Dublin Airport Operating Expenditure: Bottom-up Efficiency Assessment

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Commission for Aviation Regulation

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CONTENTS

EXECUTIVE SUMMARY

Scope of work

Dublin Airport is subject to price-cap regulation by the Commission for Aviation Regulation (CAR), with the current price control running from 1 January 2015 to 31 December 2019. CAR has commissioned CEPA and Tailor Airey to assess the efficiency of Dublin Airport's operating expenditure (opex) using bottom-up analysis, and to forecast the airport's efficient opex for the next regulatory period.

Context

Traffic at the airport has grown rapidly during the current price control period, with passenger numbers and opex exceeding the forecasts laid out in CAR's 2014 determination.[1] This large increase in passenger numbers seen over the current control period has meant that Dublin Airport has been able to spend more while maintaining profitability. Our analysis shows that if Dublin Airport's opex allowance was set using forecast passenger numbers that matched actual traffic, opex would have exceeded the allowance by €53 million in 2017.

Most of the increase in spend has been driven by staff costs, which make up approximately 60% of Dublin's opex. The airport has chosen to hire additional staff to handle the extra passenger traffic, including within its corporate departments, and has increased staff salaries in real terms over the current price control period.

Conclusions

CAR's issues paper[2] for the next price control period (the "2019 determination" likely to be 2020-2024) noted several possible explanations for the difference between outturn opex and the opex allowance:

- The assumptions around the elasticity of opex with respect to passenger numbers were unrealistically low – in other words, the expectations around economies of scale from an increase in passengers were too ambitious;
- Dublin Airport failed to realise efficiencies that were potentially achievable;
- The increase in passenger numbers happened too quickly and at too large a scale to allow for a planned response, which would have been more efficient in the longer term; or
- A combination of the above.

Our report finds that opex has exceeded the efficient level, even when allowing for a growth in passenger numbers, for a combination of the reasons that the CAR identified:

The airport faces some difficult challenges for example where staff, especially those in Terminal 1, benefit from terms and conditions that are outside of current wider market norms. This combined with a challenging employment market has made it difficult to drive down cost as was anticipated in the last determination. However, we consider that Dublin Airport could have been more cautious about hiring

[1] When CAR set its targets, it used a combination of both high and low ambition forecasts from the previous efficiency study and updated them using newer passenger forecasts. As the determination only included high-level targets, we went back to the efficiency study to understand the implied targets at a more granular level, replicating CAR's assumptions around passenger numbers and level of ambitiousness.

[2] https://www.aviationreg.ie/_fileupload/2019%20Determination/2018-04-30%20CP7%20Issues%20Paper.pdf

staff. We find that the airport has not achieved some efficiencies that we consider are achievable e.g. through delivering service in other ways (for example improving signage and using fewer wayfinding staff), making the best of outsourcing where that is achievable (e.g. cleaning) and/or negotiating greater employment flexibility as a means to deliver cost efficiency. We also find limited evidence to justify the large growth of staff numbers in central (corporate) departments.

In part we consider that the inability to make these sorts of changes has been driven by the need to respond rapidly to growing numbers of passengers particularly in Terminal 1 where space is constrained. However, the airport has not demonstrated that it can readily unwind resulting cost increases when it is in a position to implement longer term more efficient solutions. We find that the cost increases made in the current period are generally included in the base costs from which the airport then projects it future costs. Overall, we consider Dublin Airport could do more to reduce opex by thinking differently and over the longer term about how it meets the needs of a growing airport rather than reverting to increasing costs e.g. employing more staff, to manage growth.

Implications of our findings for cost forecasts

Our analysis has been conducted on a bottom up basis, through a detailed review of the 18 categories of opex which make up the complete operating cost of the airport. The base data that we have used was provided by Dublin Airport and is formed of actuals to end 2017, a mix of actual and projected costs for 2018 and projected costs for 2019.

Our forecasts start from 2019 and run to 2024 i.e. they cover the current year and next control period. In some cases, we do not adopt Dublin Airport's actual or estimated costs as our start point. This is because we consider that the efficient level of costs is lower. We do however allow some glidepath for costs that we consider are as a result of structural issues that Dublin Airport could not reasonably have been expected to reduce over the current determination period. Conversely, we do not include a glidepath for efficiencies that we believe were achievable by an efficiently run airport. It will be for CAR to determine whether the allowances set for Dublin Airport start from our forecast levels or from Dublin Airport's current levels of opex (or some other point).

Overall our estimate for 2019 expenditure is higher than the CAR's 2014 determination target (because we are allowing for passenger growth), but approximately €27 million lower than Dublin Airport's budgetary estimate for the year. The gap between our forecasts and those procured by Dublin Airport grows over the course of most of the next control period; there is some narrowing of the gap but only in 2024.

Our forecasts are driven, principally, by staff costs and assume a steady increase in staff numbers over the next determination period but starting from a lower base than that assumed in Dublin Airport's budgetary forecasts. Under our forecasts, headcount per passenger reduces from 78 per million passengers to 69 per million passengers between 2019 and 2024, bringing it into line with other similarly sized airports.

Our review also covers the impacts that Dublin Airport's capital investment programme will have on future opex. Dublin Airport has produced a high-level estimate of these impacts which we have used for the purposes of our review. We accept most of the impacts the airport has set out and make corresponding adjustments to our cost forecasts. However, we make some adjustments to certain categories e.g. CIP IT projects, where we consider that not doing so would result in a material double counting of costs already included.

Our final forecasts are provided below:

Table 1: Summary of forecast opex at Dublin Airport, 2019-2024 (€ million, 2017 prices)

	2019	2020	2021	2022	2023	2024
Payroll						
Security	37.8	39.0	39.9	40.9	41.8	42.8
Maintenance	15.3	15.5	15.6	16.0	16.1	16.2
Central functions	23.1	23.6	24.0	23.9	23.8	23.8
Facilities and cleaning	21.5	21.6	21.6	21.6	21.6	21.6
Campus services	21.9	22.4	22.7	23.1	23.5	23.8
IT	7.0	7.2	7.3	7.5	7.7	7.8
Retail	16.9	16.0	15.4	15.2	15.1	14.9
Airside operations	6.5	6.7	6.8	6.9	7.0	7.1
Car parking	1.7	1.8	1.8	1.7	1.7	1.7
Capital projects	1.9	2.4	2.8	2.8	2.9	2.9
Non-pay						
Maintenance	13.1	13.1	13.2	13.4	13.4	13.4
Facilities and cleaning	3.7	3.6	3.6	3.6	3.5	3.5
IT	8.9	8.9	8.8	8.7	8.6	8.5
Car parking	4.8	4.9	5.0	5.1	5.2	5.3
Employee-related overheads	6.0	6.0	6.0	6.0	6.0	6.1
Rent and rates	14.2	14.2	14.2	14.2	14.2	14.2
Consultancy services	6.1	6.3	6.3	6.4	6.5	6.6
Marketing	7.4	7.5	7.6	7.7	7.8	7.9
Insurance	3.7	3.8	3.8	3.9	4.0	4.0
PRM	8.2	8.5	8.7	9.0	9.3	9.5
Other overheads	21.6	23.6	23.7	22.9	23.0	23.1
Utilities	7.4	7.6	7.9	8.0	8.2	8.4
Totals						
Pay	153.8	156.0	157.8	159.6	161.1	162.8
Non-pay	105.2	108.0	108.9	109.0	109.7	110.6
Total opex (excluding CIP)	**258.9**	**264.1**	**266.7**	**268.6**	**270.9**	**273.3**
CIP		0.5	3.4	14.7	18.3	17.2
Total opex (including CIP)	**258.9**	**264.6**	**270.1**	**283.3**	**289.1**	**290.5**
Opex per passenger, excl. CIP (€)	8.0	7.9	7.7	7.5	7.4	7.2
Opex per passenger, incl. CIP (€)	8.0	7.9	7.8	7.9	7.9	7.7

1. INTRODUCTION

1.1. BACKGROUND

Dublin Airport is subject to price-cap regulation by the Commission for Aviation Regulation (CAR), with the current price control running from 1 January 2015 to 31 December 2019. CAR has commissioned CEPA to assess the efficiency of Dublin Airport's operating expenditure (opex) using bottom-up analysis, and to forecast the airport's efficient opex for the next regulatory period.

Dublin Airport is Ireland's busiest airport and the only one subject to price-cap regulation. It is operated by daa plc, a state-owned enterprise operating on a commercial basis. daa plc currently has four main parts:

- Dublin Airport, which is considered the 'regulated entity' for the purposes of this report;
- Cork Airport, which is not subject to economic regulation;
- Aer Rianta International (ARI), which operates duty free and airport retail outlets at various airports both domestically and internationally; and
- daa International, which operates terminal concessions at airports outside Ireland.

A proportion of daa's group costs are allocated to the regulated entity for the purposes of setting a price cap.

1.2. CURRENT PRICE CONTROL PERIOD

Dublin Airport traffic has grown rapidly during the current price control period, with passenger numbers and opex all exceeding the forecasts laid out in CAR's 2014 determination.[3] Passenger numbers grew on average by 11% per annum over the period 2014 to 2017, compared with a CAR assumption of 3%. During the preceding price control period, passenger growth was lower, having grown by an average of 4% per annum over the period 2010 to 2014.

Higher outturn passenger numbers partially explain the difference between actual opex and forecast opex. However, most of the difference comes from the 2014 determination assuming much lower elasticities of opex with respect to passenger numbers than was actually experienced. In other words, the 2014 determination was set on the basis that opex would grow more slowly than passenger numbers.[4] As shown in Figure 1.1 below, if Dublin Airport's opex allowance was set using forecast passenger numbers that matched actual traffic, opex would have still exceeded the allowance by €53 million in 2017.

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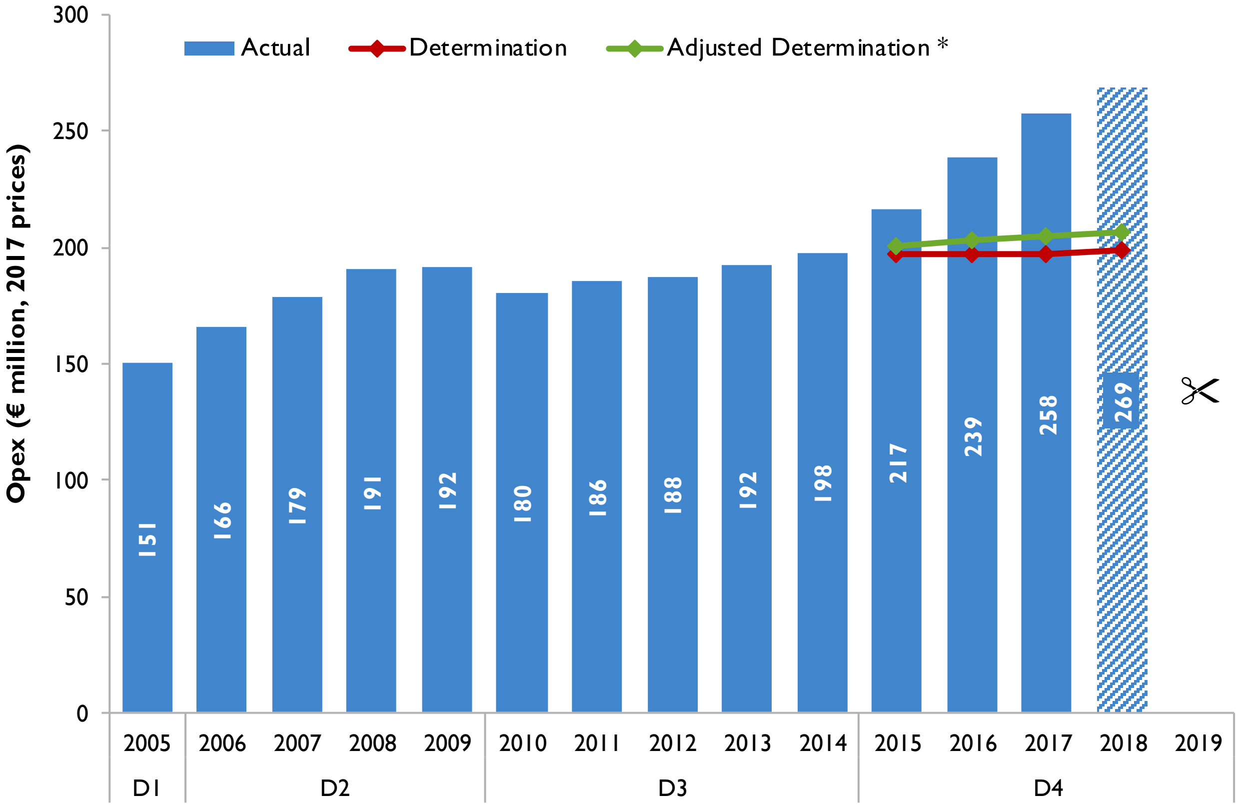
[3] When CAR set its targets, it used a combination of both high and low ambition forecasts from the previous efficiency study and updated them using newer passenger forecasts. As the determination only included high-level targets, we went back to the efficiency study to understand the implied targets at a more granular level, replicating CAR's assumptions around passenger numbers and level of ambitiousness.

[4] The CAR typically sets Dublin Airport's opex allowance with reference to cost elasticities, i.e. for every percentage point increase in passenger numbers opex is assumed to grow by X%, with X% being the cost elasticity. Different cost elasticity assumptions are set for different types of operating cost, as some types of cost will be more driven by passenger numbers than others. By applying the cost elasticity assumptions used in the 2014 determination to actual passenger numbers, we can see the extent to which the increase in opex is due to a higher than expected increase in passenger numbers or due to other reasons.

Figure 1.1: Dublin Airport outturn operating expenditure against CAR Determination, (€ million, 2017 prices)



Source: Dublin Airport; CAR determination; CEPA analysis
Note: The adjusted determination is what the CAR determination would have been if passenger numbers had been accurately predicted

CAR's issues paper[5] for the next price control period (the "2019 determination" likely to be 2020-2024) noted several possible explanations for the difference between outturn opex and the opex allowance:

- The assumptions around the elasticity of opex with respect to passenger numbers were unrealistically low – in other words, the expectations around economies of scale from an increase in passengers were too ambitious;
- Dublin Airport failed to realise efficiencies that were potentially achievable;
- The increase in passenger numbers happened too quickly and at too large a scale to allow for a planned response, which would have been more efficient in the longer term; or
- A combination of the above.

1.3. Our study

This study provides an independent forecast of the efficient level of opex at Dublin Airport over the 2019 determination period. This study will inform CAR when it sets the airport's opex allowance, which is one of the regulatory building blocks for the price control.

[5] https://www.aviationreg.ie/_fileupload/2019%20Determination/2018-04-30%20CP7%20Issues%20Paper.pdf

CAR has commissioned CEPA to take a 'bottom-up' approach to forecasting efficient opex, where the operating expenditure is taken at its most granular level and projected forward. This means taking individual items of operating cost (e.g. security staffing, energy costs, rents etc.) and determining efficient levels of these costs, either through benchmarking, expert judgement, or other quantitative methods. We are being supported by Taylor Airey in this study, which has experience in airport operations and in developing efficient staffing arrangements.

For this study, we have reviewed Dublin Airport's performance since 2014 to see whether its recent growth in opex can be considered efficient. We have then forecast efficient operating expenditure by cost category and under different scenarios. To do this, we have used cost elasticity assumptions, i.e. estimates of how we expect expenditure in different categories to grow relative to passenger growth. The scope of the study covers all opex within the regulated entity – excluding capitalised costs but including costs incurred by daa group that are allocated to the regulated entity.

Our opex forecasts present what we believe would be achievable if Dublin Airport had been exposed to a fully competitive environment over the current determination period. Where we identify areas of inefficient expenditure that we believe Dublin Airport could have reduced over recent years, we remove such expenditure. However, our forecasts include allowances for structural inefficiency where we believe these are difficult to resolve. It will be up to CAR to set the opex allowance for Dublin Airport, given its existing levels of expenditure and our overall forecast for 2020-2024.

The results of our analysis are presented in this publishable draft report, ready to inform the draft price control determination due to be published in April 2019. Following a consultation on CAR's draft determination, we will review submissions received on our report and on the draft determination. We will then provide a revised set of forecasts for CAR's final determination.

1.4. This report

The remainder of this report is structured as follows:

- In Section 2, we provide regulatory context and detail our approach, specifying the evidence we have used and the stakeholder engagement we have conducted, and presenting the elasticities and other assumptions used in our forecasts;
- In Section 3, we provide an overview of Dublin Airport's historic operating expenditure, its staffing and salary levels, and assess its performance relative to the 2014 determination;
- In Section 4, we present our efficiency analysis and forecasts for each staff-related opex category;
- In Section 5, we present our efficiency analysis and forecasts for each non-pay opex category;
- In Section 6, we present our review of Dublin Airport's Capital Investment Plan and our estimates of the impact of the plan on opex; and
- In Section 7, we summarise the results of our forecasts.

2. APPROACH

2.1. Regulatory context

In this study, we have been tasked with identifying an *achievable* efficient level of opex for Dublin Airport for the years 2020 to 2024. We have built up an estimate of efficient level of costs by examining a) salary levels b) staff numbers and c) efficiency of non-staff costs.

In doing so, we have concluded that the efficient level of opex is below existing levels of expenditure. For example, in 2018 operating costs were estimated to be €268 million and Dublin Airport are predicting costs to be ✂✂✂✂ in 2019, whereas our estimate of the efficient level of costs in 2020 is €263 million (all in 2017 prices).[6]

It is important to note that this is not a "green-field" level of efficient opex. It is higher than such an exercise would identify as we have made allowance for structural inefficiencies, which we believe would be difficult to resolve in the next control period. Our forecasts are set at a level that we believe Dublin Airport could have delivered by now if opex had been more closely managed from 2015 to 2019. Our forecasts do not include any reduction in staff numbers or salary levels below those forecast in the 2014 Determination.

Efficiencies had previously been identified by CAR and were used in setting the allowances for the 2014 determination (2015-2019). CAR's consultants had identified additional efficiencies in their study that were not used by CAR in setting the opex allowance. In key cost items, CAR used "low ambition" levels of efficiency improvements but these efficiencies have not been realised by the airport.

We discuss in the rest of the report, how passenger growth between 2015 and 2018 exceed normal levels and how Dublin Airport did not always respond to this with the most efficient solutions. In some case we have allowed Dublin Airport time to achieve efficiencies. In others, where we believe Dublin Airport should be at the efficient level identified (if costs from 2015-2018 had been more controlled) we have not allowed time to achieve the efficiencies. This is detailed fully in Sections 4 and 5.

It is not within the scope of this study, or the role of the regulator, to prescribe the exact methods for Dublin Airport to achieve the level of opex we have identified. There are many ways this could be achieved. Much can be achieved through natural attrition and filling roles with staff on more flexible contracts. More flexibility in contracts, for example, would allow staff to work on a range of different activities during the day, depending on necessity enabling them to be more productive than otherwise. More can also be achieved through changes in working practices, such as improvements to signage and less reliance on staff for wayfinding. It is also worth noting here that opex is set in real terms, so salary increases to keep up with inflation are included when adjusting the price cap for inflation.

CAR will now consider what allowances to set for Dublin Airport. It must decide if the starting point is where Dublin Airport could have been if there had been more control on costs in the past 3 to 4 years, as we have identified, or if the starting point is the current level of opex, or somewhere in between.

[6] The 2018 and 2019 figures are based on Dublin Airport's estimates as of November 2018

2.2. Data collected / stakeholder consultation

We use several sources of evidence in this report. Our primary source is the cost and budget data provided by Dublin Airport for the years 2010 to 2019, augmented with data for the years 2005 to 2009 taken from spreadsheets used in the previous opex efficiency study.[7] Whilst the data to 2017 is based on audited accounts and is reflective of actual costs, data for 2018 is partially based on outturn spend and partially on anticipated expenditure for the remainder of the year. 2019 figures are budgetary forecasts provided by Dublin Airport.[8]

Other evidence we have analysed includes:

- material provided to us by Dublin Airport following information requests, such as staff rostering patterns, airport usage metrics, and passenger forecasts;
- information gathered from discussions with airport and airline management;
- benchmark data from other airports' annual accounts;[9] and
- desk research and analysis.

In our meetings with Dublin Airport, we interviewed members of both the regulatory and finance teams, as well as members of the senior management team responsible for maintenance, retail, operations and HR. We discussed:

- how key functions of the airport operate;
- how Dublin Airport's opex has evolved during the current determination period;
- what steps airport management has taken to improve efficiency;
- the impact of additional passenger numbers on opex; and
- how airport management expect opex to evolve in future.

Our meetings with airlines included interviews with Aer Lingus and Ryanair. We discussed their perceptions of the efficiency of Dublin Airport, how service quality has evolved over time, and their recent experience in the local labour market compared to Dublin Airport's experience.

2.3. Core assumptions

Inflation / Price base – The majority of monetary figures presented in this report are presented in 2017 prices. Where monetary figures are given in nominal terms, we state this explicitly. We have used the Consumer Price Index (CPI) for Ireland to inflate historic figures to 2017 prices. For future rates of inflation, we take an average of available CPI forecasts to produce a consensus forecast based on:

- Central Bank of Ireland Quarterly Bulletin, Q4 2018 (2018-2020)
- IMF World Economic Outlook, October 2018 (2018-2023)

We assume inflation in 2024 will be the same as 2023.

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[7] As the historic data is taken from two different data sources, there are some small areas of discrepancy where Dublin Airport have recategorized certain areas of spend since the last efficiency study was conducted. We have compared the two sets of data and concluded that they do not affect the results of our analysis. We therefore present the determination target as originally set (under the old categorization), but present outturn expenditure against Dublin Airport's new categorization.

[8] The 2018 and 2019 figures are working estimates as understood by Dublin Airport when the figures were extracted from their accounting system

[9] Annual accounts are taken from each airport's website

Passenger forecasts – As we are forecasting opex using passenger elasticities, our projections are inevitably very sensitive to the passenger forecasts. We use CAR's emerging passenger forecasts, which are set at an airport-wide level, to estimate future opex growth. Although recent growth in Terminal 1 has been stronger than Terminal 2, we do not have a strong evidence base to suggest this trend will continue. We therefore assume percentage growth in both terminals will be equal.

