.1: Opex Outturns v Commission Forecasts



Source: Dublin Airport Regulatory Accounts, CAR Determinations, CAR Calculations

6.7 Chart 6.2 compares outturns and forecasts Opex per passenger. At a per passenger level, outturn Opex fell from €9.86 in 2010 to €8.65 in 2015, but this fall has since slowed. The fall has been driven by increased passenger numbers more than balancing out increased Opex. With outturn passenger numbers, the 2014 Opex model predicts Opex per passenger of €7.32 for 2016, compared to actual Opex per passenger of €8.56. This again demonstrates that the assumed inelastic response to changes in passenger numbers has not been realised.

Chart 6.2: Opex per passenger has not fallen as expected, given the increase in passengers



Source: Dublin Airport Regulatory Accounts, CAR Determinations, CAR Calculations

Opex Drivers and Elasticities

6.8 As shown above, economies of scale have not materialised as expected. The elasticity of Opex with regard to passenger numbers implicit in the 2014 financial model is about 0.16, meaning that a 10% increase in passengers would be expected to lead to a 1.6% increase in Opex. Instead, over the period 2013-2016, the outturn elasticity has been approximately 0.68. There are a number of possible explanations:

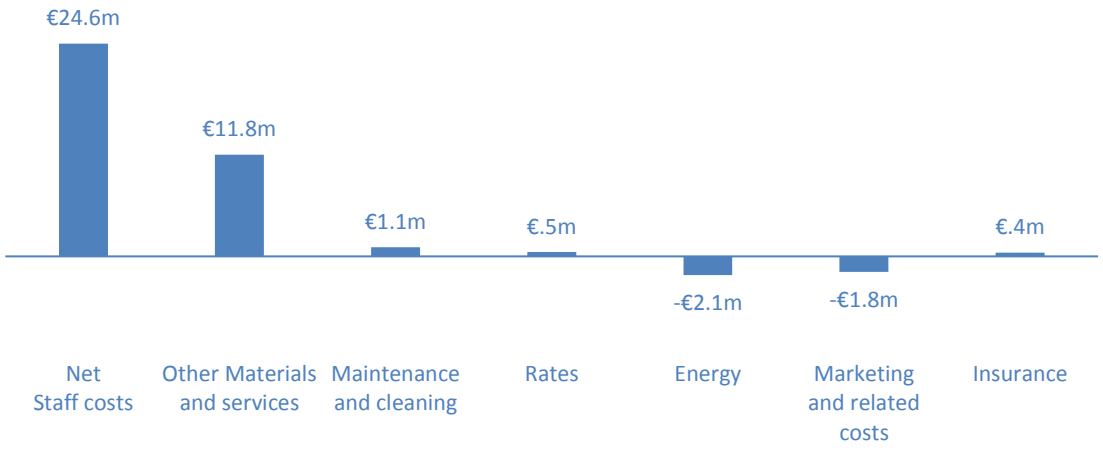
- The Opex elasticity assumptions were unrealistically low.
- Dublin Airport failed to realise efficiencies, of scale or otherwise, that were available to it.
- The increase in scale occurred unexpectedly quickly which could have prevented an efficient response.

- A combination of the above.

6.9 In a situation where passenger growth was very sharp, Dublin Airport's main focus may switch to facilitating this growth rather than seeking efficiencies. This might have led to relatively higher levels of Opex than the steady 3% annual passenger growth envisaged in the 2014 Determination would have led to.

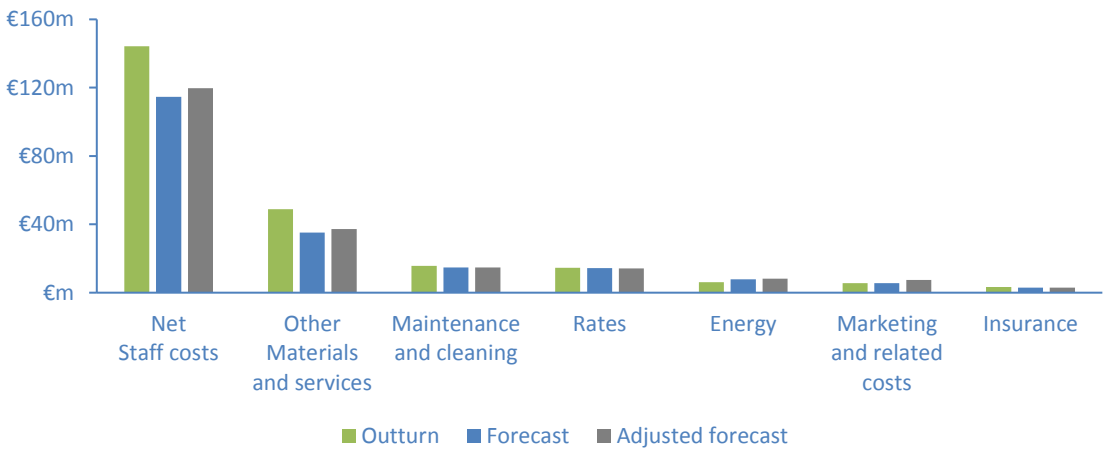
6.10 To shed some light on this question, we have sought to isolate those elements of Opex which have responded more elastically than anticipated. As shown in Charts 6.3 and 6.4, in 2016, the €35m deviation from forecast Opex was driven by staff costs €25m higher than would have been forecast, together with 'Other Materials and Services', which was €12m higher.[23] Dublin Airport achieved savings in energy and marketing costs of approximately €2m each. We have looked at 2016 in detail as an example; a similar picture emerges for 2015 and 2017. 'Other Materials and Services' includes PRM services, technology operating costs (such as Common User Passenger Processing System, or CUPPs), consultancy, and a range of overhead costs. Of the €12m, €7m (or 20% of the total deviation) is accounted for through increased consultancy/professional fees.

Chart 6.3: The 2016 deviation from forecast was largely driven by staff costs and consultancy costs



Source: Dublin Airport Regulatory Accounts, CAR Determinations, CAR Calculations

Chart 6.4: The 2016 Opex overspend was mainly driven by the variation in Net Staff Costs



Source: Dublin Airport Regulatory Accounts, CAR Determinations, CAR Calculations

[23] These figures are based on the low ambition savings scenario set out in the 2014 Opex model. For the 2014 Final Determination, the Commission used a mix of low and middle ambition savings for staff costs.

6.11 The biggest factor leading to the increased Opex, accounting for about 70% of the deviation in 2016, is staff costs. In advance of any detailed assessment of efficient staff costs and the relationship between these and passenger numbers, we cannot come to a conclusion on this expenditure. However, Charts 6.5 and 6.6 provide some preliminary analysis of staff costs at Dublin Airport, in terms of FTE (Full Time Equivalent) staff.

Chart 6.5: Average staff cost per FTE

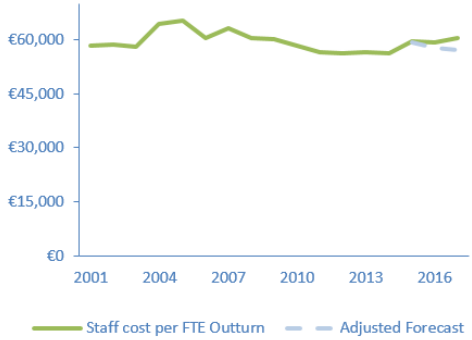
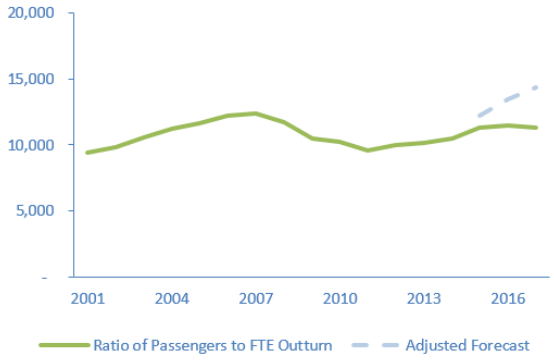


Chart 6.6: Ratio of Passengers to FTEs



Source: Dublin Airport Regulatory Accounts, 2014 Opex model

6.12 In real terms, the average staff cost per FTE has changed little since 2001, with a spike from 2004 to 2007 giving way to a marginal downward trend, a trend which has reversed since 2015. The ratio of passengers processed to FTEs has increased steadily since 2011. With regards to the adjusted forecasts, we see that the efficiency savings envisaged have not materialised due to:

- Significantly more staff than the 2014 model would have predicted to be required (363 more FTEs in 2016)
- A higher cost per FTE than the model would have predicted (€1,500 higher in 2016)

Of these, the increased number of staff is by far the bigger factor, accounting for approximately €21.5m of the passenger traffic adjusted overspend in 2016, while the increased cost per FTE accounts for roughly €3.5m.

6.13 We seek views on whether the difference between forecast and outturn Opex is explained by unrealistically low assumed responsiveness to passenger numbers, relative to Dublin Airport not realising efficiencies that were available to it.

Risk Allocation

6.14 We seek views on whether to continue to assign the full risk of Opex deviating from the forecasts to Dublin Airport, as has been done in previous determinations.

6.15 Assigning this risk to Dublin Airport without qualification implies that the Opex allowance set in the Determination is fixed, regardless of outturns, passenger numbers, or any other changes in circumstances (unless the Commission changes the allowances through an Interim Review). As a result of this, the Opex overspend in the current period will not be passed on to airport users.

6.16 The main reasons in favour of assigning this risk to Dublin Airport would be that Dublin Airport is best placed to control its own Opex, and that it is best placed to respond appropriately to changed circumstances, as demonstrated in Section 4. The current risk allocation provides a

strong incentive to seek efficiencies. On the other hand, certain unforeseen changes that would affect Opex may not be within the control of Dublin Airport, such as changes in security requirements.

6.17 Like passenger traffic, the degree to which Dublin Airport can control its own operating costs can be debated. However, its ability to respond to changing circumstances demonstrates, in our view, one of the main benefits of assigning Opex risk to Dublin Airport.

6.18 If we were to move away from the current risk allocation, there are several ways in which risk could be shared between Dublin Airport and users, to different degrees.

6.19 We could make provision for the sharing of some/all unanticipated Opex costs or savings with users. This could apply to:

- All unanticipated changes in Opex.
- Just those outside the control of Dublin Airport, for example mandated security requirements.
- Changes in the set of line items of Opex only, i.e. the unanticipated emergence of new line items of Opex or the redundancy of pre-existing ones, and not to an unanticipated change within a particular line of Opex.

6.20 We could apply bands to the Opex allowances, such that when Opex variation reaches a certain threshold, provision is made for adjusting the allowance.

6.21 We could implement a mechanism to share the risk of Opex deviations between Dublin Airport and users that could be according to a stated ratio (for example, 50/50).

6.22 These mechanisms could either be written into the regulatory formula, such that any adjustments would be reflected in the final price cap for a given year, or a 'lookback' could be carried out at the end of the regulatory period to make any appropriate adjustments. Carrying out the adjustment on a yearly basis may provide more ongoing certainty to stakeholders regarding our views on whether outturn Opex contained unanticipated elements, or was outside the control of Dublin Airport. On the other hand, carrying out a yearly Opex reconciliation would take significant time for the Commission and potentially other stakeholders.

Approach to Setting the Allowances

6.23 We seek views on the methodology we should use for arriving at a figure for the Opex allowances. Previously we have relied primarily on 'bottom-up' type studies. Such an assessment would typically seek to isolate, at as detailed a level as possible, each different element of operating costs faced or likely to be faced by the airport. Benchmarking and/or expert judgment would then be used to set the efficient cost and the appropriate elasticity with respect to passenger numbers, potentially giving a range of scenarios such as high ambition savings, low ambition savings, and a baseline/no savings scenario.

6.24 Outturn Opex has responded more elastically than was predicted by the 2014 bottom-up assessment (and also the 2009 study). As noted above, in advance of a detailed study, it is difficult to identify the extent to which this can be explained by inaccurate elasticities rather than Dublin Airport not achieving efficiencies to the extent that it might have done.

6.25 In 2014, we also carried out some 'top-down' analysis, providing a more high-level comparison with other airports, as well as some other potential comparators. Such analysis can be based on statistical benchmarking or econometric analysis, such as stochastic frontier analysis. These assessments are vulnerable to the criticism that they ignore factors specific to the firm in

question; hence the 2014 mix of bottom up analysis to provide a range of scenarios, and top down analysis to help inform a decision on these scenarios and to provide a sense check.

6.26 We could seek to implement a longer run approach to Opex. The 2014 bottom-up assessment took 2013, the year in which the study was carried out, as a baseline, and sought potential efficiencies from there. There is a risk that by repeating this approach over multiple regulatory periods, we are resetting the targets each time; any inefficient expenditure would be reduced or removed from the targets over the course of the regulatory period, but if not realised in Dublin Airport's outturn expenditure, simply reintroduced at the beginning of the next period.

6.27 Adopting a longer run approach, whereby some or all previously identified targets are assumed to have been met regardless of whether the airport has exceeded or fallen short of the targets, could have the effect of maintaining the pressure to achieve identified efficiencies across regulatory periods. This could work both ways, for as long as the policy was in place; if the targets are exceeded, Dublin Airport would keep the associated savings for longer, while if the targets are not met, Dublin Airport would continue to fund the difference until it caught up with the targets.

Appropriate Benchmarks

6.28 Regardless of the methodology chosen, arriving at Opex allowances will likely involve some sort of benchmarking. Therefore, we seek views on appropriate benchmarks, or principles to be guided by when seeking benchmarks. A bottom-up assessment involves identifying individual lines of Opex, and typically benchmarking them against appropriate comparators, while a top-down assessment involves benchmarking at a more macro level. The selection of appropriate comparators is key in any such analysis.

6.29 A bottom-up analysis typically requires the identification of a wide range of benchmarks given that each line of Opex is distinct. As well as being directly comparable to the line of Opex in question, the analysis could also consider any country or firm specific factors. For example, using Irish Naturalisation and Immigration Service (INIS) staff costs as a benchmark for Dublin Airport security staff, you would expect country specific factors to be implicit.

6.30 A top-down analysis would seek to compare Dublin Airport Opex with peer airports, or other companies. In 2014, we carried out an extensive top-down exercise comparing operating costs per passenger at as many European airports served by Ryanair and/or Aer Lingus as data was available for; 69 airports in total. We also compared the evolution of Opex per passenger at Dublin Airport to that of Ryanair and Aer Lingus over the preceding years. Finally, we compared Dublin Airport with a selection of other semi-state companies; An Post, Bord Gais, CIE, ESB, IAA, and RTE.

6.31 We could also carry out benchmarking of Dublin Airport against elements within the wider Irish (or European) economy. This could include benchmarking the productivity and/or the cost per unit of production factors, such as labour.

Other Issues in Opex

6.32 This subsection sets out some specific issues which we think may be relevant for the upcoming Opex assessment. We would welcome views on them. We would also welcome views on principles on which we should rely on when considering these issues or similar issues as they arise.

New Categories

6.33 From time to time new cost items are undertaken by the airport, either as part of obligations or identified opportunities. Conversely, other items become obsolete, and associated allowances should therefore fall away. In order to allow sufficient time for any such items to be assessed, parties should make us aware of them early in the process. By way of example, Dublin Airport now bear the operating cost of running hold baggage screening, whereas at the time of the 2014 Determination it was borne by the airlines.

Contractual Commitments

6.34 Where Dublin Airport has entered into contractual commitments covering the period in question, such as, for example, commitments to incremental progression in salary, these costs may be viewed in different ways:

- They are costs which Dublin Airport must pay, and thus should be fully allowed for as they stand.

- Dublin Airport chose to enter into such contracts; reasonable efficiency targets should be set independently. If these contracts are efficient relative to the targets, Dublin Airport will benefit from achieving that efficiency, whereas if they are inefficient, Dublin Airport will lose out on the difference.

Recovery of Upfront Costs of Reducing Employee numbers

6.35 If opportunities are identified to reduce Opex through reductions in FTEs (either through efficiency gains or technological advances such as automation), a key question will be whether associated upfront costs, such as severance packages, should be remunerated. One point of view is that a scheme of voluntary severance, while costing Opex in the short term, may lead to long run efficiencies. Thus, where such schemes can be demonstrated to provide a Net Present Value benefit, they could be considered efficient and an Opex allowance provided to cover the associated costs. Another view would be that reductions in FTEs can be achieved by management of attrition and by scale effects.

6.36 In the 2009 Determination we identified Opex efficiency savings which could be achieved through the reduction 468 FTEs, but we did not make an allowance for upfront costs associated with the reduction. Dublin Airport appealed the 2009 Determination on this point (among others) arguing that not making an allowance for upfront costs (estimated by Dublin Airport at €48m) was "wholly inappropriate and inconsistent with regulatory best practice." The Commission argued that the reductions in FTEs could be made through natural attrition and through scale effects identified by the Commission's consultants. The appeals panel did not find in Dublin Airport's favour on this point and did not refer this point back to the Commission for consideration.[24]

Environment

6.37 Expenditure intended to address environmental issues such as energy use, airborne emissions, or noise, whether required by EU/National Regulations or in response to Government policy, or otherwise, is likely to be relevant in the next regulatory period.[25] Consideration needs to be given to the criteria used to assess such costs, which may not have as robust a business case

[24] https://www.aviationreg.ie/_fileupload/2010-06_AP2010_Decision_DAA.pdf

[25] See page 18 http://www.dttas.ie/sites/default/files/publications/aviation/english/national-policy-statement-airport-charges-regulation/nps-airport-charges-regulations-amended-oct-6.pdf

as other cost items. One point of view is that all costs should be subject to the same rigorous assessment regardless of motivation, whereas another is that the full benefits of such measures may not be accurately assessed in a business case type justification.

Opex Rolling Schemes

6.38 Rolling schemes for Opex targets were introduced in the 2009 Determination. In 2014, rolling schemes were implemented for 13 out of 18 cost categories. In 2017, a share of €177.2m out of total Opex of €256.9m was captured under rolling schemes.

6.39 In the current regulatory period, Opex outturns have remained above the gross rolling scheme target. In 2017, the gross rolling scheme target of €139.76m (€139.82m in 2016) was exceeded by €37.48m (€27.55m in 2016). Table 6.1 lists the gross rolling scheme targets for 2016 and 2017 and contrasts them with outturn figures.

Table 6.1: 2016-2018 Total Gross Rolling Scheme Targets v Outturn

Year	Total gross scheme Target (€m)	Total Outturn (€m)	Difference (€m)
2016	139.82	167.37	27.55
2017	139.76	177.24	37.48
2018*	139.98	N/A	N/A

*Note: *No outturn values available for 2018 as of April 2018.*
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

6.40 Based on current Opex outturns, no rolling target adjustments will be required for the next regulatory period. There may still be a need for adjustments if targets are outperformed in 2018. However, given that the targets are in gross terms rather than per passenger terms, this seems unlikely. Passenger levels, which are a driver of gross Opex, will presumably continue to significantly exceed our forecasts for the remainder of the current regulatory period.

2019 Rolling Schemes

6.41 We are interested in views on whether and how we should continue implementing Opex rolling schemes in the next regulatory period.

6.42 One aspect we are interested in is whether gross schemes are an appropriate format, or whether we should use per passenger schemes, which would instead amend the incentives at a per passenger level.

6.43 Another aspect we are interested in is the interaction between rolling schemes for Opex and rolling schemes for commercial revenues. There may be an argument that because of asymmetry in the consequences of over- and underperformance, Dublin Airport faces an incentive to strategically overspend on certain Opex (e.g. Marketing) if this increases commercial revenues to a level above the rolling scheme targets.

High-level Consultation Questions

Q7. What methodology should we use to forecast operating costs? What are appropriate benchmarks?

Q8. If efficiencies are identified, how long should Dublin Airport have to achieve them?

Q9. Should we continue to use rolling schemes to maintain a consistent incentive to realise efficiency gains throughout the regulatory period?

7. Commercial Revenues

7.1 This section explores how Dublin Airport has performed in the current regulatory period with regard to commercial revenues and asks how we should forecast this building block in the forthcoming Determination. This includes comparing outturns with the forecast at the time of the 2014 Determination. Of particular interest is the extent to which elasticity estimates for the various revenue categories, with respect to changes in passenger levels, were borne out.

7.2 The following key questions are addressed:

- Should we amend the econometric models used to estimate revenue elasticities?
- Should we consider alternative approaches to forecast future commercial revenues?
- Should we introduce benchmarks as a tool to identify scope for efficiencies/commercial opportunities?
- How should we consider the impact of events such as Brexit and a trend towards e-commerce?
- Should we adapt our approach to manage incentives for revenue maximisation for certain commercial services?
- What should be our approach to rolling schemes?

Aggregate Forecasts and Outturns

7.3 Commercial revenues at Dublin Airport have been increasing significantly in the current regulatory period. Total net commercial revenues rose from €151.6m in 2014 to €223.6m in 2017 growing at an average real annual rate of 13.5%. The growth in commercial revenues surpassed both the growth in aeronautical revenues (with an average annual growth rate of 8.3%) and growth in absolute passenger numbers (with an average annual growth rate of 10.1%).

7.4 Commercial revenues grew quicker than our forecast predicted. We predicted commercial revenues to be €162.5m in 2017, implying an average annual growth rate of 5%. The difference between forecast and outturn increased from €24.6m in 2014 to €61.1m in 2017. A detailed comparison of our forecasts to outturn commercial revenues is presented in Table 7.1 below.

Table 7.1: Outturn Commercial Revenues significantly exceed our 2014 forecasts

Year	CAR Forecast		Outturn		Difference to Forecast	
	CR (€m)	Growth	CR (€m)	Growth	CR (€m)	Growth
2015	151.6	3%	176.1	16%	▲ 24.6	16%
2016	153.9	2%	200.0	14%	▲ 46.1	30%
2017	162.5	6%	223.6	12%	▲ 61.1	38%
2018*	166.2	2%	N/A	N/A	N/A	N/A
2019*	170.2	2%	N/A	N/A	N/A	N/A

Note: Reported are net commercial revenues (i.e. excluding costs of goods sold) denominated in December 2017 prices. Outturn figures are net of revenue associated with the till exit of Dublin Airport City (DAC).
**No outturn values available for 2018 and 2019 as of April 2018.*
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

7.5 The extent to which our forecasts underestimated outturn commercial revenues varies across categories. The largest share of the difference stems from retail revenues; in 2017, 47% of the difference (€29m) was due to this category. The remaining difference is due to Property, Car Park, and Other revenues. Table 7.2 illustrates the differences between revenue categories using the year 2017 as an example.

Table 7.2: 2017 Outturn v Forecast per category

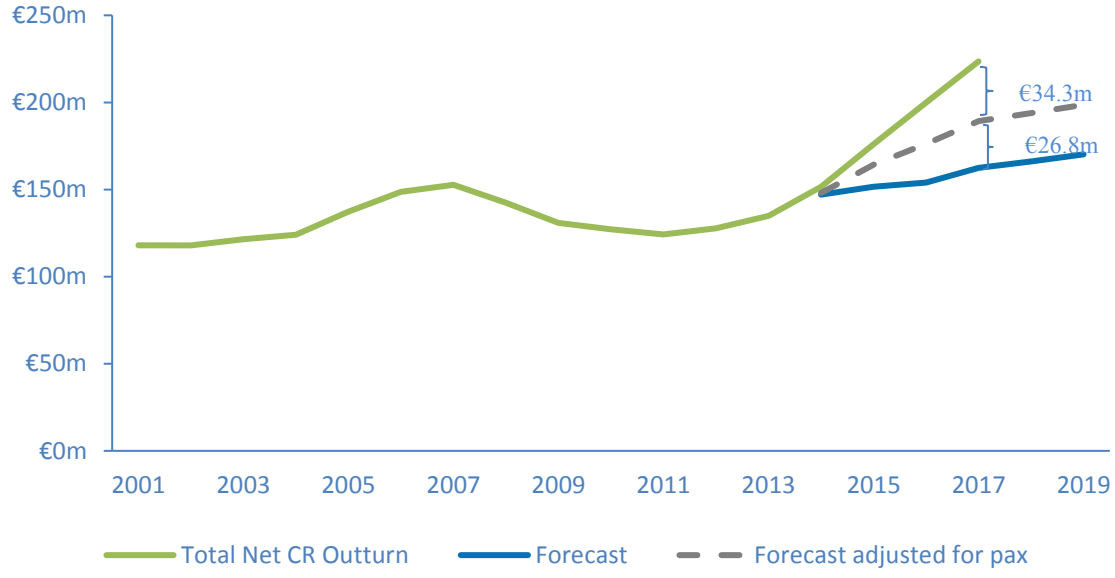
Category	Forecast (€m)	Outturn (€m)	Difference (€m)	Difference to Forecast	Category share in overall difference
Net Retail	64.3	93.2	▲ 29.0	45%	47%
Property	43.3	54.3	▲ 11.0	25%	18%
Car Park	33.6	43.5	▲ 9.9	29%	16%
Advertising	4.7	4.4	▼ 0.3	-6%	0%
Other	16.6	28.1	▲ 11.5	69%	19%
Total	**162.5**	**223.6**	**▲ 61.1**	**38%**	**100%**

Note: All values are denominated in December 2017 prices. Outturn figures are net of revenue associated with the till exit of DAC.
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

7.6 The reasons behind the significant differences across categories are twofold. Firstly, as outlined in Section 5, growth in passenger numbers has exceeded our forecast substantially. As a consequence, passenger number estimates that were too low were used as an input to forecast commercial revenues. Secondly, our elasticity estimates overestimated the reduction in average commercial revenue per passenger following an increase in overall passengers. The low average revenue estimate resulted in a further underestimation of total net commercial revenues. In summary, the increase was due to a combination of increased commercial revenue per passenger, and increased passenger numbers.

7.7 Chart 7.1 compares our 2014 forecast and a forecast adjusted for actual passenger numbers against outturn of net commercial revenues. In 2017, almost half of the observed difference between forecast and outturn (€26.8m out of €61.1m in 2017) is due to actual passenger growth surpassing our estimates. The slightly larger share (€34.3m) is due to average commercial revenue per passenger increasing at a higher rate than predicted in our forecast model.