Energy and fuel price growth – We use the UK Department of Business Energy and Industrial Strategy's (BEIS) fossil fuel price forecasts to generate assumptions around the growth of energy and fuel costs. We have tested these against the assumptions used by Dublin Airport and they are broadly similar.

Wages – We have used statistics on historic wage growth to compare how wages for specific roles compare with similar roles elsewhere in the Irish economy. We use data from the Central Statistics Office, specifically the June 2018 release of Annual Earnings and Labour Costs, including bonuses and overtime. The data is provided for wages in Ireland as a whole, as well as wages in specific economic subsectors. We assume in using this data that Dublin Airport unit payroll costs should grow at the same rate as appropriate Irish wage forecasts.

All our forecasts are based on an average of available forecasts of nominal wage growth in the Irish economy using:

- ESRI Quarterly Economic Commentary, Winter 2018 (2018-2019)
- Central Bank of Ireland Quarterly Bulletin, Q4 2018 (2018-2020)

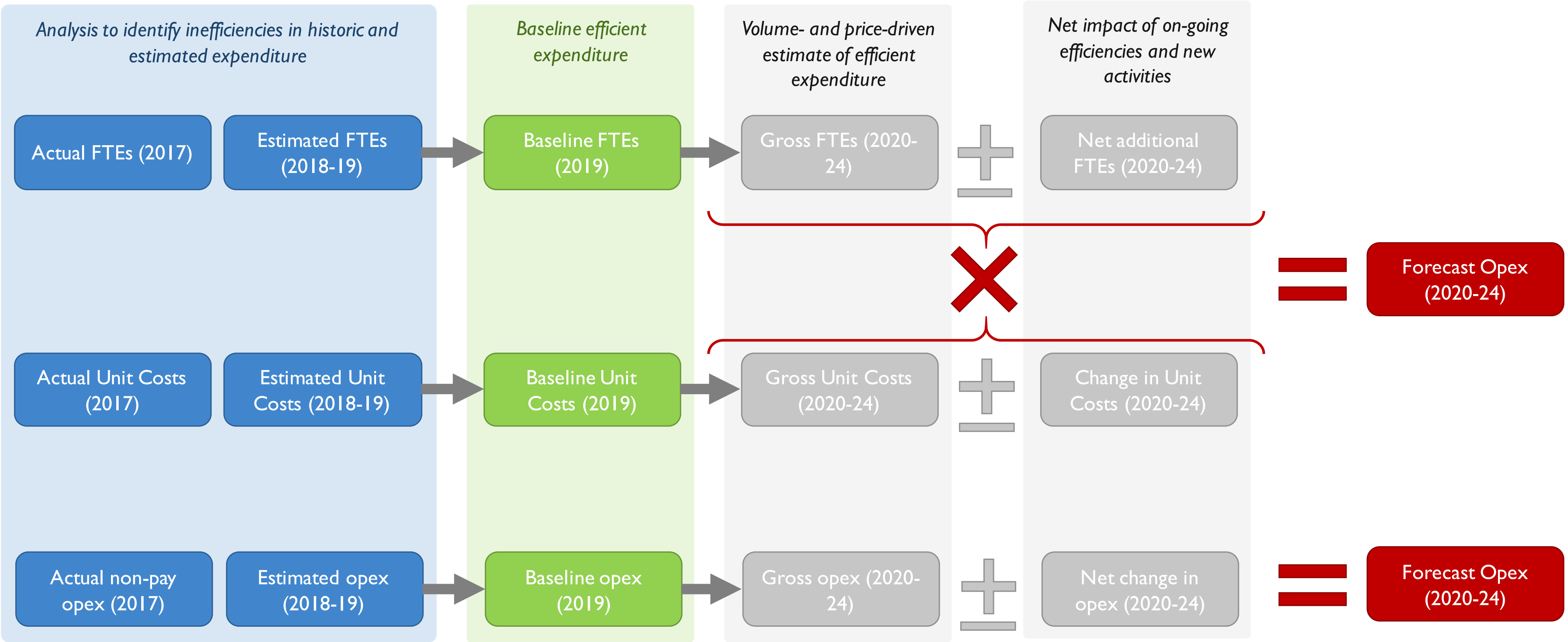
We assume real wage growth from 2021 onwards will be 1.5% in line with the historic average growth in real wages in the Irish economy in recent decades. In Section 4.1, we present further detail on our approach to forecasting wages for each role.

2.4. OUTLINE ANALYTICAL APPROACH

Our approach at a high level has been to deconstruct the costs and operations of the airport into its component parts, and largely consider these separately, except to the extent that there are identifiable dependencies. We have considered 18 broad categories of spend, though where appropriate we have split this into more granular components, separately assessing individual accounting lines, and separately considering staff numbers, unit payroll costs, and non-pay costs.

We illustrate in Figure 2.1, the analytical approach we have taken to producing the opex forecasts.

Figure 2.1: Approach to estimating forecast efficient operating expenditure at Dublin Airport



2.4.1. Identifying the efficiency gap

For each category of spend, we examined actual expenditure against what was assumed in the 2014 determination. We assessed the efficiency of outturn expenditure, benchmarking externally against other airports or internally between terminals, and by calculating productivity metrics. We also considered qualitative evidence on the efficiency of expenditure provided by Dublin Airport and airlines.

For staff and utilities costs, we considered staffing levels and utility usage rather than spend as a whole. We then assessed the efficiency of salary costs and unit utility costs separately.

Collectively, this evidence allowed us to determine whether historic expenditure has been efficient and to determine the size of any inefficiency. We then sought to identify any themes running across the categories of spend, their overall implications for opex, and to identify any specific conditions that exist at Dublin Airport that would affect its operating costs.

2.4.2. Establishing baseline expenditure

Once we identified the size of the efficiency gap for each category, we constructed an estimate of 2019 expenditure, which formed our baseline. We constructed this in one of two ways:

- Taking Dublin Airport's estimate for 2019 expenditure / staffing levels and removing any inefficiency; or
- Taking Dublin Airport's outturn 2017 expenditure / staffing levels, removing any inefficiency and then forecasting forward using appropriate volume or cost drivers.

The scale of inefficiency we have removed is based on both our judgement of what is immediately achievable, and what could and should have been achieved during the current determination period.

As we have conducted our efficiency analysis against outturn 2017 data, we have used this year as our starting point. However, for some areas of spend, Dublin Airport estimate a notable increase or reduction in expenditure or staffing levels between 2017 and 2019. Where these have been adequately explained by Dublin Airport, we have used the 2019 estimate having first removed inefficiency.

For unit payroll costs, the unique nature of many roles at Dublin Airport means that we have not been able to find reliable, external estimates of efficient salary costs. As a result, we have relied on making comparisons between staff at Terminal 1 versus those at Terminal 2, and comparisons with Dublin Airport's historic performance, to estimate efficient payroll costs.

2.4.3. Forecast expenditure forwards

From this baseline, we project gross expenditure by applying a passenger volume related elasticity to passenger forecasts. For certain cost categories, we use other cost drivers, such as energy price forecasts or projections of wage growth. Finally, we produce the forecast efficient expenditure by adjusting the gross expenditure estimates for any anticipated step changes, such as costs arising from new activities, the implementation of efficiency initiatives and ongoing productivity improvements.

2.4.4. Opex implications of capital expenditure

We separately assess the opex impact of Dublin Airport's Capital Investment Plan. Dublin Airport has presented to us its estimates of how operating expenditure is likely to be affected by future capital spending. We have reviewed these estimates and the methodology used to produce them. Where we believe these estimates are reflective of efficient costs, we have included them in our forecasts. We have also considered areas of capital investment that should lead to reduced expenditure, through lower maintenance costs or efficiencies in the placement of staff.

2.5. ELASTICITY ASSUMPTIONS

To build our passenger elasticity assumptions, we used a selection of evidence:

- We conducted a literature review of previous consultancy studies, academic articles, and regulatory reviews, on the economies of scale of airport operations and cost elasticities with respect to passenger numbers.
- We undertook econometric analysis of how different categories of opex respond to passenger numbers, for a panel of twelve airports. We generally found results that were insignificant or sometimes contradictory depending on the time period used. This highlights the difficulty of undertaking analysis at a more granular level, where data is not always consistently defined between airports. We also considered how this varies by airport size and whether economies or diseconomies of scale are non-linear to the number of passengers. A full description of our econometric analysis can be found in Appendix B.
- Where we had a detailed understanding of how particular areas of airport operations are affected by passenger numbers, we used bottom-up calculations to estimate elasticities.
- For other categories of opex where we did not have evidence on cost elasticities, we used broad approximations for our elasticity assumptions based on our understanding of how the area of operation is likely to be affected by passenger numbers. For example, where we believed there is a weak link to passenger numbers, we applied an elasticity of 0.1.
- We separately account for short-run and long-run elasticities. We assume that in the short-run, airport capacity is fixed while in the long-run it can adjust to changes in passenger traffic. The elasticities presented in this section represent the short-run reaction of cost to passenger numbers only. We separately account for any changes in capacity through step-changes in our forecasts.

For categories of opex where a link to passenger numbers may not appropriately reflect how costs evolve, we considered other drivers that provide a better forecast. For example, we estimate elasticities of non-payroll car park costs with respect to both passenger numbers and fuel prices. Staff numbers required for certain functions such as cleaning, are forecast with respect to terminal space.

2.5.1. Elasticity of overall opex

There is extensive literature on how airport opex generally responds to passenger numbers. However, most of the literature has focused on total opex rather than attempting to separately estimate the elasticity of different components of opex with respect to passenger numbers.

Some of the literature are regulatory studies by consultancies, competition authorities and economic regulators, which have tended to focus on a small panel of airports and result in lower estimates of cost elasticities. Others have been academic studies that were conducted on datasets covering a large sample of airports and resulted in higher estimates of cost elasticities.

The general consensus of the regulatory studies is that the elasticity of opex with respect to passenger numbers is between 0.3 and 0.5, whilst the academic papers estimate an elasticity in the range 0.5 to 0.7. One explanation for this difference is that academic papers may take a long-run approach to estimating airport elasticity where capacity is treated as variable. If airports increase capacity in the long-run in response to growing passenger numbers, this can explain why academic studies find higher elasticity estimates than their regulatory counterparts. As we are separately dealing with any capacity related cost increases, we use a short-run elasticity estimate in line with the regulatory literature studies. Our econometric benchmarking estimated cost elasticities within this range, finding that economies of scale reduce as airports get larger.

However, as we are undertaking a bottom-up assessment of future efficient opex at Dublin Airport, an overall cost elasticity is of limited helpfulness. Where we believe particular cost areas have some link to passenger numbers but are not directly linked on a one-for-one basis, we use a mid-point elasticity estimate of 0.4 in the absence of any better evidence on the relationship with passenger numbers. The use of this mid-point estimate is supported by our own elasticity benchmarking where we find a short-run elasticity estimate of 0.37. For these areas, we therefore assume that a 1% increase in passenger numbers will lead to a 0.4% increase in expenditure.

The aggregate effect of our short-run cost elasticity assumptions is approximately 0.33, which is within the range estimated in the regulatory studies referenced above and similar to our own econometric benchmarking analysis. When we incorporate the impact of the CIP on opex (presented in Section 6), we find a total implied long-run elasticity of 0.73.

2.5.2. Elasticity of staff numbers

The table below shows the elasticity of staff numbers with respect to passenger numbers used in this study, compared with the previous two efficiency studies. Where the table notes a different driver, this has been used instead of passenger numbers.

Table 2.1: Elasticity assumptions related to staffing requirements used in this study compared with previous studies

	Jacobs	SDG	CEPA	Driver	Explanation
Security	1.00	0.30			For Terminal 1 and Terminal 2 security, we make a bottom-up assessment of operational processes to estimate the cost elasticity.
- Terminal 1 security			0.62		
- Terminal 2 security			0.56		
- Other			-		
Maintenance	0.60	-			We make a judgement based on the activities undertaken by role. We are supported by the econometric analysis which shows that at larger airports, maintenance costs are less elastic to passenger numbers than at smaller airports.
- passenger driven			0.40		
- non-passenger driven			-		
Central functions	-	-			We make a judgement based on staff roles. For most roles we would not expect staffing levels to be driven by passenger numbers. For HR staff, we apply an elasticity of 1 for those whose numbers are directly affected by staff numbers and apply and elasticity of 0 for the rest.
- HR			0.69	Staff numbers	
- transfer facility			0.20		
Facilities and cleaning	0.60	-			We estimate these based on historic patterns at Dublin Airport
- cleaning			0.40	Pax accessible space, m^2	
- terminal services			0.20		

- other			-		
Campus services	-	-	0.10		We make a judgement based on the role and based on historic patterns at Dublin. We expect most of these roles to be driven by the size of the campus rather than passenger numbers.
IT	-	-	0.10		Judgement based on the activities undertaken by role.
Retail	0.30	0.70	0.20		Judgement based on the activities undertaken by role.
Airside operations	-	-	0.10		We estimate these based on historic patterns at Dublin and the link between flight numbers and passenger numbers.
Car parking	-	-	-		We find no historic link between staffing requirements and passenger numbers.
Capital projects	-	-	-		We find no historic link between staffing requirements and passenger numbers.

2.5.3. Elasticity of non-pay costs

The table below shows how we expect non-staff costs to develop, for areas that include both payroll and non-pay costs.

Table 2.2: Cost elasticity assumptions related to non-pay costs

Cost category	CEPA	Driver	Explanation
IT	-		We would not expect there to be a short-run link with passenger numbers
Facilities and cleaning	-		We would not expect there to be a short-run link with passenger numbers
Car parks - bussing contract - other	 1.00 -	Wages and fuel costs	Make a judgement that the cost of the bussing contract will depend on fuel costs and payroll costs, as Dublin Airport maintains continuous bussing provision regardless of passenger numbers. Without further evidence on the relative proportion of payroll costs versus fuel costs, we weight them equally.
Maintenance	1.00	Total maintenance payroll costs	We expect outsourced maintenance costs to follow a similar profile to in-sourced costs. We assume that the ratio of non-pay to pay expenditure stays constant.

The table below shows the estimated elasticity of non-pay costs with respect to the cost driver used in this study. It compares these estimates with those used in the two previous efficiency studies.

Table 2.3: Cost elasticity assumptions related to non-pay costs

Cost category	Jacobs	SDG	CEPA	Driver	Explanation
Rent and rates	-	-	-		We would not expect there to be a short-run link with passenger numbers
Consultancy	-	-	1.00	Skilled wage growth	We estimate these based on historic patterns at Dublin Airport
Marketing	-	1.00	0.40		We estimate these based on historic patterns at Dublin Airport
- Customer support	0.95				
Passengers with Reduced Mobility (PRM)	-	1.00	1.01		We estimate this based on historic increases in propensity to use PRM services, which has grown by an average of 2% per annum. We expect this will continue to grow but at a marginally lower rate.
Utilities	-				We estimate these based on historic patterns at Dublin Airport
- Water		0.50	0.50		
- Other		0.10	*1.00	*Fuel costs	
Insurance	-	-	0.55		We make a bottom-up assessment based on historic expenditure patterns.
Other staff costs	1.00		0.95		We estimate these based on historic patterns at Dublin Airport
- Travel		1.00		Staff numbers	
- Other		-		Staff numbers	
Other	-				We would not expect there to be a link with passenger numbers
- Telephone and print	-	0.30	-	Driver: staff numbers	
- Bank charges	-	0.30	1.00		

3. OVERVIEW OF OPERATING EXPENDITURE

Summary

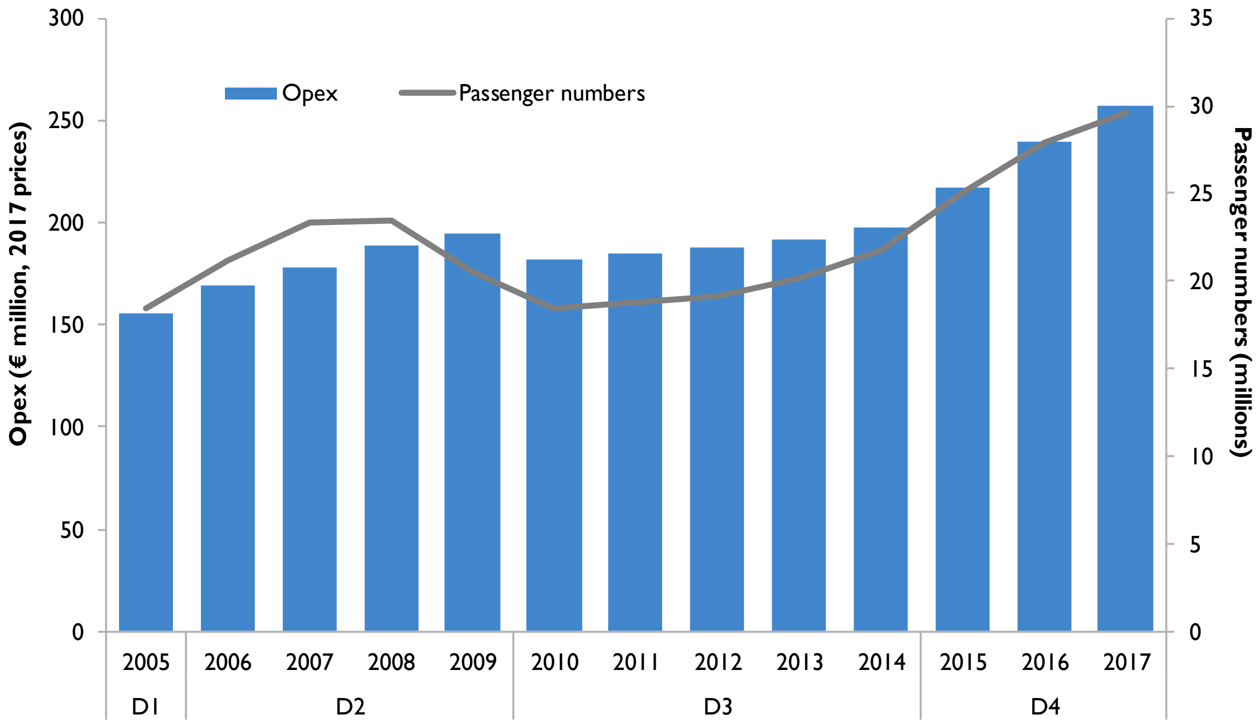
Dublin Airport's opex has risen consistently over the current determination period, exceeding CAR determination targets. Most of the increase in spend has been driven by staff costs, which make up approximately 60% of Dublin's opex. Some of this is due to higher than anticipated passenger numbers, though the airport would have exceeded CAR's target for opex even if it had been set with reference to actual passenger growth.

We note that the airport has chosen to hire additional staff to handle the extra passenger traffic but has also struggled to contain increases in staff salaries. Given the previous study found salary levels for staff on older contracts to be higher than would be considered efficient, we find little justification for the scale of the increase seen over the current determination period. We also believe the airport could have considered options for improving productivity to reduce the need to hire more staff.

3.1. Expenditure over time

Figure 3.1 compares growth in opex with growth in passenger numbers over time. Opex has been on a general upward trend in real terms, rising steadily between 2005 and 2009 before declining in 2010. This decline was a result of cost-cutting measures implemented following a fall in passenger numbers and came about despite Terminal 2 being opened in the same year. Growth in opex resumed after 2010, gradually at first but at a much faster pace after 2014, when passenger numbers started growing more rapidly.

Figure 3.1: Operating expenditure and passenger numbers at Dublin Airport, 2010-2017



Source: Dublin Airport

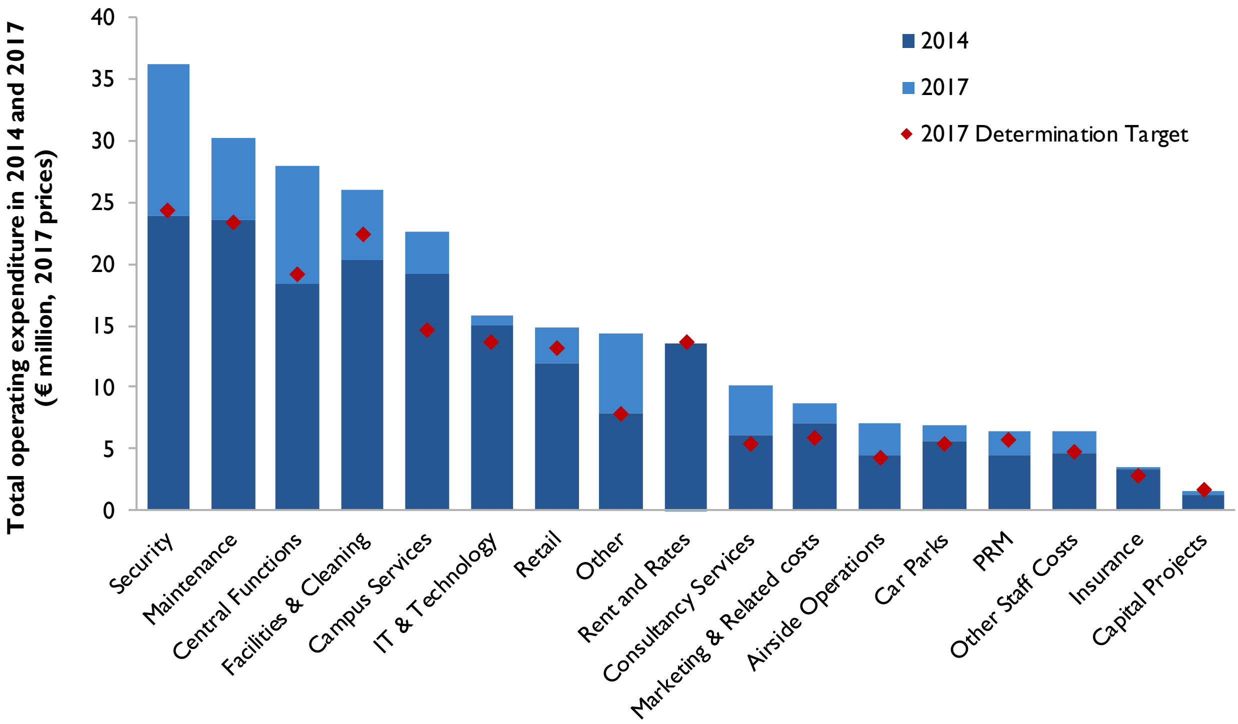
Opex has grown by 4.3% per annum on average between 2005 and 2017, compared with annual passenger growth of 4%. This implies an overall cost elasticity of more than 1, greater than the 0.3-0.5 range typically assumed in regulatory studies.[10]

Throughout this period, payroll costs have made up approximately 60% of total opex. This is higher than many other airports due to Dublin Airport having more functions in-sourced, e.g. cleaning and maintenance.

3.2. OPEX OVER CURRENT PRICE CONTROL PERIOD

Figure 3.2 shows Dublin Airport's opex by category of spend and shows how expenditure has evolved since 2014 (the final year of the previous price control period). The largest areas of spend are security staff, maintenance, central functions staff and facilities and cleaning staff, collectively making up just under half of total opex in 2017.

Figure 3.2: Outturn operating expenditure at Dublin Airport compared against CAR target by type of cost, 2017



Source: Dublin Airport; CAR determination

Since 2014, expenditure in all areas has increased in real terms with the largest absolute increases coming from higher spend on staff working in security and in the central administrative functions. Dublin Airport's total expenditure is higher than the target set in CAR's 2014 determination, exceeding it in all categories of spend except for utilities and capital projects. Whilst the CAR determination target was based on slower passenger growth assumptions, Dublin Airport's outturn opex in 2017 would have still exceeded a target based on actual passenger growth.

On a per passenger basis, expenditure has declined from €9.12 in 2014 to €8.71 in 2017. However, Dublin Airport has not achieved many of the efficiencies identified in the previous efficiency study. The significant growth in passenger numbers should have enabled Dublin Airport to achieve greater economies of scale

[10] See Section 2.5.1

than have actually been realised over this determination period. For example, whilst outturn expenditure was €8.71 per passenger in 2017, the CAR determination assumed a target of €8.42 per passenger, and if the CAR determination had been set using actual passenger numbers, it would have implied a target of €6.66 per passenger.

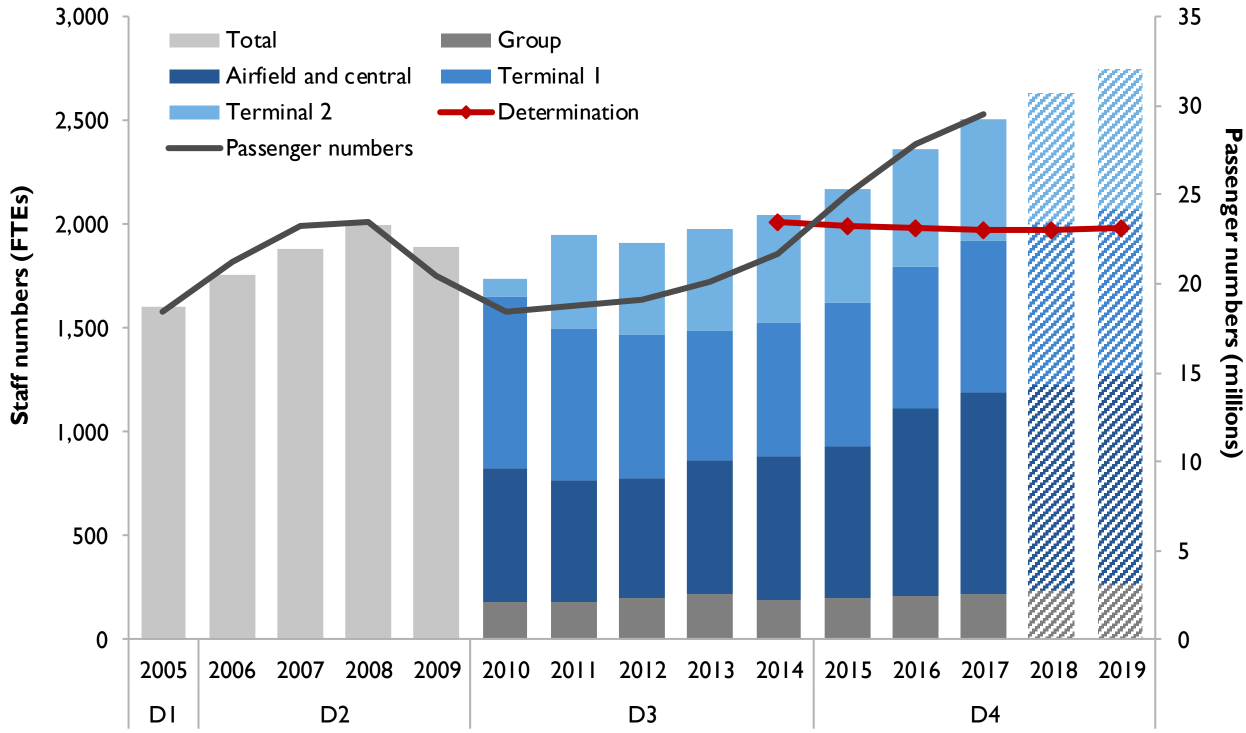
3.3. Staffing levels

3.3.1. Historic staffing levels

The rapid growth of passenger traffic has meant that Dublin Airport has gone from having excess capacity in many of its facilities at the start of the determination period, to being capacity constrained in some areas. Airport management has relied primarily on opex solutions to handle the additional traffic, though there has been some capital investment during this period. As a result, staffing levels increased between 2014 and 2017 and are due to rise further by the end of the determination period.

As Figure 3.3 shows, staff numbers have risen continuously since 2012 though growth has accelerated over the current determination period. Numbers increased by 22% between 2014 and 2017 and are expected to rise by 34% over the complete determination period. This equates to approximately 702 additional full-time equivalents (FTE). Roughly 90% of these staff are employed directly by the airport, with the remainder being staff employed at group level by daa group.

Figure 3.3: Staff numbers at Dublin Airport, 2005-2019 (full-time equivalents)



Source: Dublin Airport; CAR determination

Much of the increase in FTE has come from additional security employees, with the second largest increase being central functions staff e.g. in HR and commercial. On a per passenger basis the number of staff declined from 94 FTE per million passengers in 2014 to 85 FTE per million passengers in 2017, a decline of 10%. This compares favourably against the CAR determination, which assumed 84 FTE per million passengers by 2017. However, as stated previously, the CAR determination was set under an assumption of significantly lower traffic growth, so we would expect there to be greater economies of scale and lower average headcount per passenger.

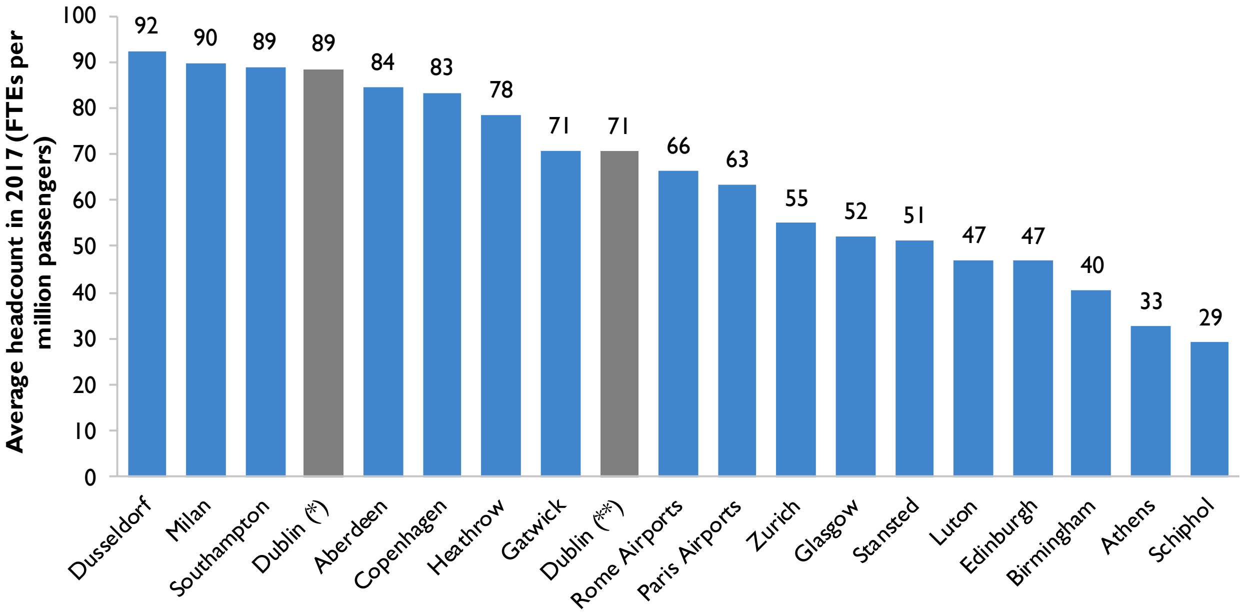
3.3.2. Staffing efficiency

Dublin Airport's management believe that the physical constraints of the airport have compelled them to hire additional staff in the short to medium term, in order to maintain service levels as they grow. They highlight that growth has been strongest at Terminal 1, where the infrastructure constraints are most acute. For example, in the Terminal 1 central search area, space restrictions drive sub-optimal placement of security lanes. This, they state, has led to the airport being able to process fewer passengers per lane, and as a result requiring them to open up more lanes and have more staff available. In the longer term, airport management expect that the physical constraints will be lifted through additional capital spending, which would allow staff to be used more efficiently.

They also highlighted the additional requirements arising from the introduction of the transfer facility and the US customs and border protection (US CBP) pre-clearance facility. Airport management state that whilst these facilities add to the operational complexity of the airport and require additional staff, the revenues generated from them justify the additional expenditure.

Figure 3.4 suggests that Dublin Airport continues to have a relatively high number of staff, on a per passenger basis, relative to other airports that are of similar size and have similar levels of operational complexity. This is despite Dublin's recent growth in passenger numbers. When including staff working on capital projects, Dublin Airport has 89 full-time equivalent staff per million passengers, which is higher than other similarly sized airports, such as Paris Orly, Zurich, Copenhagen and Stansted. When excluding staff working in retail operations and cleaning, which in most airports tends to be provided by third-parties, Dublin Airport has approximately 71 full-time equivalent staff per million passengers, which puts it on par with Gatwick but continues to be higher than other similarly sized airports.

Figure 3.4: Average headcount per million passengers in 2017 (FTE per million passengers)



Source: Airport annual reports;
** Dublin Airport including capitalised; ** Dublin Airport including capitalised but excluding retail operations and cleaning*
Note: The data for some airports includes group-level headcount estimates, and as such includes employees not working directly on airport related activities. Additionally, airports having varying levels of outsourcing arrangements, which inevitably affects the estimates of average headcount.

Other stakeholders suggested that although they did not believe Dublin Airport was overstaffed when it came to operations roles, they had greater concerns regarding staffing levels in administrative roles. Some highlighted that they felt Dublin Airport preferred 'managed solutions' rather than taking a strategic consideration of whether needs could be better met by changing the way they approached airport operations, or through infrastructure or technology investments. This inevitably leads to greater staff numbers than would otherwise be necessary.

The evidence we have gathered leads us to conclude that whilst some of the increase in staff numbers has been necessary to manage the additional passengers travelling through the airport, there still remains some inefficiency in headcount. We are concerned that there has been insufficient consideration of how the airport should seek to attain efficiencies once physical constraints are lifted, or how to ensure efficient operations within existing physical constraints. As passenger numbers and the scale of the airport infrastructure continues to grow, we would expect staffing levels on a per passenger basis to be able to take advantage of scale efficiencies and more closely match the larger airports in Europe, such as London Gatwick, Paris Orly and Rome Fiumicino. In the following section, we review staff numbers at a more granular level to identify the areas of operation where there is staffing inefficiency.

4. EFFICIENCY OF STAFF-RELATED EXPENDITURE

In the following sections we analyse the efficiency of staff-related expenditure under each CAR staff category. We begin by assessing the efficiency of salary costs and producing a forecast of salary costs by role for the next determination period. We separately consider the efficiency of staffing at a more granular level and use our elasticity estimates to forecast future staffing requirements. Combining the two gives us our forecast of staff-related expenditure for each category across the next control period to 2024.

4.1. Salary costs

Summary

A key feature of Dublin's payroll expenditure is the existence of staff employed before 2010 under one broad set of terms and conditions, and staff employed after 2010 under a second set of terms and conditions. There is a clear evidence of a wage differential between the two types of contract with staff on the older terms being paid higher salaries than those on newer terms. We see this as evidence of inefficiency in the wage rates for certain groups of staff, though we accept that this is a structural inefficiency that cannot be immediately removed.

When assessing the overall growth in unit payroll costs for all staff, we conclude that wage rises since 2015 have been inefficient. For certain roles, wage growth has exceeded growth seen elsewhere in the economy. We therefore reset 2019 salary levels to reflect our view on efficient wage growth between 2015 and 2019.

To deal with structural inefficiencies, we allow a longer period for Dublin Airport to adapt. We assume that natural attrition of such staff and constrained future wage growth will improve efficiency over the next determination period. Although our forecasts are developed assuming constrained wage growth, such inefficiencies might equally be reduced by increasing the productivity of staff on older terms. It is up to Dublin Airport to determine how best to achieve these efficiencies.

We generally project future wage rates based on external wage growth forecasts. We assumed wage growth for most roles will be equal to wage growth elsewhere in the economy, given the context of full employment in the Irish labour market.

4.1.1. Staff contractual arrangements

Staff at Dublin Airport (and daa group) are employed under a range of different contracts depending on their role and when they started their employment. The opening of Terminal 2 in 2010 coincided with the recession and a decline in passenger numbers, which led to a deterioration in Dublin Airport's financial performance. As a result, Dublin Airport introduced a series of contracts with lower salary rates and more flexible terms and conditions than historic norms.

Staff on these 'post-2010 contracts' were initially hired to work in Terminal 2 with longer serving staff on 'pre-2010 contracts' located at the existing facilities in Terminal 1. However, due to natural attrition of staff, a growth in the workforce and increasing number of workers at Terminal 1 are also employed under the newer contracts.

Figure 4.1 shows, for different categories of staff, the proportion of staff on older pre-2010 contracts versus those on newer post-2010 contracts. Between 2013 and 2017, the number of staff on old contracts has declined by approximately 25%. We understand from Dublin Airport that this has been largely due to natural attrition and staff progression. The proportion of staff on the older contracts has declined more steeply over the period, given the growth in overall staff numbers.

Figure 4.1: Number and proportion of staff on old contracts versus new contracts, 2013 and 2017

Source: Dublin Airport; CEPA analysis

In addition to more efficient salary levels, staff on post-2010 contracts have fewer restrictions on working practices, allowing them to work more flexibly when compared to staff on pre-2010 contracts. The newer contracts have operational benefits, allowing airport management to deploy staff more flexibly in response to passenger flows, e.g. to scale up the number of staff working during busier periods, and scale down during quieter periods. It also allows airport management to adapt the activities undertaken by staff, depending on necessity, such as moving staff into customer support roles during peak flows and then onto other tasks when the flow subsides. Overall, the newer contracts allow airport management to use staff more productively, lowering the numbers of staff needed and total payroll costs.

4.1.2. Historic and current payroll costs

Figure 4.2: Average unit payroll costs and by type of role, 2010-2019 (€, 2017 prices)

Source: Dublin Airport; CEPA analysis

Unit payroll costs (inclusive of bonuses, pension and social insurance payments, and one-off costs) have, on average, increased by 12% in real terms between 2014 and 2017, as shown in Figure 4.2. Over the longer term, unit payroll costs declined between 2010 and 2011, as a result of an agreement with unions to reduce average wages by 5.5% in response to Dublin Airport's financial position. Between 2011 and 2015, real unit payroll costs stayed relatively constant as the airport began to recover in terms of passenger numbers.

The efficiency study for the 2014 determination highlighted the pay and productivity differential between staff on pre-2010 contracts versus those on post-2010 contracts. It also concluded that the differential demonstrated inefficiency in Dublin Airport's operations. In some areas therefore, the study suggested that efficiency could be gained by outsourcing some functions currently undertaken by staff on pre-2010 contracts.

The study concluded that payroll costs for staff on pre-2010 contracts could be reduced by up to 40% from 2014 levels under a high-ambition scenario, where most functions carried out by staff on pre-2010 contracts were outsourced. Ultimately, the determination set a target that would keep unit payroll costs largely constant at 2014 levels rather than assuming a reduction.

However, outturn payroll costs have increased since 2014. A significant factor in this increase has been several pay settlements agreed over the current determination period:

- The pay cuts enacted in 2010 were reversed in 2016 after Dublin Airport achieved target profit levels;
- A Labour Court judgement recommended an additional 2% per annum increase for two years with effect from 1st July 2014; and
- In 2018, Dublin Airport reached an agreement with unions for pay rises between 2% and 4% per annum until 2020.

Dublin Airport also believe the suggestion of outsourcing certain functions was unrealistic given the company's state-owned status, the potential public reaction to outsourcing, and the adverse impact such a move could have on industrial relations. Whilst they were open to outsourcing where they believed it made commercial sense, they did not consider this to be the case for the suggestions put forward in the previous efficiency study. They believe that retaining staff in-house for these functions enables airport management to have greater control over quality and cost and are a key component of the airport's value proposition.

Whilst we do not have separate estimates for unit payroll costs for staff on old contracts versus those on new contracts, we continue to see a differential between Terminal 1 staff and Terminal 2 staff. As the majority of staff on the older contracts are located in Terminal 1, we believe the difference between Terminal 1 and Terminal 2 staff provide a proxy for the wage and productivity differential between staff on the two types of contracts.

Figure 4.3 illustrates the differential in unit payroll costs between Terminal 1 and Terminal 2 for different roles. We can see that the differential continues to exist in most roles, though there have been notably large declines for retail staff and security staff. For retail staff, we believe this is as a result of a reduction in the number of staff on old contracts, by approximately a third between 2014 and 2017. This means that in 2017, only half of the retail staff working in Terminal 1 were employed under the old contracts. For security staff, we believe the reduction in the payroll cost differential is due to the large increase in new staff since 2014 all hired under the new terms and conditions. As a result, the proportion of Terminal 1 and Central security staff employed under the old contract fell from 80% to 49%.

Figure 4.3: Differential in unit payroll costs between staff based at Terminal 1 and Terminal 2, 2012-2019 (% difference)

Source: Dublin Airport; CEPA analysis

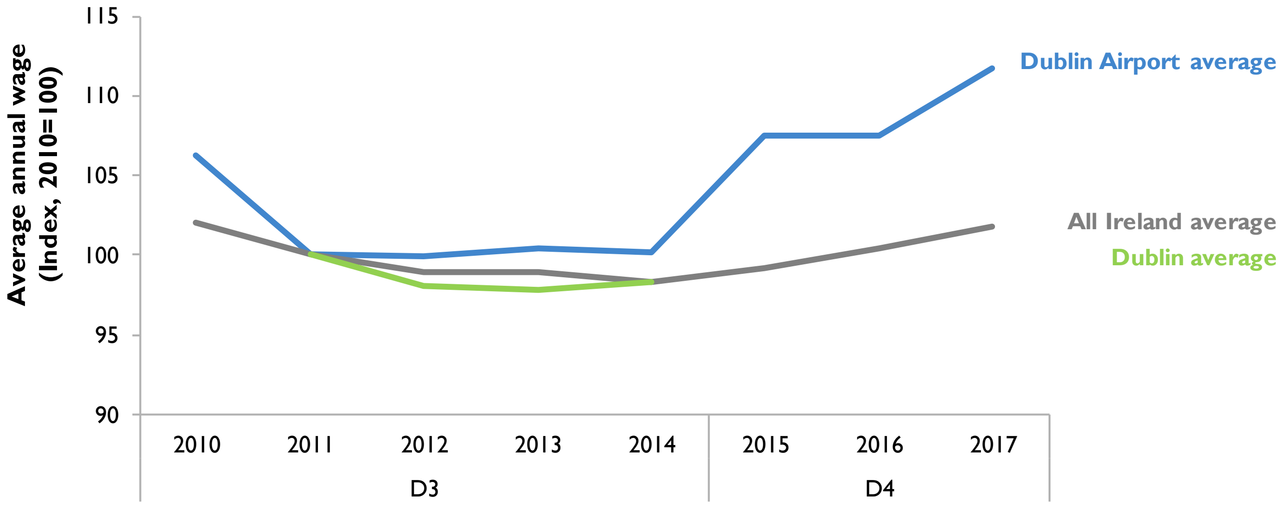
When calculating the pay differential between staff based at the two terminals, we have attempted as far as possible to compare staff on a like for like basis, considering staff that are undertaking similar roles. Despite this, some of the differential may be explained by different levels of seniority between staff at the two terminals. However, as the differential has been pervasive over a long-time period and exists for all terminal staff, we believe this is evidence of inefficiency in pay rates for staff based at Terminal 1. Specifically, we believe this is evidence of a structural inefficiency in pay rates for staff based on old pre-2010 contracts. We believe it would be difficult to reduce this inefficiency over the short-term, we would expect this disparity to reduce over the longer term.

4.1.3. Analysis

Figure 4.4 shows that the reductions in salary costs expected in the 2014 determination have not materialised and instead, average wages have increased since 2014. We understand from the previous section that these were due to a series of pay settlements agreed with unions, including an automatic reversal of the 2010 salary reductions once Dublin Airport returned to target levels of profitability. However, as the figure shows, these reductions in wages were reversed by 2015.

Compared with average wages in the Irish economy, wages at Dublin Airport have risen at a faster pace. In real terms, between 2014 and 2017, these grew by 3.4% and 11.6% respectively. Only average wages for retail staff have grown by less than average wage growth in the economy. This suggests that a general tightness in the labour market is not sufficient justification for the rates of wage growth seen at Dublin Airport. We therefore conclude that there exists some inefficiency in average payroll costs.

Figure 4.4: Growth in nominal wages at Dublin Airport and in the Irish economy more broadly, 2010-2017



Source: Dublin Airport; CSO Average Annual Earnings and Other Labour Costs by Type of Employment; CEPA analysis

We also consider wage growth for staff on old contracts versus new contracts. With the exception of maintenance staff, average wages for staff based at Terminal 2 has grown more rapidly than wages for staff based at Terminal 1. However, as stated previously, there continues to exist a pay differential between staff based at the two terminals, which in 2017 ranged from ✂ for security staff to ✂ for facilities and cleaning staff. Dublin Airport anticipate this pay differential will increase for most roles over the remainder of the price control period, rising to ✂ for facilities and cleaning staff.

We note concerns raised by some airlines that Dublin Airport does not seem to have an effective strategy for reducing the wage premium and relative inefficiency of staff on pre-2010 contracts.