Chart 7.1: Commercial Revenue Outturns v Commission Forecasts



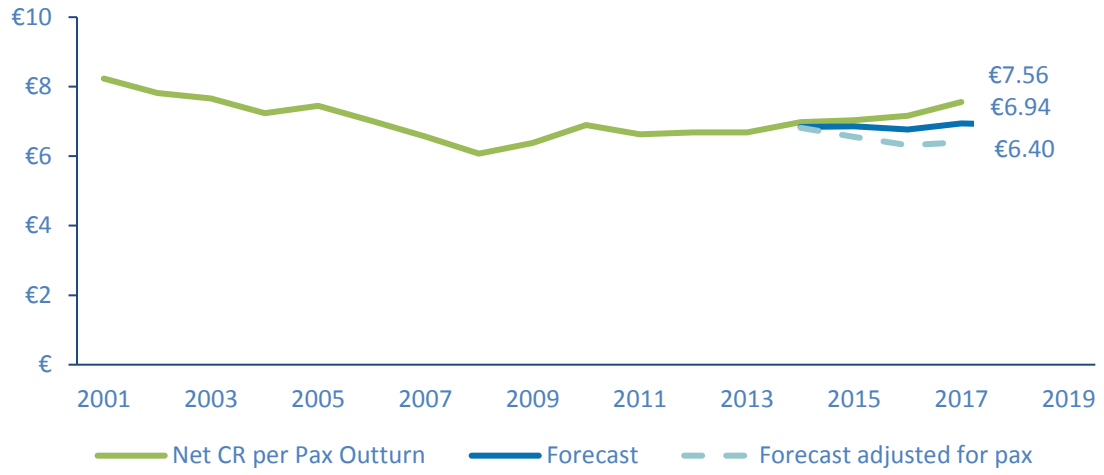
Source: CAR Calculations, 2014 Determination, Dublin Airport Regulatory Accounts

7.8 The difference between forecast and actual passenger numbers is discussed in detail in Section 5. In this section, we analyse the difference between forecast and outturn revenue per passenger with respect to changes in passenger numbers, i.e. the passenger elasticity. In 2014, these elasticities were estimated through econometric modelling.

Commercial Revenue per Passenger – Forecasts and Outturns

7.9 Chart 7.2 compares forecasts and outturns at a per passenger level. The 2014 forecast predicted relatively stable per passenger commercial revenues, fluctuating between €6.84 in 2014 and €6.94 in 2017. When corrected for actual passenger numbers, the predicted average revenue per passenger drops from €6.82 in 2014 to €6.40 in 2017. However, outturn per passenger increased from €6.98 in 2014 to €7.56 in 2017. Thus, growing passenger numbers led to an increase rather than a decrease in average revenue per passenger. This is contradictory to what our forecast model predicted and may be an indication that some of the passenger elasticities are too conservative.

Chart 7.2: Commercial Revenues Outturns v Commission Forecasts Per Passenger



Source: CAR Calculations, 2014 Determination, Dublin Airport Regulatory Accounts

7.10 The 2014 forecast model is generally based on one unique passenger elasticity estimate per revenue category, with Property being the exception to the rule. Commercial revenues from property concessions and property rents are estimated separately. Table 7.3 lists the elasticities underlying the forecast model and contrasts them with corresponding values that are implied by outturn data. These implied elasticities were calculated by dividing the outturn growth rate for the relevant revenue category over the 2014-17 period, by the actual passenger growth rate over the same period.

Table 7.3: 2014 Model v Implied Elasticities

Category	2014 Model elasticity	Elasticity implied by Outturn
Net Retail	0.67	1.44
Property	0 - 0.2*	0.50
Car Parking	0.99	1.24
Advertising	1.14	0.29
Other Revenue	2.08	4.23
Total	**0.64**	**1.29**

Note: Implied elasticities were calculated comparing the growth in commercial revenues per category with the growth in total passenger numbers. Reported are averages of the three point estimates for 2014-15, 2015-16, and 2016-17. Outturn values underlying the calculations of implied elasticities were adjusted for uplifts from revenue generating Capex projects, which were excluded from the base forecast, by subtracting plan figures. For better comparability, the calculation of the implied elasticities was based on deflated outturn figures in 2014 prices.

* We used elasticity estimates of 0 for revenues from Property Rents and 0.2 for revenues from Property Concessions during the 2014 Determination. The aggregated reporting within the Dublin Airport Regulatory Accounts does not allow to separately calculate implied elasticities for the two categories.

Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

7.11 The differences between model and implied elasticities are substantial. However, the reasons for these differences are not evident. Several explanations are plausible.

7.12 One explanation would be that passenger numbers alone cannot capture all relevant drivers of commercial revenues (at least not for some of the categories). By relying on passenger elasticities only, our forecast methodology imposes a linear bivariate relationship between passengers and commercial revenues that may not fully capture all relevant factors. Some observed changes in the level of commercial revenues may have falsely been attributed to simultaneous, but unrelated movements in passenger numbers leading to biased elasticity estimates.

Econometric Models Underlying the Revenue Forecasts

7.13 The observed discrepancy between forecast and outturn commercial revenues in the 2015-2017 period raises the question of whether we should continue using our current forecast approach or whether we should try to improve it for the 2019 Determination.

7.14 The specifications underlying the econometric models are reasonably straightforward. Most models only use aggregate passenger levels as a predictor variable. Arguably there are many additional factors that determine the level of commercial revenues in most categories. In fact, it is likely that for some categories, passenger numbers play a minor role compared to other determining factors. For example, it is not clear how changes in passenger levels would drive property rents and concessions.[26] However, this does not necessarily mean that they will remain constant over time. Fluctuations in other drivers, such as land prices or demand for office space, will certainly influence revenues from these sources.

7.15 Thus, there is an argument for refining the econometric models to incorporate additional drivers and control variables. For example, the models could be expanded by including the variables set out in Table 7.4. These are kept specific to the individual revenue categories to reflect the likely differences between the underlying economic mechanisms.

[26] Our forecast model reflects this by assuming a passenger elasticity for revenue from property concessions of 0 i.e. they remain unaffected by passenger growth.

Table 7.4: Possible Additional Explanatory Variables

Category	Candidate variable	Potential motivation
Net Retail	GDP indices for Ireland, the UK, and continental Europe	Economic activity serves as a proxy for passenger purchasing power
	Mix of long and short haul passengers	Long haul passengers may be more inclined to shop
	Mix of leisure and business passengers	Leisure travellers may be more inclined to shop
Property	Land price index	Serve as a proxy for the level of rents that can be extracted from concessions, lease, and revenue sharing agreements
	Airline mix	Full service carriers tend to increase the need for facilities (e.g. hotel beds) compared to low cost carriers
Car Parking	Share of transit passengers	Transit passengers do not require car parking
	Average prices from alternative modes of access	Serve as proxy for competitive pressure from bus and off-airport car parking
Advertising	Mix of leisure and business passengers	Serves as proxy to capture companies' varying willingness to pay for reaching different target groups
Other Revenue	Airline mix	Serves as a proxy for demand for US Border Control services

Source: Commission for Aviation Regulation

7.16 A potential advantage of additional predictive variables is that the risk of estimating biased revenue forecasts is mitigated. This is particularly important for time series models such as those used in 2014. Time series models are prone to omitted variable bias because many continuous variables that develop over time will naturally be correlated with each other.

7.17 The disadvantage of more predictive variables is that the model would rely on additional variables that are unknown at the time of the forecast. Thus, all additional variables would have to be predicted themselves in some way in order to be used for the forecast model. For variables such as GDP, we could rely on the same sources that we use for passenger forecasts. Other variables would likely have to be forecast using their own projection methods. This would introduce additional methodological uncertainty to the forecasting for commercial revenues.

7.18 Using additional control variables is one possible approach for improving the forecasting precision of the econometric models. Another approach consists of splitting out the aggregate category models into multiple models per subcategory. Estimating separate models for disaggregated revenue sources would allow us to disentangle the influence of the various drivers behind the individual revenue streams. Ideally, their effects on commercial revenues would be quantified more precisely.

7.19 In 2014, separate models were estimated for Net Retail, Property Concessions, Car Parking, Advertising, and Other Revenues. However, the individual revenue streams within these categories may have very heterogeneous characteristics and may react differently to changing circumstances. For example, stronger competition from off-airport parking may affect Car Parking revenues from long term car parks differently to short term car parks. Similarly, revenues from landside shops (e.g. bookshops) may react differently to changes in GDP levels than revenues from airside specialist shops (e.g. duty free luxury shops).

7.20 Parties are invited to outline any changes to the econometric approach for forecasting commercial revenues they would like us to adopt for the next Determination. A key consideration is whether added complexity to, and loss of transparency in, the forecast process would be more than compensated by the possibly gains in forecasting accuracy.

Forecasts based on Airport Business Plans

7.21 A general disadvantage of econometric models is that they must be calibrated using historic data. It is impossible to predict future trends and disruptions based on econometric techniques without historic precedents.

7.22 In response to the 2014 Draft Determination, Dublin Airport suggested that we use a forecast approach similar to the one adopted by the Civil Aviation Authority in the UK (CAA). The CAA typically carries out a detailed review of the various commercial revenue streams.

7.23 The starting point is a business plan prepared by the airports. Business plan sections on commercial revenues present disaggregated estimates based on bottom-up models for a large range of revenue streams. The CAA assesses the robustness and appropriateness of the various estimates on an individual basis using some or all of the following approaches:

- **Industry experts' assessment of trends** and their effects on the various streams of commercial revenues;
- **Interviews and consultation process** with relevant stakeholders (i.e. representatives of the airport, airlines and retail partners) to test assumptions;
- **Sophisticated econometric models** (i.e. individual models per revenue category with dozens of control variables) to cross-check forecasts against historic outcomes; and
- **Analysis and benchmarking of specific performance indicators** in order to identify scope for improvement.

7.24 Where the CAA comes to the conclusion that the airport's business plan underestimates or overestimates the revenue potential, it will adjust its own estimate accordingly. Econometric models based on historic data will be used to sense check and identify risks, but otherwise do not play a major role in the forecasting process.

7.25 An advantage of such an approach is that it is inherently forward looking. Considerations about future industry trends and disruptions are at the core of the estimates. For example, an assessment of Heathrow's commercial revenues during the H7 regulatory review recently discussed what the likely impacts of the e-commerce revolution on retail revenues will be.

7.26 However, the reliance on business cases and industry experience bears the risk of leading to a more lengthy and inefficient regulatory process. Naturally, expert views on the impact of future trends and disruptions will diverge, depending on their experience or perspective. For example, there are widely differing assessments of the impact of e-commerce on airports' commercial revenues ranging from the prospect of dampened retail revenues to representing an opportunity for creating a whole new consumer experience.

7.27 Parties with views on whether alternative approaches should complement or replace the current method based on econometric models are invited to share them with us.

The Use of Benchmarks to Identify Scope for Efficiency Gains

7.28 Complementary to the discussion of alternative forecast methods, there is an argument for adopting benchmarking techniques to identify the scope for efficiency gains.

7.29 In practice, the approaches to forecasting commercial revenues discussed above build upon some existing level of observed revenues. Whether future revenues are projected based on historic data or whether they are predicted based on expected changes to current levels, there is an argument that scope for efficiency hidden in existing revenues remains unnoticed.

7.30 In the context of commercial revenues, scope for efficiency gains may encompass suboptimal pricing schemes, inefficient allocation of resources (e.g. not enough retail space), or unexplored opportunities for revenue generation.

7.31 Benchmarking can help identify scope for efficiencies by comparing performance indicators across various airports. The choice of performance indicators depends on the nature of the efficiency that one wishes to explore, the choice of comparator airports and on the data availability.

7.32 A simple example of a benchmark using commercial revenues per passenger as performance indicator is displayed in Chart 7.3. The example is an extension of a benchmark analysis prepared by consultants for the CAA's assessment of commercial revenues at Heathrow Airport. Dublin Airport is roughly in the middle compared with other leading European airports.

Chart 7.3: 2015 Benchmark of commercial revenue per passenger across leading European airports

Note: Revenues reported for 2015. For comparator airports originally denominated in £, they were converted to Euro at average rates for 2015 and converted to December 2017 prices.
Source: Dublin Airport Regulatory Accounts, Steer Davis Gleave (2017) final report on Heathrow Airport's commercial revenues for the CAA.

7.33 Table 7.5 presents a list of other possible key performance indicators we have seen, in work done or commissioned by other regulatory bodies. These try to capture certain aspects of the various revenue categories and are therefore more specific than the broad total revenue per passenger indicator used above. The idea is that they would allow for more narrow conclusions as to where there is potential scope for improvement.

Table 7.5: Possible key performance indicators for benchmarking

Category	Candidate Performance Indicator	Used in
Net Retail	Net retail revenue per passenger	1, 2, 3
	Retail revenue per subcategory Duty Free, Specialist Shop, and Bureau de Change	1, 2, 3
	Income per passenger category (business vs leisure)	1
	Retail space (in m^2) per passenger	1
Property	Property revenue per passenger	1, 2
	Concession margins	2
	Catering revenues per passenger	2
Car Parking	Car parking revenues per passenger	2,3
	Off airport parking spaces per passenger	1
	Parking tariffs	1
Advertising	Advertising revenues per passenger	2

1 CAA to inform H7 regulatory process,
2 CAA in Q6 price control for Heathrow Airport,
3 CAA in Q6 price control for Gatwick Airport.
Source: Civil Aviation Authority, Steer Davies Gleave.

7.34 Besides performance indicators, another important decision in benchmark analyses is the composition of the comparator set. Ideally, the comparator airports face the same conditions as Dublin Airport, so that differences in outcomes are likely to be due to inefficiencies rather than differences outside the airport's control.

7.35 Depending on the performance indicator, the appropriate composition of the comparator set may vary. For example, Heathrow may be appropriate to benchmark Dublin Airport's advertising revenue per passenger, but may be inappropriate to benchmark Dublin Airport's car parking revenues per passenger, as Heathrow accommodates a larger share of transit passengers and is arguably more constrained by alternative modes of access than Dublin Airport, which can only be accessed by road.

7.36 Candidate comparators could include European airports of similar size (in terms of passenger numbers), similar airline mix (Full Service Carrier and Low Cost Carrier), and similar passenger mix (business and leisure as well as transit and Origin/Destination).

7.37 We welcome views on whether benchmarks would add to or should replace the current forecasting methodology for commercial revenues.

Impacts from Foreseeable Events

7.38 Another issue related to forecasting commercial revenues is how impacts from foreseeable trends and events should be treated.

7.39 An event that is likely to have an appreciable impact on commercial revenues is Brexit. More than a third of Dublin Airport's passengers travel on routes from or to UK airports. London Airports Heathrow, Gatwick and Stansted are the top three destinations in terms of passenger volume.

7.40 It is still very unclear what the relationship between the EU and the UK will be after March 2019. Naturally, a hard Brexit including a departure from the single market would likely decrease the movement of people between the EU and the UK. The resulting reduction in traffic on routes between Dublin Airport and UK airports could significantly impact commercial revenues, as well as many other building blocks.

7.41 More idiosyncratic to commercial revenues would be the impact of the UK leaving the EU customs union. Depending on how an alternative customs arrangement between the EU and the UK would turn out, duty free shopping at Dublin Airport may become significantly more attractive for passengers travelling to the UK.

7.42 Another source of uncertainty is how the general trend in retail industry towards e-commerce will affect commercial revenues. Whereas high street 'brick and mortar' shops are faced with new competitive constraints from online shopping, it is unclear whether the same holds true for retail business at airports. For example, footfall at airside shops is likely to be less affected by e-commerce than at high street stores because passengers must pass by them (or through them) on their way to the boarding gates. In fact, the online segment may even be complementary to existing airport retailing and open additional sources of revenue.

7.43 We are interested in views on what the likely impact from future events such as Brexit and e-commerce will be, and how we should account for these impacts in commercial revenue forecasts, if at all.

Interaction with Other Building Blocks

7.44 Another issue for the 2019 Determination is the interactions between commercial revenues and other building blocks. In particular, the Opex and Capex allowances must be sufficient to deliver the commercial revenue targets.

7.45 Another interaction is the potential for Dublin Airport to exit certain activities from the regulatory till. Specifically, Dublin Airport have put forward a proposal to move the land and assets associated with Dublin Airport City from the regulated entity to the non-regulated part of daa plc, effectively transferring the risk of proceeding with this development from users to the shareholder. This till exit will decrease expected commercial revenues for the regulated entity, but will also reduce the RAB and hence capital cost allowances. The effect of these changes on future price caps is uncertain. In CP3/2014, we estimated that charges are unlikely to be much different between the project not proceeding, or Dublin Airport proceeding with the project outside the regulatory till.

7.46 Our guidance paper on the Till Exit of Lands Associated with Dublin Airport City from December 2014 summarises our current thinking on the matter.[27] Implementation decisions on the till exit will be made in the forthcoming determination.

Incentives for Revenue Maximisation

7.47 There may be an argument that users do not benefit from Dublin Airport having incentives to maximise some commercial revenues. Particularly in areas where users do not have much choice, it is unclear whether Dublin Airport should be incentivised to fully exploit its market power. For example, some important commercial service offerings to airlines do not seem to face stronger competition than many of the aeronautical services regulated through the price cap.

7.48 One example of such services is access to installations (ATI). Statutory Instruments No. 505 of 1998 mandates us to determine whether Dublin Airport's ATI fees are relevant, objective, transparent, and non-discriminatory. For the 2010-14 period, we applied an adjustment to the price cap to claw back €1.9m for over collection of ATI fees. We plan to repeat this process for

[27] https://www.aviationreg.ie/_fileupload/2014-12-10%20CP3%20Dublin%20Airport%20City%20valuation%20and%20till%20exit.pdf

the current regulatory period if there has been over collection.

7.49 Another example is Preclearance for U.S. Customs and Border Protection in Terminal 2. Currently, Dublin Airport is incentivised to maximise revenues from this service, despite what is arguably a dominant market position; Dublin Airport is a monopoly provider of Preclearance services.

7.50 An argument against specific measures to mitigate price pressure for these services may be that the costs associated with price regulation surpass the benefits. For example, ATI services accounted for only €2.7m, or 5% of income from Property in 2017, meaning that the potential benefit from intervention is limited. In the past, Dublin Airport have disagreed with an intervention on the basis of this "De Minimis" argument.

7.51 We are interested in parties' views on whether we should attempt to mitigate pricing pressure on exposed commercial services through regulatory measures or whether we should relax such practises.

Rolling Schemes

7.52 In 2014, we introduced rolling schemes for all categories of commercial revenues. This encompassed per passenger schemes for Retail, Car Parking and Advertising and a gross revenue scheme for revenues from Property Concessions and Rent.

7.53 The motivation for rolling over outperformance as adjustments on future targets is to ensure Dublin Airport faces an equal incentive to maximise its commercial revenues at every point in time during the regulatory period. Thus, one key question for the effectiveness of rolling schemes is whether the Airport generated higher commercial revenues in 2016 and 2017 than it would have done in the absence of rolling schemes.

7.54 Table 7.6 lists the total per passenger scheme targets for the 2016-2018 period and contrasts them with outturn figures. In 2016 and 2017, Dublin Airport outperformed by €0.62 and €0.86 respectively.

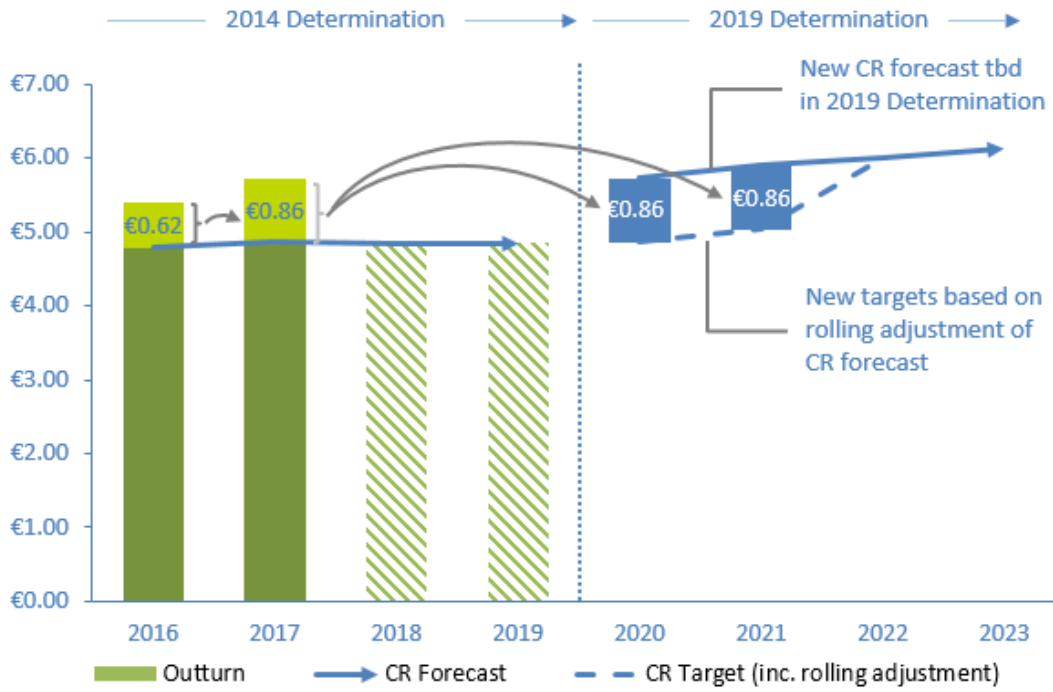
Table 7.6: 2016-18 Per Passenger Rolling Scheme Targets v Outturn

Year	Target	Outturn	Outperformance
2016	€4.78	€5.40	€0.62
2017	€4.86	€5.72	€0.86
2018*	€4.85	N/A	N/A

Note: Total target per passenger schemes is the sum of all individual rolling scheme targets expressed as per passenger target i.e. Net Retail, Car Parking, Advertising, and Other Revenue.
**No outturn values available for 2018 as of April 2018.*
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

7.55 Commercial revenue targets for the next regulatory period will be adjusted downwards to reflect the outperformance in 2016 and 2017. For example, assuming 2018 and 2019 outturns will match our forecasts, an adjustment of €0.86 per passenger will be rolled over into the next regulatory period for 2020 and 2021. The adjustment will disappear in 2022 and the target will reconcile with the forecast. This effect of outperforming current targets on future targets in the 2019 Determination is displayed in Chart 7.4.

Chart 7.4: Effect of Over Performance on Price Cap



Note: Illustration based on the assumption that future outturns match our forecasts. Final amounts and duration of rolling adjustments in the next regulatory period are uncertain, as outturns in 2018 and 2019 are not known yet. For example, a difference to target of €0.86 and less in 2018 would lead to an adjustment of the same extent in 2022. An outperformance in 2018 of more than €0.86 would increase all adjustments from 2019 to 2022. Commercial Revenue forecasts for the next regulatory period are not known yet and included in the graph only for illustrative purposes.
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts.

7.56 Dublin Airport also outperformed the gross scheme target for revenues from Property Concessions and Rents in 2016 and 2017. In 2017, Dublin Airport generated €15.02m (€12.11m in 2016) in excess of a target of €39.23m (€37.30m in 2016). Table 7.7 summarises target and outturn figures for the gross scheme.

Table 7.7: 2016-18 Gross Rolling Scheme Target V Outturn

Year	Gross scheme target (€m)	Total gross schemes outturn (€m)	Outperformance (€m)
2016	37.30	49.41	12.11
2017	39.23	54.25	15.02
2018*	39.92	N/A	N/A

Note: Gross scheme target encompasses the rolling scheme target for Property Rents and Concessions (excluding ATI) expressed in gross terms. Target and outturn numbers excludes revenues from ATI fees.
**No outturn values available for 2018 as of April 2018.*
Source: CAR 2014 Determination, Dublin Airport Regulatory Accounts, CSO

7.57 We welcome suggestions on whether the rolling schemes for commercial revenues should be continued in this fashion or whether they require amendment.

High-Level Consultation Questions

Q10. What methodology should we use to forecast commercial revenues? What are appropriate benchmarks?

Q11. Should Dublin Airport be incentivised to maximize revenue from all commercial activities?

Q12. Should we continue to use rolling schemes to maintain a consistent incentive to realise commercial opportunities throughout the regulatory period?

8. Capital Expenditure

8.1 This section explores the key issues relating to capital expenditure (Capex) ahead of the 2019 Determination.

8.2 In a competitive environment, an airport would be incentivised to deliver the required capital projects in a timely manner and at efficient cost, as not doing so would result in a competitive disadvantage. Our goal when setting capital cost allowances is to replicate these incentives as much as possible. We seek to do this by:

- Providing allowances only for projects which meet the needs of current and future users.
- Providing efficient allowances (i.e., no more than the minimum amount of money required to deliver a project).

8.3 The preservation of these incentives must be balanced with flexibility for Dublin Airport to adjust Capex in response to changing circumstances or changing needs of users. There must also be sufficient regulatory certainty for Dublin Airport regarding remuneration of these efficient costs.

8.4 As part of the 2019 Determination, we intend to consider allowances in relation to the investment plan on which Dublin Airport will consult with users later this year ('Capex allowances 2020-202X'). We will also reconcile expenditure and allowances from the 2014 Determination to determine the opening Regulatory Asset Base (RAB) for 2020.

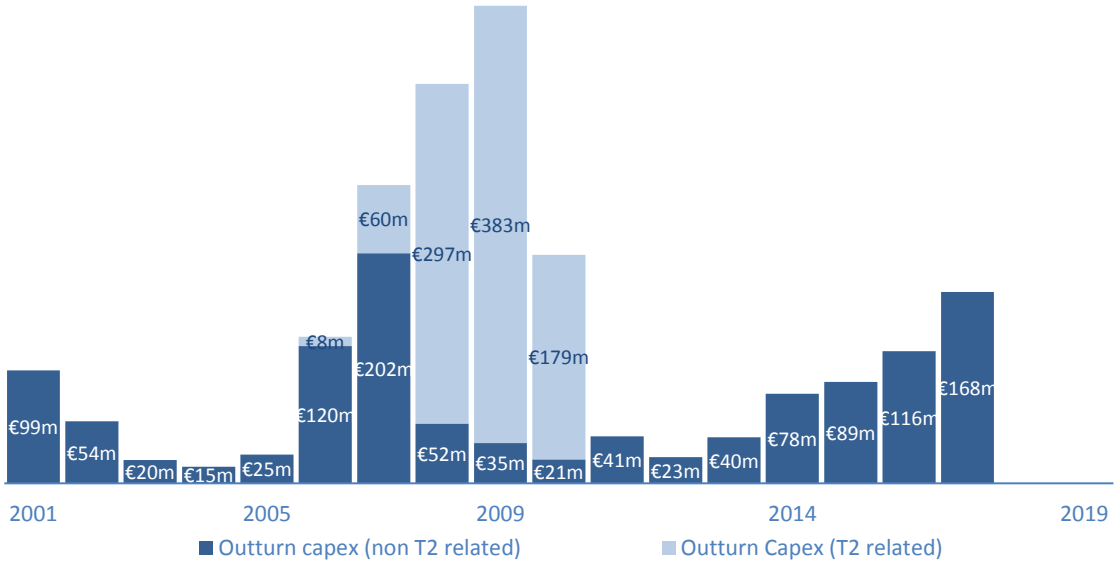
Masterplan

8.5 The various Capex programmes should be underpinned by and in line with a rolling Masterplan. This ensures that the airport is developed in a coherent and structured way, avoiding nugatory expenditure. A full and meaningful consultation process should be held when drawing up the Masterplan, given its substantial impact on Capex programmes. There should then be a clear relationship between shorter term investment plans and the longer term rolling master plan. In 2018 we will work with Dublin Airport to ensure that users can understand how the five-year plan has been derived from the longer-term plan.

Update on Capex

8.6 Chart 8.1 traces annual Capex at Dublin Airport since 2001, highlighting the inconsistent or 'lumpy' nature of airport Capex. Following the completion of Terminal 2 a steep fall in expenditure is observed over the 2009-2012 period. Since 2014, expenditure has begun to rise again.

Chart 8.1: 2001-2017 Capex at Dublin Airport



Source: CAR, reported by Dublin Airport

8.7 Interim Reviews in relation to Capex have been a feature of this regulatory period. In 2017, we redefined the trigger related to the North Runway project, in order to better align remuneration for the project with the timeline for delivery. We did not amend the quantum of the allowance (€246m), or the 50/50 risk sharing mechanism for cost deviations from that allowance.[28] We did leave open the possibility for Dublin Airport to re-consult on a proposed increased allowance, together with removing the risk sharing mechanism. Dublin Airport has stated that the cost of delivering the runway is over €70m higher than the 2014 allowance. However, Dublin Airport has notified us that it has opted not to consult again and so the original allowance and risk sharing mechanism remain in place.

8.8 In 2016, we published a decision on a process for providing a supplementary Capex allowance within a determination period.[29] Dublin Airport made use of this process in December 2017 to seek an allowance for an investment plan referred to as the Programme of Airport Campus Enhancement (PACE). Our Draft Decision on the PACE has been published, in which we set out our proposal to allow for €267.5m additional business development Capex for these projects. In line with the supplementary Capex process, this will not enter the price cap in the current regulatory period. We publish a final decision later in 2018.

8.9 In February of this year, Dublin Airport held a consultation on a project to implement Hold Baggage Screening (HBS) Level 3 in Terminal 1. It expects to submit a request for a supplementary Capex allowance later this year.

8.10 In the 2007 Interim Review of the 2005 Determination, we split remuneration for Terminal 2 into 2 boxes.[30] Box 1 commenced remuneration once the terminal opened; we committed to remunerating Box 2 once a threshold of 33m passengers per year was reached.[31] This threshold is unlikely to be met in the current period, but may be met in the next period. The 2007 Interim Review allowed for a Return on Capital to accrue to Box 2 until 2018, at which point it will be 'frozen' at €192.9m; from this point, only CPI adjustments will be implemented. We will need

[28] December 2017 prices.
[29] https://www.aviationreg.ie/_fileupload/supplementary%20capex%20decision/2016-12-09%20Decision%20on%20process%20for%20supplementary%20capex%20allowances.pdf
[30] https://www.aviationreg.ie/_fileupload/Image/PR_AC2_PUB1_CP6_2007.pdf
[31] As noted in Section 5 the planning permission of Dublin Airport is currently capped at 32m passengers.

to consider how to give effect to this commitment. Our initial view would be to include a trigger in the regulatory formulae to appropriately remunerate Box 2, in the event that the threshold is reached.

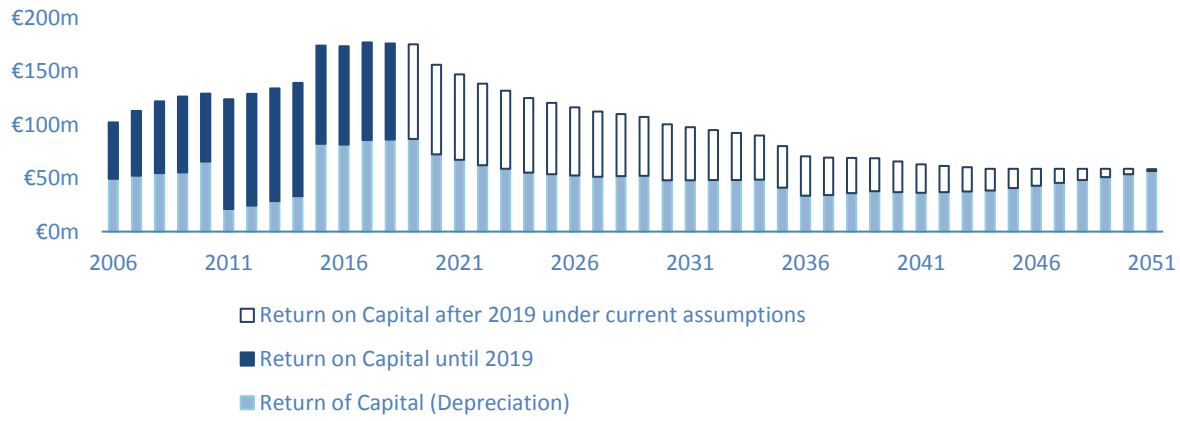
8.11 In 2014, Dublin Airport sought to exit Dublin Airport City from the regulatory till. We expect to adjust the 2020 opening RAB downwards by €47.8m as a result of this till exit.[32] This exit is discussed further in Section 7.

The Regulatory Asset Base (RAB)

8.12 The RAB is the set of capital investment costs for which we intend to make ongoing provision for in determinations. We do this by depreciating the RAB according to the depreciation profile of the various allowances which make up the RAB. It thus forms the basis of the building block for capital costs, in the form of depreciation and a return on capital.

8.13 Chart 8.2 shows annual capital costs since 2006, and capital costs projected out over the lifetime of the RAB as it currently stands. However, the profile of future capital costs will change as new expenditure enters the RAB.

Chart 8.2: Capital Costs from the Current/Historic RAB

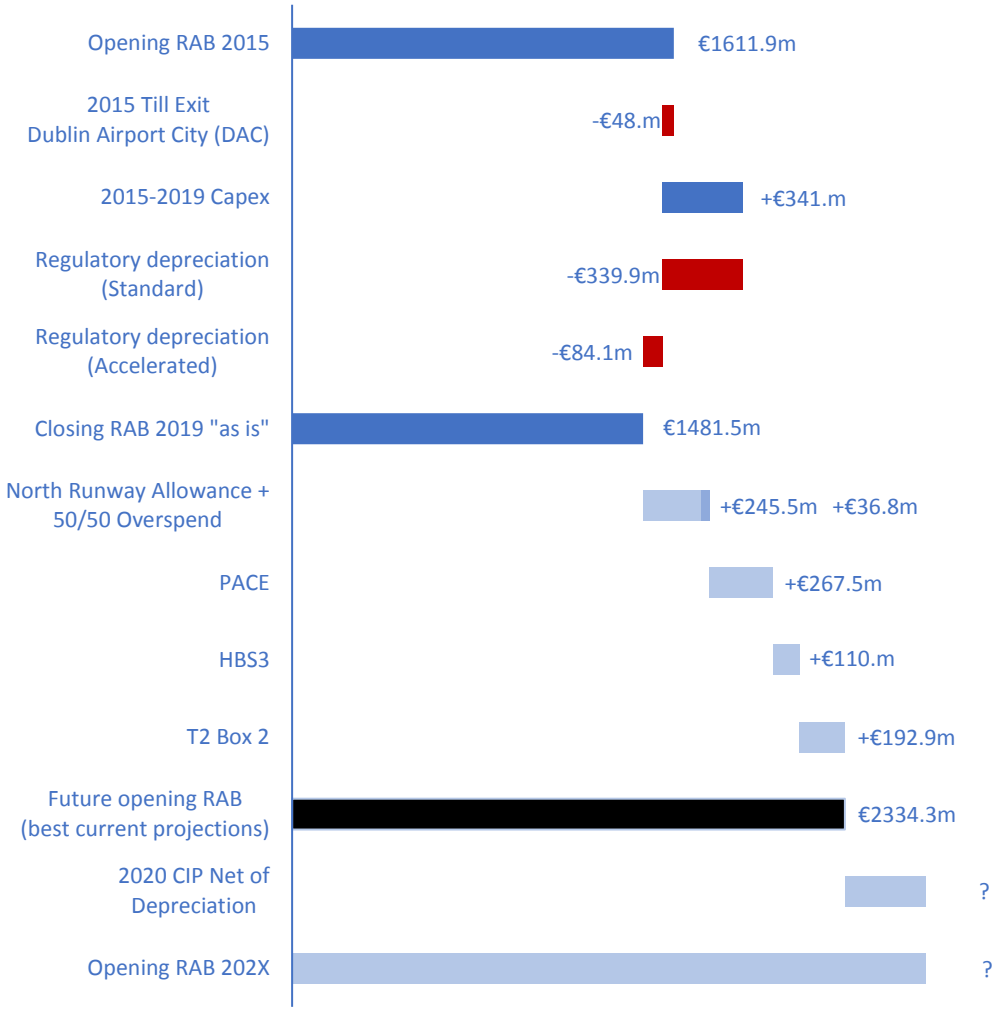


Note: This chart assumes no adjustment to the RAB including: new investments post 2019, reconciliation of outturn expenditure until 2019, or changes in depreciation profiles or the allowed Cost of Capital (WACC) set out in 2014.
Source: CAR Determinations, CAR calculations

8.14 For the purposes of estimating a potential future RAB, Chart 8.3 makes some assumptions regarding the above expenditure entering the RAB, based on best current information, for illustrative purposes. Given the actual or proposed regulatory treatment of some of this expenditure, this potential future RAB may not be fully realised until the regulatory period subsequent to the 2019 Determination, or later.

[32] https://www.aviationreg.ie/_fileupload/2014-12-10%20CP3%20Dublin%20Airport%20City%20valuation%20and%20till%20exit.pdf

Chart 8.3: Opening RAB, Year 202X

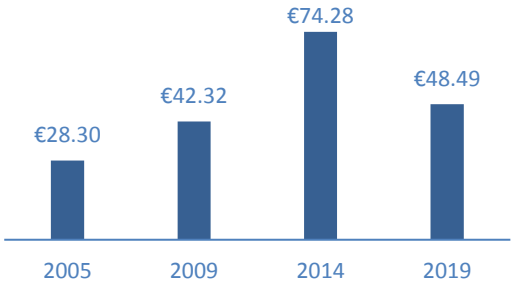


Note: Assumes North Runway outturn spending will be €320m (current estimate). PACE number is from our Draft Decision on PACE – subject to change. HBS3 number is indicative only, the process for HBS3 is ongoing and final cost could be significantly different. Till number is indicative only.
Source: 2014 Determination, CAR Calculations, Regulatory Accounts and Capex expenditure reported by Dublin Airport.

8.15 The quantum of Capex in the next regulatory period, which would allow for calculation of the final piece to Chart 8.3, is not yet known.

8.16 The RAB per passenger has fluctuated across different determination years. Most notably, the opening RAB almost doubled between 2010 and 2015; this was predominantly due to the entry of Terminal 2 Box 1.

Chart 8.4: RAB Per Passenger in Previous Determination Years



Note: 2019 figure assumes mid-range passenger forecasts and 2019 'as is' closing RAB scenario.
Source: CAR calculations and regulatory accounts.

Consultation and Reporting

8.17 The Capex consultation process to be held by Dublin Airport must be meaningful, to ensure that proposed projects meet the requirements of an appropriately broad range of users. The final investment plan should reflect the consultation feedback, or state the reasons for why particular feedback was not reflected.

8.18 In the Supplementary Capex Decision paper, we set out detailed consultation and reporting requirements for Dublin Airport. Table 8.1 summarises those requirements. Dublin Airport followed these requirements with regard to the PACE. Our view was that this consultation process was effective, given that:

- The final investment plan appropriately reflected feedback from users on the draft plan.
- The consultation documents met the requirements set out in Table 8.1, which allowed users to take an informed view on the proposed investment.

8.19 Thus our view, in general terms, is that a similar process should be followed ahead of the 2019 CIP.

Table 8.1: Consultation and Reporting Requirements as in Supplementary Capex Decision

The process for Dublin Airport is as follows:
- In advance of making a submission to the Commission, Dublin Airport shall consult with users on the following:
  - the need/merit of the project;
  - details on delivery of proposed project; and
  - timelines for the delivery of the proposed project.
- Proposed projects to deliver additional capacity must be underpinned by a capacity assessment showing that existing infrastructure is being maximised. This assessment can be conducted by Dublin Airport or a third party.
- Detailed business cases and cost information must be provided to users. Costs must be worked up comprehensively to allow an assessment by users of the costs and benefits of projects.
- Where appropriate, Dublin Airport should present the costs and benefits of a number of options for addressing a need.
- Detailed timelines and milestones for projects should be consulted on.

The Commission will:
- require Dublin Airport to develop and implement specific reporting requirements for approved projects; and
- require Dublin Airport to develop a timeline for the project (in consultation with users and with the agreement of the Commission) and to report regularly against this timeline

Source: CAR Decision CP7/2016

8.20 Where Dublin Airport makes use of any Capex flexibility by postponing, adding, or dropping projects over the course of a Capital Investment Programme, this should be explained as part of the regular reporting set out in Table 8.1. We seek stakeholders' views on the suggested consultation and reporting requirements for Dublin Airport for the 2019 Determination. We also look forward to hearing any suggestions regarding how the consultation process could be improved with reference to the PACE consultations.

Efficient Allowances

8.21 Our intention is to make provision for efficient allowances for 2020-202X for any projects which are in the interests of current and future users. We need to decide on the appropriate methodology to arrive at efficient allowances for Capex 2020-202X. By an efficient allowance, we mean the minimum cost of delivering a project, taking account of all relevant factors.

8.22 We have previously carried out ex-ante assessments/benchmarking exercises to derive efficient costs of proposed projects, against which actual expenditure can later be reconciled. For example, regarding the PACE projects, we commissioned SDG to carry out such an assessment.[33]

8.23 Alternatively, we could carry out an ex-post assessment after project delivery, i.e. a 'lookback' assessment. This would assess the efficiency of actual expenditure, with appropriate downward adjustment made to the amount entering the RAB if necessary. The main drawback to this approach is that stakeholders would have less certainty over the Commission's view on efficient allowances, until the projects are complete or at an advanced stage. This would reduce the scope for informed decision making; Dublin Airport would have to decide in advance whether to progress a project, while airlines and other stakeholders would have to decide on whether to support it.

8.24 We could carry out both an ex-ante and an ex-post assessment. In this case, the ex-ante assessment would inform the initial allowances, while the ex-post assessment would be used to better inform the reconciliation process. If a flexible allowance has been reallocated, the ex-post study could also assess the efficiency of the reallocated expenditure, reducing the scope for regulatory gaming as described in paragraph 8.30.

8.25 A final option would be not to carry out a cost efficiency assessment at all, instead assessing the corporate governance of the Capex programme; it could be argued that if a project is appropriately scoped and put to the market, we should rely on the market to return with the efficient cost.

Grouped Allowances and Deliverables

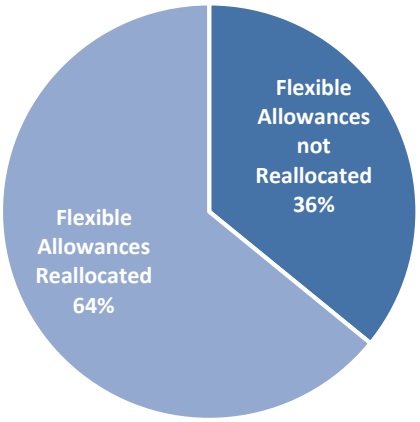
8.26 In the 2009 and 2014 determinations, we chose to group project allowances under various headings such as maintenance, business development and revenue. Grouped allowances are then reconciled together, meaning that Dublin Airport has the flexibility to reallocate expenditure to other projects which would fall within that same group. Allowances may be reallocated to projects which have not received an allowance at all, or to projects which have received an allowance but Dublin Airport wishes to spend more on. The exception to this are 'Deliverables'; these are projects which must be delivered as per the investment plan, or the associated allowance falls away.

8.27 The 2014 Determination contains six Capex groupings: Airfield Maintenance, Terminals Maintenance, Business Development, IT, Revenue and Other. Across the 6 groupings, there were five deliverables, with allowances totalling €81m or 24% of the total non-triggered Capex allowance of €339m. This leaves 76% (€258m) which was flexible within its grouping. Chart 8.5 demonstrates how Dublin Airport has used this flexibility to respond to changing circumstances, notably the increase in passenger numbers, in the current regulatory period. Projects towards which allowances have been reallocated include the realignment of Taxiway

[33] The draft SDG report can be found here: https://www.aviationreg.ie/_fileupload/PACE%20Draft%20Decision/Dublin-Airport_Supplementary-CIP-Efficiency-Assessment_DraftReport_v_4_0.pdf

Z to improve South Apron access, and the Terminal 2 bus lounge.

Chart 8.5: Reallocation of Flexible Allowances in the Current Regulatory Period



Note: Chart based on the quantum of flexible allowances. Indicative figures, final figure will only be calculable when full reconciliation is carried out and all expenditure has been assigned to a capex grouping.

Source: Dublin Airport, 2014 Determination

8.28 We have not previously applied strict rules regarding which projects are classified as deliverables. Rather, we have assessed projects on a case-by-case basis. A non-exhaustive list of factors which would weigh in favour of classifying a project as Deliverable are presented below:

- Projects with a very specific output that cannot be substituted by a different project. [34]
- A project where the output is necessary to fulfil legal or regulatory requirements.
- A large-scale project.
- A project with potential or actual regulatory compliance issues (e.g. a complex safety case) raising uncertainty about its feasibility.
- Projects which span regulatory periods.[35]
- A project which has previously received an allowance, but was then deferred or dropped.

8.29 This approach strikes a balance between incentivising Dublin Airport to seek efficiencies, and providing business flexibility and regulatory certainty.

8.30 There is a trade-off between generating efficient incentives and providing flexibility. We could provide further flexibility by reducing the number of groupings e.g. to the limit case of a single grouping. In that case the airport could reallocate any allowance to any project. We could also reduce the number of Deliverables, or remove the concept entirely. However, further flexibility would increase the scope for Dublin Airport to engage in regulatory gaming, by, for example:

- Seeking a higher allowance to fund projects it does not intend to build, and then

[34] An example would be a project to resurface a specific runway to a particular standard. On the other hand, if the output of a project was additional stands, a better option to provide this output may emerge over the course of the regulatory period. In that case, it would be in the interests of users for Dublin Airport to reallocate this allowance to the better option.

[35] Making such projects Deliverable allows us to set an initial trigger type mechanism, providing certainty to Dublin Airport regarding continued remuneration across regulatory periods provided that it meets a specified condition or conditions.

reallocating that allowance to other projects.

- Dropping one or more projects for which a flexible allowance has been provided, allowing an 'overspend' on other projects.

8.31 The limitations on flexibility imposed by grouped reconciliation combined with Deliverables reduce the scope for such gaming.

8.32 Alternatively, we could reduce the level of flexibility by increasing the number of groupings, e.g. to the limit case where each project is in its own 'grouping'; this would be analogous to making each project a Deliverable. Less flexibility would maintain efficiency incentives and reduce the scope for regulatory gaming but would also reduce Dublin Airport' ability to respond to changing circumstances.

8.33 We seek stakeholders's views on whether we should add or reduce flexibility in the 2020-202X Capex allowances and how we should do it. We are also keen on receiving any suggestions as to the criteria for Deliverables.

Reconciliation

8.34 As per the 2014 Determination, the 2015-2019 Capex allowances will be reconciled at group level in accordance with the RAB roll forward principles. In the case of each Capex grouping, we intend to:

- Revise the allowance downward for any Deliverables which have not been delivered.

- Compare outturn expenditure on projects which would come under that grouping, with the allowance.

- Add whichever of these 2 figures is lower to the 2020 opening RAB, unless Dublin Airport can demonstrate substantial user support for overspending an allowance or that the overspend was outside its control.

8.35 We must decide on the approach for reconciling the 2020-202X Capex allowances. We have previously set out the following principles for the reconciliation of outturn expenditure at the end of a determination period and are considering whether they are still fit for purpose. [36]

[36] Annex 1, https://www.aviationreg.ie/_fileupload/2009_07_06_draft_determination_redacted_version.pdf

Table 8.2: Current Principles for Rolling Forward the RAB

Scenario	Treatment
Investment delivers expected output at lower cost than allowed for.	The lower cost enters the RAB. Dublin Airport benefits from the saving within the determination period only, as the additional capital cost allowance earned over that time is not clawed back.
Investment delivers expected output at higher cost than allowed for.	The overspend will not enter the RAB, unless Dublin Airport can demonstrate substantial user support for the overspend or that the overspend was outside its control.
Investment does not take place, output is not delivered.	The RAB is revised down accordingly. The associated capital cost allowance is clawed back.
Investment delivers different output to that initially envisaged.	The RAB is revised down accordingly and the associated capital cost allowance is clawed back, unless Dublin Airport can show that the changed scope was due to user requirements.
Investment abandoned prior to completion	The RAB is revised down accordingly, monies already spent are not clawed back.
Existing asset in RAB has become obsolete or needs to be removed for other development.	No effect on the RAB.
Existing asset in RAB has been sold.	The RAB is revised down by the amount for which the asset was sold (provided that this was at or close to market price).

8.36 How we view 'expected output' depends on the classification of the allowance. In the case of Deliverable or Trigger projects, the expected output is the specific project for which the allowance was afforded. Where an allowance is flexible, the expected output is expenditure on projects which would fall within the same grouping for which the allowance was afforded.

8.37 In the 2014 Determination we introduced a 50/50 risk sharing mechanism, as a modification to the RAB roll forward principles, for certain projects of significant scale. We stated that this approach struck a better balance between our statutory objectives in certain situations. Through this mechanism, 50% of deviations from the cost allowance are passed on to users, whether positive or negative. This mechanism was applied to the reconciliation of outturn expenditure on Terminal 2 and will apply to the North Runway. We stated that trigger projects in the 2014 Determination would be reconciled in this way in the 2019 Determination.

8.38 We are also considering the appropriate price index to use when reconciling outturn expenditure with initial allowances. As there is time lag between setting the allowances and expenditure (whether assumed or actual), the selection of price index can be a significant factor. We have previously used the CSO consumer price index, the same index as we use for other aspects of the determination. Specific construction price indices can vary significantly from general price indices; it could be argued that these would provide a better estimate of the evolution of the efficient costs from the time the allowance was set until the expenditure was actually incurred. Before making a decision to use such an index, the Commission would have to satisfy itself that the index is sufficiently robust to outliers and likely to continue to be published into the future.

8.39 Some of the key decisions that we seek views on in relation to Capex reconciliation include whether:

- the RAB roll forward principles should vary according to whether an allowance is flexible, deliverable, or triggered and how.
- the 50/50 risk sharing mechanism should be considered for new allowances in the 2019

Determination.

- a construction based price index for reconciliation should be used, and if so which one.

Triggered Projects

8.40 Ahead of the 2019 Determination we should consider under what circumstances, if any, should we add triggers to the regulatory formulae. In recent determinations, we have set out a number of triggered allowances tied to specific projects. These allowances enter the price cap during a regulatory period, in a manner which is predetermined in the regulatory formula, on the occurrence of a given event or events.

Table 8.3: Trigger Projects in the 2014 Determination

Project	Trigger
Northern Runway (including planning, design and house buyouts).	If passenger traffic exceeds 25mppa in a 12-month period.
Additional line-up points (Runways 28 and 10)	If declared peak capacity in the busy hour reaches 37 departures.
T2 HBS Standard 3	Year in which the standard is mandated for T2 by regulatory authorities.
Pier 2 Segregation	Year in which segregation of the pier occurs, provided it is mandated by a regulating authority.

Source: 2014 Final Determination

8.41 Triggered allowances can broadly be categorised as demand based triggers or regulatory/compliance based triggers. They can also be used to give effect to certain commitments we have made, such as the aforementioned Terminal 2 Box 2 remuneration. Demand based triggers have previously been used for a project which the Commission believes should not be progressed at the time of making the determination, but may become needed, depending on developments during the regulatory period. Compliance based triggers can be useful if there is uncertainty over the development of regulatory requirements in the upcoming period. Thus, if well defined, triggers can build flexibility into the regulatory formula, provide regulatory certainty and remuneration for Dublin Airport, and further the interests of users by incentivising appropriate timing for delivery of a project.

8.42 However, it can be difficult to define demand based trigger projects appropriately, as either the defined scope of the project or expectations regarding the trigger event can prove to be wrong over the course of a regulatory period. Of the 4 trigger projects in the 2014 Determination, the Pier 2 segregation trigger has been met, while the North Runway trigger has been amended through an Interim Review carried out for that purpose. The Draft Decision on the PACE Interim Review proposes to remove the line-up points trigger, as that project has been superseded by a PACE project and is no longer optimal. Thus, neither of the demand based triggers have worked out as intended.

8.43 Given the introduction of the formalised supplementary capex process, there may be less need for trigger projects, especially demand based triggers, although the supplementary Capex process does not allow for within-period price cap adjustments.

Depreciation Profiles, Time Profiling and Prefunding

8.44 In the next determination, we will define depreciation profiles of allowed Capex and the timing of remuneration, both for triggered and non-triggered Capex allowances.

8.45 Depreciation is governed by the asset life and the depreciation profile. We would generally

adopt the asset life proposed by Dublin Airport, unless it seems unreasonable. In recent determinations, we have chosen to depreciate the RAB by means of annuities, rather than straight-line depreciation. The depreciation profile is scaled such that when combined with the allowed return on capital, the capital cost allowance for Dublin Airport is the same for each year of the asset life of a given project (similar to how a mortgage works). The corollary of this is that, all else being equal, users pay the same amount in each year until the project is asset life expired. If we were to use straight-line depreciation, the depreciation allowance would itself be the same for each year; consequently, the return on capital would decrease over time due to a declining principal. For that reason, our view is that an annuity based approach is superior to straight-line depreciation.