Our discussions with airport management did highlight a view that the increases in wages for staff on old contracts were necessary to allow for more flexibility in working arrangements. These changes would allow staff on older contracts to become more productive. Further on in this chapter, we investigate the view of airlines that insufficient progress has been made at improving the productivity of staff on older contracts. Our conclusions lead us to agree with this view, as there continues to be a productivity differential between Terminal 1 and Terminal 2 staff in most operational areas.

We acknowledge that industrial relations concerns and the general tightness in the labour market has made the possibility of pay cuts infeasible for Dublin Airport over the current determination period. We are also of the view that this would be unachievable even if Dublin Airport was exposed to competitive pressure in its operation of Dublin Airport. In other words, an efficiently run company would also be unable to reduce average payroll costs in the current labour market context. But we also believe that there has been insufficient pay restraint over the price control period and that wage increases for staff on older contracts in particular cannot be justified.

4.1.4. Future projections

In our forecasts, we consider staff on older contracts versus those on newer contracts separately. We also group certain roles together when estimating efficient unit payroll costs, to average out any year-to-year fluctuations in exceptional costs and reallocations of senior staff between categories. Table 4.1 below shows our grouping:

Table 4.1: Grouping of roles when producing salary forecasts

Salary grouping	Functions / roles (CAR Category)
Maintenance *	All (Maintenance)
Facilities and Cleaning *	All (Facilities and cleaning) Transfer product (Central functions) Terminal facilities (Campus services) Car park operations (Cark parks)
Retail *	Terminal retail (Retail)
Security *	Terminal security (Security) Campus security (Security) Group security, daa group (Security)
IT	All (IT)
Fire / Police	Fire (Campus services) Police (Campus services)
Commercial	Commercial (Central functions)
Central Finance	Finance except SSC (Central functions)
Shared Services Centre	SSC
Airside Operations **	All (Airside operations)
Admin	All remaining (Central functions) Capital projects (Capital projects) Security management (Security) Staff planning and administration (Campus services) Retail management and logistics (Retail)

** Groups where staff on older contracts are considered separately to those on newer contracts.*
*** For airside operations, we do not consider staff on older contracts separately as we do not have an estimate of the wage premium. We therefore treat all staff in the function as if they were on newer contracts.*

Baseline

In the absence of external estimates of efficient payroll costs, we generally come to three conclusions from our analysis of the evolution of salary costs at Dublin Airport:

- **Unit payroll costs for staff at Terminal 1 are less efficient than payroll costs for staff at Terminal 2.** This comes from our finding that there is a continued pay premium for staff at Terminal 1 that cannot be explained by differences in productivity. We believe this is due to the contingent of staff on older contracts at Terminal 1.
- **For staff on older contracts, it would be difficult for an efficiently run company to implement nominal or real wage reductions. However, wage rises since 2014 have been inefficient.** Given Dublin Airport's state-owned status, and the relatively strong recovery of

the labour market since 2014, it would be difficult for any efficiently run company to attempt to reduce the wage differential through salary reductions. However, we also note that the wage reductions agreed in 2010 were reversed by 2015 and subsequent salary increases have not been matched by improvements in productivity.

- **Unit payroll costs for the period 2010 to 2014 can be considered relatively efficient, and 2015 unit payroll costs may be efficient.** We believe that salary costs for new staff in 2010 and 2011 were a reasonable reflection of efficient unit payroll costs at the time, given the financial constraints faced by Dublin Airport. Over the period 2011 to 2014, average wages at Dublin Airport closely tracked unit payroll costs in the Dublin area and in the Irish economy more broadly (as can be seen in Figure 4.4). Since then however, payroll costs at Dublin Airport have risen at a much greater pace than wages in the economy as a whole. While the increase between 2014 and 2015 may be justified because of the labour court judgement and the reversal of salary cuts implemented in 2010, subsequent increases are less justifiable.

As a result of the conclusions, we estimate efficient unit payroll costs for 2017 based on historic growth in economy-wide wage rates since 2015; 2015 being our most recent estimate of *achievable* efficient payroll costs. The 2017 estimate is our view of what payroll costs would have been had they followed an efficient growth path from 2014. From our 2017 estimates, we forecast forwards to estimate a 2019 baseline using our core wage forecasts.

The only exception to this is payroll costs for security, where we note Dublin's difficulty in recruiting and retaining security staff. We see this as evidence of the market demanding higher salaries for security officer roles as the Irish economy has strengthened. As a result, we forecast from Dublin Airport's outturn 2017 salary levels to estimate our baseline.

Table 4.2 shows our baseline estimate of unit payroll costs for 2019, compared with Dublin Airport's estimate for 2019 and outturn unit payroll costs for 2017. As can be seen in the table, we generally find evidence of inefficiency in salary costs for most landside terminal roles, whereas we find less evidence of inefficiency in salary costs for the corporate functions. This results in our estimate of efficient payroll costs for 2019 being lower for some roles than 2017 outturn costs. It is for CAR to consider whether such unit payroll costs are immediately achievable or whether there should be a glide path.

Table 4.2: Baseline unit payroll costs, compared with Dublin Airport 2019 estimate and 2017 outturn (€ to nearest 100, 2017 prices)

Staffing group	2017 (outturn)	2019 (Dublin Airport estimate)	2019 (CEPA baseline)
Maintenance	✂	✂	✂
Facilities and Cleaning	✂	✂	✂
Retail	✂	✂	✂
Security	✂	✂	✂
IT	✂	✂	✂
Fire / Police	✂	✂	✂
Commercial	✂	✂	✂
Central Finance	✂	✂	✂

Staffing group	2017 (outturn)	2019 (Dublin Airport estimate)	2019 (CEPA baseline)
Shared Services Centre	✂	✂	✂
Airside Operations	✂	✂	✂
Admin	✂	✂	✂

Forecast

To forecast salary costs from 2019, we use our core wage forecast as described in Section 2.3. We do not make any adjustment to this core wage forecast, except for roles where there exists a wage premium between staff based in Terminal 1 and those based in Terminal 2 (i.e. maintenance, facilities and cleaning, retail, and security).

We would typically expect there to be higher wage growth for skilled workers, particularly for IT staff where there are often acute shortages. However, in the context of full employment, wage growth is likely to be universal. We also do not find enough evidence to justify a growth premium for skilled staff, with the most recent set of economic statistics showing job vacancy rates for professional staff that are only marginally higher than the economy-wide average.[11]

For roles where, due to a certain proportion of Terminal 1 staff being on pre-2010 contracts, there exists a wage differential between Terminals 1 and 2, we take a slightly different approach to forecasting wages. We start by making an estimate of the size of the wage premium for staff on older contracts, by assuming all staff on pre-2010 contracts are based in Terminal 1. As we know how many staff in each type of role are employed under the old contracts, we can estimate the size of the premium using the wage differential between Terminals 1 and 2 (and by assuming that newer staff at both terminals are paid the same on average).

While we note that it may be difficult for an efficiently run company to implement real wage cuts for staff on older contracts, constraining wage growth is much more feasible. We believe using a lower wage growth rate would maintain pressure on Dublin Airport to reduce the wage premium while remaining achievable. We therefore set wage growth for staff on the older contracts at half of our core forecast. We believe this is an achievable level and an appropriate target to improve efficiency.

When forecasting total payroll costs, we multiply our staffing forecast with an average unit payroll cost for each staffing group, weighted by the proportion of staff on pre-2010 contracts versus post-2010 contracts. We assume that historic attrition rates for staff on the older contracts will continue and as a result the wage differential between Terminal 1 and Terminal 2 staff would reduce.

We calculate the payroll costs for new staff using the same unit payroll costs. Although this approach has the potential to overestimate payroll costs for new staff (as new staff are more likely to be paid at the bottom of any pay range), we believe it is a broadly appropriate assumption as our unit payroll costs inevitably capture staff at different grades.

Table 4.3 summarises our wage growth assumptions by role.

[11] Central Statistics Office Statbank (2018) Job Vacancies by Private or Public Sector, Economic Sector NACE Rev 2,

Table 4.3: Forecast unit payroll costs from 2019 to 2024 (€ to nearest 100, 2017 prices)

Staffing group	2019	2020	2021	2022	2023	2024
Maintenance *	✂	✂	✂	✂	✂	✂
Facilities and Cleaning *	✂	✂	✂	✂	✂	✂
Retail *	✂	✂	✂	✂	✂	✂
Security *	✂	✂	✂	✂	✂	✂
IT	✂	✂	✂	✂	✂	✂
Fire / Police	✂	✂	✂	✂	✂	✂
Commercial	✂	✂	✂	✂	✂	✂
Central Finance	✂	✂	✂	✂	✂	✂
Shared Services Centre	✂	✂	✂	✂	✂	✂
Airside Operations	✂	✂	✂	✂	✂	✂
Admin	✂	✂	✂	✂	✂	✂

** Weighted average of staff on pre-2010 contracts and those on post-2010 contracts*

4.2. Security

Summary

The security function is the largest component of opex at Dublin Airport and accounts for most of the increase in spend over the current determination period. Although expenditure has exceeded the CAR determination target, we believe the elasticities used to produce the target were less relevant in the context of large increases in passenger numbers.

In our analysis, we consider rostering patterns for terminal security staff, where we would expect close alignment with passenger flows. We also consider the throughput of passengers through security, and the extent to which that has improved over time with various technology investments and changes to the placement of security lanes. We find that Dublin Airport has made some progress towards improving its efficiency since the start of the determination period. We note from our discussions with Dublin Airport that it has employed considerable resources to continuously refine the efficiency of the security operation.

However, we also find that there remain opportunities for further efficiency gains through refinements to rostering patterns. We find that infrastructure constraints and less flexible working patterns for Terminal 1 staff limit opportunities for greater efficiency.

In our projections, we apply both a baseline efficiency saving in areas where we believe savings are immediately achievable, as well as longer-term efficiencies we expect to materialise over the determination period. We separately estimate the elasticity of staffing requirements for each terminal, as they are affected differently by infrastructure constraints. For other areas of security, we do not expect future staffing requirements to be driven by passenger numbers.

4.2.1. Introduction

The security function is the single largest component of opex at Dublin Airport. Most of the expenditure is on directly employed staff carrying out security-related activities. The operating and maintenance cost of security equipment and facilities is included in other opex lines of the accounts.

The overall workforce of security staff are grouped according to their functions and geography as follows:

Terminal Security – Security within the terminal buildings delivered by the Airport Search Unit (ASU), comprising:

- Passenger and hand baggage screening for departing passengers, and transfer passengers when this is needed;
- Airside staff and goods screening; and
- Staffing static control points within the terminal building to manage passenger flows.

Terminal security is managed as two separate business units for Terminal 1 and, since 2010, Terminal 2.

Vehicle Control Points (VCP) – Security outside the terminal buildings, comprising:

- Managing control posts on the airfield perimeter, including screening of staff and vehicles working on the airfield; and
- Perimeter security, monitoring the integrity of the airfield boundary.

VCP staff numbers and costs have been accounted for separately from Terminal Security since 2016. Prior to that, they were included with central search functions making detailed historic analysis more difficult.

Management and other Security functions – These are predominantly support functions necessary for the functioning of the security operation at Dublin Airport including management, compliance officers and staff planning. Certain functions, including security training and a function simply called "security", are accounted for at group level.

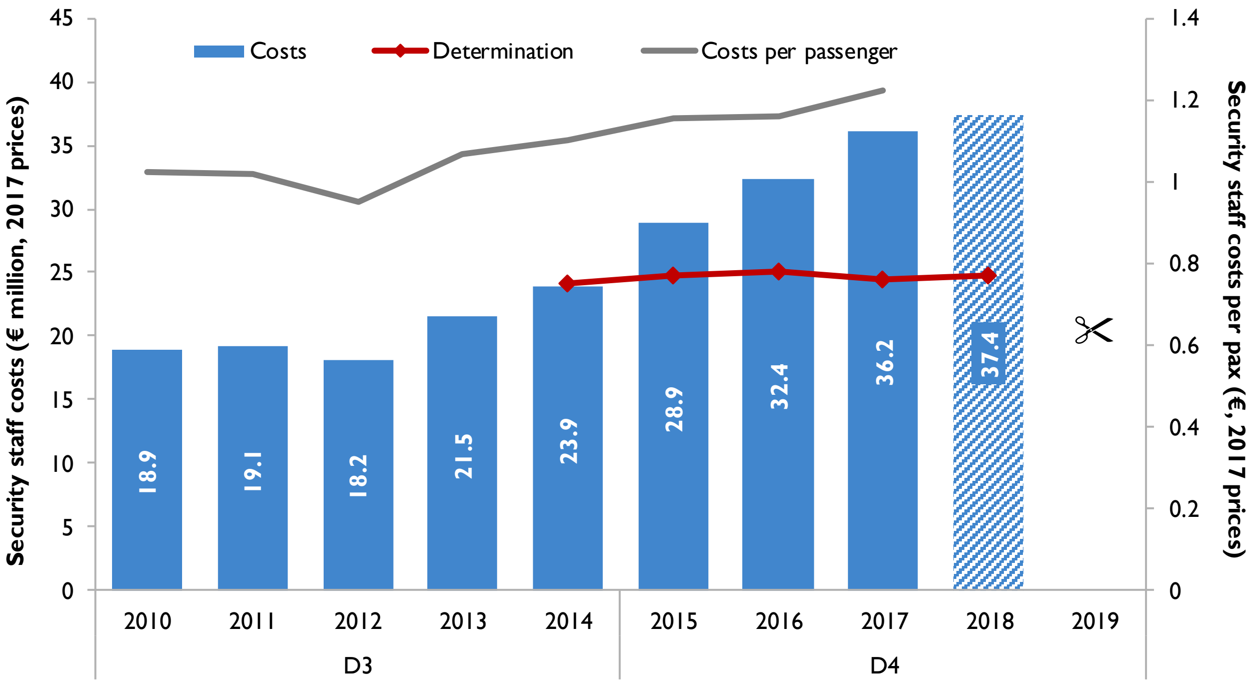
4.2.2. Historic expenditure

Payroll costs

Security staff costs have increased every year since 2012 and have grown by 52% in real terms over the period from 2014 to 2017, as shown in Figure 4.5. Security staff costs are expected to rise further in 2018 and 2019 with the 2019 cost expected to be 74% higher than in 2014. In the current regulatory period, the average security staff cost per passenger processed at the airport increased by 11% from 2014 to 2017.

These increases compare with a determination assumption that security staff costs would remain relatively flat, driven by lower staff unit costs from improved roster efficiency.

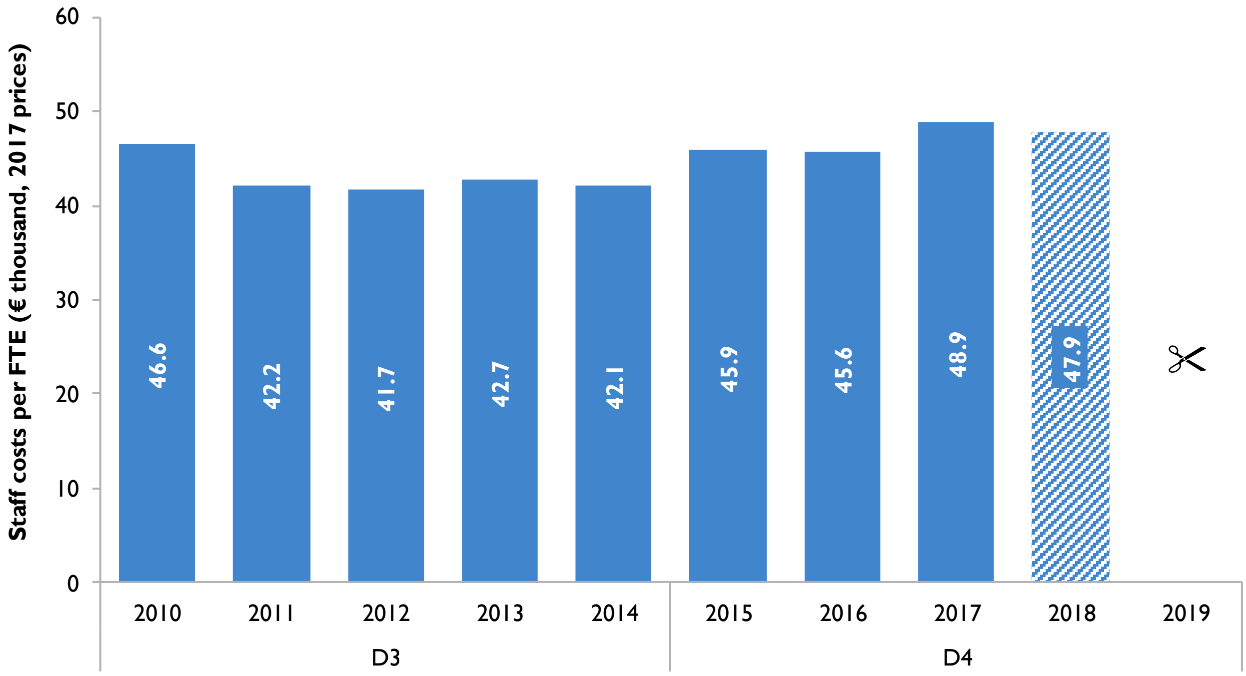
Figure 4.5: Security staff costs, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination; Taylor Airey analysis

Unit payroll costs increased by 16% between 2014 and 2017 and is forecast to rise further by 2019. This can be seen in Figure 4.6 below.

Figure 4.6: Security staff costs per FTE, 2010-2019 (€ thousand, 2017 prices)

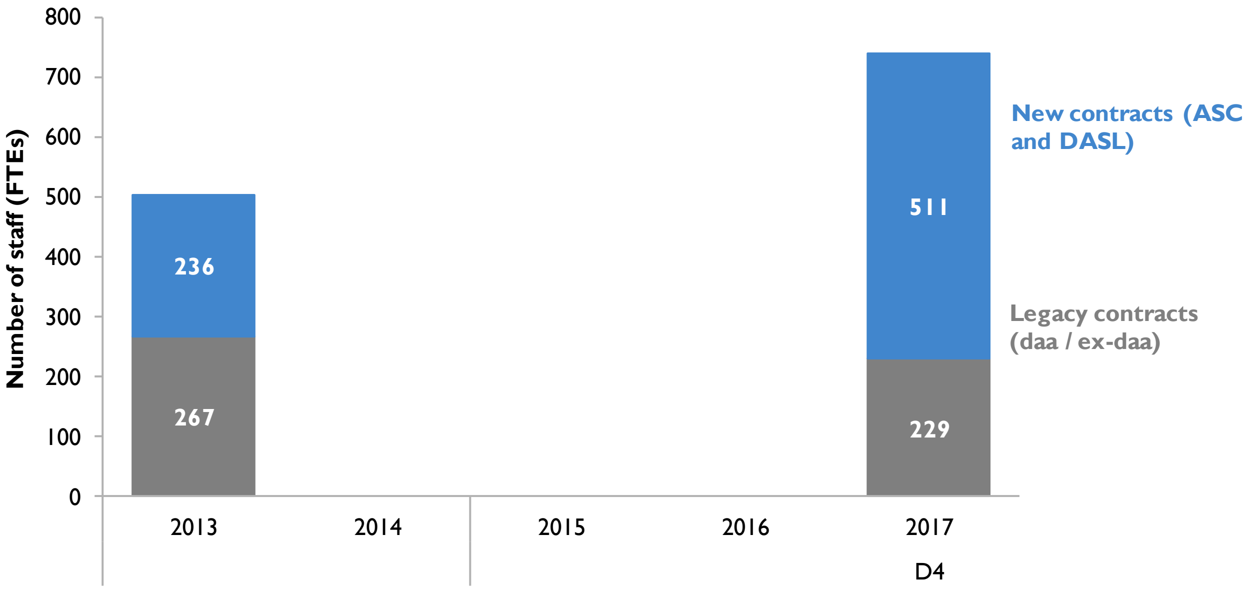


Source: Dublin Airport; Taylor Airey analysis

Staff in security are employed on a mixture of contractual terms which attract different average pay rates. As of the end of 2017, 31% of staff in security were employed on pre-2010 terms, whereas 69% of staff were on post-2010 contracts. By comparison, in 2013, 53% of staff employed in security were on the older terms.

However, it can be seen in Figure 4.7 that this change in proportions of each contract type in the workforce has been predominantly driven by the recruitment that has taken place in this period. By contrast, there were only 39 fewer FTE on pre-2010 terms in 2017 when compared with 2013, representing a 14% reduction due to attrition.

Figure 4.7: Security staff contract types, 2013 and 2017



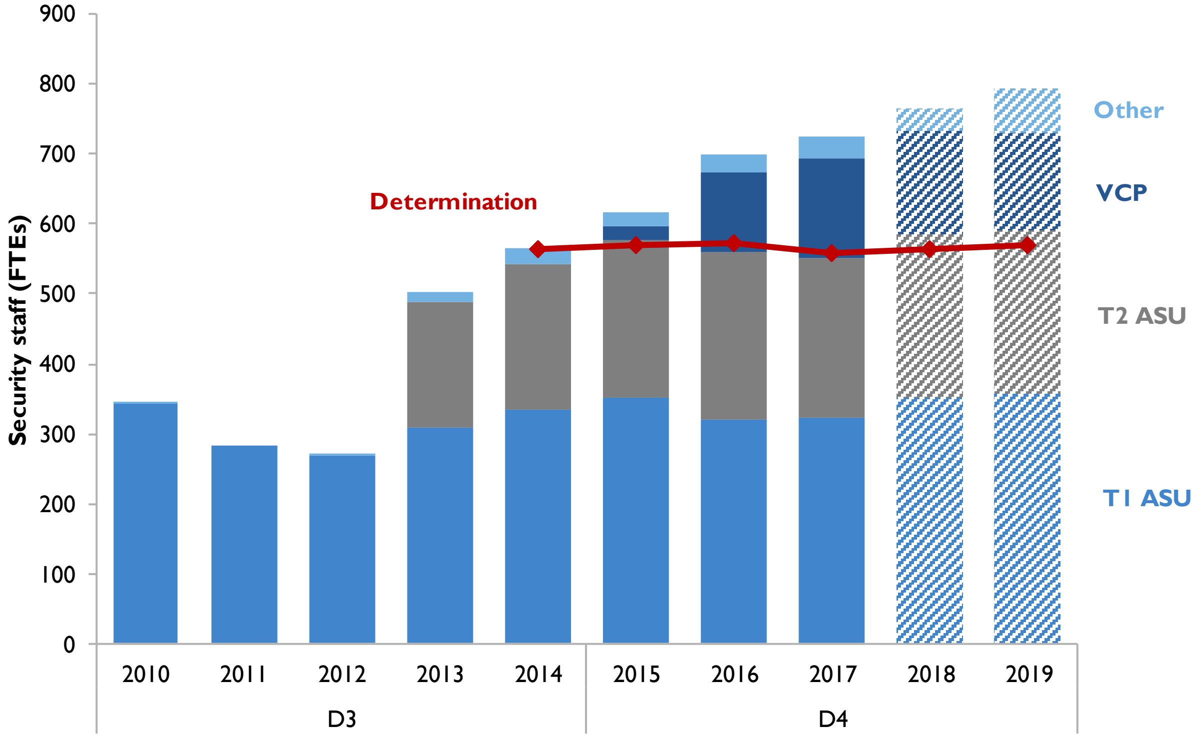
Source: Dublin Airport; Taylor Airey analysis

Staff numbers

As shown in Figure 4.8, the number of FTE employed in security has increased every year since 2012 and has grown by 31% between 2014 and 2017. Staff numbers are forecast to rise further with the 2019 FTE total forecast to be 44% higher than the 2014 figure. These staffing increases in the current regulatory period compare with a determination assumption that staff numbers would increase by 1% over the five-year period.