8.46 We have previously taken the view that in general, infrastructure should not be significantly prefunded, with remuneration instead being linked to project delivery. This means that the bulk of the costs of a project are remunerated by users that enjoy the benefits of the project. This is not an absolute rule; projects are assessed on a case by case basis to ensure that we strike a balance between our statutory objectives. For example, when we reviewed the timing of the North Runway trigger, we allowed for 10% of the associated Capex to enter the price cap on the commencement of the main works, 85% when the runway is fully operational, and the final 5% when the associated house buy-out scheme closes.[37]

8.47 We need to decide whether non-triggered capital cost allowances will be spread evenly across the regulatory period, tailored according to the timeline for project delivery or expenditure in the investment plan, or a mixture of these. We will not have visibility over how exactly Dublin Airport would spend capital allowances over the regulatory period. It is therefore difficult to tailor the allowances to fully align with any regulatory policy, such as just-in-time funding, pre-funding, or post-funding, while also furthering our objectives in relation to incentive regulation, regulatory certainty, and financial viability.

8.48 In the 2014 Determination, most of the capital cost allowances were spread evenly from 2015-2019, except for Capex relating to a number of commercial revenue projects. Commercial revenues associated with these projects had been included as part of our commercial revenue forecasts, in accordance with the timeline for delivery set out by Dublin Airport.

8.49 It could be argued that linking more cost allowances to the timeline for project delivery would better fit the 'User Pays' principle outlined in paragraph 8.46. On the other hand, the actual timeline for expenditure or project delivery may not match that which was initially envisaged, particularly where a flexible allowance is reassigned. In that case, the purpose of the exercise would be undermined.

High-level Consultation Questions

Q13. How should we establish if a capital investment project should be given an allowance?
Q14. Should we continue to group projects together to allow flexibility?
Q15. How and when should we establish the efficient cost of a project?
Q16. How should we reconcile completed projects against the allowance?

[37] https://www.aviationreg.ie/_fileupload/Decision%20MASTERCOPY%202017-04-28.pdf

9. Cost of Capital

9.1 The cost of capital that we allow in the price cap should fairly remunerate shareholders and holders of debt of Dublin Airport for the capital necessary to provide efficient infrastructure and operations at the airport.[38] Estimating a fair cost of capital is important to enable the airport to invest in capital infrastructure, while also protecting current and future passengers who ultimately bear this cost.

9.2 Similar to other building blocks, there is a risk that the outturn cost of capital will differ from our estimates and we need to consider how this risk is allocated.

Weighted Average Cost of Capital (WACC)

9.3 In previous determinations, we have estimated the cost of capital using the Weighted Average Cost of Capital (WACC) method. This method calculates the cost of capital as the weighted sum of the cost of debt and the cost of equity. These costs are the estimated returns that Dublin Airport would need to offer holders of debt and shareholders, respectively.

9.4 The WACC depends on both macroeconomic variables and airport-specific estimates. For example, some components such as the risk-free rate and the equity-risk premium are estimated without reference to Dublin Airport. In contrast, the debt premium used to estimate the cost of debt and the beta used to estimate the cost of equity are more specific to Dublin Airport. Chart 9.1 on the left shows the split of the cost of capital allowed in 2014 between cost of debt and cost of equity. Cost of equity accounts for 74% and cost of debt for 26% of the total cost of capital. The Chart also shows that the beta adjusted equity risk premium accounts for 52% of the total cost of capital. Chart 9.2 on the right illustrates the break-down between risk-free rate, tax allowance and mark-ups for debt and equity in the cost of capital. The risk-free rate is an element of both the cost of debt and cost of equity. It represents 26% of the total cost of capital.

Chart 9.1: Cost of Equity is 74% of Total Cost

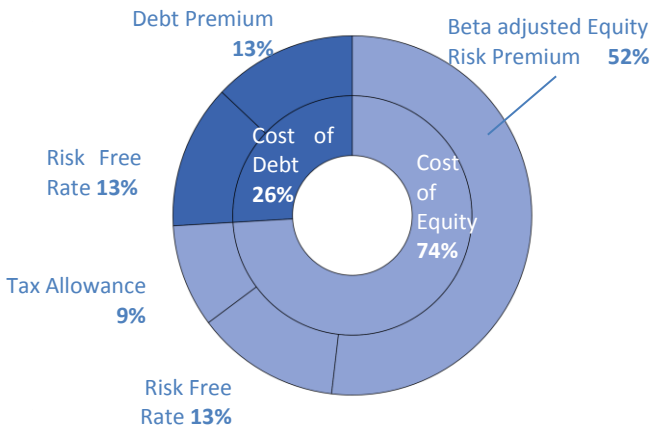
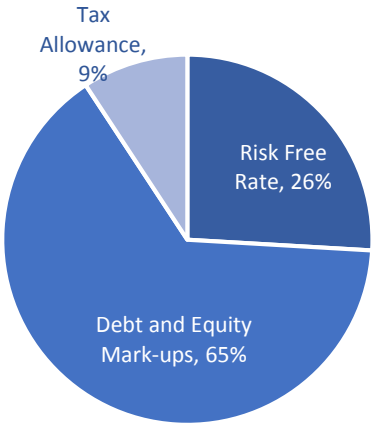


Chart 9.2: Risk-free rate is 26% of Total Cost



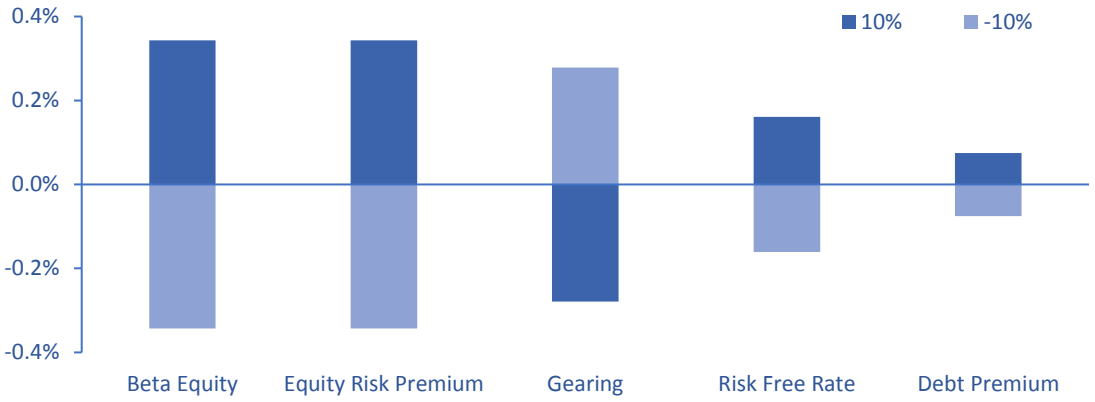
Source: 2014 Determination, CAR Calculations

9.5 We investigated the sensitivity of the cost of capital to positive and negative changes of 10% in one component at a time. The results are displayed in Chart 9.3. As expected, the total cost of capital is most sensitive to changes in the largest components, beta equity and equity risk

[38] The "Principal Shareholder" of daa plc is the Minister for Public Expenditure and Reform, and the "Shareholder" is the Minister for Transport, Tourism and Sport.

premium, closely followed by changes in gearing (i.e., the relative proportion of debt and equity). The increase in gearing reduces the cost of capital because the cost of debt is lower than the cost of capital and we are not assuming an increase in financial risk. However, in reality as gearing increases, the unit cost of debt increases too and the change in the cost of capital would be difficult to estimate. The cost of capital is less sensitive to changes in the risk-free rate and debt premium, which are currently low.

Chart 9.3: The Cost of Capital is most sensitive to changes in the Beta Equity and Equity Risk Premium



Source: 2014 Determination, CAR Calculations

9.6 The WACC used in our determinations was real (adjusted for inflation) and pre-tax (the return for shareholders includes the revenue for Dublin Airport to meet Irish corporate tax liabilities). See Appendix 1 for technical details on the WACC formulas.

Headroom in the Cost of Capital and Interaction with Other Building Blocks

9.7 If the cost of capital for Dublin Airport is set too high, passengers bear an extra cost in the short term. However, if the cost of capital is set too low the needs of passengers may not be met. This may be the case if, for instance, necessary projects cannot be completed because the airport is unable to obtain finance from the markets at the level of capital cost allowed. To mitigate the risk of setting a capital cost that is too low, regulators sometimes include headroom in the form of "aiming-up allowances" or choosing mid-point values from estimated ranges for the components of the cost of capital.

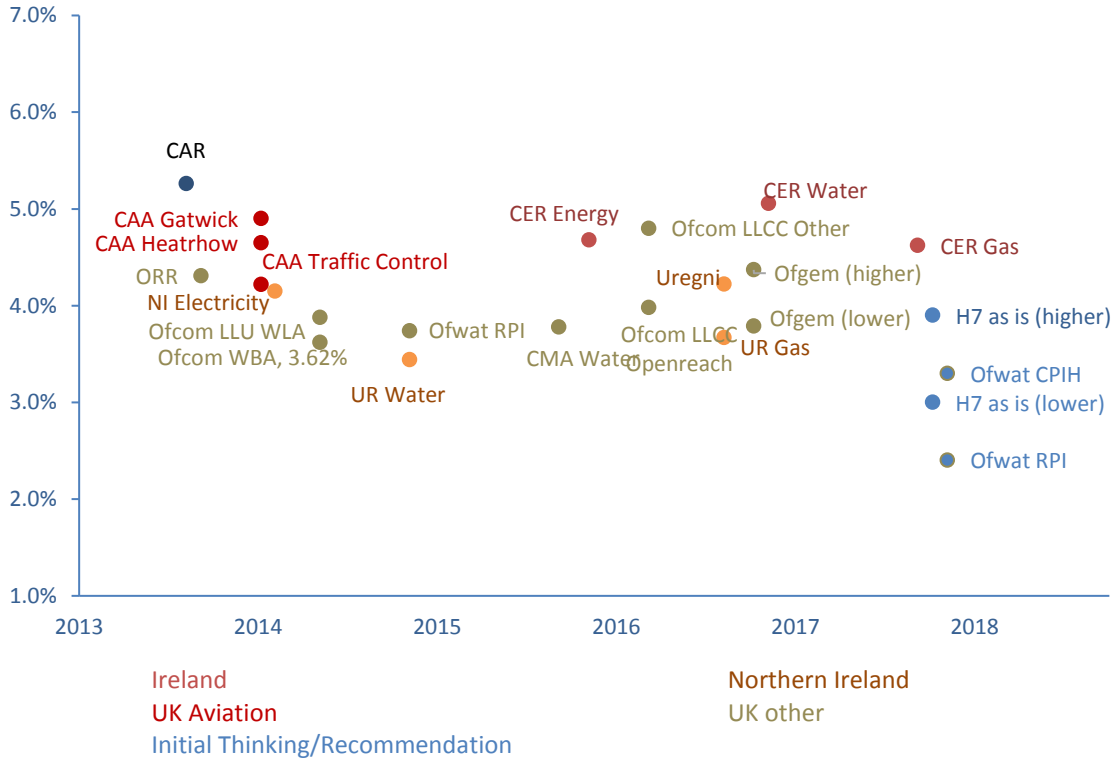
9.8 The cost of capital is one means to remunerate Dublin Airport for bearing business and financial risks. We also allocate some of those risks through the decisions we make in other building blocks. Therefore, we will normally set the cost of capital taking account of the risks that are already mitigated or not in other building blocks through the risk allocation of, for example, outturns differing from the forecasts for passenger numbers and commercial revenues, and from allowances for Capex and Opex.

Regulatory Precedents

9.9 In estimating the cost of capital, we look at regulatory precedents in different sectors and countries. We acknowledge that the cost of capital may justifiably vary between regulated sectors, according to their level of competition, nature of the assets concerned, and levels and types of risk. Such variation is mainly driven by differences in the credit rating and the equity beta that are more specific to individual companies. However, there are some components that would be expected to be similar if regulators were taking their decisions about the cost of capital at the same time and using a similar method.

9.10 Chart 9.4 compares our previous cost of capital decisions with recent regulatory decisions across different sectors in Ireland, Northern Ireland and the UK. The Chart includes initial thinking by Ofwat and a recommendation for H7 for the CAA. The estimates are shown as vanilla WACC in order to compare them across countries with different tax rates. See formula in Appendix 1. Recent decisions and recommendations in different sectors show a trend of lower cost of capital.

Chart 9.4: Lower VANILLA WACC trend in different sectors in Ireland, Northern Ireland and the UK



Source: CAR Determinations, CAA, CER, CMA Water, NI Electricity, Ofcom, Ofgem, Ofwat, ORR, UR, Uregni.

9.11 Below we discuss how we have calculated the individual components of cost of capital in previous determinations and what factors might influence their values in the 2019 determination (if we continue with the same general approach to estimating the cost of capital).

Cost of Debt

9.12 When setting the cost of debt, we must allocate, between Dublin Airport and passengers, the risk of the outturn cost deviating from our forecast cost (the "forecast risk"). Dublin Airport has some control over their financing costs and therefore may be best placed to minimise the cost by assuming the forecast risk. We need to decide how to allocate this risk.

9.13 The cost of debt was previously estimated by adding a mark-up known as the debt premium to the risk-free rate. We must decide whether to continue estimating the cost of debt using this methodology. We are keen on receiving suggestions on alternative methodologies and data, if any. We will discuss both components below.

Risk-free Rate

9.14 In previous determinations, we have estimated a real risk-free rate based on the yields of 10-year German Government bonds. We need to consider whether to continue using this approach and data, which is consistent with the Thessaloniki Forum recommendations (see Appendix 2). The rationale is shown in Table 9.1.

Table 9.1: Rationale for choosing 10-year German Government Bonds as risk-free rate

Characteristics	Rationale
Type of Bond	Government bonds are perceived to be as free of risk as it is possible to find in the market.
Country	German Government bonds are traded often ensuring a larger sample of prices, are euro-denominated, and have a strong credit rating.
Maturity	10-year maturity bonds are less volatile than shorter-term bonds and most closely relate to the maturity of bonds of Dublin Airport. 10-year bonds ensure a larger sample of prices compared to bonds with longer maturity.
Current Rate vs Historical Average	In the 2001, 2005 and 2009 Determinations, we have used a long-term historic average because as it is less volatile. In 2014, we used the current rate to account for the possibility to refinance debt at current rates.
Country Risk Premium	To date we have not added a country risk premium to the estimated risk-free rate.

Source: CAR Determinations

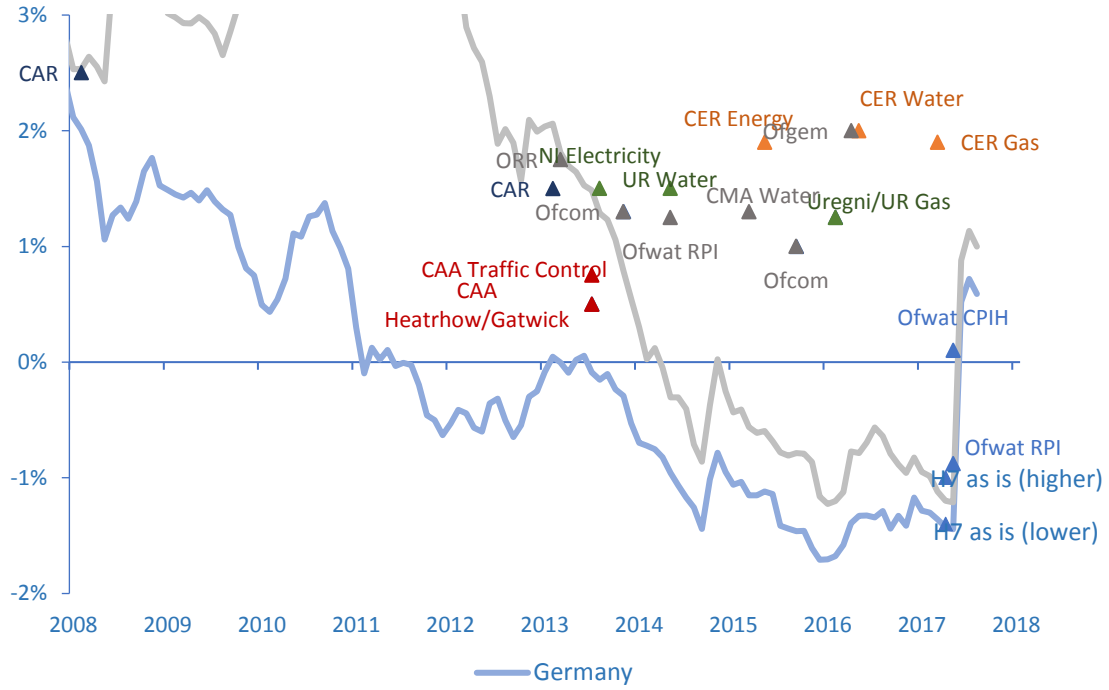
9.15 As coupon payments of German Government bonds are not inflation-indexed, the yields of 10-year bonds include the market's expected rate of inflation over the next 10 years in addition to the real interest rate. In the past, we have used the relationship between nominal interest rate and expected inflation implied by the Fisher equation to estimate the real risk-free rate, see Appendix 1. We seek views on if this methodology is still fit for purpose.

9.16 In 2014, we used survey data to estimate expected inflation. At the time, we found evidence for a real risk-free rate ranging between 0% and 1.5%. We chose a point value of 1.5%. We updated the calculations underlying the 2014 Determination with current market data and found evidence for a real 2018 risk-free rate between 0% and 1%. This reduction is mainly due to a decrease in the nominal yield for German Government bonds.[39]

9.17 In 2014, we also looked at regulatory precedents in Ireland, Northern Ireland and the UK regarding the risk-free rate. In this spirit, Chart 9.5 displays recent risk-free rate decisions besides real yields on German and Irish Government bonds. In 2015, 2016 and 2017, the Commission for Regulation of Utilities Water and Energy (CRU), formerly known as CER, applied real risk-free rates of 1.9% and 2.0% in its determinations for gas and water. In 2016, the Northern Ireland Authority for Utility Regulation (NIAUR), formerly known as Uregni, used an estimate of 1.3%. In 2017, PwC on behalf of the CAA UK estimated a risk free rate of -1.4% (lower scenario) while in 2016 Ofcom estimated a risk free rate of 1%.

[39] In the weeks prior to publication of this paper there has been volatility in the bond markets which we have yet to fully examine.

Chart 9.5: Real yields on Government bonds and recent risk-free rate regulatory decisions



Source: Statistics from HIS Market Indices, Central Bank of Germany, Regulatory Decisions and Current Thinking Reports.

Debt Premium

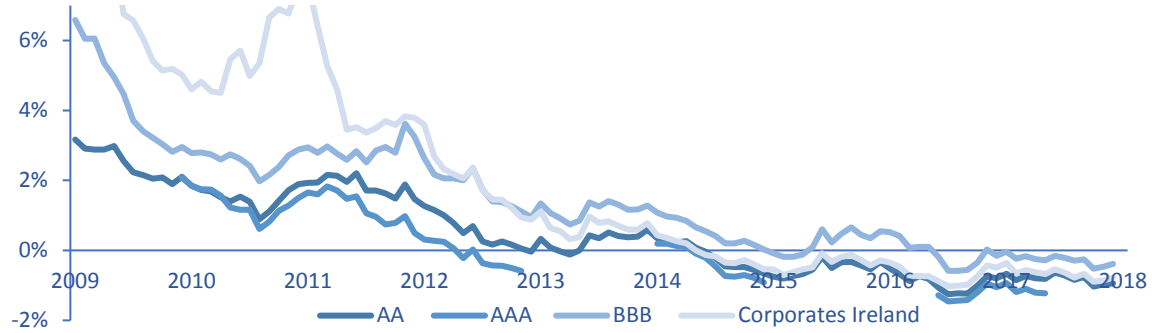
9.18 As part of the cost of debt calculation, we seek views on an appropriate methodology and data to estimate the debt premium. In previous determinations, we have estimated the cost of debt with reference to the cost of issuing new debt. The cost of embedded debt, for which Dublin Airport has already committed to a stream of payments, has not been considered in previous determinations.

9.19 In 2014, we arrived at a debt premium range between 1% and 1.5% and a point estimate of 1.5%. We took account of:

- the cost of debt of comparator companies: we estimated the cost of issuing new debt using the yield rates of corporate nonfinancial bonds issued by a firm with a minimum BBB rating and a maturity of 7-10 years; and
- the credit rating (S&P) of daa plc at the time: BBB+

9.20 In November 2015, daa plc was upgraded to a credit rating of A-, which suggests a decrease in cost of debt for Dublin Airport. This is also consistent with our observation that borrowing costs are generally lower in 2018, and there is no significant premium for Irish corporate bonds (real yield, average maturity 5 years and investment grade credit rating) compared to the European benchmark. That being said there needs to be some consistency between the credit rating that we use for calculating the cost of capital and that used for testing if the regulatory decision enables Dublin Airport to raise finance.

Chart 9.6: iBoxx European Corporate Non-Financial (7-10 Years) and Corporate Irish Bonds (5 years)



Source: HIS Markit Indices

9.21 Table 9.2 shows the evidence available in 2014 and 2018.

Table 9.2: Evidence related to the Cost of Debt in 2014 and 2018

	2014 Determination	2018
daa plc Credit Rating	BBB+	A-
daa plc bonds	Not referenced.	Issued in 2016 (12-year maturity) with a nominal coupon of 1.55%, representing a real return of 0.3%.[40]
Ryanair bonds	€850m bonds with nominal coupon of 1.875%, representing a real return of close to 0%;	Issued in 2015 (8-year maturity) and 2017 (6-year maturity) with a nominal coupon of 1.13%, representing a real return of around minus 0.7%.[41]
Yields for European BBB bonds	around 1% in real terms	Close to or below 0% in real terms.
Country Risk Premium	No significant premium for bonds with 7-10 years maturity and BBB rating.	No significant premium for Irish Corporate bonds with 5 years maturity and investment grade rating.
Regulatory precedents	Not referenced.	1% in Ireland (CER 2015-2017) and Northern Ireland (Uregni 2016), and range from 0.15 to 2.3% in the UK.

Source: CAR Determinations, Ukrn, Cer Regulatory Decisions.

Debt Indexation and Embedded Debt

9.22 Below we discuss the effect of debt indexation and embedded debt on the trade-off between cost pass-through and efficiency incentives. We have not used debt indexation. That is, we have used the cost of debt estimated at the start of the regulatory period. Alternatively, we could update the cost of debt based on a pre-determined indexation formula. Regulatory precedents include Ofcom, Ofgem, Ofwat, and ORR in the UK. However, indexation is more difficult in aviation than in other regulated sectors, where there are fewer reference points for analysis, as well as regulatory precedents.[42]

9.23 Also, up to now, we have estimated the cost of debt based only on the cost of issuing new debt.[43] We could potentially estimate the cost of debt as a weighted average of the cost of new

[40] Assuming an expected inflation in 2016 for 1 year ahead of 1.2%, Source ECB Survey of Professional Forecasters.
[41] Assuming an expected inflation in 2017 for 5 years ahead (longer term) of 1.8%, Source ECB Survey of Professional Forecasters.
[42] http://publicapps.caa.co.uk/docs/33/CAP1562_Cost_of_Debt_report_by_CEPA.pdf
[43] The CAA in the UK has based the cost of new debt for regulated airports based on expected movements in the current debt yields, and the cost of embedded debt based on the airport's actual debt costs, cross-checked against a benchmark index for efficiency.

and embedded debt. The cost of embedded debt is based on the actual borrowing cost paid by Dublin Airport. Allowing a pass-through of the costs of embedded and/or new debt may lower the incentive for Dublin Airport to manage its financing costs. If we decided to allow the cost of embedded debt we would have to consider the practicalities of this method such as the type of instruments to be included (for instance, bonds, bank loans, and/or credit facilities), and those that would need to be excluded to account for potentially inefficient debt on the balance sheet. We would need to use historical yields on corporate bond indices to develop a view on efficient cost of embedded debt. Finding an appropriate benchmark index for the efficiency assessment is difficult.

9.24 Table 9.3 summarises the risk allocation, incentives for Dublin Airport, and impact on passengers associated to various types of cost of debt allowances, ranging from fixed allowance (no indexation) to full indexation (of new and embedded debt), and indexation of new debt only.

Table 9.3: Incentives and impact on users of different types of cost of debt allowances

Type of Cost of Debt Allowance	Incentive for the Airport	Impact on Users
Fixed Allowance- No indexation	- The forecast risk is allocated to Dublin Airport. - **Strong incentive** for Dublin Airport to manage debt costs. -The airport may have windfall gains and losses from variance in the forecast cost of new debt.	- Users **do not share the benefits or costs** from market changes in the cost of new debt.
Indexation of Cost of New Debt Only	-Potential **forecast errors** from estimating the cost of new debt at the start of a regulatory period are **corrected**. -**Stronger** incentive to manage the cost of embedded debt than full indexation, but **weaker** incentive to manage the cost of new debt compared to the fixed allowance.	-The forecast risk of the cost of new debt lies with users, as deviations in the market rates from the forecast are passed on to them. - Compared to full indexation, the volatility of passenger charges is reduced.
Full Indexation of Cost of Debt	- **Weaker incentive** for Dublin Airport to manage debt costs. -The incentive could be strengthened by conducting an **efficiency assessment** of the airport's embedded debt. -The cost of debt becomes less risky for the airport. -Indexation takes better account of timing of debt issuance, and may suit infrequent or large issuers.	- The forecast risk is allocated to passengers, and airport charges may become volatile. - In theory, users would pay the cost of debt that would be set if the forecast was correct. It would be fair if the indexation is based on a benchmark of efficient costs. -Users will **benefit** if there are reductions, but are **exposed** to the risk of increases in the cost of debt.

Note: Incentive depends on the indexation mechanism.
Source: based on Oxera, Ofwat consultation on the approach to the cost of deb t for PR19.

Cost of Equity

9.25 In previous determinations, we have estimated the cost of equity using the Capital Asset Pricing Model (CAPM), which defines cost of equity as the sum of the real risk-free rate and a mark-up known as the equity premium. The equity premium is comprised of a company specific beta equity parameter and an Equity Risk Premium determined by the market.

Equity Risk Premium

9.26 As part of the cost of equity estimation, we need to establish an appropriate methodology and data to estimate the equity risk premium. The equity risk premium is the expected mark-up over the risk-free rate investors expect when holding a market portfolio. The equity risk

premium is forward looking and therefore cannot be observed or measured directly.

9.27 The three main techniques to estimate this premium are: expert surveys, economic models and evidence using long-term historical data. Long-term historical data is the most common technique given that equity returns are cyclical and volatile. In previous determinations, we have used an equity risk premium estimated by Dimson, Marsh and Staunton using long-term global historical evidence.[44]

9.28 In 2014, we estimated the equity risk premium to be between 4.5-5.0%. In 2017, the CER estimated a range of 4.5%-5.25% by estimating a Total Equity Market Return (TMR) over time of 6.5%-6.75% (i.e. total returns earned by equity investors) and then deducting the estimate of the current risk-free rate of 1.5%-2%. The TMR was estimated based on regulatory precedents and evidence such as Dimson, Marsh and Staunton.

9.29 Ofwat arrived at an equity risk premium of 6.3% in its 2017 methodology for the 2019 price control. Ofwat calculated this equity risk premium, similar to the CER, as the total market return (5.44%) minus the risk free rate. However, given that the estimate of Ofwat for the risk free rate is negative (-0.88%), the equity risk premium is higher (6.3%). Therefore, the estimation of the equity risk premium is dependent on that of the risk free rate. Table 9.4 shows the evidence in relation to the equity risk premium available in 2014 and 2018.

Table 9.4: Evidence related to Equity Risk Premium in 2014 and 2018

	2014 Determination	2018
Long-term historical data by Dimson, Marsh and Staunton's	4.5%-5%	4.7% for Ireland and 4.4% for the World.
Regulatory decisions of Equity Risk Premium	between 4.5% and 5.75%	4.75% in Ireland (CER 2017), and 6.3% in UK (Ofwat Methodology 2017)

Source: CAR Determinations,

Equity and Asset Betas

9.30 The other key decision in relation to the cost of equity is the methodology and data to estimate the equity and asset Beta for Dublin Airport. The equity beta captures the systematic risk of Dublin Airport that an investor cannot diversify, i.e. the extent to which the airport faces risks that are correlated with general market risk. Equity beta is usually estimated by analysing the change of the equity's price over time relative to a market index.

9.31 In 2014, we estimated an equity beta of 1.2. An equity beta higher than 1 represents an investment with larger systematic risk than the market (see Appendix 2). An equity beta of 1.2 will amplify by 1.2 times the equity risk premium. The Thessaloniki Forum guidelines state that the systematic risk of a regulated airport should be lower than the market ($\beta e < 1$). This is because, as a general rule, the more market power held by an airport, the lower the numerical value of the equity beta is likely to be.

9.32 Usually, the equity beta can be estimated directly using market evidence from share price movements. However, for Dublin Airport the use of share price data is not possible as the company is not publicly listed. Therefore, in previous determinations we used the equity and asset betas of publicly listed European airports with similar systematic risk. The major challenge with this approach is to find a robust sample of publicly listed comparable airports. Appendix 1 displays the formula which shows the relationship between the asset and equity

[44] This is published annually by the Credit Suisse Research Institute in its Global Investment Returns Yearbook.

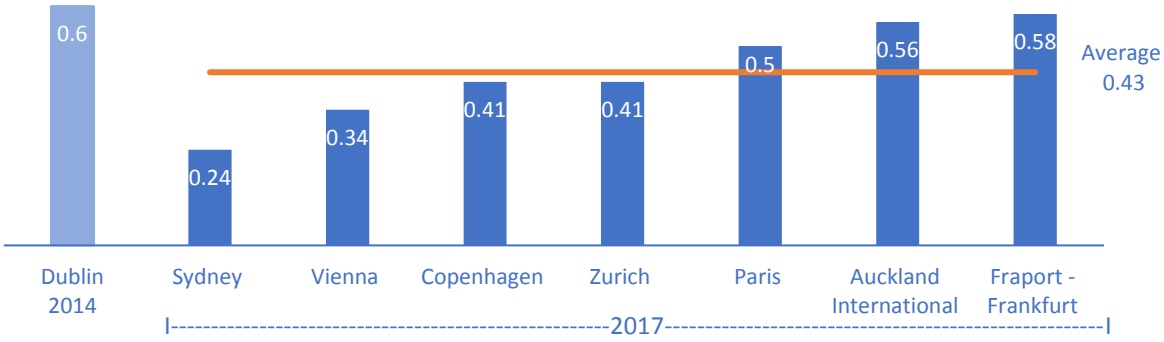
betas.

9.33 In 2014, we estimated the equity beta for Dublin Airport by adjusting the equity betas of available comparator airports for differences in capital structure and business risk. We adjusted for:

- the difference in capital structure by un-levering and re-levering the beta; and
- the business risk based on a comparative analysis of the difference in business risk. Assessing the difference in business risk between airports is complex.

9.34 The equity beta of 1.2 estimated for Dublin Airport in 2014 was based on an estimated asset beta of 0.6. The evidence in 2017 shows a range of asset betas for selected airports between 0.24 and 0.58. An equity beta estimated for the average asset beta of 0.43, using the formula in Appendix 1, would be 0.8.

Chart 9.7: 2017 Estimates of Asset Betas (2 year monthly average) of Publicly Listed Airports



Source: CAR 2014 Determination and PwC Economics, Estimating the cos of Capital for H7. A report prepared for the CAA.

Table 9.5: Evidence Related to Airports' Asset Beta in 2014 and 2018

	2014 Determination	2018
Asset beta of comparator airports	Ranging from 0.1 to 0.6. We used a global stock market index.	Ranging from 0.24 to 0.58. See Chart 9.7.
Airports' asset beta decisions	Between 0.35-0.6.	0.5 for Heathrow Airport (2014-2019). 0.6 for Wellington International Airport (2018-2022).
Business Risk assessment of Dublin Airport	Unchanged assessment of traffic and revenue risks, and the regulatory treatment of costs for Dublin Airport.	Not yet assessed.

Source: CAR Determinations,

Gearing

9.35 Gearing is the ratio of debt to equity in a company's capital structure. Optimal gearing is the level of debt at which the tax benefits of debt begin to be outweighed by the costs of financial distress caused by servicing higher debt obligations. Optimal gearing is difficult to determine. In addition, the low corporate tax rate in Ireland makes the concept of an optimal gearing less important to the company's financial risk.

9.36 A notional gearing represents a theoretical capital structure that is taken as a base case for

setting the cost of capital. It is up to Dublin Airport to choose its actual gearing. In the 2001, 2009 and 2014 Determinations we have used a notional gearing assumption of 50%. The actual gearing of 46% was used in 2005. For the 2019 Determination, we must decide whether to continue assuming a notional gearing.

9.37 In 2014, we decided on a point estimate of gearing of 50% based on the majority of regulatory decisions at the time, including that proposed by the UK's CAA for Heathrow and Gatwick airports. Regulatory precedents in 2018 still show that most regulators use nominal gearing in Ireland, Northern Ireland and the UK. The use of notional gearing is consistent with the Thessaloniki Forum recommendations.

Corporate Tax

9.38 In all previous determinations we have used the rate of corporate tax in Ireland. Since the 2005 Determination, the tax rate used was 12.5%. In the Budget 2018 Statement dated 10 October 2017, the Minister for Finance and Public Expenditure and Reform stated that "the 12.5% tax rate is, and will remain, a core part of our offering".[45] Stakeholders should inform us if they have any views on the appropriateness of using the current Irish corporate tax rate.

High-level Consultation Question

Q17. What methodology and data sources should we use to calculate an appropriate return on capital?

[45] http://www.budget.gov.ie/Budgets/2018/Documents/Budget_2018_Financial_Statement.pdf

10. Financial Viability

10.1 A financially viable price cap enables a regulated entity to raise debt at reasonable costs for a healthy company (i.e. corresponding to an investment grade credit rating). We have due regard to financial viability not only because we are statutorily required to, but also because raising debt below investment grade would result in increased financial risk for the airport which would not be in the interest of users.

10.2 Controlling financial risk matters to both the airport and its users. Increased financial risk means that a higher cost of debt is passed on to users through airport charges. As financial risk grows, the airport operator may also become unable to secure debt for Dublin Airport to invest in new capital projects or maintain the current infrastructure. In the worst case, if daa cannot raise any debt at all, it may not be able to continue operating the airport. Such outcomes would be contrary to our statutory objectives to protect reasonable interests of current and prospective users of Dublin Airport and to enable efficient operation and development of the airport in a financially viable manner.

10.3 In 2019, we will set a price cap that strikes a balance between:

- enabling Dublin Airport to generate timely cash flows from airport charges and raise investment grade debt to maintain and develop the airport infrastructure in an efficient manner and
- protecting users against increases in price cap that shield investors in Dublin Airport from general business risk or that serve to cross-subsidise the financial risk of the daa group as a whole.

Statutory Objectives

10.4 Our statutory objective related to financial viability was introduced by the 2004 State Airports Act. The objective states that we should enable daa to operate and develop Dublin Airport in a sustainable and financially viable manner.

10.5 In 2005 and 2009, we had due regard to financial viability by checking that, when all the building blocks were taken together, the daa group was able to raise debt at an investment grade credit rating. To conduct this check, we analysed the financial position of the entire daa group, as Dublin Airport raises funds through debt issued by the daa group.

10.6 In 2014, we changed our focus to assessing financial viability and analysed the financial position of Dublin Airport only. The reasoning is to avoid cross-subsidisation between Dublin Airport and the rest of the daa group in the financial viability assessment.

10.7 For the next determination, we will continue to have due regard to our statutory objectives and current Government Policy. Implementation of the 2017 Policy Statement on Airport Charges Regulation will introduce a number of changes to the regulatory regime, including the removal of our statutory objective to enable daa to operate and develop Dublin Airport in a sustainable and financially viable manner. The Policy Statement considers that the need for an efficient, commercially viable airport company is intrinsic in the primary objective which will be protecting the interests of current and future passengers.[46]

[46] http://www.dttas.ie/sites/default/files/publications/aviation/english/national-policy-statement-airport-charges-regulation/nps-airport-charges-regulations-amended-oct-6.pdf

Financial Viability When Circumstances Change during a Determination Period

10.8 Financial viability is not a building block but rather a cross-check that all the building blocks taken together allow Dublin Airport to be financially viable. Our financial viability assessment aims to ensure that the price cap, which results from the interaction of all building blocks, enables the airport to absorb risk and raise finance at investment grade rating.

10.9 In 2014, the financial viability assessment also encompasses testing the sensitivity of the financial situation with regard to different forecast scenarios of passenger numbers, operational expenditure and capital expenditure. The objective was to check whether Dublin Airport is financially viable, under the proposed price cap, even if some of the building blocks were to differ from our assumed forecasts.

10.10 The price cap allows for efficient expenditure and capital remuneration under the assumptions made at the time of writing a determination. During a determination, Dublin Airport is expected to adjust its business model according to the evolution of the economic environment. We have observed such adjustment on various occasions in the past. For example, when traffic declined in the recent downturn:

- The airport was able to achieve efficiencies and reduce its Opex which yielded a net operational profit (EBITDA) gain, and
- The airport suspended dividend pay between 2009 and 2016.

10.11 Dublin Airport has discretion to use its dividend policy to maintain its financial viability. In March 2017, the daa Board approved a dividend policy which provides for a dividend payment between 30% and 40% of normalised profit after tax subject to the priority that daa can maintain a minimum credit rating of BBB+. We also note that while the 2015 National Aviation Policy states that profitable commercial State companies should pay a financial dividend to the State[47], it recognises that:

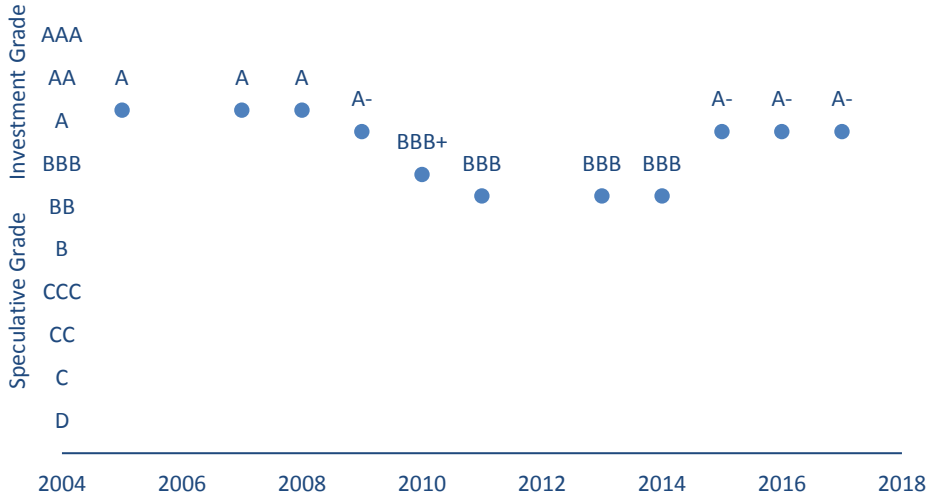
- The dividend paid may be more or less than the 30% guideline, depending on circumstances.
- The state-owned aviation companies return a non-financial dividend to the State in the form of wider socioeconomic benefits through trade and tourism facilitation, regional development, aviation safety etc.

10.12 As noted in Section 4, it is Government policy that the daa operates without recourse to Exchequer funding or equity injections. Therefore, if Dublin Airport wanted to improve its financial viability through equity, it could only do so by increasing its retained earnings.

10.13 Chart 10.1 displays the S&P credit ratings of the daa group for 2005-2017. Since 2005, the daa group has been able to maintain a credit rating of at least BBB despite changes in the economic environment. Since 2015, the daa has improved its credit rating to A-. In May 2017, S&P affirmed the A- credit rating and revised the outlook to positive because daa is expected to continue delivering strong credit metrics despite large investments and higher dividends. S&P also revised the financial risk of daa (cash flow/leverage) from intermediate to modest and states that the liquidity is strong. Some of the main factors that S&P takes into account are the expected performance of the Irish economy, the regulatory regime, traffic volumes and earnings and expenditure by the airport. To date, daa has been able to pay dividends to the State during this regulatory period totalling €85m.

[47]The guideline figure is 30%. http://www.dttas.ie/sites/default/files/publications/aviation/english/national-aviation-policy-ireland/national-aviation-policy-ireland.pdf

Chart 10.1: 2005-2017 S&P DAA Ratings



Source: S&P daa Ratings Services

Financially Viable Credit Rating

10.14 In the past, we deemed the price cap to enable financial viability if the forecast for selected financial metrics for Dublin Airport meet or exceed a minimum threshold. In the 2014 Determination, we set the threshold for Dublin Airport to be the lowest investment grade credit rating of BBB. This is the same credit rating level used in the regulatory settlements for Heathrow and Gatwick Airports. Credit ratings below BBB would imply higher debt financing costs for the airport and users and higher financial risks including reduced access to debt finance. Therefore, lower credit ratings would not enable the airport's financial viability and economic development and be against the interests of the airport's users.

10.15 In past determinations, the financial viability assessment was based around the following questions:

- Are Dublin Airport's forecast financial metrics consistent with an investment grade credit rating of BBB used by the daa's credit rating agency S&P?
- What is the impact on the forecast financial metrics from various business risks (e.g. changes in traffic volumes and operational expenditure)?

10.16 In 2014, we used the same ratios and targets as S&P to test the financial viability of our regulatory settlement. However, our financial metrics were for Dublin Airport only, while S&P's credit rating is for the whole daa group.

2014 Financial Viability Check

10.17 In 2014, we forecast four financial metrics for Dublin Airport that are used by S&P to assess the level of cash flow and debt leverage. The financial metrics and their definitions are summarised in Table 10.1.

Table 10.1: S&P Coverage Ratios used in the 2014 Determination

Coverage Ratio	Measure of
FFO: net debt (%)	Debt burden relative to operational income.
Debt: EBITDA (x)	Ability to pay off debts.
FFO (pre-interest): cash interest	Ability to meet interest payments from operational cash flows.
EBITDA: interest	Profitability to pay off interest.

Source: S&P 2013 Corporate Methodology

10.18 We evaluated whether Dublin Airport's forecast financial metrics meet the S&P benchmark ranges for an *Intermediate* rating of cash flow/leverage in low volatility industries. The benchmark ranges for the relevant metrics are summarised in Table 10.2.

Table 10.2: S&P Cash Flow/ Leverage Analysis Ratios for Low Volatility Companies

	FFO/debt (%)	Debt/EBITDA (x)	FFO/cash interest (x)	EBITDA/interest (x)
Minimal	35+	Less than 2	More than 8	More than 13
Modest	23-35	2-3	5-8	7-13
Intermediate	13-23	3-4	3-5	4-7
Significant	9-13	4-5	2-3	2.5-4
Aggressive	6-9	5-6	1.5-2	1.5-2.5
Highly Leveraged	Less than 6	Greater than 6	Less than 1.5	Less than 1.5

Source: S&P Corporate Methodology 2013.
Source: CAR Calculations

10.19 The charts below show the outturn performance of Dublin Airport's financial metrics compared to the 2014 Determination forecasts. Chart 10.2 on the left shows that the 2016 outturn ratio of Funds from Operations (FFO) to net debt is roughly double the minimum S&P target of 13% and well beyond our forecast of 16%. Chart 10.3 on the right shows that the ratio of debt to Earnings before Interest, Taxes, Depreciation and Amortization (EBITDA) has reached a value below the maximum of 4.0 in 2015, four years earlier than forecast.

Chart 10.2: FFO: net debt

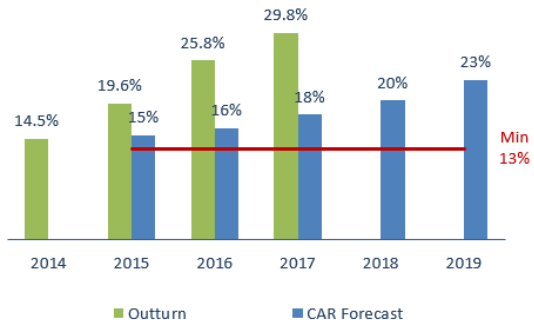
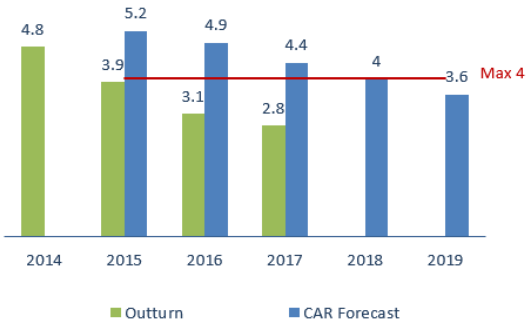


Chart 10.3: Debt: EBITDA



Souce: 2014 Determination, Dublin Airport Regulatory Accounts, CAR Calculations

10.20 Charts 10.4 and 10.5 show that the ratios of Funds from Operation and EBITDA to cash interest are below our 2014 forecast but above the S&P minimum targets.

Chart 10.4: FFO: cash interest

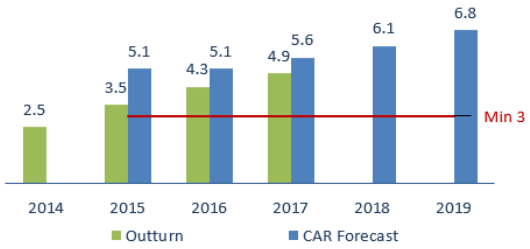
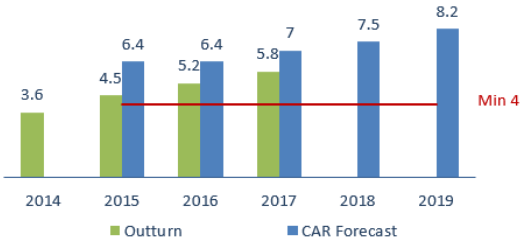


Chart 10.5: EBITDA: interest



Souce: 2014 Determination, Dublin Airport Regulatory Accounts, CAR Calculations

Why is the building blocks approach in itself not sufficient to enable financial viability?

10.21 Under certain circumstances the price cap may not be sufficient to enable the financial viability of the airport. For example, there may be a mismatch in the short term between cash flow and the expectations of investors. This might arise, for instance, if the regulator sets prices based on a depreciation profile that defers recovery of the costs of some investments a long time into the future. More generally, investors may be wary about investing in a company that has assumed a lot of debt which it will not be able to service in the short term.

10.22 Regulators may apply remedies if they conclude that the price cap is not financially viable. Remedies for financial viability are generally only available at the time of making a determination or through an interim review. In the 2009 Determination, we enabled the financial viability of the price cap by accelerating depreciation. This remedy resulted in users paying higher airport charges in the short-term but lower airport charges in the long-term.

10.23 In general, we could enable the financial viability of the price cap also through other building blocks, most notably through headroom in the cost of capital. However, we have decided against this approach in the past because of the following reasons:

- The principle of estimating the cost of capital based on market data would be undermined and efficiency incentives would be reduced.
- The airport's financial performance should depend on the operational and financial outturn, and not on an artificially imposed rate for cost of capital.
- Raising the cost of capital would increase airport charges to the detriment of current and future users.
- Accelerating depreciation is Net Present Value neutral whereas increasing the cost of capital is not.

Principles Used by Other Regulators

10.24 The financial viability check of the 2013-2020 Ofgem price control was based on long-term credit metrics and a cost of capital return that reflects the cash flow risk. Ofgem set out depreciation according to expected economic life of assets and uncertainty in the future use and usefulness of assets. Ofgem focused on enabling the financial viability of regulated companies by setting adequate cost of capital and depreciation profiles, while balancing the costs paid by existing and future consumers.

10.25 Ofwat proposes that water companies address the financial viability of their business plans for the 2020-2025 price control by adjusting the rates of pay-as-you-go (similar to Opex) and regulatory capital value (similar to Capex). Ofwat then checks that the companies have accounted for the balance of charges between current and future customers.

High-level Consultation Questions

Q18. How should we enable Dublin Airport to operate and develop in a sustainable and financially viable manner?

Q19. Is investment grade the appropriate benchmark to use?

11. Quality of Service

11.1 One of the objectives of price cap regulation is to incentivise Dublin Airport to achieve efficient cost levels. In 2009, we introduced a quality of service regime that helps to ensure that the cost efficiencies achieved by the airport are not made at the expense of the quality of service for users.

11.2 The regime is in line with our statutory objective to protect the interests of current and prospective users of Dublin Airport. It is also supported by the 2017 Policy Statement on Airport Charges Regulation, which states that regulation should ensure that passengers are presented with choice, value and quality services.

2014 Measures, Targets and 2015-2017 Performance

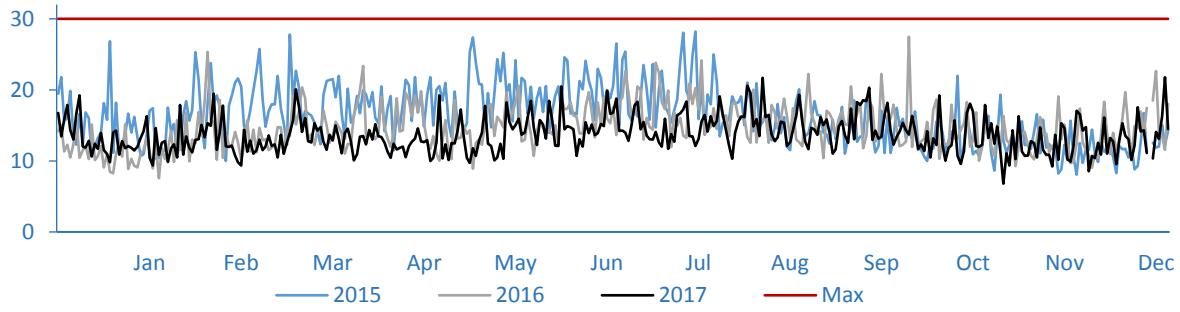
11.3 When setting the targets in 2014 we considered peer group performance (75 percentile) and scores achieved by Dublin Airport between 2012 and 2014. We set the levels to maintain the existing level of quality of service. When setting other building blocks, we were mindful of the quality targets.

11.4 The 2014 Determination set out 12 individual measures and the level of allowed revenue at risk for each measure.[48] These measures have not changed since their introduction in 2009.[49] Dublin Airport has met most of the quality of service targets, despite the increase in passenger numbers since 2015.

Security Queue Times

11.5 The most important measure in terms of allowed revenue at risk is the 30-minute maximum security queue target, which can reduce the price cap by up to 1.5% in a given year. During 2015-2017, there have been no breaches of the security queue target in Terminal 2. Chart 11.1 shows that the 2017 maximum queue times are generally lower than those in 2015 and 2016.

Chart 11.1: 2015-2017 Maximum Daily Security Queue Times in Terminal 2

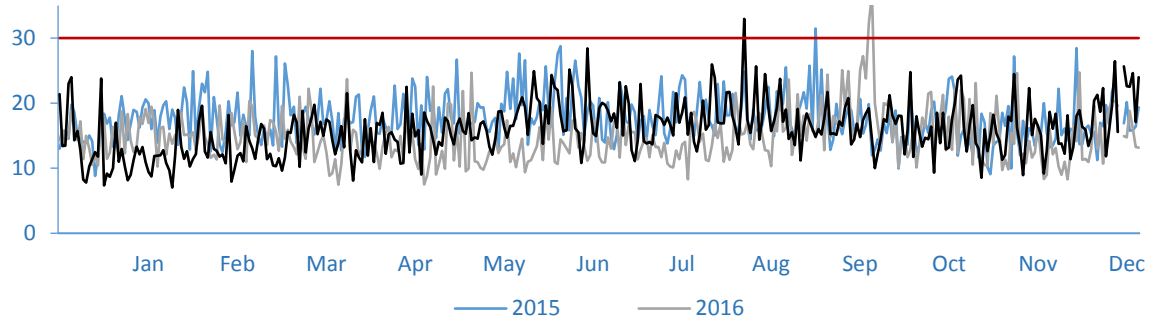


Source: Dublin Airport

11.6 To date, breaches of the maximum security queue time have been limited to Terminal 1. Chart 11.2 shows that in Terminal 1 security queue times in 2017 are not lower than in previous years, as seen in Terminal 2.

[48] Allowed revenue at risk is expressed as a percentage of the total revenue available to be collected by the regulated entity in a given year, with reference to the price cap for that year.
[49] In 2009, there were 13 measures. Only one passenger survey measure set out in 2009 was dropped (i.e. feeling of being safe and secure).