Between 2014 to 2017, the total number of passengers processed at the airport per security staff FTE has shown a decrease of 4%.

Figure 4.8: Security staff numbers



Source: Dublin Airport; Taylor Airey analysis; CAR determination

4.2.3. Analysis

The following section provides a summary of our findings when assessing the efficiency of operating expenditure on terminal security and staff working at vehicle control points. A detailed presentation of our analysis can be found in Appendix B.1.

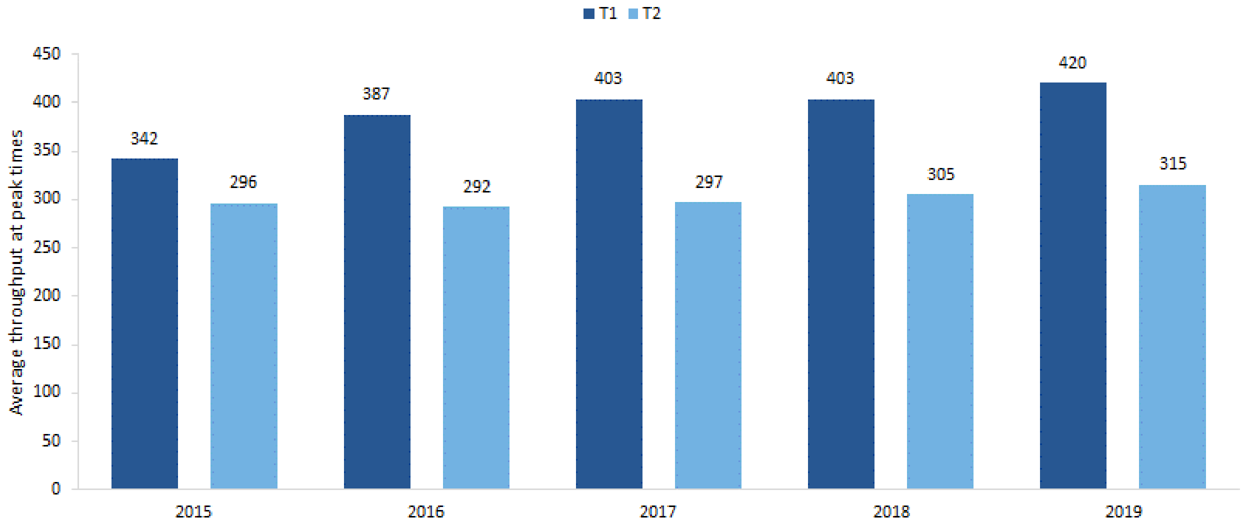
Terminal security

When assessing the efficiency of terminal security, we have considered a number of factors:

- Whether the capacity at the central search locations for each terminal is efficient from an operations perspective;
- Whether the staff planning process has been optimised to maximise efficiency;
- Consideration at a high-level of whether staff numbers appropriately match passenger numbers; and
- Detailed consideration of rostering efficiency at both terminals for typical peak and off-peak periods.

Over the past three years, Dublin Airport has improved the throughput of the X-ray machines used for hand baggage screening at Terminals 1 and 2, as shown in Figure 4.9. The throughput of the X-ray machines is the constraining capacity factor at the central search locations where passenger and hand baggage security screening occurs. The improvements, which are more marked for Terminal 1, have the potential to enable a reduction in staffing requirements of approximately 14% in Terminal 1 and 3% in Terminal 2, compared to the scenario in which the improvements had not been made. It is not clear whether this potential has been realised over the past three years. Further throughput improvements are planned for 2019. These and those that could have been achieved by 2018, should be factored into the forward opex projections.

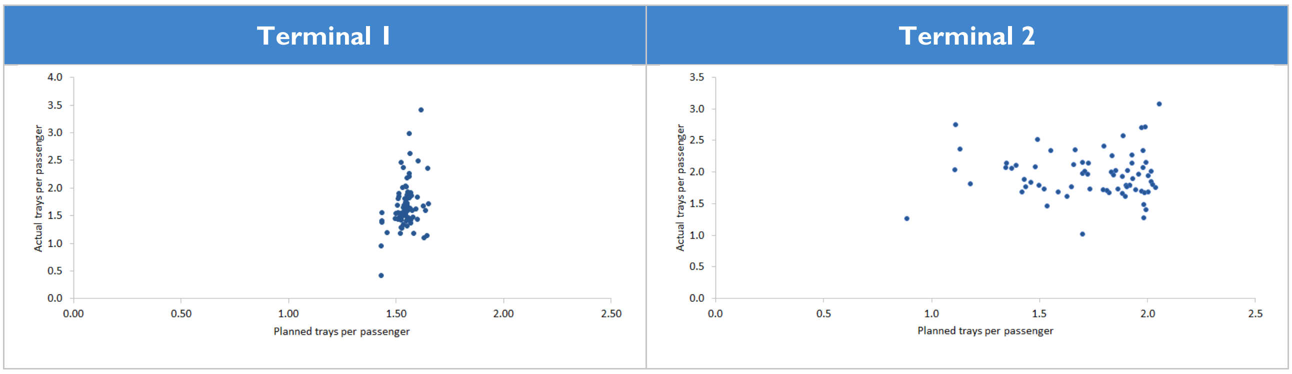
Figure 4.9: Evolution of X-ray machine tray throughput, 2015-2019



Source: Dublin Airport

The staff planning process has evolved to be based on baggage tray processing through the Central Search X-ray machines rather than simple passenger numbers. This has the advantage of accounting for the capacity constraint in the system as well as accommodating differences between summer and winter through the variation of the ratio of trays to passenger. However, there is only a weak correlation between the planning assumptions on trays per passenger made for Terminal 1 and the distribution observed on the day. There is no correlation between the planning assumptions made for Terminal 2 and observations on the day, as can be seen in Figure 4.10. With the caveat that this analysis is based on a very small sample, Dublin Airport should consider simplifying or refining its planning assumption, especially for Terminal 2.

Figure 4.10: Correlation between planned and actual trays per passenger at Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Based on the detailed data for the single sample day provided, Terminal 2 operations appear more controlled than those at Terminal 1 evidenced by narrower distributions for both passenger-per-X-ray lane and passenger-per- security officer deployed. In terms of staff per passenger as a productivity measure, Terminal 2 is more efficient than Terminal 1 despite faster flows through the Terminal 1 system, albeit with higher staffing per lane in Terminal 1.

The Terminal 1 summer roster is very complex, with 19 different rosters being applied. Over a busy week, the roster over-provides on the staffing level required by approximately 32%. Although it is not possible to match the roster to the demand profile exactly, improvements can be made by adjusting the current roster to match demand and supply better over each of the days of the week and reduce the absence rate from the 9% at present to the target of 5.5%. This results in a staffing reduction of approximately 10% across the summer roster. Complete redesign of the roster might result in higher savings.

The Terminal 1 winter roster is very closely aligned to demand with very little over-provision. Depending on queue lengths it may be necessary to increase the staffing levels in the Terminal 1 winter roster. There appears to be no scope for efficiency savings in this roster.

The Terminal 2 summer roster is simple compared to Terminal 1, comprising only three separate rosters. Over a busy summer week, the roster over-provides on the staffing level required by approximately 26%. Unlike the Terminal 1 roster, it does not appear possible to make substantial savings by making simple adjustments to the roster. By adjusting the current roster to match demand and supply better over each of the days of the week (including an increase in staffing levels early in the morning to cater for that demand when it occurs) and reduce the absence rate from the 9% at present to the target of 5.5%, it is possible to reduce the staffing level by approximately 1%.

By adjusting the Terminal 2 winter roster to match demand and supply better over each of the days of the week (including an increase in staffing levels early in the morning to cater for that demand when it occurs) and reducing the absence rate from the 9% at present to the target of 5.5%, it is possible to reduce the staffing level by approximately 10% to 15% over the winter period. This would require special provisions to be made at peak winter times around Christmas and Easter.

It is important to note that the identified over-rostering has only slightly translated into more lanes being open. Thus, the identified over-rostering does not imply that queue lengths would be shorter at these times.

Vehicle control points

For staff working at vehicle control points, we consider that a reduction in absence rates could reduce the number of staff required. The staff rostered as spare amount to approximately 11 FTE per day and are used to cover absence. A reduction in the absence rate from 9% to 5.5% would potentially reduce the spare requirement from eleven to seven FTE.

4.2.4. Future projections

Staff numbers

We use the quantitative analysis described above to determine efficient staffing levels for Airport Search Unit and Vehicle Control Post staff (the two largest categories) and make a more qualitative assessment for other categories of staff. For most areas, passenger numbers do not affect security staffing needs, except for the Airport Search Units. Here, we use a bottom-up assessment of the elasticity to forecast future staffing needs. Table 4.4 details the approach taken for each category of security staff.

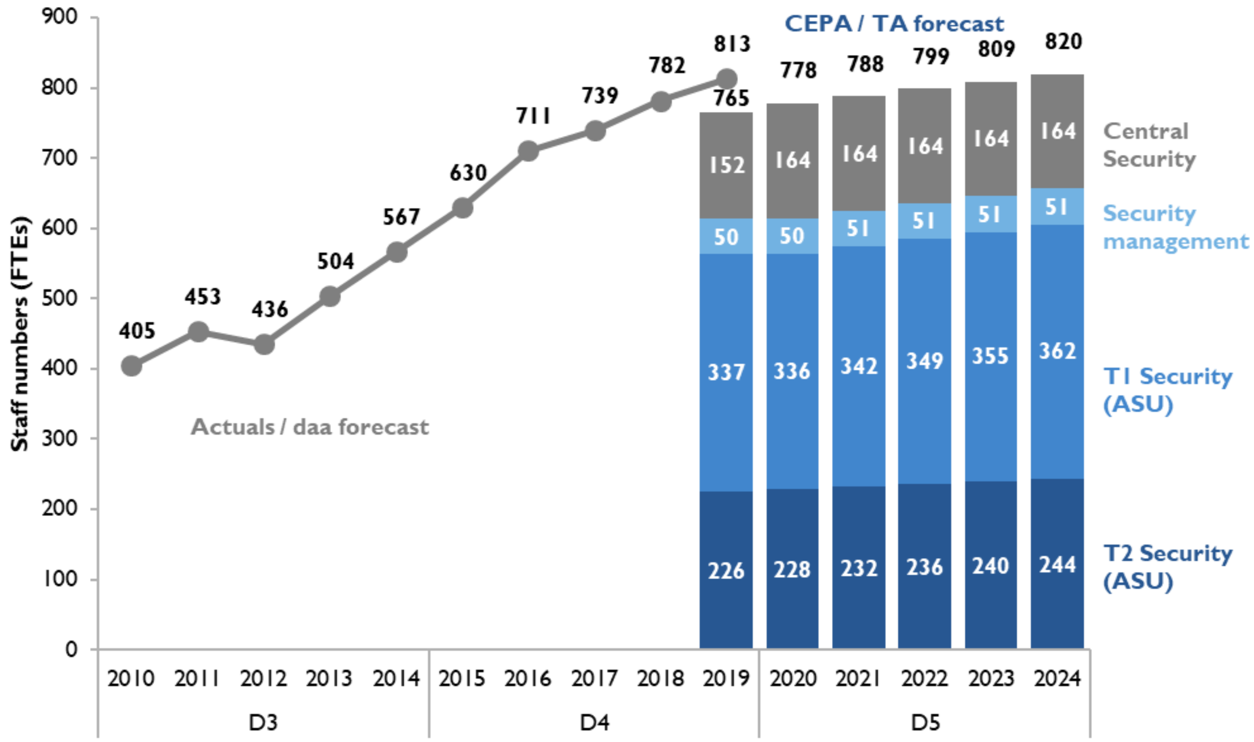
Table 4.4: Approach taken to produce forecasts of security staffing levels

Staff category	Approach
Terminal 1 ASU	*Baseline efficiency adjustment* – In our analysis in the previous section, we found potential savings of 10% in the 2018 summer roster, which equate to 6% when averaged over the full year. We establish a 2019 baseline by applying the 6% efficiency saving to Dublin Airport's 2018 estimate of staffing levels. *Elasticity* – We apply an elasticity of 0.62 with respect to passenger numbers. Our estimate of this elasticity is based on analysis of the variation of X-ray lane requirements with traffic growth coupled with the Terminal 1 lane staffing profile for the passenger traffic distribution. *Other adjustments* – We also apply an efficiency saving to account for the projected throughput improvements for Terminal 1 X-ray machines up to a limit of 420 trays per machine per hour. The throughput efficiency savings are applied in the year after they are planned to be introduced.
Terminal 2 ASU	*Baseline efficiency adjustment* – Similar to the Terminal 1 analysis, we establish a 2019 baseline by applying a 4% efficiency saving (averaged from a 10% efficiency saving to the winter roster) to Dublin Airport's 2018 estimate of staffing levels. *Elasticity* – We apply an elasticity of 0.56 with respect to passenger numbers. Our estimate of this elasticity is similar to our analysis of Terminal 1 ASU staff. *Other adjustments* – We apply an efficiency saving to account for projected throughput improvements for Terminal 2 X-ray machines up to a limit of 315 trays per machine per hour.
VCP	*Baseline efficiency adjustment* – We estimate a baseline for 2019 by taking estimated 2018 staffing levels and removing 11 FTE that we consider to be surplus. This reduction is based on the 5 FTE reduction we believe is achievable through a reduction in the absence rate, plus a 6 FTE reduction from efficiency savings identified by Dublin Airport. In addition to manging business as usual operational flows, part of normal VCP operations is to manage the airside ingress and egress of construction and maintenance traffic. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Security management and supervisors	*Baseline efficiency adjustment* – We estimate a baseline in 2019 by making an adjustment for additional staffing requirements. A vulnerability highlighted in a recent security audit, was the lack of dedicated supervision at all screening entry points within the Terminals. Dedicated supervision at staff, entry points during opening hours was deemed to be a requirement to mitigate against compliance deficiencies and potential insider threats. Based on current opening hours and roster requirements this equates to an additional 12 FTE. Dublin Airport expect a growth in staff between 2018 and 2019 beyond the additional security supervisors identified above that we have not seen justification for. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Security training	*Baseline efficiency adjustment* – We make a large baseline adjustment to the number of security training staff in 2019. Dublin Airport's projections foresee a large increase in security training staff from 8 to 20 between 2017 and 2019. Based on the assumptions that Dublin Airport's security training programme is adequate so does not need a

	major transformation and that it is volume-driven by the number of staff needing training, we limit this increase by assuming that the growth of security training staff will be proportionate to the increase in other security staff numbers over the next control period. This results in a saving of approximately 60% compared to Dublin Airport's plans. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers. Instead we have applied an elasticity of 1 for security training staff with respect to other security staff numbers.
Other	*Baseline efficiency adjustment* - The remaining functions consist of some operational roles (hold baggage screening and a behavioural detection unit) and planning and compliance roles (including group security). We make no adjustments to the 2019 planned levels. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.

Figure 4.11 shows our projected security staffing levels based on the analysis for the period 2019 to 2024 and compares this to Dublin Airport's actual and projected staff numbers for 2015 to 2019. The figure shows that the re-baselining realises a reduction in FTE of approximately 6% in 2019 from the Dublin Airport's 2019 estimate.

Figure 4.11: Projected re-baselined security staff numbers compared to current staff numbers, 2010-2024

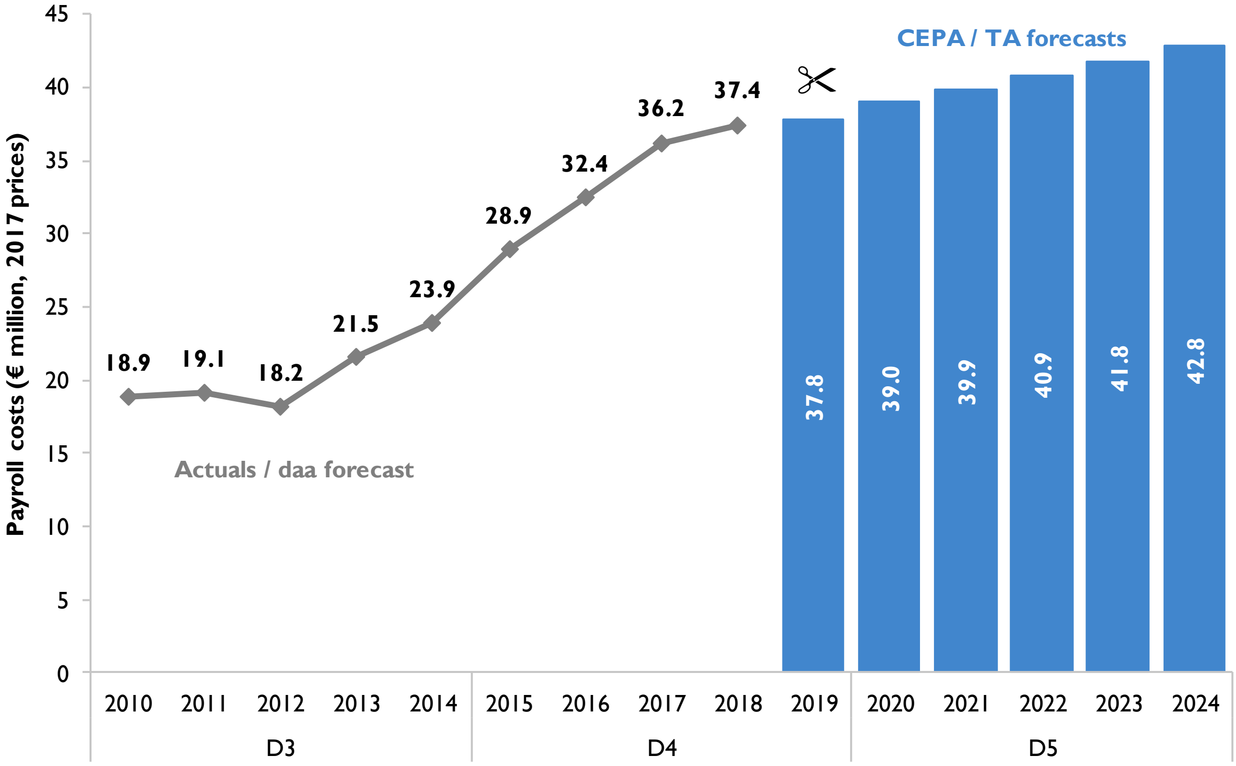


Source: Dublin Airport; Taylor Airey analysis

Payroll costs

We project 2019 efficient payroll costs to be €37.8 million compared with Dublin Airport's estimate of ✂✂✂✂. We then forecast this to grow to €42.8 million by 2024, as shown in Figure 4.12. On a per passenger basis, this implies security expenditure falling from ✂✂✂ per passenger in 2019 to ✂✂✂ per passenger in 2024. This compares with outturn per passenger expenditure of €1.26 in 2017.

Figure 4.12: Forecast payroll expenditure compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis

4.3. Maintenance

Summary

Dublin Airport's spend on maintenance in recent years has exceeded CAR's determination target. An increase in staff numbers and higher than expected wage increases have each contributed to this. However, our analysis generally shows that Dublin Airport's current level of expenditure compares relatively favourably when benchmarked against other similarly-sized airports. We also conclude, following discussions with Dublin Airport and airlines, that the extra operational staff were necessary to accommodate growth in passenger numbers. Airport management have embarked on initiatives to improve the efficiency of maintenance expenditure, though evidence on the impact is limited.

We do find some inefficiency in terms of over-staffing of administrative teams and wage costs that are higher than we would expect, which we have removed from our baseline estimate of expenditure. This means our 2019 baseline estimate is approximately 6% or €1.7 million lower than 2017 outturn levels. We also find some evidence of more structural inefficiency in terms of wage costs for staff on older contracts. Taking into consideration increased requirements from passenger growth and new assets, and on-going procurement efficiency and wage restraint, we forecast spend to grow from €28.4 million in 2019 to €29.7 million by 2024.

4.3.1. Introduction

Maintenance expenditure is broadly split equally between payroll and non-pay spend. Approximately half of in-house maintenance staff are based in the terminals, with the remainder working in central areas.

Terminal maintenance includes staff working in general asset care (i.e. day-to-day repairs and maintenance), specialist staff maintaining baggage handling systems, and a small number of managerial staff. Central maintenance includes all airfield electrical and operative staff, as well as several airport-wide functions (gardening, engineering, utilities management, car park repair and maintenance, etc.). It also includes a larger maintenance management team.

Non-pay expenditure consists of a variety of outsourced repairs and maintenance across the airport campus. This includes the replacement of smaller equipment, vehicle repairs, and building and runway repairs. Our discussions with Dublin Airport highlighted that it tends to outsource functions that are either very routine, and so an effective market exists for such functions, or activities that require specialist input.