Chart 11.2: 2015-2017 Maximum Daily Security Queue Times in Terminal 1



Source: Dublin Airport

11.7 Table 11.1 shows the security queue breaches in Terminal 1 during the 2009 and 2014 Determinations.

Table 11.1: Terminal 1 breaches during the 2009 and 2014 Determinations

2009 Determination		2014 Determination	
2010	1	2015	1
2011	0	2016	2
2012	2	2017	1
2013	4	2018	N/A
2014	0	2019	N/A

Source: CAR, reported by Dublin Airport

Out-bound and In-bound Baggage Belt Availability

11.8 The second most important measure is out-bound baggage belt availability, with 0.75% of revenue at risk. The availability of out-bound baggage belts is a measure because of its impact on the satisfaction levels of departing and transfer passengers. In the current period, there has been no occasion when out-bound belts were unavailable for more than 30 minutes.

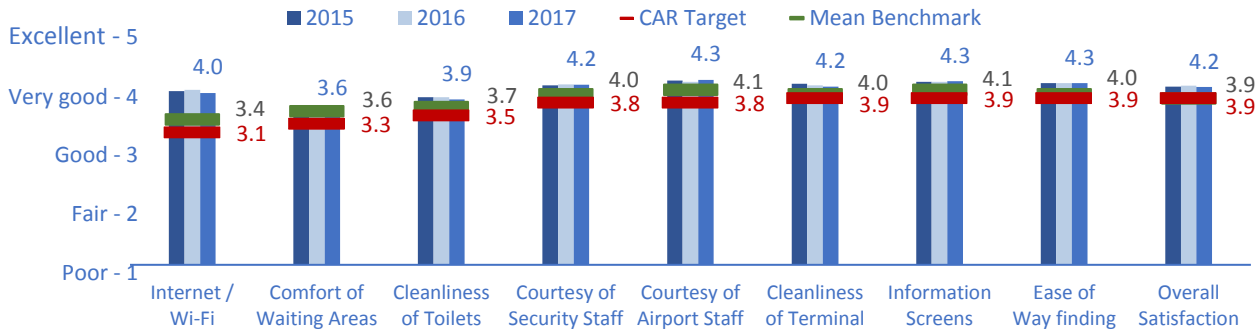
11.9 The availability of in-bound baggage belts is also a measure due to its impact on the satisfaction levels of arriving passengers. In 2014, it was given a lower revenue at risk compared to the out-bound baggage belt (0.25%). Dublin Airport has complied with the target during 2015-2017. The inbound baggage handling system has been available on average 99.8% of the time.

Subjective (Survey) Measures of Passenger Satisfaction

11.10 In 2014, we set targets for nine passenger satisfaction measures that evaluate the overall passenger experience at Dublin Airport. The revenue at risk from the nine measures is 2%. The measures are part of the Airport Service Quality (ASQ) Survey regularly conducted by Airports Council International (ACI) at airports worldwide. The survey is conducted among departing passengers only. The survey allows us to benchmark the performance of Dublin Airport against comparator airports in Europe. Up to 2016 the benchmark group for Dublin was European airports with 5-25m passengers. From 2016 the peers are airports with over 25m passengers.

11.11 Chart 11.3 compares the 2015-2017 performance of Dublin Airport against our targets and the average performance of the benchmark group. Our targets are below the ACI benchmarks, except for the target of overall satisfaction which is equal to the benchmark. During the rapid passenger growth, the performance of Dublin Airport has remained largely consistent.

Chart 11.3: 2015-2017 performance of Dublin Airport compared to our targets and the ACI benchmark



Source: ACI SQM Survey, reported by Dublin Airport

11.12 Dublin Airport has exceeded our targets in each quarter of 2015-2017. In general, passenger satisfaction at Dublin is also above the mean ACI benchmark.

Outcomes and Measures

11.13 In the 2019 Determination, we will decide whether to change the quality of service regime. For this purpose, Dublin Airport is first expected to consult with users on the right outcome or outcomes (ultimate goals) for the regime. Outcomes should ideally be informed by a robust, comprehensive and transparent understanding of user preferences.

11.14 Identifying the outcomes at the outset will help us to select appropriate and sufficient measures to fulfil those outcomes. Preferably, proposed measures should be:

- feasible to collect in large samples and in a cost-effective way,
- objective (subjective measures such as passenger surveys may have a lower weight) and
- verifiable / auditable.

11.15 When proposing measures and/or targets for measures, stakeholders could take account of:

- The forecast level of passenger numbers and construction/delivery of new or upgraded facilities, for example from supplementary Capex projects (PACE)[50] and the next Capital Investment Program (CIP).
- Whether target levels should be set relative to peer airports and continue to be the same for both Terminals. For instance, Heathrow Airport has different targets for each terminal.
- The trade-off between quality of service level and the cost of providing it.
- Types of incentives; penalties or bonus and the possibility of non-financial incentives.
- The appropriate financial incentive for different measures, and overall allowed revenue at risk of the regime.

Within Control of Dublin Airport

11.16 Current measures are all under direct control of Dublin Airport. However, we are interested in views on the possibility of mechanisms to include outcomes which have shared responsibilities. For example, Gatwick Airport has contracts with airlines in which it sets minimum quality of service targets for airlines. Gatwick Airport publishes the performance of airlines and their ground handlers with regards to baggage delivery and flight punctuality. If airlines do not meet their targets, Gatwick Airport reduces the airline's entitlement to rebates

[50] For example, Advanced Visual Docking Guidance System (AVDGS), Fixed Ground Electric Power (FGEP), stands, bussing, etc.

from breaches on the quality service level provided by Gatwick Airport.

11.17 Alternatively, measures outside (or partially outside) the control of Dublin Airport could also be reported for publication and monitoring only, without financial penalty.

Exemptions

11.18 In 2014, we stated that if Dublin Airport fails to meet a target, we will consider any evidence of extenuating circumstances that the airport may provide. In particular, we made a list of non-exhaustive exemptions in relation to the measures of baggage handling. For instance, some of the exemptions listed are:

- planned and preventative maintenance where it does not impact on operations;
- replacement and upgrades, where this is done in consultation with users and the time period is specified in advance;
- fault, misuse, abuse or malicious actions caused by third parties;
- serious disruption caused by weather, etc.

11.19 For 2019, stakeholders should consider valid exemptions, especially for the new measures they propose.

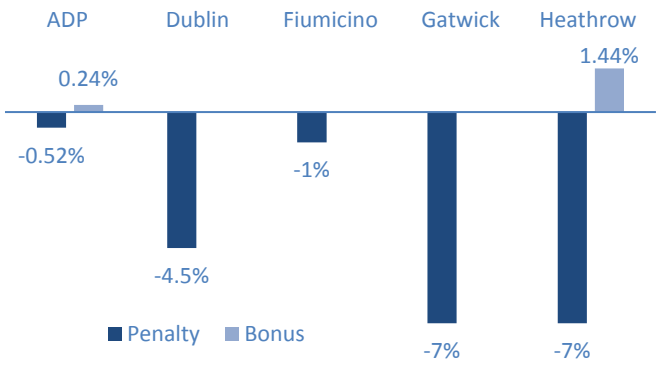
Initial Thinking - Outcomes and Measures

11.20 For example, for the next determination, the identified outcome for passengers might be an easy, fast and comfortable journey through the airport. Table 11.2 illustrates some potential measures, whether directly or indirectly controlled by Dublin Airport, which could then be selected to assess service quality.

Annual Cap at Risk

11.21 In the 2009 and 2014 determinations, the maximum annual amount at risk for breaches of quality of service has been 4.5% of the price cap.[51] Chart 11.4 compares the maximum annual price cap at risk for breaches and allowed bonus for doing better than targets at selected comparator airports with similar price cap regulation or price monitoring.

Chart 11.4: Percentage of Annual Cap at Risk for Breaches, and Allowed Bonus at Selected Airports



Source: Aeroports de Paris, CAR, ENAC, Gatwick Airport, CAA, Heathrow Airport

[51] It was up to 3.5% in 2010.

Table 11.2: Examples of Passenger Outcomes for Quality of Service Regime

Overall Airport Journey					
Sample Outcome	***Reliable, efficient (fast), easy and comfortable journey through Dublin Airport***				
Sample Measures	1- Overall Satisfaction 2- Helpful staff 3- Ease of way finding 4- Information Screens 5- Satisfaction with PRM assistance 6- Cleanliness of Toilets and Terminal 7- Internet Wi-Fi				
Departures/ Transfer	**Check-in →**	**Security →**	**Walking to Gate →**	**Waiting at Gate →**	**Boarding and Departing**
Sample Outcomes	***Reliable and Efficient Check-in and Baggage Delivery to Aircraft***	***Efficient Security Search***	***Easy Arrival to Gate***	***Comfortable Waiting at Gate***	***Easy and Efficient Boarding and Departing***
Sample Measures	1-Wait time at check-in 2- Available outbound baggage belt 3- Wait time for delivery of bag to airline groundhandler. 4- Baggage delivered to aircraft on time for departure.	1- Security queue times (departing, transfer - CBP, and staff) 2- Helpful security staff	1- Walking distance in terminal 2- Available escalators, lifts travellators.	1- Available seats 2- Comfort at Gate	1- Available airbridges, stands, FEGP, AVGDS. 2- Pier serviced stands 3- Bussing time 4- Taxi-out time 5- Airfield congestion (Number of movements lost or deferred*)
	1- Overall Satisfaction Departures 2- Waiting time for reserved departing PRM				
Arrivals	**Baggage Reclaim**	**Immigration ←Inspection**	**Walking to ←Immigration**	**Landing and ←Disembarking**	
Sample Outcomes	***Reliable and Efficient Baggage Delivery to Passengers***	***Efficient Immigration Process****	***Easy and Efficient Arrival to Immigration***	***Easy and Efficient Landing and Disembarking***	
Sample Measures	1- Availability of inbound baggage belt 2- Waiting time for delivery of bag to passenger	1-Immigration queue times 2-Helpful immigration staff	1- Walking distance in terminal 2- Available escalators, lifts travellators.	1 to 3 same as Boarding and Disembarking 4- Taxi-in time	
	1- Overall Satisfaction Arrivals				

**For example, at Heathrow Airport, a rebate shall be paid in respect of the number of departures or arrivals where a material event has occurred and which was caused primarily by Heathrow Airport or its traffic controller or their agents or contractors (excluding groundhandlers). For details on the calculation and definitions see the 2014 Licence of Heathrow Airport.*

*** Immigration and border controls at Dublin Airport are fully maintained by the Irish Naturalisation and Immigration Service (INIS) of the Department of Justice and Equality.*

Weight of Objective vs Subjective Measures

11.22 In the 2009 and 2014 determinations, three "objective" measures accounted for 2.5% of the potential penalties compared to 2% for nine "subjective" measures. Table 11.3 summarises the objective and subjective measures along with their data source and notes.

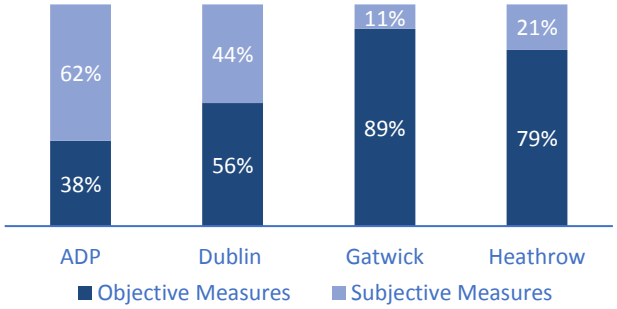
Table 11.3: Measures in the 2014 Determination

Measures		Collected by	Notes
Objective	Security Queue Times	Blip Track System	Large sample but measurement of maximum is challenging.
	Out/In-Bound Baggage Handling System	Dublin Airport	It measures only one element of the baggage delivery system, namely the belts.
Subjective	Nine Measures from Passenger Views on Quality of Service Performance	ACI Passenger Survey	Wide range of measures. Allows Benchmarking. Results depend on survey design and data collection.

Source: 2014 Determination

11.23 Chart 11.5 shows that for Gatwick and Heathrow airports the revenue at risk is weighted towards objective measures.

Chart 11.5: Objective and Subjective Measures to Calculate Penalties in Selected Airports



Source: Aeroports de Paris, CAR, Gatwick Airport, CAA

11.24 We seek views on what the appropriate level of total annual revenue at risk is and should be the relative weight of revenue at risk of objective and subjective measures.

Quality of Service Regime at Comparator Airports

11.25 The following paragraphs compare the quality of service regime at Dublin and other airports. It shows some of the measures existing at other airports that could potentially be introduced, in an appropriate form, at Dublin Airport. The measures are classified into overall journey, departures/transfer, inside the terminal, airfield and arrival.

Overall Airport Journey - ACI Measures

11.26 Table 11.4 compares the 9 passenger satisfaction measures at Dublin Airport with those from the comparator airports. The table shows that:

- The current passenger satisfaction measures at Dublin Airport are more comprehensive than other airports in relation to the overall airport journey.[52]
- The targets at Dublin Airport are mostly lower or equal to those at comparator airports.
- The revenue at risk per measure at Dublin Airport is similar to that at Gatwick and lower than Heathrow. However, the overall revenue at risk for all passenger satisfaction measures at Dublin Airport is higher than at Gatwick or Heathrow because of the higher number of measures.

[52] However, overall satisfaction at Dublin Airport is surveyed only among departing passengers. While departing passengers are asked about their last experience in arriving in Dublin Airport, for some departing passengers this could be a long time in the past. The satisfaction result may not accurately reflect the experience of arriving passengers. To tackle this issue, Aeroports de Paris has, for example, separate measures for overall satisfaction for arriving and departing passengers.

Table 11.4: Measures, Targets and Revenue at Risk at Comparator Airports

Process	Measure	Dublin	ADP	Fiumicino	Gatwick	Heathrow
		Targets and Revenue at Risk (%)				
Overall Airport Journey	Overall satisfaction	**3.90*-0.25%**	Arrivals 92%**-0.08% Departures 3.7 – 0.08%	-	-	-
	Ease of way finding through airport	**3.90 - 0.25%**	Orientation 3.9 – 0.04%	88%**	4.1- 0.2%	4.1 - 0.36%
	Flight information screens	**3.90 - 0.25%**		85%**	4.2- 0.2%	4.3 - 0.36%
	Cleanliness	**Terminal 3.90 - 0.25% Washrooms 3.50 - 0.25%**	4.0 – 0.04%	**Washrooms** 87%**	4.0- 0.2%	4.0 - 0.36%
	Internet / Wi-Fi	**3.10 - 0.25%**	-	80%**	-	Publication only
	Courtesy, helpfulness of airport staff	**3.80 - 0.10%**		-	-	-
Departure /transfer	Comfort of waiting / gate areas	**3.30 - 0.25%**		Peak Hour Pax/airside seats = 2	3.8***- 0.2%	3.8*** - 0.36%
Security	Courtesy, helpfulness of security staff	**3.80 - 0.15%**		-	-	Publication only

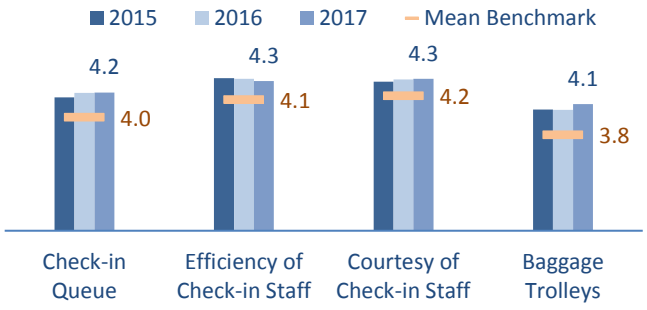
** 5: Very satisfied, 1: Not satisfied.*
*** Percentage of satisfied passengers. All targets for ADP are those for 2020 and for Fiumicino Airport for 2021.*
**** Seats available.*
Source: Aeroport de Paris, CAR, Gatwick Airport, CAA

Departures/ Transfer

Check-in

11.27 Currently, there are no targets set in relation to check-in at Dublin Airport. Airlines have significant control over the check-in experience. Dublin Airport may also influence the check-in experience by, for instance, providing automated technology and sufficient space. Passenger satisfaction in relation to check-in is above the ACI benchmark.

Chart 11.6: Satisfaction with various check-in stages



Source: ACI SQM Survey, reported by Dublin Airport. Q1 and Q2 only for 2017

11.28 Targets for check-in queue times are set at Fiumicino and Gatwick airports. At Fiumicino Airport, the target is 10 minutes or less for 90% of passengers. Airlines at Gatwick Airport must

ensure that the waiting time at check-in is less than 30 minutes in 95% of cases. In case of breach, airlines risk a 1% reduction in the monthly quality of service rebates which they are eligible for if Gatwick misses its targets.

Out-bound Baggage Belt Availability

11.29 Table 11.5 shows the commitment by Gatwick Airport to a maximum time for delivery of bags to the airline groundhandler, and the associated financial penalty if not met.

Table 11.5: Measures, Targets and Revenue at Risk in Relation to Outbound Baggage

Airport	Measure	Target	Revenue at Risk
Dublin	**% of time out-bound baggage handling system unavailable for longer than 30 minutes**	**0%**	**0.75%**
Gatwick	% of flights when bags are delivered to the airline ground handler 25 minutes or more before the scheduled time of departure*	99% monthly	0.7% max per month

Source: CAR, Gatwick Airport
**Specific measure agreed with airlines and endorsed by the UK CAA, as of January 2017*

Security Queue Times

11.30 Table 11.6 summarises the measure, target and revenue at risk for security queue times at Dublin and comparator airports. At Dublin, the definition of queue includes unimpeded walking time, and the measures are automated instead of manual. Aeroports de Paris monitor waiting times at security but do not have an associated financial penalty.

Table 11.6: Security Queue Time Measure, Target and Revenue at Risk

Airport	Measure	Method	Current Target	Revenue at Risk
Dublin	**% of passengers queuing < 30 minutes**	**BlipTrack [53] Average sample: 40% of departing passengers**	**100%**	**1.5%**
Fiumicino [54] 2021	% of passengers queuing < 4 minutes (from getting in line to placing baggage on X-ray scanner).	Daily surveys by a third-party company	90%	
Gatwick[55]	% of passengers queuing < 5 minutes and % of passengers queuing < 15 minutes*		95% and 98%	1%
	Day when single time slice > 30 minutes*		no days	0.7% per month
Heathrow [56]	% of passengers queuing < 5 minutes and % of passengers queuing < 10 minutes*	Manual every 15 minutes.	95% and 99%	1%

**Queueing time does not include unimpeded walk time between portal and security roller bed.*
Source: Aeroports de Paris, CAR, Gatwick Airport, CAA

11.31 Table 11.7 shows that Gatwick and Heathrow airports also have security queue time targets for transfer passenger and staff search.

[53] https://blipsystems.com/airport/
[54] http://www.adr.it/documents/17615/9522342/2017-21+Qualit%C3%A1+-+Incontro+Utenti+2016_ING+09+settembre.pdf/ff9740b5-e22d-42cd-875d-b95ce5d64cc1
[55] https://www.gatwickairport.com/globalassets/publicationfiles/business_and_community/all_public_publications/2017/2017-18-conditions-of-use---final---sent-30jan17.pdf
[56] https://www.caa.co.uk/Commercial-industry/Airports/Economic-regulation/Licensing-and-price-control/Economic-licensing-of-Heathrow-Airport/

Table 11.7: Security Queue Times Measure, Target and Revenue at Risk in Comparator Airports

Airport	Measure	Current Target	Revenue at Risk
Gatwick	% of transfer passengers queuing < 10 minutes	95%	0.2%
	% of staff (Terminals and Crew) queuing < 5 minutes	95%	0.35%
Heathrow	% of transfer passengers queuing < 10 minutes	95% – 99% *	0.5%
	% of staff queuing < 10 minutes	95%	0.38%

**Depends on the terminal.*
Source: Gatwick Airport, CAA

Security Queue Audit

11.32 In 2016-2017, we conducted an audit to assess whether the passenger experience is accurately reflected by the maximum queue time reported by Dublin Airport. See Appendix 4 for further details. The evidence from the audit led us to make the following two main conclusions:

- The automated system allows for the collection of a much larger sample of queue times than would otherwise be feasible; the trade-off is the introduction of what appears to be inaccuracy into the measurements. This must be compensated for by an additional outlier filter, currently a median filter.
- The median filtered queue time appears to be a reasonably good reflection of queue times actually experienced by passengers. In some cases, particularly when the queue is very short, it appears that the current methodology overstates the length of the queue.

11.33 Dublin Airport and airlines should take account of the findings and conclusions of this audit when consulting on this target.

11.34 As a reference, the ACI passenger survey related to satisfaction with waiting times in security inspection shows that, during 2015-2017, Dublin Airport scored 4.1 out of 5. This is just above the ACI benchmark of 3.9.

Inside the Terminal

11.35 The following are some measures of passenger satisfaction within the terminals which are currently not part of the quality of service regime but may be of interest ahead of the 2019 Determination.

Walking Distance

11.36 In 2017, passenger satisfaction with walking distance inside the terminals at Dublin Airport was 3.6, below the ACI benchmark of 3.7. The Airport Development Reference Manual (ADRM) published by the International Air Transport Association (IATA) recommends that:

- walking distances inside terminals should be as short as possible, and
- any walking distance in excess of 300 meters should be provided with moving walkways that reduce unaided walking distances.

Ease of making connections

11.37 in 2017, Dublin Airport was rated at 4.2, above the ACI benchmark of 3.9. The measure may now be more relevant, given the increase in the number of transfer passengers in recent years and the continued development of Dublin Airport as a hub airport.

Passenger Facing Equipment and PRM

11.38 We have not previously sought information on passenger satisfaction in relation to the availability of seats or other passenger facing equipment (escalators, lifts, travellators, etc) in the terminal or at departure gates. The assistance for Passengers of Reduced Mobility (PRM) at Dublin Airport complies with the requirements set out in the ECAC Document 30.[57] Examples of measures and targets relevant to PRM at other airports are shown in Table 11.8.

Table 11.8: Measures, Targets and % Revenue at Risk at Comparator Airports

Measures	ADP	Fiumicino	Gatwick	Heathrow
	Targets and Revenue at Risk			
Availability of passenger facing equipment (such as lifts, escalators, travellators)	96% - 0.04%	-	General 99%-0.05% Priority 99%-0.5%	General and Priority 99%-0.35%
Availability of seats in airside area	-	2 pax per seat (peak hour)	-	-
Satisfaction with departure lounge seating availability	-	-	3.8-0.2%	3.8 - 0.36%
Satisfaction with the ease of connection with other flights	3.57 - 0.08%	-		
Waiting Time for reserved departing PRM	-	10 minutes or less for 90% of PRMs	-	-
Satisfaction with effectiveness of assistance to PRM	-	99% passengers	-	-

Targets for Aeroports de Paris are for 2020 and for Fiumicino Airport for 2021.
Source: Aeroport de Paris, CAR, Gatwick Airport, CAA

Airfield: Boarding/Disembarking, Departing/Landing

11.39 There are currently no targets at Dublin Airport in relation to the airfield. Dublin Airport and stakeholders should consider whether monitoring and/or financial penalties for quality of service measures should be introduced for existing infrastructure or when new infrastructure becomes operational. Below are some potential measures, some of which are fully within the control of Dublin Airport and some of which are partly within its control. Examples are:

- Bussing times (average or by gate zones)
- Taxi in/out times
- Availability of Fixed Electrical Ground Power (FEGP) at stands where this has been installed
- Availability of Advanced Visual Docking Guidance System (AVDGS)at stands where this has been installed
- Availability of stands (e.g. airbridge served stands)

11.40 Proposed exemptions to the above measures should be consulted on with interested parties. Usual exemptions for these measures at other airports include bad weather or when pieces of infrastructure are taken out of service while investment/replacement/refurbishment projects are being undertaken in the vicinity. The condition is that the work is done in consultation with users and the time of work is specified in advance. Table 11.9 shows examples of regulated measures at other airports.

[57] https://www.ecac-ceac.org/documents/10189/51566/Doc30+Part+I-11thEdition-Amdt5-December2015e.pdf

Table 11.9: Measures, Targets and % Revenue at Risk at Comparator Airports

Measures	ADP*		Gatwick		Heathrow	
	Target	Revenue at Risk	Target	Revenue at Risk	Target	Revenue at Risk
Availability of aircraft stands	95%	- 0.04%	99%	-0.05%	99%	-0.25%
Availability of electrical supply	97%	-	99%	-0.05%	99%	-0.20%
Availability of airbridges	96%	- 0.04%	99%	-0.30%	99%	-0.25%
Stand Entry Guidance (such as A-VDGS)	-	-	-	-	99%	-0.25%
Pier-served stand usage**	-	-	95%	-0.50%	95%	-0.30%
Aerodrome congestion term: max. cumulative movements deferred after a material event.***	-	-	>3	- 0.70%	>3 fixed penalty. Increases with number of flights until a cap of 20 flights.	

**Targets for Aeroports de Paris are for 2020.*
***Percentage of time when stands with pier service are available as opposed to remote stands. This measure is based on the total number of passenger movements (arrivals and departures). Includes stands where passengers are able to walk into the pier.*
**** The material event should be caused primarily by a failure of Heathrow airport, the air traffic provider, their respective agents or contractors (excluding groundhandlers). A list of material events is in the 2014 Licence.*
Source: Aeroport de Paris, CAR, Gatwick Airport, CAA

Journey of Arriving Passengers

11.41 Below we discuss three ACI survey results for Dublin Airport relating to the journey of arriving passengers. These are not part of our quality targets. The results are obtained by surveying departing passengers about their last experience of arriving in Dublin Airport. For some departing passengers this could have been some time ago. For this reason, it is possible that their answers do not accurately reflect the current experience of arriving passengers.

11.42 Stakeholders should consider:

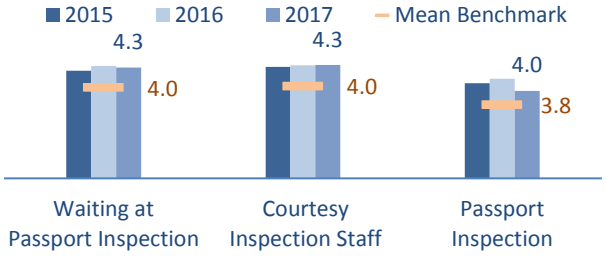
- Whether there is merit in including arrival measures in the quality of service regime.
- The costs and benefits of surveying arriving passengers to obtain more accurate results for the arrivals measures.
- If a cost allowance for the cost of surveying arriving passengers should be given to Dublin Airport.