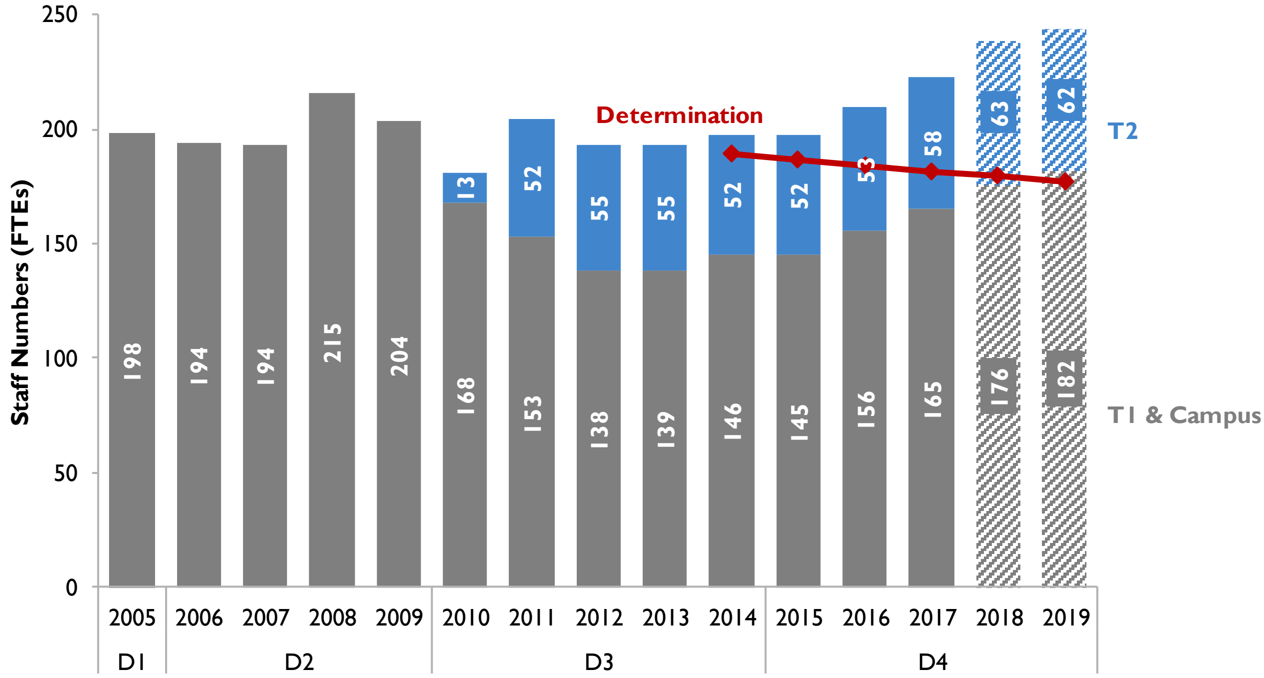
4.3.2. Historic expenditure

Staff numbers

As shown in Figure 4.13, since the beginning of the current price control up to 2017, staff numbers have increased by 13% whereas the 2014 determination target assumed a 4% reduction. Staff numbers are expected to continue to rise to 2019. Despite this increase, 2017 was the first year in which FTE exceeded the previous peak seen in 2008.

Dublin Airport anticipate that there will be an additional 46 FTE by 2019 compared with 2014. This growth has been spread across the airport. The largest increase comes from an extra 12 FTE working in airside maintenance and an additional 9 FTE in the management team.

Figure 4.13: Maintenance related staff numbers, expressed in full-time equivalents at Dublin Airport, 2005-2019



Source: Dublin Airport; CEPA analysis; CAR determination

Payroll costs

As shown in Figure 4.14, unit payroll costs have increased steadily since 2014. While some growth was anticipated in the 2014 determination, by 2017, wages were 11% higher than forecast. Dublin Airport forecast this gap to reduce to ✂ by 2019. Between 2014 and 2017, Terminal 1 staff have exhibited a wage premium of roughly ✂ over staff in Terminal 2.

Figure 4.14: Maintenance payroll costs per full-time equivalent staff by terminal, 2005-2019 (€, 2017 prices)

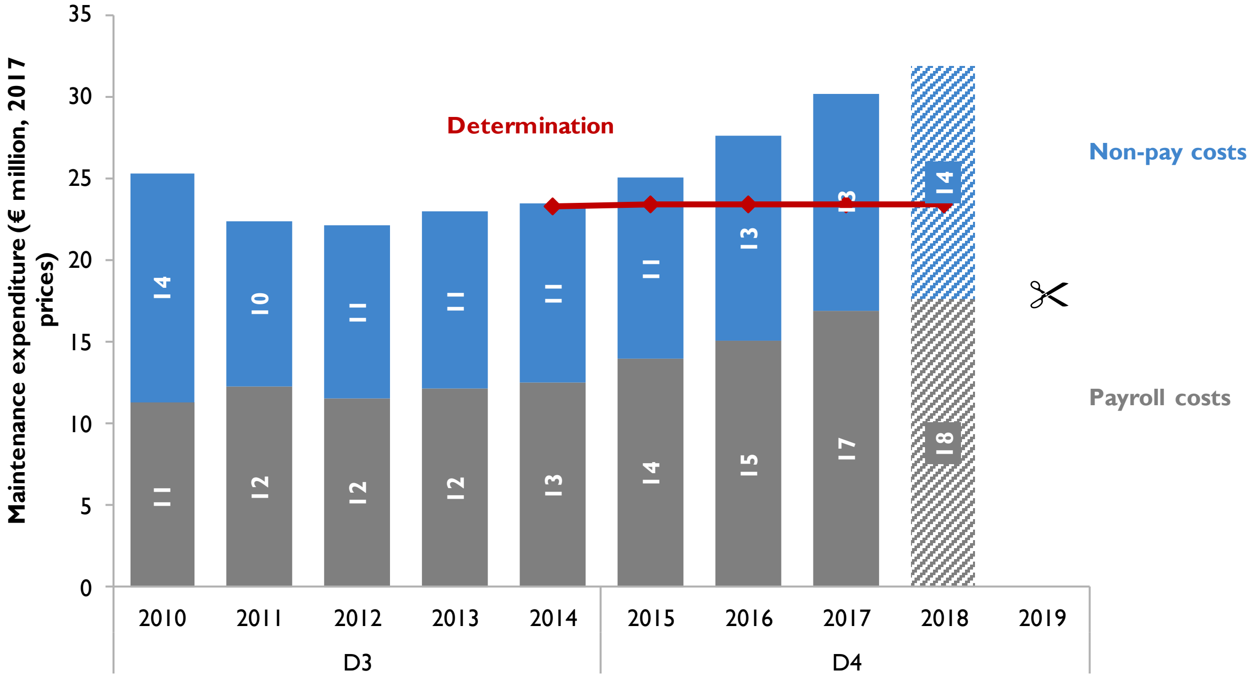
✂

Source: Dublin Airport; CEPA analysis; CAR determination

Non-pay costs

Apart from in 2010, non-pay spend has constituted a little less than half of total maintenance costs. Figure 4.15 shows the evolution of non-pay expenditure as well as the 2014 determination targets. Much like payroll costs, non-pay expenditure has grown faster than assumed in the 2014 determination, rising from €11 million in 2014 to €13.2 million in 2017. Overall this means that the airport is forecast to exceed its maintenance expenditure target for the current price control by €29 million.

Figure 4.15: Outturn maintenance expenditure compared with the CAR determination, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis; CAR determination

4.3.3. Analysis

Overall maintenance expenditure

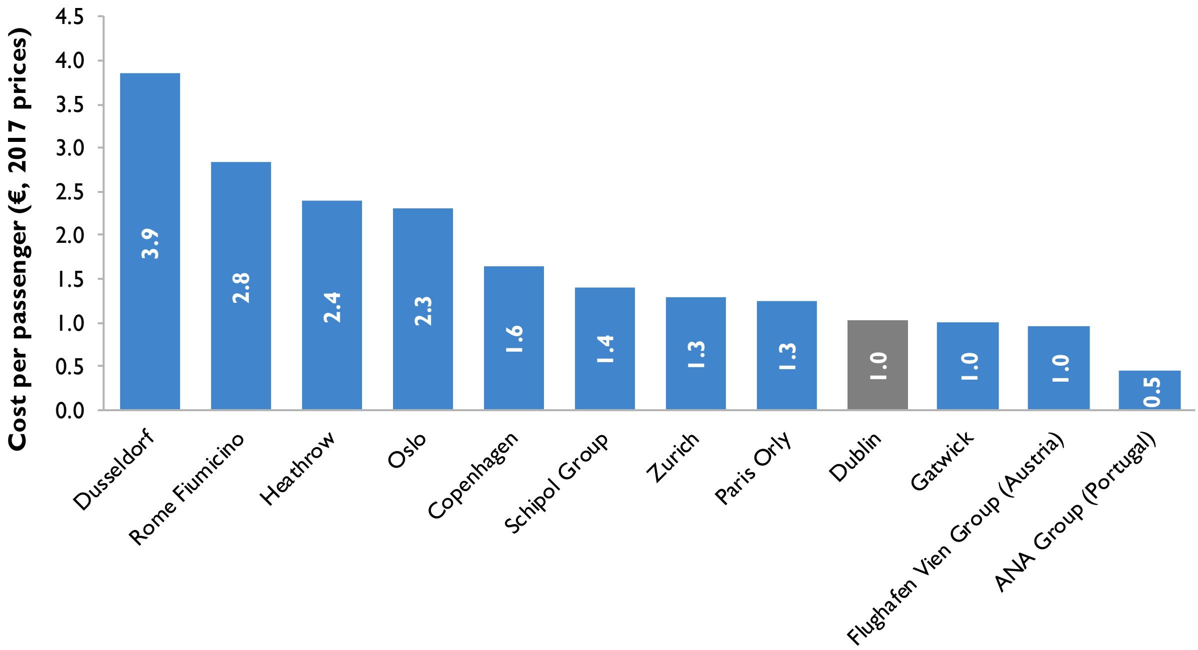
Dublin Airport attribute the increase in maintenance costs to several different factors:

- The airport has expanded its typical hours of operation due to the increase in flights, resulting in reduced access times and a higher proportion of works being carried out at night;
- The size and complexity of the asset base has increased, such as the automatic tray return system, hold baggage screening equipment etc.;
- The asset base is ageing and needs more maintenance, such as the Terminal 1 baggage system and Terminal 2 more broadly; and
- The increase in ATMs has meant the runway is used more intensively and therefore requires more regular maintenance.

In our discussions with Dublin Airport's asset care team, they highlighted the steps they have taken to improve efficiency. This included implementing LEAN workflow methods and taking a more planned approach to maintenance as opposed to reacting to issues. But it is unclear whether such efforts have been successful at introducing efficiencies, as costs have increased over time. We also note that approximately a third of new maintenance staff have been hired into management and administrative roles rather than operational roles.

In order to assess the efficiency of Dublin Airport's maintenance expenditure, we benchmark it against other European airports. We expect maintenance requirements to be primarily driven by the physical assets at an airport (as measured by, for example, terminal area), but such a metric can be difficult to obtain consistently. Instead we compare maintenance costs per passenger, as shown in Figure 4.16. Having collected this data from annual reports, it is important to recognise maintenance is not necessarily consistently defined. Published accounts typically give a limited breakdown of costs and while the selected airports publish the cost of maintenance externally contracted, it is not always clear whether in-house expenditure is included. For Dublin, total maintenance cost per passenger is displayed.

Figure 4.16: Maintenance costs per passenger in 2017



Source: CEPA analysis of Dublin Airport data and airport annual accounts

Nevertheless, the figure above suggests Dublin's unit maintenance costs are reasonable compared to the selected European airport groups[12]. Dublin Airport's costs have reduced by roughly 6% on a per passenger basis since the beginning of the current price control, from €1.08 in 2014 to €1.02 in 2017.

We also consider maintenance costs per square metre of terminal area. As shown in Figure 4.17, there has been a steady increase in unit cost from roughly €89 per square metre in 2014 to over €113 per square metre in 2017. Despite this increase, unit costs remain lower than they were before 2010, when Terminal 2 was opened. When unit costs are benchmarked against other airports for which data is available, Dublin Airport performs well with an average unit maintenance cost in 2017 that was lower than Heathrow at €312 per square metre and Gatwick at €179 per square metre.[13]

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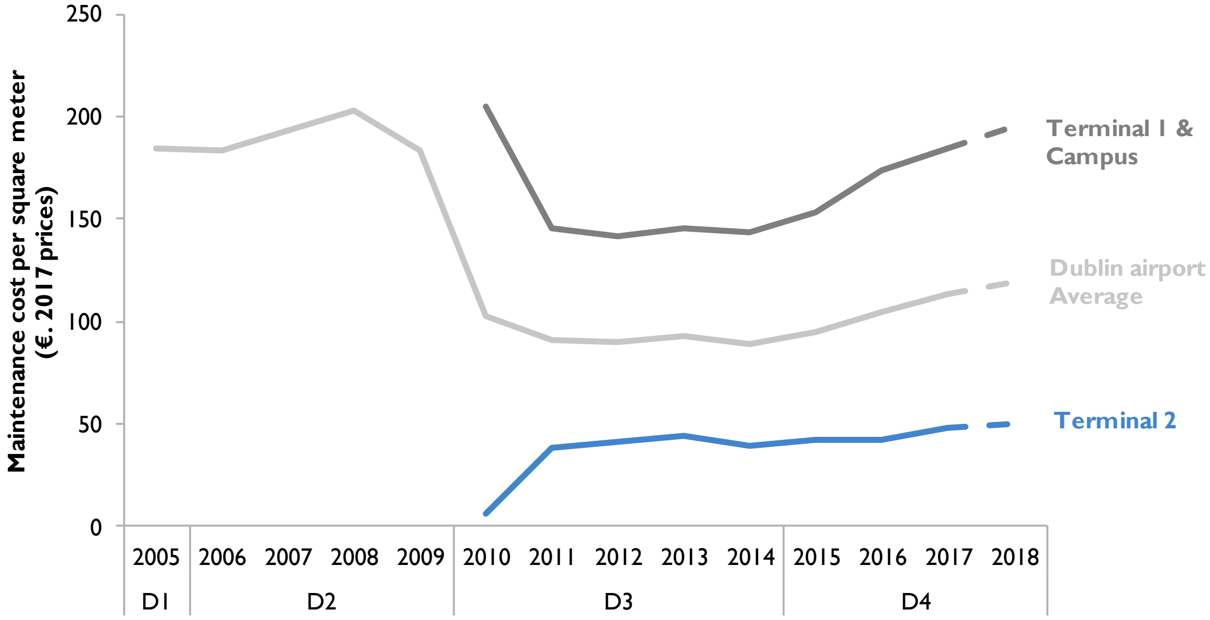
[12] Our selection of comparator airports is based on data availability. The comparator airports vary in terms of passenger numbers and in infrastructure complexity, though we note that some are more closely comparable to Dublin than others. Dublin is one of the smaller airports on a per-passenger basis, with its infrastructure of two terminals connected by a walkway and two runways being of broadly intermediate sophistication. In contrast, Heathrow is a large airport with a highly complex set up.

[13] As calculated from airport annual accounts

Figure 4.17: Maintenance costs per terminal area from 2005 to 2019 (€ per m², 2017 prices)



Source: Dublin Airport; CEPA analysis

There is however a variation between the unit maintenance costs of Terminal 1 compared with Terminal 2, as displayed in the figure below. Terminal 2 costs are consistently lower than those for Terminal 1 and the Central Campus. A differential in unit costs between the two terminals is expected to a certain extent, given Terminal 2 is newer and has been designed with consideration of on-going maintenance costs. However, the scale of the differential between the two terminals is unlikely to be explained by this alone, particularly as the scale of the differential has increased in recent years.

From our discussions with airlines, we note that they have generally been happy with the service provided by Dublin Airport with regards to the maintenance of key assets. The availability of key assets such as the baggage handling system has been well within the service quality targets for this determination period. Despite this, airlines consider that the existing service quality metrics are insufficiently challenging and possibly lacking in focus on the issues that matter to airlines.

Our benchmarking analysis suggests that overall, Dublin Airport performs well against comparator airports. Where it performs less well, is when we compare the airport's current expenditure on maintenance against historic levels, or when we compare between the two terminals. Taking the growth in cost per terminal area, we believe this can only be justified by an improvement to the quality of service or by increased requirements due to more intensive use of infrastructure.

We have not been able to find any clear evidence to suggest that quality has improved, or that more intensive use of infrastructure has necessitated the scale of additional maintenance spend. We do acknowledge that reduced access times and increased requirements are likely to mean some additional maintenance staff are required, leading to additional payroll spend. However, it is less clear that the increase in management staff was necessary given we cannot see any evidence of a step change in the productivity of maintenance staff or quality of maintenance outputs.

4.3.4. Future projections

As our benchmarking suggests that overall maintenance expenditure at Dublin Airport is reasonable when considered on a cost per passenger basis, we have focused our baseline efficiency adjustment in two areas:

- We adjust the number of staff required to reflect that there is little justification for additional maintenance staff in management roles, or in other maintenance roles where the activities carried out are unaffected by passenger volumes.
- We also adjust unit payroll costs to reflect that wage growth over the current determination has been higher than we believe is efficient.

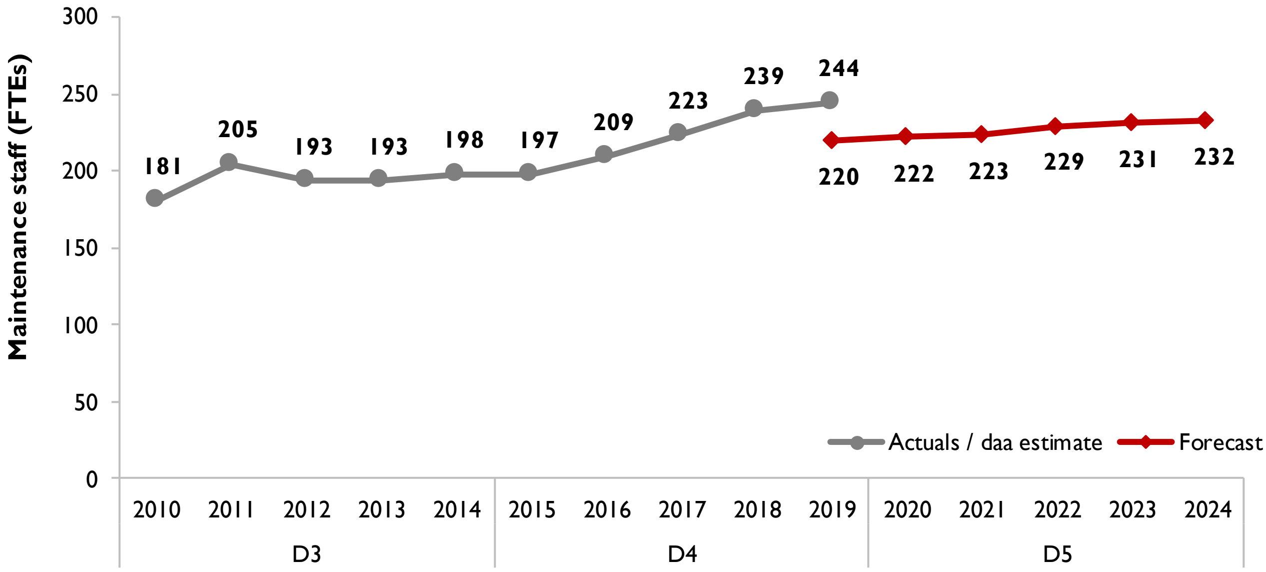
Staff numbers

For our baseline adjustment to staffing levels, we begin by splitting maintenance staff into roles that we believe are passenger driven versus those that are not passenger driven. We then project from 2014 (where costs were at their lowest) reflecting increased passenger numbers, by applying our elasticity estimate of 0.4 to expected passenger growth between 2014 and 2019. This provides us with a baseline estimate for 2019 staffing levels, of 220 FTE compared with a Dublin Airport estimate of 244 FTE. For maintenance staff in roles that we do not believe are passenger driven, we have kept staff numbers at 2014 levels implying a reduction of 17 FTE from 2017 levels and a reduction of 23 FTE from Dublin Airport's 2019 estimate. Overall, this means that our baseline estimate for maintenance staff numbers is 4 FTE lower than 2017 outturn and 25 FTE lower than the 2019 estimate.

To project maintenance staffing levels for the next determination, we first estimate the effect of increased passenger volumes. For the maintenance staff who work in roles that are passenger driven, we assume a 1% increase in passenger numbers will require a 0.4% increase in the number of staff required (i.e. we assume an elasticity of 0.4). For the remaining maintenance staff, we keep their levels constant.

Dublin Airport has also identified several areas where it believes additional staff are needed beyond passenger driven growth. Where we agree that these additional staff are necessary, we have included them in our forecasts. We present the detail of these additional cost items later in this section. Our overall forecasts of maintenance staffing levels are illustrated in Figure 4.18.

Figure 4.18: Forecast maintenance staff numbers, compared with historic, 2010-2024 (full-time equivalent)

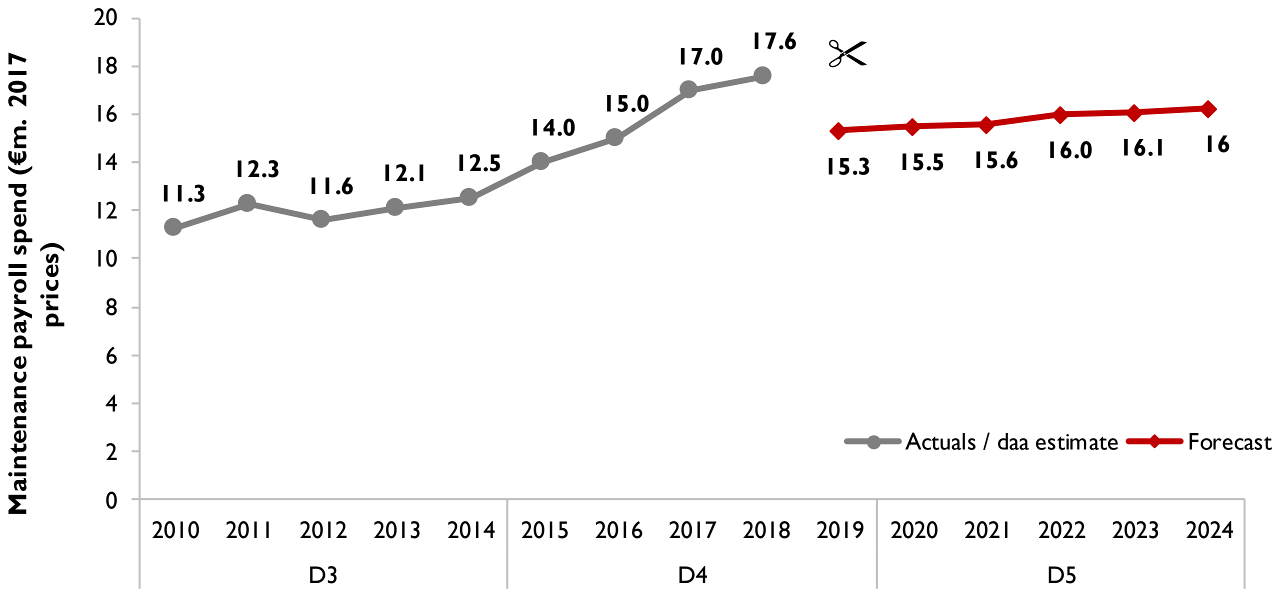


Source: Dublin Airport; CEPA analysis

Payroll costs

We project 2019 total efficient payroll costs to be €15.3 million compared with Dublin Airport's estimate of ✂✂✂✂. Using our assumptions on efficient future wage growth over the determination period, we forecast this to grow to €16.2 million by 2024, as shown in Figure 4.19. On a per passenger basis, this implies expenditure on maintenance staff falling by 9% from €0.47 per passenger in 2019 to €0.43 per passenger in 2024. This compares with outturn per passenger expenditure on maintenance staff of €0.60 in 2017.

Figure 4.19: Forecast maintenance payroll expenditure, compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

Non-pay costs

For outsourced costs, we do not apply a baseline efficiency estimate as we have not identified any areas of inefficiency. We therefore use Dublin Airport's 2019 estimate for non-pay expenditure as our baseline. We forecast growth in non-pay maintenance expenditure based on growth in payroll costs (i.e. assuming the ratio of pay to non-pay expenditure stays constant).

We judge that savings equivalent to 5% of our 2019 estimate of non-pay costs should be achievable by 2024. The 5% saving is based on what we believe can be achieved through improved procurement and through economies of scale in procurement as the airport's asset base increases. As the airport increases in size, we expect it will have greater bargaining power when negotiating contracts with suppliers. We also understand from discussions with Dublin Airport that investment has been made in reviewing and developing the procurement function at the airport. We would expect this investment to generate efficiencies throughout the next regulatory period.

After applying the efficiency, we add any additional cost items we believe to be efficient (as discussed below). The overall effect of this is to increase expenditure on outsourced maintenance from ✂✂✂✂ in 2019 to €13.4 million in 2024.

Additional cost items

As noted above, Dublin Airport has identified a number of cost items, which it believes are incremental to existing maintenance expenditure. These are:

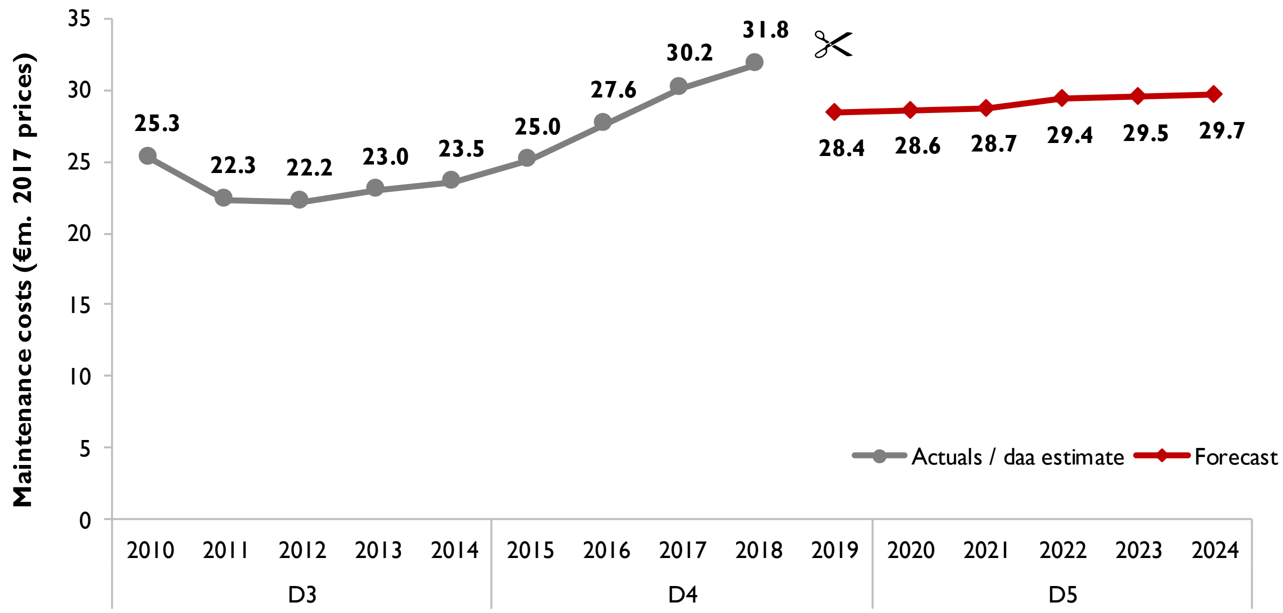
- **✂✂✂ per annum in non-pay expenditure for the maintenance of foam tenders and snow equipment, and for the replacement of various parts of lifts, escalators and travellators**. Dublin Airport argue that this is additional expenditure as the typical lives of such assets mean they were not replaced in the current price control period (ranging from 5 to 12 years). However, we would expect Dublin Airport to have many assets with varying lengths of useful life, a certain proportion of which will be replaced in every control period as part of any normal asset management regime. We do not consider this to be genuinely additional expenditure that would not be netted off against reduced expenditure elsewhere. Where Dublin Airport are planning to invest in new equipment, we consider the maintenance cost of this separately in Section 6 in which presents our discussion on the CIP.

- **✂✂✂ per annum in payroll and ✂✂✂ per annum in non-pay expenditure for the maintenance of fixed electrical ground power (FEGP) units** approved under the PACE consultation. We do consider these costs to be reasonable and note that the maintenance costs of these will be recovered through charges to airlines users. The operational costs of these will be borne by ground handlers and airlines.
- **✂✂✂ in payroll and ✂✂✂ in non-pay expenditure for the second northern parallel runway, which is due to be in full operation by 2022.** The payroll estimates imply an additional 4 FTE, compared with 22 FTE in such roles in 2014. Non-pay expenditure for runway and taxiway maintenance has historically averaged approximately ✂✂✂ per annum in nominal terms. We believe the uplift in FTE and in non-pay expenditure estimated by Dublin Airport for the maintenance of the second northern runway is broadly reasonable and have therefore included it in our forecasts.

Forecast summary

As shown in Figure 4.20 below, we expect maintenance expenditure as a whole to increase from €28.4 million to €29.7 million over the course of the next control period. On a per passenger basis, this implies a decline from €0.88 per passenger in 2019 to €0.78 per passenger by 2021.

Figure 4.20: Forecast maintenance cost, compared with historic, 2010-2024 (full-time equivalent)



Source: Dublin Airport; CEPA analysis

4.4. Central functions staff

Summary

The previous efficiency study commissioned by CAR concluded that Dublin Airport had more administrative staff than would be expected for an airport of its size. Our analysis shows that this remains the case with staff numbers and payroll costs expected to be over 50% higher by the end of the current price control period, compared with the final year of the previous control period. We find little justification for this, either in terms of increased requirements or improved outcomes. We consider that the higher than expected passenger growth, has allowed Dublin Airport to maintain profitability without fully considering the efficiency of its administrative staffing levels.

We therefore make an efficiency adjustment to 2019 payroll costs; €4.8 million lower than 2017 outturn costs. Our forecasts also reflect, a) our view that most central functions are largely unaffected by passenger volumes, and b) on-going efficiency initiatives we expect to materialise over the next determination period.

4.4.1. Introduction

Central functions staff are split roughly equally between Dublin Airport and daa group. The employees work mostly in administrative roles such as commercial, finance, human resources, and airport management. Passenger support staff working in Dublin Airport's new transfer facility have also been allocated to this category. Whilst we have included commercial staff working in car parking revenue generation in our analysis in this section, they are also considered in detail in the Section 4.10 so we can consider the car parking function holistically.

4.4.2. Historic expenditure

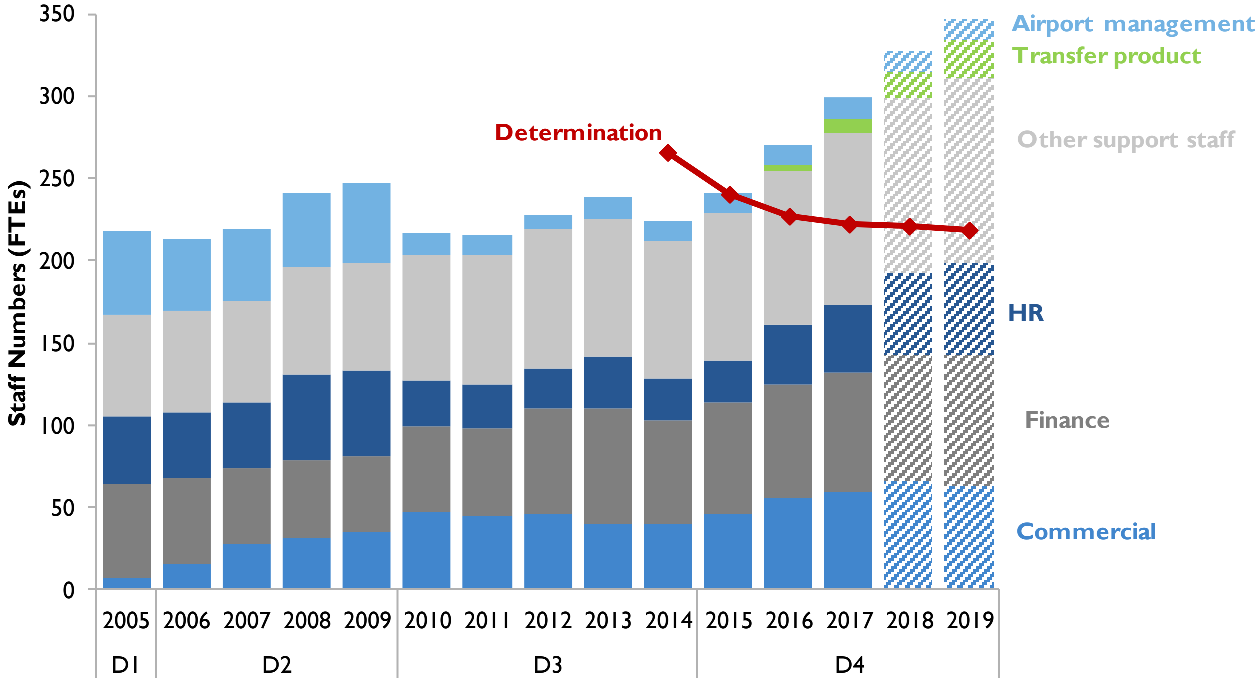
Staff numbers

Between 2014 and 2017, both average staff numbers and unit payroll costs increased, despite the 2014 determination forecasting a decline in staff numbers and much slower growth in payroll costs. As shown in Figure 4.21, staff numbers in all central functions have increased since 2014, with 123 additional FTE staff expected by 2019 compared with the start of the price control period. 22 of the forecast staff in 2019 have been allocated to support passengers using Dublin Airport's new transfer facility. The overall increase in central function staff numbers equates to a growth of 55% over five years.

CAR's 2014 determination assumed a decline in the number of administrative support staff from 266 FTE in 2014 to 223 FTE by 2017. Current staffing levels exceed this despite some staff being recategorized from central functions into other areas.[14] On a per passenger basis, central functions staff per million passengers has declined slightly from 10.3 in 2014 to 10.1 in 2017. This implies an elasticity of 0.93 compared with the 2014 assumption that the number of central functions staff is not elastic to passenger numbers.

[14] Comparing staff numbers in previous analysis with the data provided to us by Dublin Airport suggest nearly 30 FTE staff have been reallocated to other categories. In Figure 4.21 and Figure 4.22, data before 2010 uses the old categorisation.

Figure 4.21: Staff working in central administrative functions, 2005-2019 (full-time equivalents)

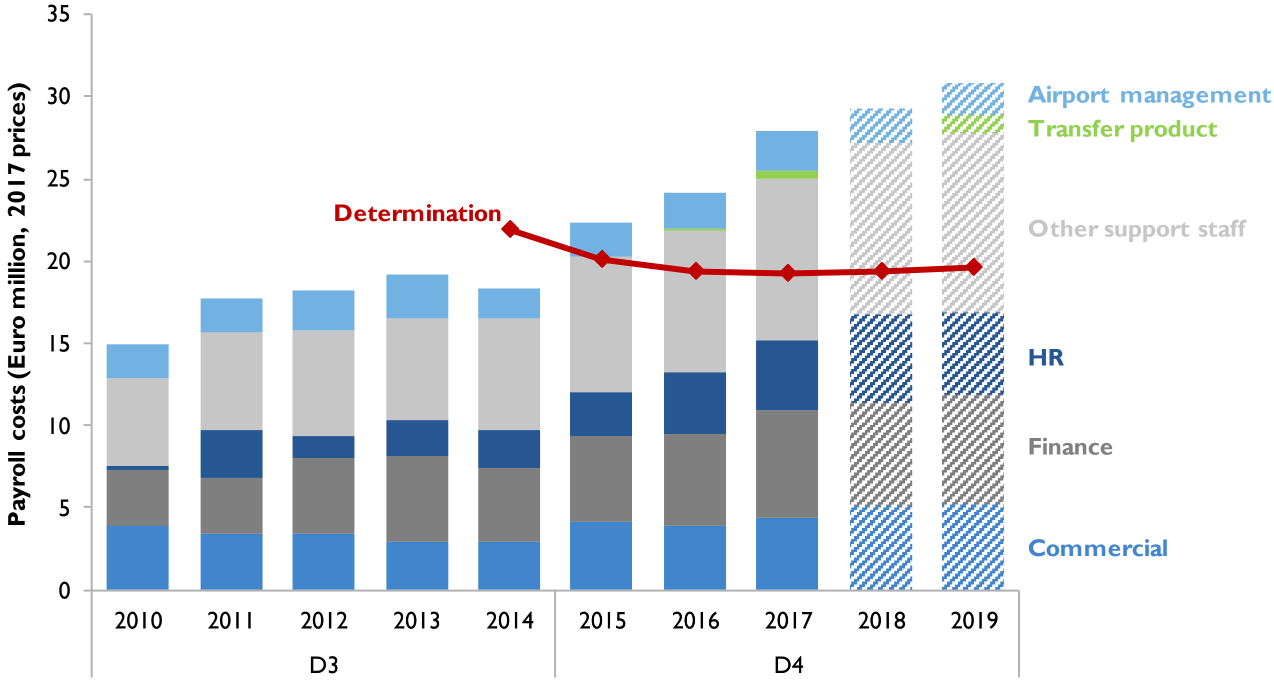


Source: Dublin Airport; CEPA analysis; CAR determination

Payroll costs

As shown in Figure 4.22, total payroll costs increased from €19.3 million in 2014 to €27.9 million in 2017, a rise of 52%. Dublin Airport forecast this to rise to ✂✂✂✂ in 2019, which compares with CAR's determination assuming payroll costs would decline over the period. The difference between the two means that total payroll costs are expected to be 55% higher than the determination by 2019.

Figure 4.22: Payroll costs for staff working in central administrative functions, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis; CAR determination

Overall, the biggest increases in staff numbers have been seen in HR, commercial and support services, whilst the biggest increases in unit payroll costs have been in finance. When considering payroll costs as a whole, the implied elasticity on a per passenger basis is 1.4.

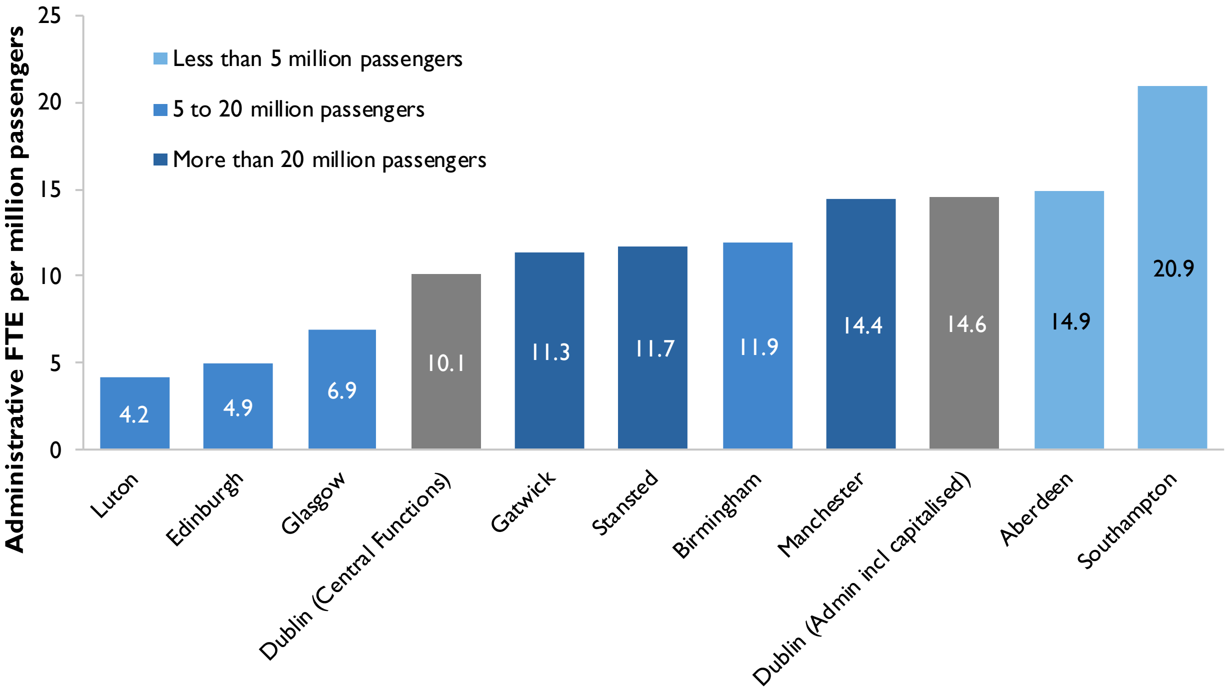
4.4.3. Analysis

Staffing levels

To assess the efficiency of Dublin Airport's expenditure on central functions staff, we have benchmarked administrative staffing levels with other airports.[15] We have used data in annual reports to calculate benchmarks, recognising that such data is not always consistently defined. To aid comparability, we have taken the number of staff working in non-operational roles, which we believe is comparable to the number of staff at Dublin Airport working in a central function, IT and in staff planning (including those that have been capitalised). Where an airport is part of a group, we have apportioned group level administrative staff to subsidiary companies, based on revenues generated.

As can be seen in Figure 4.23, the ratio of non-operational staff to passengers varies by airport, and by airport size. At 2017 levels, Dublin Airport appears to have many more employees working in administrative roles than other comparable airports, with only two small airports having a higher staffing ratio. This, coupled with the growth in staff over the current price control period, suggests that Dublin Airport is overstaffed in administrative areas. Keeping staff numbers at 2014 levels would imply a ratio of 7.56 FTE per million passengers, whilst a reduction of staff numbers in line with the 2014 determination would imply a ratio of 7.53 FTE per million passengers.

Figure 4.23: Benchmark number of administrative FTE per million passengers, 2017



Source: Dublin Airport; CEPA analysis; airport annual accounts

Looking at the commercial function, the number of employees working in property, concessions or advertising rose from 26 FTE in 2014 to 45 FTE in 2017. As a way of assessing whether these additional

[15] We use airports for which data exists and which can be considered reasonably comparable to Dublin.

staff have been necessary, we have considered the non-aeronautical revenues generated over the same period. Whilst revenues outside of car parking and retail (which are dealt with by other commercial staff) have risen from €64 million in 2014 to €83 million in 2017 (in 2017 prices), this is a decline in per passenger terms from €2.95 per passenger in 2014 to €2.81 per passenger in 2017. An alternative way of considering this is by looking at revenue generated per commercial FTE; this has declined from €1.61 million per FTE in 2014 to €1.4 million per FTE in 2017. This suggests that the increase in commercial staff is difficult to justify solely on the basis of additional revenues generated.

The number of finance staff, except for the shared services centre (SSC), has stayed relatively constant throughout the current price control period. We understand from discussions with Dublin Airport that the SSC has been expanded to take on transactional functions previously undertaken by individual finance teams. As the SSC is located outside of Dublin, payroll costs are expected to be lower leading to efficiencies. However, whilst we believe this is a logical step, we have not seen any evidence of efficiencies arising from this expansion. For example, between 2014 and 2017 wages for SSC finance staff grew by 30% whilst wages for financial professionals in the wider Irish economy grew by only 7% over the same period. We have also not seen any reduction in the number of finance staff in other areas, which would be an obvious efficiency of some functions being transferred over to the SSC.

The number of support staff has increased by 37 FTE between 2014 and 2017, with Dublin Airport expecting staff numbers to rise by an additional 23 FTE by 2019. The largest increase is due to additional HR staff being hired as part of a HR transformation programme. The aim of the programme is to implement a new timesheet system, which digitalises key processes related to payroll activities and is expected to lead to administrative efficiencies in the medium term. However, the size of such efficiencies has not been estimated.

The second largest increase in staff numbers, is from additional staff hired to support passengers using the new transfer facility. The remainder of the increase in administrative staff is in a number of different support roles.

Overall, our analysis suggests that Dublin Airport central administrative and management functions are overstaffed. In particular, we find evidence of inefficiency in the commercial and finance functions. Whilst some of the additional staff taken on recently may be justified given higher per passenger revenues generated in areas such as car parking, we believe the growth in employee numbers exceeds what would be expected for an airport the size of Dublin.

4.4.4. Future projections

Staff numbers

Our forecasts are constructed using different assumptions across central function staff roles. Table 4.5 describes the approach taken for each category of central functions staff.

Table 4.5: Approach taken to produce forecasts for central functions

Staff category	Approach
Commercial (property, advertising and concessions)	*Baseline efficiency adjustment* – We have applied a reduction of 12 FTE to the 2017 outturn number of commercial staff working in revenue generation for property, advertising and concessions. This has been estimated by ensuring the ratio of staff growth to income growth has stayed constant since 2014, which is when commercial revenues in these areas per FTE were at their highest.