Immigration Inspection

11.43 Immigration and border control is operated by the Irish Naturalisation and Immigration Service (INIS), which is part of the Department of Justice and Equality.[58] However, similar to check-in, Dublin Airport may influence the experience in immigration by, for example, providing adequate space, managing queues and facilitating the use of automation such as e-gates. Aeroports de Paris monitors the waiting times at border control, without imposing any financial penalty. At Dublin Airport immigration queue times could be measured using the same system as security queue times. Chart 11.6 shows that the satisfaction of passengers with immigration control at Dublin Airport is above the mean ACI benchmark.

[58] https://www.dublinairport.com/at-the-airport/passenger-information/customs-immigration

Chart 11.6: Satisfaction with immigration control.



Source: ACI SQM Survey, reported by Dublin Airport

Baggage Reclaim and Customs Inspection

11.44 In 2017, the satisfaction of passengers at Dublin Airport in relation to the speed of baggage delivery (3.8) and customs inspection (4.0) is higher than the mean ACI benchmarks (3.6 and 3.8 respectively).

11.45 Other airports measure the availability of in-bound baggage handling systems but also waiting times for the first and last baggage delivered. See Table 11.10.

Table 11.10: Measures, Targets and Revenue at Risk in 2009 and 2014 Determinations

Airport	Measure	Target	Revenue at Risk
Dublin	**% of time in-bound baggage belt available**	**99%**	**0.25%**
ADP	% of time inbound baggage belts/carrousels available	98%	0.04%
	Baggage delivery times Availability of carousel baggage input belts	Monitoring	
Fiumicino	Combination between: % of waiting time for first baggage delivery < 26 minutes % of waiting time for last baggage delivery < 34 minutes	 90% 90%	
Gatwick	% of time arrivals reclaim (baggage carousel) available	99%	0.5%
Heathrow	% of time arrivals baggage carousels are serviceable and available for use, independent of any other element.	99%	0.35%

Note : targets for Fiumicino Airport are for 2021.
Source: Aeroport de Paris, CAR, Gatwick Airport, CAA

Ground Transport

11.46 In 2017, Dublin Airport was rated at 4.1 above the ACI Benchmark of 3.9. Currently, the quality of ground transport services is not monitored by the Commission. Dublin Airport has some influence on the quality of the taxi service provided through the taxi permits the airport grants.

High-Level Consultation Questions

Q20. Should the current scheme of Quality of Service targets and penalties be amended? What outcomes should be targeted and how?

Q21. What is an appropriate amount of revenue to put at risk?

12. Other Issues

Passenger Engagement in the Regulatory Process

12.1 In our strategic plan 2017-2019, we committed to examine how to better engage the passenger in the regulatory process. We look forward to implementing new mechanisms to become better informed on the views and needs of passengers; this will allow us to better reflect these views in our regulatory processes. This work stream is in line with the 2017 Policy Statement on Airport Charges Regulation, which states that the primary purpose of regulation shall be to protect the passengers at Dublin Airport.

12.2 In April 2017, we examined how other regulators have sought to improve consumer representation and developed high-level proposals for our own regulatory framework. In September we held a first public consultation (CP9/2017). Following this, we concluded that the extent to which passenger views are explicitly taken into account in our regulatory process should be improved.

12.3 Based on this conclusion, in December 2017 we published our decision CP15/2017 to implement guidelines and incentives in relation to passenger engagement by Dublin Airport, airlines and other stakeholders, as well as rules governing an ad hoc advisory panel set up by the Commission. Alongside our decision, we published a second consultation paper CP16/2017 on the detailed implementation of these mechanisms. We will shortly publish a decision on this.

Incentive Schemes

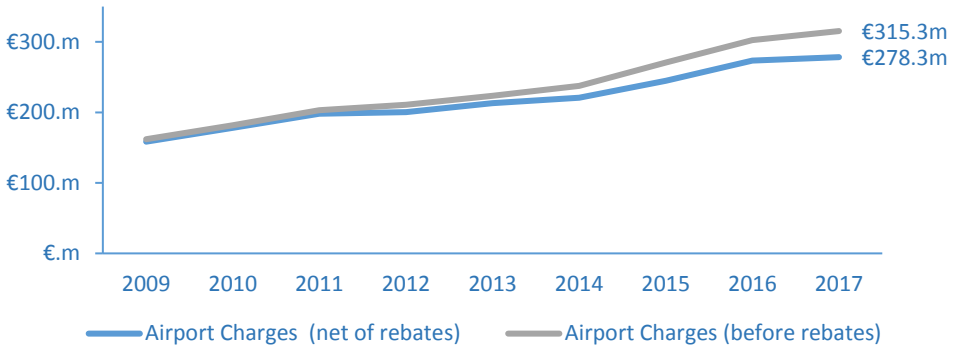
12.4 We invite submissions on the appropriate regulatory treatment of incentive scheme costs having regard to ICAO principles, our statutory objectives and the potential effect of any policy change on either airport charges or the continued existence of incentives.

Rebates and Discounts on Airport Charges

12.5 The incentive schemes currently offered by Dublin Airport can be categorised as rebate based schemes and discount/waiver based schemes.[59] For rebate schemes, aeronautical revenue is collected as per the menu of charges and, if conditions of the schemes are fulfilled, rebates are issued. In the case of discounts or waivers, Dublin Airport does not collect the associated revenue. Chart 12.1 shows that rebates have been steadily growing since 2011.

[59] Rebates relate to growth in overall and transfer passenger traffic. Discounts are for new routes (alongside marketing support), standby aircraft, early morning remote/satellite stand usage, use of remote stands by long haul morning arrivals and capacity optimisation. https://www.dublinairport.com/regulation-and-planning/dublin-airport-charges/incentive-schemes

Chart 12.1: Aeronautical revenues before and after rebates for 2009-2017



Source: Dublin Airport Regulatory Accounts

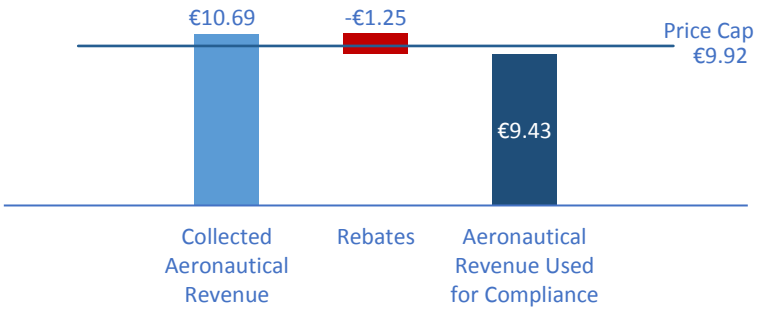
Positive Externalities (Benefits)

12.6 Incentive schemes at Dublin Airport may lead to improved overall welfare of all users, not just the welfare of those that receive the rebates or discounts directly. The potential benefits include increased traffic and connectivity, a lower price cap due to increased passenger numbers, and more efficient use of infrastructure. Incentive schemes may also influence the economic viability of marginal routes.

Current Regulatory Treatment

12.7 Currently, compliance with the price cap is assessed based on the net aeronautical revenues (collected after deducting rebates). Therefore, gross aeronautical revenue per passenger in a year may exceed the price cap, provided that when rebates are deducted, it does not exceed the cap. Chart 12.2 demonstrates this using 2017 outturn data. The potential foregone aeronautical revenue due to discounts or waivers is currently not considered either.

Chart 12.2: 2017 Gross Aeronautical Revenues Exceed the Price Cap



Source: CAR Calculations, 2014 Determination, Dublin Airport 2017 Regulatory Accounts

12.8 The current treatment means that Dublin Airport does not bear the cost of these schemes, unless, for a given year, Dublin Airport prices low enough that none of the costs of the schemes are recovered, either in the year in question or two years later as part of the K Factor. This has not occurred to date. Further discussion on the K Factor is below.

ICAO Principles and Thessaloniki Forum Guidelines

12.9 ICAO states that incentive schemes should be assessed on a case-by-case basis, guided by the

'principles of non-discrimination, transparency, no cross-subsidisation, and time limitation.'[60] The Thessaloniki Forum guidelines on Consultation and Transparency recommend that airports disclose to users the costs of incentive schemes and how the schemes affect airport charges.[61]

12.10 Cross subsidisation occurs when the cost of an incentive scheme borne by a user is greater than the benefit it receives. No cross subsidisation can only be guaranteed if a scheme is self-funding; for our purposes, that would imply treating incentive scheme costs as non-recoverable Opex.

12.11 If a different regulatory treatment is applied, the schemes may or may not lead to cross-subsidisation, depending on whether positive externalities as described above are considered as part of the benefits received by users. Such benefits are difficult to quantify; we do not have a counterfactual situation, where the schemes are not in place, against which to compare the broader outcomes for users. However, the forecasts of benefits and costs made at the time when the discounts where offered can be used to assess if the schemes are self-funding and therefore profitable. This is the methodology used by the European Commission in assessing whether bilateral contracts between airports and airlines are profitable or not and therefore whether they constitute State Aid.

Alternative Accounting Approaches

12.12 We may continue with the current accounting treatment of incentive schemes if deemed appropriate. Alternatively, to reduce the likelihood of cross subsidisation we may consider other approaches such as:

- Treating incentive scheme costs as non-recoverable operating expenditure. The full cost of the schemes would be borne by Dublin Airport paid for by the benefits generated. The first column in Chart 12.2, collected revenue, would be used when assessing price cap compliance.
- Treating the costs as recoverable or partially recoverable operating expenditure. In this case, collected revenue would again be used when assessing compliance, but an allowance for the cost of incentive schemes would be included in the price cap (care would be needed in devising the correct mechanism for this).[62]

12.13 We are interested in views on the impact of such a change.

Under and Over Collection - K Factor[63]

Over Collection

12.14 Currently, if Dublin Airport over collects with respect to the price cap, it must reimburse users within 90 days of the end of the year.

Under Collection

12.15 The K Factor adjusts the price cap in a given year to account for any under collection from two years previously. It is capped at 5% of the per passenger price cap in the year in which the under collection occurred. The K Factor is adjusted by the interest accrued in the 2 years elapsed since the under collection, and also by the difference in forecast passengers between these two years. We invite views on whether the K Factor term should continue to be included

[60] http://www.icao.int/sustainability/Documents/Doc9562_en.pdf
[61] https://www.aviationreg.ie/_fileupload/ACD/Thessaloniki%20Forum%20Consultation%20Dec%2016.pdf
[62] The 2014 Determination included an Opex allowance for marketing support.
[63] Prices are nominal in this subsection

in the price cap formula for the 2019 Determination, and if so, how it might be improved.

12.16 The Commission stated in CP2/2015 that *"The objective of the k factor is to allow the regulated entity some flexibility on pricing, in particular to mitigate a potential situation where towards the end of the year the regulated entity is not going to reach the price cap without changing prices mid-season."*[64]

12.17 Thus, the K Factor is a recognition that Dublin Airport cannot set prices to hit the cap perfectly, rather than a tool to adjust the flows of allowed revenue.

Volume Risk and the K Factor Formula

12.18 The K Factor is adjusted by the difference between forecast passenger numbers in the two years in question, to reflect the fact that the under collection is recovered in a different year to that which was initially intended, and adjust the amount to be recovered appropriately. However, where the difference between forecast passengers in both years is not equal to the difference between outturn passengers in both years, the adjustment does not operate as intended.

12.19 For example, the 2014 Determination forecast difference in passenger numbers between 2015 and 2017 was 6%; the outturn difference was over 18%. As it is based on forecasts, the K Factor is adjusted down by just 6%, despite the fact that it was collected from over 18% more passengers. This is an unintended consequence of the K Factor formula, which is currently leading to overcollection; in each of the pairs of two years, the airport benefits from passenger numbers increasing by a greater percentage than the forecast percentage increase. This is akin to sets of periods of volume risk, in which each year is set against the year two previous.

12.20 We further develop the example of the 2015 K Factor. In 2015 the airport under collected by €0.51 per passenger, which is 5% of the cap. As shown in Table 12.1 in 2015, the foregone revenue for the under collection is €12.7m. In 2017, the airport could recover a K Factor of €0.48, which is the under collection of €0.51 adjusted by 2015-2016 interest and the difference between 2015-2017 forecast passenger numbers. The extra revenue from the K Factor in 2017 is €14.2m. In conclusion, in 2017 there was additional revenue of approximately €1.5m.

Table 12.1: The 2015 K Factor recovered in 2017 led to an overcollection of €1.5m

	2015	2017	Difference	
Revenue per passenger	€0.51 (under collection)	€0.48 (K Factor)	€0.03	▼6%
Passenger numbers	25m	29.6m	4.6m	▲18%
Total Revenue	**€12.67m (foregone)**	**€14.2m (collected)**	**€1.5m**	**▲12%**

Source: CAR 2014 Determination, CAR Calculations, Regulatory Accounts.

12.21 If the Airport expects that in two years' time, passenger numbers will have increased by a lower percentage than forecast, it is incentivised to recover airport charges as close to the cap as possible and therefore minimise the K Factor. Conversely, if the Airport expects passenger numbers to have risen more quickly than forecast, it is incentivised to under recover to the fullest extent permitted, which is currently 5% of the price cap. As noted above, the purpose of the K Factor is not to assign further traffic volume risk to the airport.

12.22 Table 12.2 suggests that the Airport targeted a lower K Factor during 2010-2013 compared to 2014-2016.

[64] http://www.aviationreg.ie/_fileupload/2015/review/2015-12-22%20Decision%20on%20Conducting%20Review.pdf

Table 12.2: The under collection of airport charges was low in 2010-2013 compared to 2014-2016

	2010	2011	2012	2013	2014	2015	2016
Price Cap	€9.76	€10.64	€10.79	€10.65	€10.66	€10.27	€10.31
Outturn Charge	€9.67	€10.57	€10.50	€10.56	€10.16	€9.76	€9.79
Under collection (as % of the price cap)	0.9%	0.6%	2.7%	0.8%	4.7%	4.9%	5.0%

Source: CAR Calculations, 2014 Determination, Dublin Airport Regulatory Accounts

Amending the K Factor

12.23 There are two key decisions we seek view on in relation to the K Factor. First, if we should retain the K Factor. Second, if we retain it, should we improve it and how.

12.24 If we decided to remove the K Factor from the formula we have two possibilities to deal with under collections: either under collections are non-recoverable or they could be returned to the airport at the time of making the next determination.

12.25 If we decided to keep the K Factor, we have two options to improve it:

- Option 1: adjusting the K Factor based on outturn passenger numbers, and an updated forecast for passenger numbers ahead of the year in question. A fixed K Factor would be set in the provisional price cap statement published by the Commission each November. This would reduce the extent of volume risk in the K Factor.
- Option 2: setting a provisional K Factor as part of the provisional price cap statement, using either the current methodology or that proposed in Option 1. This would then be adjusted based on final outturns when the final price cap is calculated in the following year. This would work similarly to the adjustment for quality of service. This would entirely remove volume risk from the K Factor, ensuring perfect recovery up to the limit on the K Factor, whether 5% or otherwise.

12.26 Chart 12.3 on the left shows the calculation of the 2015 K Factor (€0.48) using the current formula. Chart 12.4 on the right shows the calculation of the final 2015 K Factor (€0.43) according to Option 2.

Chart 12.3: K Factor as per current formula

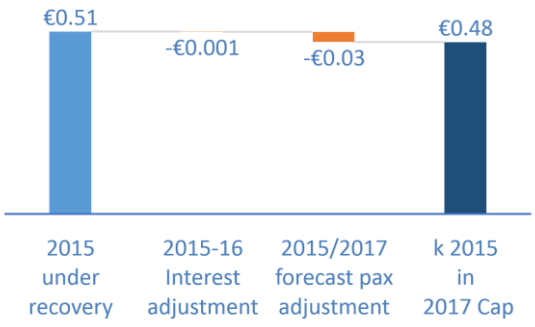
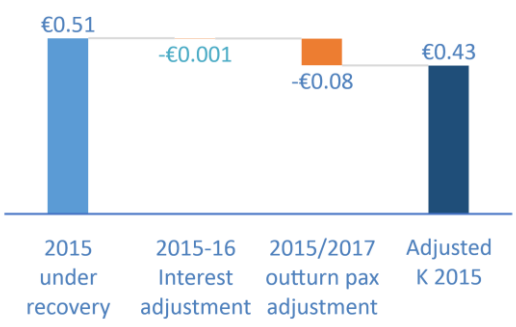


Chart 12.4: Proposed K Factor as per Option 2



Source, 2014 Determination, Regulatory Accounts, CAR Calculations

12.27 Table 12.3 shows that Option 2 would most closely align the incentives of Dublin Airport between collecting in the present year or 2 years in the future. The extra revenue from the 2015 K Factor, collected in 2017, is equal to the 2015 under collection, adjusted solely for interest rates in 2015 and 2016. The success of Option 1 in eliminating the volume risk lies between the current formula and Option 2. It depends on the quality of the updated forecast

for year t, in our case 2017. The forecast of 2017 in 2016 was approximately 29m, which is sufficiently close to the outturn of 29.6m.

Table 12.3: The 2015 K Factor recovered in 2017 led to an overcollection of €1.5m

	2015	Option 1*	Option 2
Revenue per passenger	€0.51 (under collection)	€0.44	€0.43
Passenger numbers	25m	29.6m	29.6m
Total Revenue	**€12.67m (foregone)**	**€13m**	**€12.64m**

**Assumes 29m forecast for 2017.*

Source: CAR 2014 Determination, CAR Calculations, Regulatory Accounts.

Persons with Reduced Mobility (PRM) Charge

12.1 Dublin Airport has recently notified the Commission of an issue with their current formula to calculate the PRM charge. Dublin Airport proposes two options in relation to the treatment of a cumulative under-recovery to date. We seek stakeholder views on the overall issue and the options proposed.

Regulatory Treatment

12.2 Since 2009, the Commission has included revenues from PRM charges in assessing compliance with the annual price cap and has granted Dublin Airport cost allowances for the provision of PRM services. The Commission has used the contract price that Dublin Airport pays to the contractor (currently OCS) to provide PRM services as an appropriate estimate for this cost allowance. As PRM fees are in the price cap an under-collection results in the possibility for other airport charges being higher and vice versa.

Cumulative Under Recovery by Dublin Airport

12.3 The calculation formula for the PRM fee used by Dublin Airport takes into account the audited under/over recovery from two years prior rather than the cumulative amount. This has led to significant periodic volatility in the PRM fee, while also not addressing the cumulative under-recovered amount which has continued to grow. Table 12.4 shows the cumulative under collection of PRM charges between 2009 and 2017.

Table 12.4: PRM Audited Accounts 2009-2017

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Departing passengers	10.1m	9.1m	9.3m	9.4m	10m	10.5m	12.4m	13.7m	14.6m
Actual charge	€0.33	€0.33	€0.38	€0.39	€0.50	€0.49	€0.41	€0.36	€0.42
PRM turnover	€3.3m	€3m	€3.5m	€3.7m	€5m	€5.2m	€5.1m	€4.9m	€6.2m
PRM costs	€3.8m	€3.8m	€4.3m	€4.2m	€4.4m	€4.6m	€5.1m	€5.9m	€6.5m
Annual under/over recovery	€0.5m	€0.7m	€0.8m	€0.5m	-€0.6m	-€0.6m	€0.4m	€0.9m	€0.3m
Cumulative under/over recovery	€0.7m*	€1.5m	€2.3m	€2.8m	€2.2m	€1.6m	€1.6m	€2.5m	€2.9m

**The accumulated under recovery until 2009 €0.7m is considered an unforeseen cost and was/will not be compensated for. Aviation Appeals Panel 2010.*

Source: Dublin Airport PRM Audited Accounts

12.4 Under Regulation (EC) 1107/2006 Dublin Airport may levy a specific cost-related PRM charge on users to fund the PRM services. Dublin Airport states that as the PRM charge is within the price cap, the €2.5m unrecovered to 2017 would have been recovered through higher airport charges. Dublin Airport proposes the following two options to deal with the cumulative under recovery to date.

Dublin Airport Proposed Option 1

PRM Charge outside the Price Cap

12.5 Dublin Airport's option 1 proposed that:

- PRM costs would be excluded from the price cap in the 2019 Determination, and revenues would be collected separately on a cost-related basis.
- 2019 pricing would include an adjustment for the estimated cumulative under-recovery to 2018. From 2020, Dublin Airport would estimate a charge for the year and communicate to airport users within the same time frame as the airport charges consultation.

Reconciliation

12.6 Dublin Airport would reconcile, at the end of each financial year, the costs collected to date versus those incurred. Dublin Airport would then:

- recoup further costs or issue a credit to reimburse users for over collection, as necessary, or
- take the cumulative recovery position into account when calculating the price for the next period.

Dublin Airport Proposed Option 2

PRM charge stays within Price Cap and formula is corrected

12.7 Dublin Airport's second option proposes that PRM costs would stay within the price cap calculation and the PRM charge formula would be amended so that the allowed cumulative under/over-recovery to date is taken into account.

Reconciliation

12.8 Dublin Airport proposes two options:

- 2019 pricing would ignore the cumulative under-recovered costs to the end of 2017. From 2020, Dublin Airport would take the cumulative under-recovery from the last audited financial statements from two years prior (e.g. 2020 will look at 2018).
- Dublin Airport would ignore the cumulative under-recovery to the end of 2018. This cumulative under-recovered amount will remain in the PRM statements. From 2021, Dublin Airport will take the cumulative under/over-recovered amount into the calculation from two years prior (2019), less the net cumulative 2018 under-recovered position.

High-level Consultation Questions

Q22. How should incentive schemes be accounted for in the regulatory model?

Q23. How should we address imperfect pricing by the regulated entity (over and under collection)?

Q24. How should we treat costs related to Passengers of Reduced Mobility (PRM)?

13. Appendix 1. Weighted Average Cost of Capital (WACC)

13.1 The cost of capital is the sum of the cost of debt (**r_d**) and the cost of equity (**r_e**) i.e. the compensation that Dublin Airport would need to offer holders of debt and shareholders for their capital. Both components are then averaged using weights that depend on the level of gearing (**g**) assumed, i.e. the relative share of debt and equity, and the level of corporate tax (**t**).

Cost of Debt

13.2 The cost of debt is estimated by adding a mark-up (debt premium) to the risk-free rate (**r_f**), as shown in the following equation:

$$r_d = r_f + debt\ premium$$

13.3 The risk-free rate is the return that Dublin Airport would have to pay if there was no risk associated with its debt. Since the WACC is real, we use a real risk-free rate which is calculated from a nominal rate adjusted by inflation. To estimate the real risk-free rate, we have used the Fisher equation, shown below, which links the nominal interest rate to the real interest rate plus the expected inflation.

$$(1 + r_{nominal}) = (1 + r_{real})(1 + I_{expected})$$

Cost of Equity

13.4 The cost of equity is estimated using the capital asset pricing model (CAPM). The cost of equity is the sum of the real risk-free rate (**r_f**) and a mark-up (equity premium). The equity mark-up depends on the beta equity parameter **β_e** and the Equity Risk Premium. The formula is as follows:

$$r_e = r_f + \beta_e \times Equity\ Risk\ Premium$$

13.5 The risks associated with owning an asset, such as a stock in a company, comprise systematic and idiosyncratic risks. Systematic risk is non-diversifiable, while idiosyncratic risk is asset-specific. The equity beta measures the vulnerability to systematic risk, that is the sensitivity of the expected return in a company ($R_{company}$) compared to the market as a whole (R_{market}). The beta equity is calculated as shown below.

$$\beta_e = \frac{cov(R_{company}, R_{market})}{var(R_{market})}$$

13.6 More precisely, $\beta_e = 0$ represents a risk-free investment; $\beta_e < 1$ an investment with less risk than the market; $\beta_e = 1$ an investment with the same risk as the market; and $\beta_e > 1$ an investment with larger risk than the market. The more market power held by an airport, the greater consistency in return, and the lower the numerical value of equity beta. The estimation of equity beta requires the use of share price data. Dublin Airport is not publicly listed, therefore to calculate its beta we must use the betas of listed airports with similar systematic risk.

13.7 The equity beta of a company is also called levered because it reflects the capital structure of that company. If a company had a capital structure of only equity, the beta equity would only reflect the risk of conducting that company's business. However, when the company decides to also use debt, there is a financial risk in addition to the business risk placed on shareholders.

13.8 When we estimate the equity beta for each comparable listed airport we need to unlever or de-gear each beta so as to only reflect each airport's business risk component, without the financial risk. The unlevered beta is also known as asset beta ($\boldsymbol{\beta_a}$). The asset beta of peer airports is calculated by adjusting the equity beta by the level of gearing and the tax benefit of debt for each comparator airport. The following formula shows how to arrive at the asset beta.

$$\beta_a = \frac{\beta_e}{1 + \frac{D}{E} \times (1 - t)}$$

13.9 The estimates of the asset betas of comparable airports should then be 1) adjusted for any differences in business risk between the comparator airports and Dublin Airport, and 2) re-levered using the above formula based on the level of gearing we assume for Dublin Airport. The re-levered equity beta reflects both the business and financial risks specific of Dublin Airport.

13.10 The Equity Risk Premium is the difference between the real risk-free rate (r_f) and the expected rate of return of an economic agent investing on the market (r_m).

$$Equity\ Risk\ Premium = r_m - r_f$$

13.11 The WACC calculation depends on both macroeconomic variables and airport-specific estimates. For example, the risk-free rate and the equity-risk premium can be estimated without reference to Dublin Airport. In contrast, the beta is particular to Dublin Airport.

WACC and Tax

13.12 The WACC used in our determinations is real (adjusted for inflation) and pre-tax (the return for shareholders includes the revenue to meet Irish corporate tax liabilities). The formula of the real pre-tax WACC is shown below.

$$WACC\ (pre - tax) = r_d \times g + \frac{1}{1 - t} \times r_e \times (1 - g)$$

13.13 A vanilla WACC does not account for the corporate tax liabilities, represented by $\frac{1}{1-t}$. Therefore, the formula is:

$$WACC\ (vanilla) = r_d \times g + r_e \times (1 - g)$$

13.14 A post-tax WACC takes account of the tax benefit associated with debt, since interest is deducted before tax is calculated.

$$WACC\ (post - tax) = r_d \times g \times (1 - t) + r_e \times (1 - g)$$

13.15 However, a post-tax WACC should not be used to determine price since interest is already included in taxable profit.

14. Appendix 2. Thessaloniki Forum Recommendations for WACC Estimation

14.1 In December 2016, the Thessaloniki Forum of Airport Charges Regulators published its recommendations for the setting and estimation of the WACC.[65] The Forum Recommendations state that the WACC and CAPM are acceptable models for estimating the cost of capital. The Forum makes the following recommendations to measure each of the WACC components.

Table A2.1: Thessaloniki Forum Recommendations for the Estimation of Cos of Capital Elements

WACC Component	Recommendations
Risk-free rate	-Rate of 10-year Government bonds of the State where the airport is located, if the bonds of such a State are considered risk free. The 10-year maturity should reflect the long-term investment horizon assumed by the CAPM; -Use implicit yields of the Government bond in case of multiannual periods in order to reflect the uncertainty about future returns; -Take account of the historical context of the rates and not use atypical observations.
Cost of debt	-Take into account the risk-free rate and, where deemed necessary by the ISA, an additional spread estimated according to the credit rating at the time of the estimate; -Reflect a review of market rates and on embedded debt; this review should tend to reflect the actual debt portfolio of the airport and its refinancing opportunities; -Estimate a value through comparison with other similar rated airports.
Gearing	ISAs may set a notional (or theoretical) gearing. The current capital structure of the regulated airport could be suboptimal.
Beta Parameter	-Take account of the risk of aeronautical activities only, and consider the model of regulation applied to the airport. In particular, consider the level of commercial and traffic risk at the particular airport. This risk may be: -mitigated by the resilience of air transport demand at the airport. -mitigated by the level of competition to which the airport is exposed. In most cases, the level of competition is low. -affected by the relative overall size of the operation, traffic mix, operator mix and/or capacity at the airport. -The beta equity of regulated or state-owned airports should generally be low. As a general rule, the risk of a regulated airport should be lower than the market ($\beta e < 1$). -The market portfolio used to calculate the beta equity should be the national index of the State where the airport is located. - It is acceptable to use betas of peer companies. The sample of peer airports should be restricted to the European Economic Area and Switzerland (EEA). However, if the number is limited it could be extended to countries with a comparable general economy and/or to other relevant sectors, such as the transport infrastructure sector.
Equity Risk Premium	It is a volatile variable and prone to expert controversy including, for example, whether the arithmetic or geometrical average of returns should be used for calculation. However, the following are acceptable practices: -restrict the geographical area for the estimation to the Member State or the EEA; -reflect historical analysis over a substantial period of time, i.e. several decades; -take into account a range of estimates; -include practitioner views or forward-looking estimates; and -use reference studies acknowledged by the financial and scientific literature.

[65] https://www.aviationreg.ie/_fileupload/ACD/Thessaloniki%20Forum%20WACC%20Dec%2016.pdf

15. Appendix 3. Regulatory Precedents on WACC

15.1 The table below shows the point values we selected in previous determinations for the individual variables that make up the WACC calculation. Point values for each WACC component have been chosen from a range of possible estimated values.

Table A3.1: Cost of Capital in Previous Determinations

	Cost of Capital	2001	2005	2009	2014
r_f	Risk-free rate (real)	2.6%	2.6%	2.5%	1.5%
ERP	Equity-risk premium	6.0%	6.0%	5.0%	5%
	Asset beta	0.50	0.61	0.61	0.6
β_e	Equity beta	0.93	1.10	1.22	1.2
t	Corporate tax	13.5%	12.5%	12.5%	12.5%
r_e	**Cost of equity (pre-tax)**	9.5%	10.5%	9.9%	8.6%
	Debt premium	1.1%	1.1%	1.6%	1.5%
r_d	**Cost of debt (pre-tax)**	3.7%	3.7%	4.1%	3%
g	Gearing	50%	46%	50%	50%
	Real WACC (pre-tax)	7.00%	7.40%	7.00%	5.8%

Source: CAR Determinations

Recent Regulatory Decisions on Cost of capital and Components

Table A3.2: Cost of Capital in Recent Regulatory Decisions/Proposals

	Ireland			Northern Ireland	United Kingdom	
Cost of Capital	**CER** GAS **2017-2022**	**CER** Water **2017-2018**	**CER** Energy **2016-2020**	**Uregni**[1] Gas/Energy **2017-2022**	**Ofwat**[3] Methodology **2020-2025**	**Ofcom**[4] Leased Lines **2016-2019**
Decision/Proposal Date	2017 Oct	2016 Dec	2015 Dec	2016 Sept	2017 Dec	2016 April
Risk-free rate (real)	1.9%	2%	1.9%	1.25%	-0.88%	1%
Equity-risk premium	4.75%	4.75%	4.75%	6.5%	5.5%	5.1%
Asset beta	0.42	0.45	0.40	0.4	0.30	0.70
Equity beta	0.93	0.82	0.89	0.77	0.80	0.96
Corporate tax	12.5%	12.5%	12.5%	20%		19%
Cost of equity (post-tax)	**6.3%**	**5.9%**	**6%**	**5.3%**	**4.01%**	**5.9%**
Debt premium	1%	1%	1%	1%	-	-
Cost of debt (pre-tax)	**2.5%**	**3%**	**2.9%**	**2.26% (G) 2.33% (E)**	**1.33%**	**2.2%**
Gearing (notional)	55%	45%	55%	55%	60%	30%
Real WACC (pre-tax)	**4.63%**	**5.05%**	**4.74% +0.22**[2]	**4.3%**		**6.29%**
Real WACC Vanilla	**4.22%**	**4.6%**	**4.3%**	**3.63%**	**2.40%**	**4.8%**
Real WACC (post-tax)	**4.05%**	**4.43%**	**4.1%**	**3.38%**		

1 Utility Regulator Northern Ireland.
2 Aiming-up allowance to compensate for risk of under-recovery.
3 Real WACC based on Retail Price Index (RPI) of 3%.
4 WACC for other UK telecoms – Real WACC calculated by Ukrn.
Source: CER, Uregni, Ofwat, Ukrn.

16. Appendix 4. Security Queue Audit

Security Queue Measurement

16.1 The security queue target in the 2014 Determination is 100% of passengers queueing for less than 30 minutes. For each day that Dublin Airport fails to meet its target, the annual price cap is reduced by 0.05%, up to a maximum of 30 days or 1.5% of the price cap.

16.2 Security queue times at Dublin Airport are measured by sensors which track Wi-Fi or Bluetooth enabled devices (e.g. mobile phones) carried by passengers as they pass through the security process. Measurement error may arise because of the technical capabilities of the system's sensors and/or the passengers' devices, as well as passengers' behaviours.

16.3 The system is designed to filter out spurious readings using two automated filters: the route filter eliminates invalid queueing, and the 3-stage filter excludes inactive queueing. Dublin Airport then uses the median filter which assumes that, in a given sample, any observations above the median (50%) are considered as outliers. The assessment of compliance of the security queue target is based on the daily maximum of the median filtered queue time

Audit

16.4 In 2016-2017, we conducted an audit to assess whether the passenger experience is accurately reflected by the maximum queue time reported by Dublin Airport using an automated system. The audit examined separately:

- the suitability of the system's filters by means of a walk-through test, and
- the appropriateness of the median filter applied to the system data by comparing these values with a sample of manual queue times.

Route Filtering

16.5 The automated system first measures unfiltered queue time, defined as the time spent by passengers with Bluetooth or Wi-Fi enabled devices between the start of the queue and the end of the scanners.

16.6 Users must be seen at all points up to the final point on the route to be included in the results. A route filter eliminates invalid data that initially follow the queue path but do not finish the queue or reverse to a bounce point set at the beginning of the queue. Invalid observations do not complete the queue process and are not taken into account in the queue times reported to us.

16.7 The following example illustrates how this filter works. During the walk-through test conducted on the 26 June 2016 (explained in more detail in the Walk-Through Test section), one of the test queue times in Terminal 1 was rejected as an invalid sample by the automated system. The device was rejected because it was detected at the check-in area besides the security area at 10:42 and there was then a gap of over 10 minutes before it was picked up again. As per the automated filters, if no signal is detected during a period greater than 10 minutes, the route filter is automatically applied. This is just one of many 'logics' applied by the automated system to determine which observations are valid.

Stage Filtering

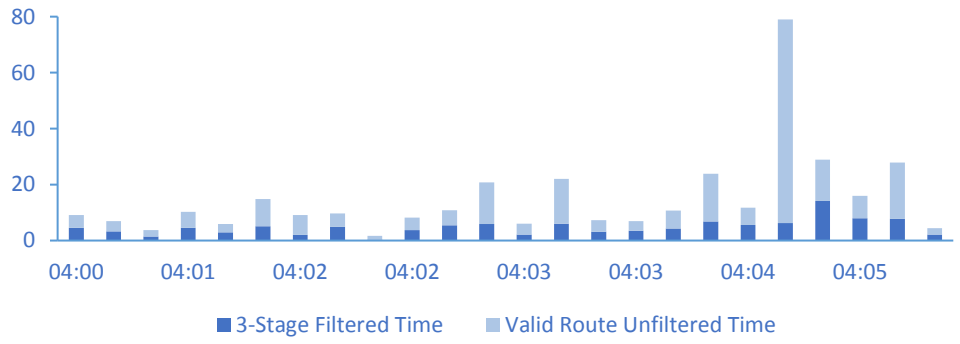
16.8 The second filter consists of a 3-stage logic that adjusts the unfiltered measured time of valid observations by choosing the appropriate start point of the queue, thus removing passengers

who are not actively queuing but rather waiting or joining the check-in process.

- Stage 3 is always active and measures queue times starting after the queueing maze.
- Stage 2, activated if the area above is full, sets the start of the queue at the start of the queuing maze.
- Stage 1 is activated if the extended queuing area (i.e. including the maze) is full, which triggers the start of the queue at the entrance to the departures floor from the doors, lifts or escalators. If Stage 1 is active, passengers who are deemed to be checking-in rather than queuing are removed. This is done by restarting the queue time the next time a passenger starts the queue process, no matter how long the passenger has been out of the start zone, if the passenger has been observed at the nearby check-in counters.

16.9 For instance, data from Terminal 1 displayed in Chart A4.1, from the 22 June 2017 between 4:00am and 4:05am, shows an observation at 4:04am that was deemed to have queued inactively for 73 minutes but actively for only 6 minutes.

Chart A4.1: Valid Route Unfiltered and Filtered Queue Times in Terminal 1



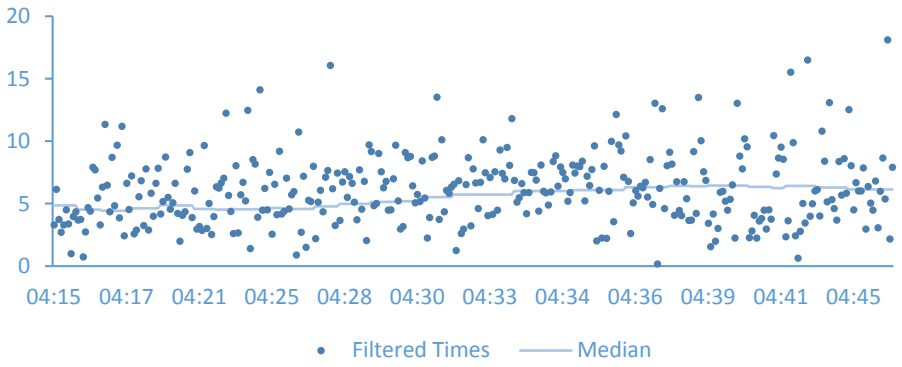
Source: BlipTrack data

Median Filter and Daily Maximum Queue Time

16.10 The median filter is applied by Dublin Airport with a view to removing outliers caused by measurement error. For example, if there were eleven observations sorted from lowest to highest value (5,7,9,11,13,14,15,17,19,21,23) within a 15 minute window, applying the median filter would mean that the maximum queue in that 15 minute window is 14 minutes (the middle value of the data series).

16.11 The median filter is applied to each 15 minute rolling window of observations (i.e. 4:00-4:14:59, 4:01-4:15:59 etc.). A filtered median time is reported for each minute that the system is in operation for the day. Chart A4.2 shows the median filter calculated using queue times in Terminal 1 the same day as above from 4:15am to 4:45am.

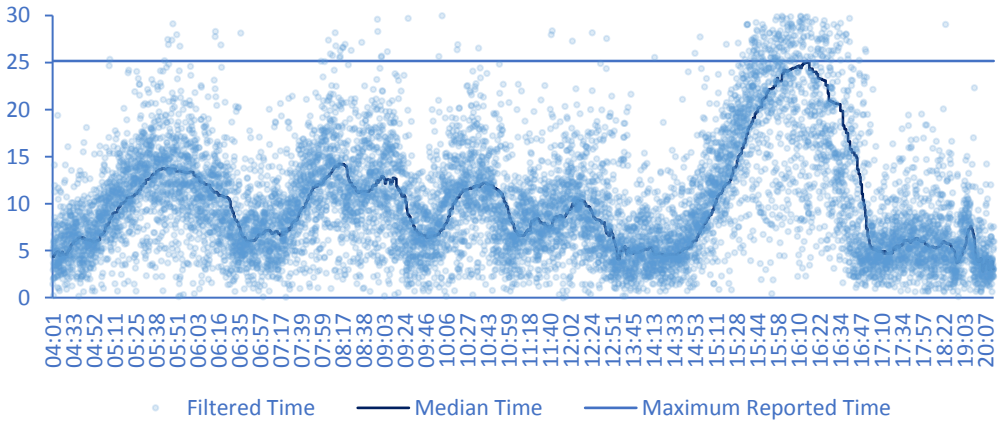
Chart A4.2: Filtered Times and Median Times in Terminal 1



Source: BlipTrack data, CAR Calculations

16.12 The highest of the median measures in each 15-minute window is then deemed to be the daily maximum queue time reported by Dublin Airport. Chart A4.3 shows that the maximum queue time was 25 minutes in Terminal 1 on the 22 June 2017.

Chart A4.3: Filtered, Median, and Maximum Queue Times in Terminal 1



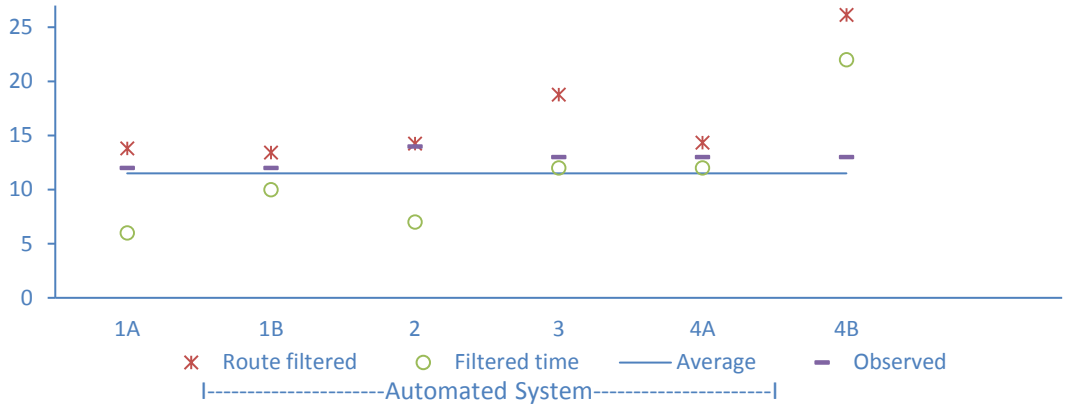
Source: BlipTrack data, CAR Calculations

Results of Walk-through Test

16.13 We conducted a physical walk-through test on 24 June 2016 in Terminals 1 and 2 to examine the accuracy of measured queue times by the automated system at Dublin Airport. Manually recorded queue times were compared with the queue time estimated by the automated systems for devices carried by the testers.

16.14 In Terminal 1, the automated system detected 7 of the 8 test devices. All of the devices detected recorded a completed route, with 6 valid samples and 1 invalid sample (referred to in the Introduction), shown in Chart A4.4. The 6 valid samples consisted of 2 individuals carrying 1 device each and 2 individuals carrying 2 devices each. The average filtered time of 12 minutes (represented by the line in the same chart) underestimates by 1 minute the average observed queue time (13 minutes).

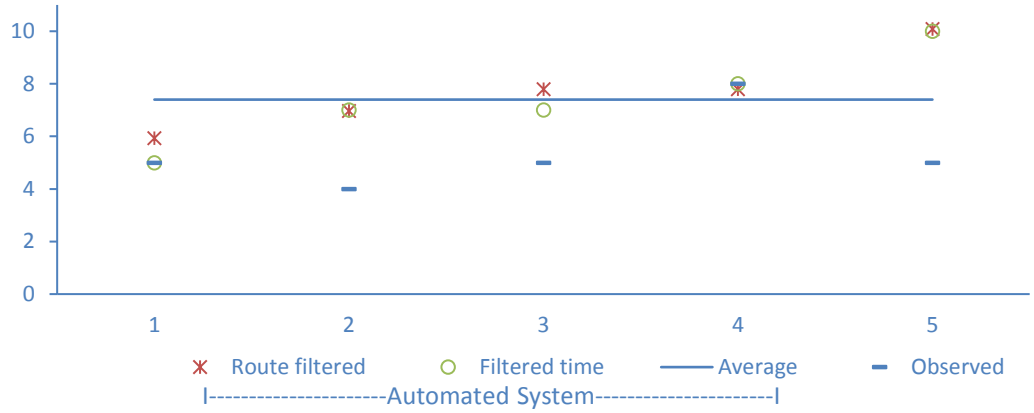
Chart A4.4: Results of walk-through test in Terminal 1, 24 June 2016



Source: BlipTrack data, CAR Calculations

16.15 In Terminal 2, 7 of the 8 test devices were detected and 5 completed routes were recorded. All completed routes, shown in Chart A4.5, were valid samples. Individuals 1 and 4 obtained similar manual and blip track times, while individuals 2, 3 and 5 had filtered times higher than the manual times. The device of individual 5 was picked up by a sensor after the individual stopped queueing, resulting in the filtered time (10 minutes) being double the manual time (5 minutes). The average filtered queue time was 7 minutes (the manual was 5 minutes) and the variance was 1.8 minutes (1.5 minutes for manual times). During the walk-through test in Terminal 2, filtered times mostly overestimated manual queue times.

Chart A4.5: Results of walk through test in Terminal 2, 24 June 2016



Source: BlipTrack data, CAR Calculations

Results of Manual Measurement

16.16 The audit recorded 93 manual queue times in Terminal 1 and 100 queue times in Terminal 2 over 4 days, 2 days in the morning and 2 days in the afternoon peaks respectively. Manual, automated filtered and median queue times recorded during the audit are displayed in the Charts below.

Chart A4.6: Terminal 1, 22 June 2017 4am-9am

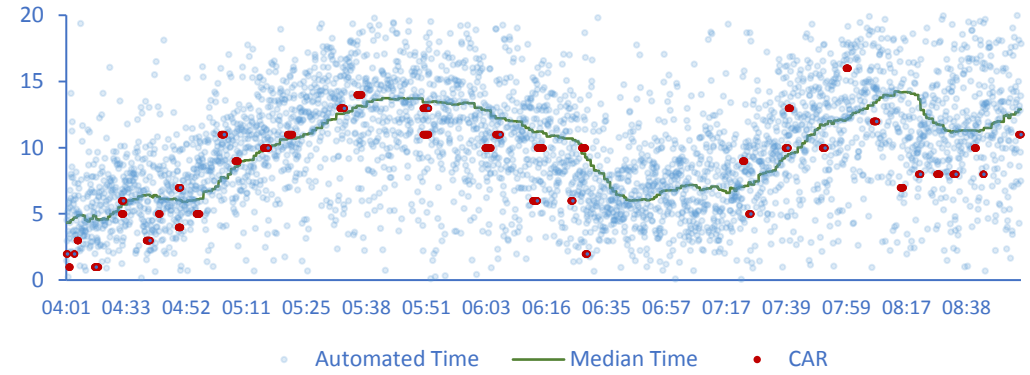


Chart A4.7: Terminal 1, 15 June 2017 9am-5pm

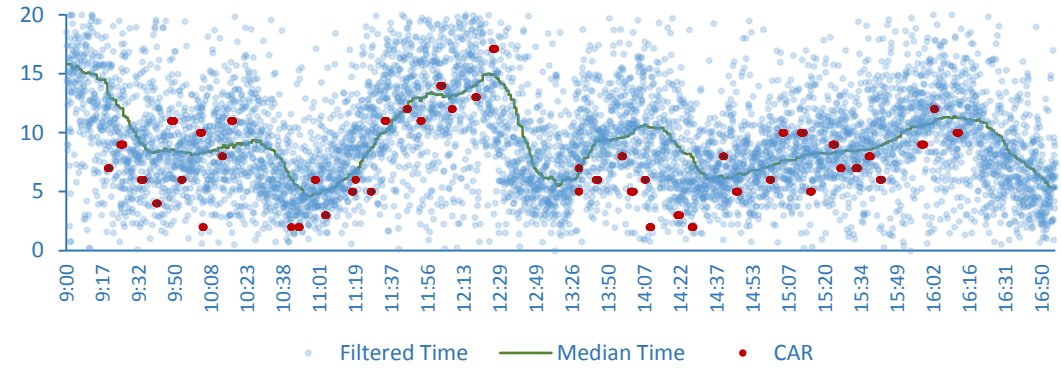


Chart A4.8: Terminal 2, 23 June 2017 4am-9am

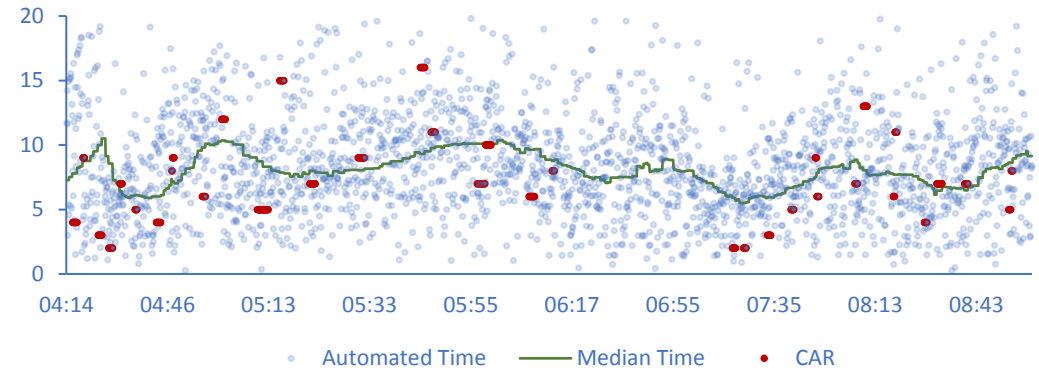
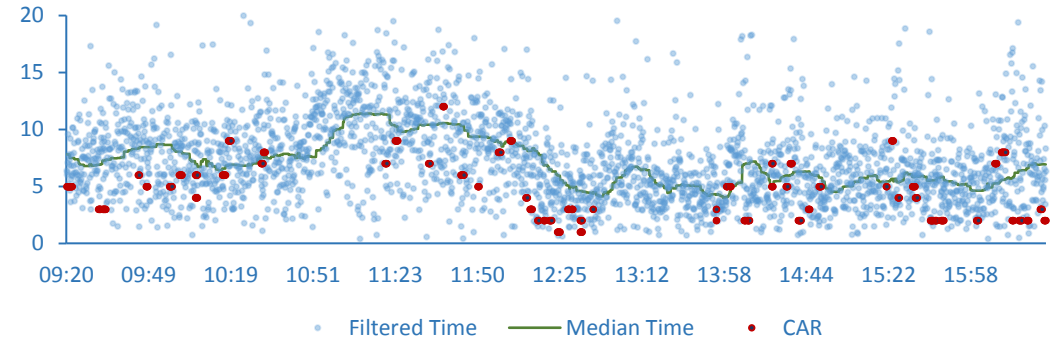


Chart A4.9: Terminal 2, 16 June 2017 9am-5pm



Source: BlipTrack data, CAR Calculations

16.17 Notwithstanding the relatively small sample size of manual queue times, the evidence points to the following two conclusions:

- The automated system allows for the collection of a much larger sample of queue times than would otherwise be feasible; the trade-off is the introduction of what appears to be inaccuracy into the measurements. This must be compensated for by an additional outlier filter, currently a median filter.
- The median filtered queue time appears to be a reasonably good reflection of queue times actually experienced by passengers, although whether it properly reflects the maximum queue times experienced, as set out in the 2014 Determination, is more difficult to say. In some cases, particularly when the queue is very short, it appears that the current methodology overstates the length of the queue.

16.18 Table A4.1 shows that 29% of sample queue times in Terminal 1, and 19% in Terminal 2 are above the median recorded when the queue finished; and 16% in Terminal 1 (13% in Terminal 2) are above all the median queue times for the following 15 minutes after the queue finished as per the 15-minute rolling window methodology. 1 sample queue time was above the daily maximum queue time in Terminal 1 on 15 June, and 1 in Terminal 2 on 23 June.

Table A4.1: Sample queue times above median values and reported maximum queue time

Sample queue times above the:	Terminal 1	Terminal 2
Median reported for the minute when an observation was obtained	29%	19%
All relevant 15-minute windows	16%	13%

Source: CAR manual sample of queue times, BlipTrack data, CAR analysis

Conclusions of the Security Queue Audit

16.19 The results of the walk-through test show that first, automated queue times may have a higher standard deviation than observed times, making it challenging to calculate maximum queue times; and secondly, the presence of inaccurate readings indicates that a filter for outliers is needed to establish the maximum queue time.

16.20 The median filter assumes that any observations above the median (50%) are considered as outliers, but the results showed that only 29% of observations in Terminal 1 and 19% of observations in Terminal 2 are above the median. This may indicate that there are inaccurate readings that need to be compensated for by using the median filter. The audit highlighted the inherent difficulty in establishing maximum queue times, but it showed that median times were good estimates of passenger queue times.

16.21 By chance, on none of the four days we were taking manual measurements at the time when the maximum automated queue time was recorded; had we been present, and this pattern continued, we may have observed more queue times greater than the daily reported maximum. We would note again the difficulty in distinguishing the true maximum queue time from outliers.

Recommendation of the Security Queue Audit

16.22 Ahead of the 2019 determination, Dublin Airport is expected to consult with users on desirable quality of service measure(s) and target(s) in relation to security queue times. The findings and conclusions of this audit should be taken into account. Dublin Airport should make users aware of any relevant information including the associated costs and implications of proposed changes. No change may be required if users are satisfied with the current target and measurement methodology.