	Elasticity – We do not expect the number of commercial staff to vary by passenger numbers. Instead it is driven largely by non-aeronautical revenue generation, and as such we have applied no elasticity.
Commercial (car parking and marketing)	*Baseline efficiency adjustment* – We have not found any significant inefficiency in the number of parking and marketing commercial staff. We have therefore taken the 2017 number of FTE staff as our baseline estimate. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Finance (SSC)	*Baseline efficiency adjustment* – We have not found any inefficiency in the number of SSC finance staff. However, we believe the move of more transactional functions from Dublin to the SSC is a sensible efficiency measure. As Dublin Airport expect the SSC to continue to expand into 2019, we take its 2019 estimate of FTE as our baseline estimate of staffing levels. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Finance (other)	*Baseline efficiency adjustment* – We believe Dublin Airport has not realised efficiencies from the expansion of the SSC. This adjustment is based on the assumption that the scale of the growth in the SSC should have been matched by a proportionate reduction in other finance staff. In other words, as the SSC is expected to grow by 33% between 2014 and 2019, we would expect to see a proportionate reduction in other finance staff. A proportionate reduction in other finance staff would lead to an efficiency saving of 6 FTE in 2019. As such, we choose 2019 as the base year of our forecast and make an efficiency reduction of 6 FTE from Dublin Airport's forecast for that year. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Airport management	*Baseline efficiency adjustment* – We have not found any significant inefficiency in the number of airport management staff. We have therefore taken the 2017 number of FTE staff as our baseline estimate. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Support (HR)	*Baseline efficiency adjustment* – We have not found any significant inefficiency in the number of HR support staff. We have therefore taken the 2017 number of FTE staff as our baseline estimate. *Elasticity* – We expect HR costs will be driven by staff numbers rather than passenger numbers. We therefore apply an elasticity of 0.69 with respect to total staff numbers (minus central functions HR staff) for staff numbers outside of the transformation office. *On-going efficiency* – We expect the number of FTE working in the transformation office will reduce from 2021 to zero staff by the end of the period.
Support (procurement)	*Baseline efficiency adjustment* – We have not found any significant inefficiency in the number of procurement support staff. We have therefore taken the 2017 number of FTE as our baseline estimate. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.

Support (strategy and regulation)	*Baseline efficiency adjustment* – We have reduced the number of strategy and regulation staff to 2014 levels, implying a reduction of 4 FTE compared with 2017 levels. We do not believe Dublin Airport has adequately justified the increase in staff numbers given its activities are largely similar in scale to its activities in 2014. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Support (communications)	*Baseline efficiency adjustment* – We have not found any significant inefficiency in the number of communication support staff. We have therefore taken the 2017 number of FTE staff as our baseline estimate. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Support (other)	*Baseline efficiency adjustment* – We have reduced the number of other support staff to 2014 levels, implying a reduction of 8 FTE compared with 2017 levels. We do not believe Dublin Airport has adequately justified the increase in staff numbers. *Elasticity* – We do not apply any elasticity to our forecast as we do not expect staff numbers to vary by passenger numbers.
Transfer product	*Baseline efficiency adjustment* – We have taken the 2017 number of FTE as our baseline estimate. This gives a baseline estimate of 8 FTE staff. Dublin Airport has forecast that this number will rise to 22 staff in 2019. Whilst we expect growth in the use of the transfer facility, we view that there are efficiencies to be gained from more flexible deployment of all terminal facilities staff including those working to help facilitate passenger transfers. *Elasticity* – We apply an elasticity of 0.2 to reflect that the number of staff required is broadly driven by the number of transfer passengers.

Table 4.6 shows the net effect of our baseline adjustments to central staff numbers, volume-driven elasticities and one-off efficiency assumptions on our forecast staffing levels.

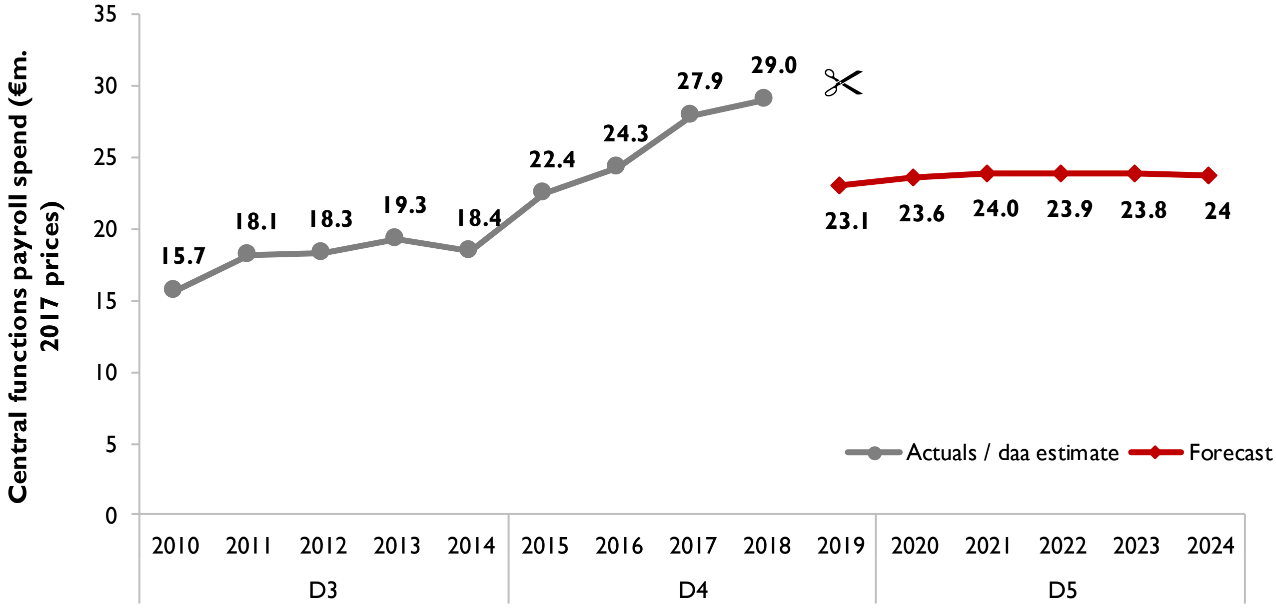
Table 4.6: Central functions forecast staffing levels

	2019	2020	2021	2022	2023	2024
Baseline	277	277	277	277	277	277
Volume-driven elasticities	-	0	0	0	1	1
One-off efficiencies	-	-	- 0	- 4	- 9	- 13
Forecast	**277**	**277**	**277**	**273**	**268**	**265**

Payroll costs

The overall impact of this on payroll costs is illustrated in Figure 4.24. We estimate efficient payroll expenditure in 2019 to be €23.1 million compared with Dublin Airport's projection of ✂✂✂✂. Our forecast rises to €23.8 million in 2020 before reducing to €23.7 million by 2024. On a per passenger basis, our estimate of 2019 expenditure is €0.71 per passenger compared with Dublin Airport's 2019 estimate of ✂✂ per passenger. We forecast this to decline to €0.63 per passenger by 2024.

Figure 4.24: Forecast payroll expenditure compared with historic and Dublin Airport estimates, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis; CAR determination

4.5. Facilities and Cleaning

Summary

Expenditure on facilities and cleaning has grown over the current determination period, for both payroll and non-pay costs. This has been largely driven by staffing increases and increases in wages for cleaning staff.

We find that cleaning staffing levels in recent years have increased by more than the campus footprint, which Dublin Airport consider is due to increased cleaning requirements from higher passenger numbers. However, we are not convinced that this fully justifies the increase in staff. We find that Terminal 1 cleaning staff cover a greater area on average than Terminal 2 staff, but as Terminal 1 employees are typically paid higher rates, the cost at Terminal 1 is greater.

The number of facilities staff has also increased, which we believe is due to capacity constraints requiring more staff to manage passenger flows. Although this may have been optimal in the short run, investments in signage should reduce these staffing requirements.

We make some small adjustments to the staffing levels of cleaning and facilities staff but make a larger adjustment to the number of control centre staff. Here, Dublin Airport is anticipating large increases in staff numbers, which we believe can be avoided through a rationalisation of control centres. Overall, our resourcing estimate for 2019 is 35 FTE lower than Dublin Airport's estimate for 2019. We project future staffing requirements to increase slightly with respect to passenger numbers, growing by 4 FTE to 2024.

4.5.1. Introduction

The facilities and cleaning function at Dublin Airport delivers cleaning, predominantly of passenger facing facilities, and other manual duties in two separate teams organised by terminal. After security, facilities and cleaning employs the second highest number of FTE in the airport:

- Terminal 1 directly employed resource consists of a dedicated cleaning function plus separate staff groups covering terminal management, customer services and baggage control.
- In Terminal 2, the directly employed resource consist of a single flexible cleaning and facilities staff group, trained to cover multiple tasks as well as cleaning functions. The FTE and associated staff costs for running the airport and terminal operations control centres are also accounted for in Terminal 2.
- From 2017, Dublin Airport has reclassified several business units such that forecourt management and trolley operations now part of a combined landside services function in campus services.

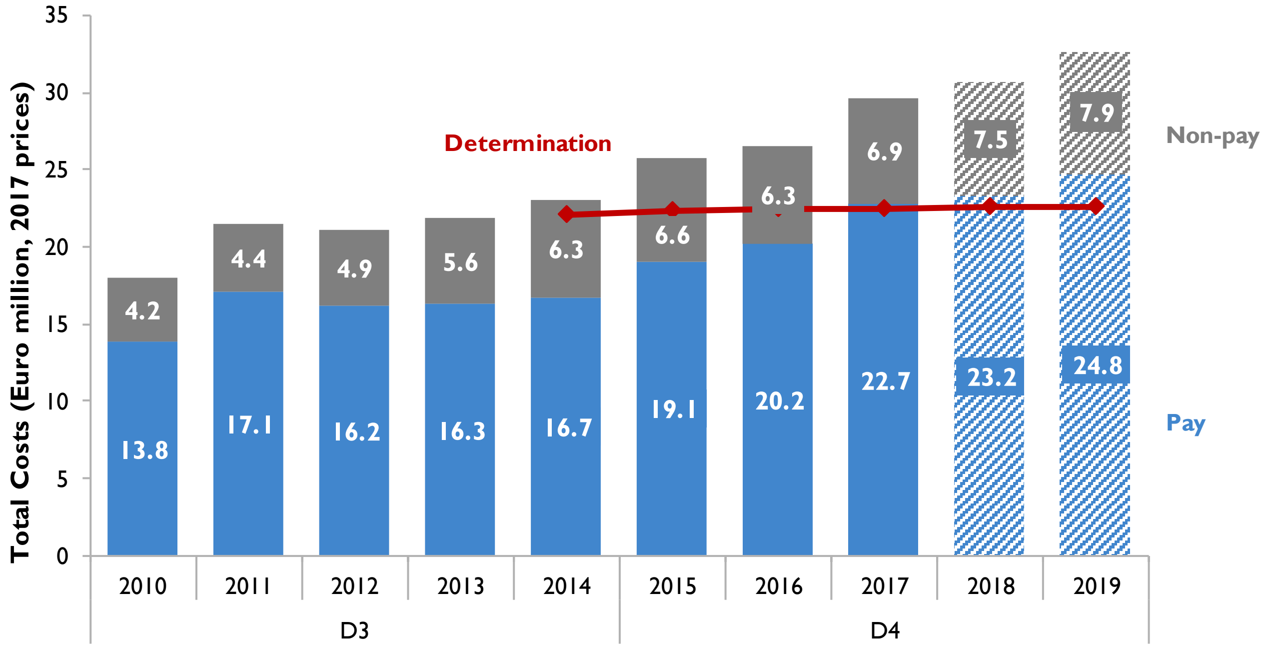
36% of staff in this function are on pre-2010 terms and these staff are mainly employed in Terminal 1.

Additional non-pay costs are associated with expenditure on outsourced cleaning contracts, primarily for back of house and tenanted office areas. The proportion of non-pay costs in this category is relatively low, accounting for around 13% of total facilities and cleaning costs in 2017.

4.5.2. Historic expenditure

In the early years of the current regulatory period, facilities and cleaning costs rose steadily such that by 2017 costs were 28% higher than 2014 on a like for like basis. By 2019, costs are forecast to be around 40% higher than 2014. This increase in total costs is driven almost entirely by staff costs with non-pay costs in 2019 only forecast to be 1% higher than 2014. As shown in Figure 4.25, this contrasts with CAR's determination for the current regulatory period which assumed that facilities and cleaning costs would be broadly flat throughout the period.

Figure 4.25: Facilities and cleaning expenditure compared with the CAR determination, 2010-2019 (€ million, 2017 prices)

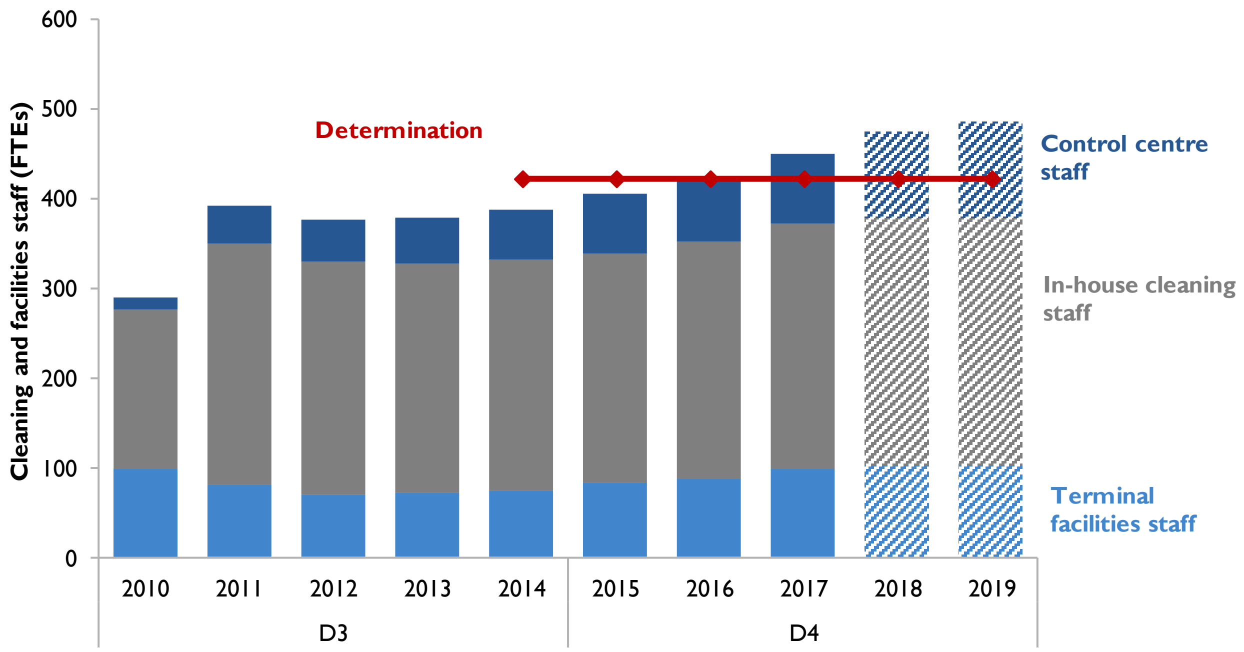


Source: Dublin Airport; Taylor Airey analysis; CAR determination

Staff numbers

As seen in Figure 4.26, facilities and cleaning staff numbers have increased in every year of the current regulatory period. Again, this contrasts with CAR's 2014 determination which assumed that FTE would be maintained at 2014 levels.

Figure 4.26: Cleaning and facilities staff numbers, 2010-2019 (full-time equivalents)



Source: Dublin Airport; Taylor Airey analysis; CAR determination

Payroll costs

As seen in Figure 4.27, the cost per FTE in shared areas appears the highest in the facilities and cleaning section, however, this is skewed by the pay rates of the airport duty managers (6 FTE).

The different staff groups within the facilities and cleaning section have different drivers of costs and these are discussed separately in the following sections.

Figure 4.27: Payroll costs per FTE by role, 2010-2019 (€, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis;

4.5.3. Analysis

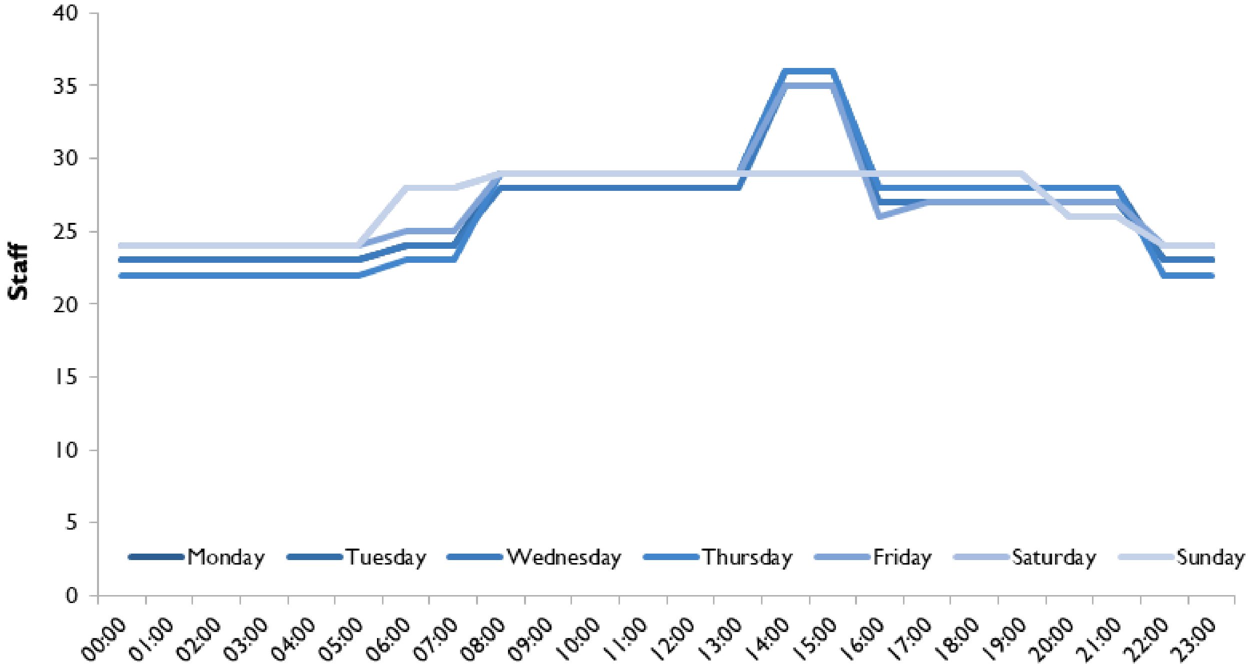
Cleaning expenditure and staffing levels

Terminal 1 cleaners perform only cleaning duties. Analysis of the Terminal 1 cleaning rosters provided by Dublin Airport and set out in Figure 4.28, shows that there is little variation in the number of staff supplied by hour of day or by day of week. We understand that Terminal 1 cleaning work practices and roster patterns are influenced by pre-2010 staff terms and agreements which limit the flexibility of rostering.

Dublin Airport has advised that it has taken certain actions to find the most efficient approach to cleaning e.g. recently letting the cleaning of the Pre-Boarding Zone (PBZ) to an external contractor rather than delivering it with in-house resource.

We observe that in areas being cleaned by in-house staff, the payroll cost per square metre of publicly accessible and pier spaces has risen during the early years of the current regulatory period. This metric is forecast to be 24% higher than 2014 for the airport as a whole when measured on a like for like basis. The same trend is observed in Terminal 1 and T2.

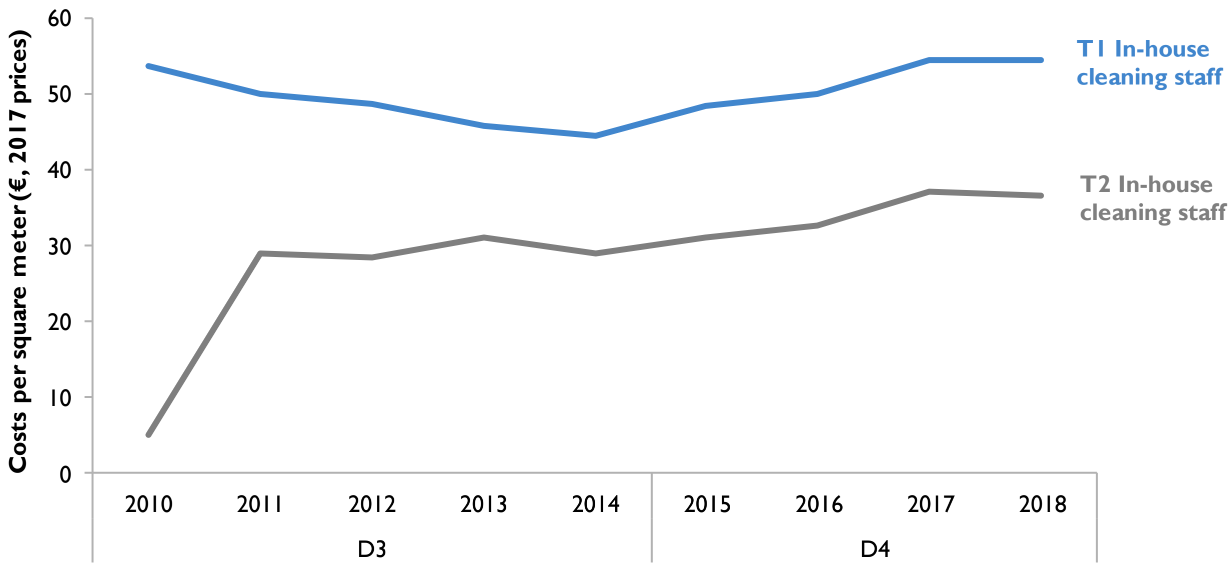
Figure 4.28: Terminal 1 cleaning staff roster supply by day of week



Source: Dublin Airport; Taylor Airey analysis;

Dublin Airport note that areas which have been more intensely utilised by the increased passenger volumes seen during the current regulatory period, have had to be cleaned more frequently to maintain service quality standards. We would note that, whilst this may mean that cleaning staff were more highly utilised during their working day, higher passenger numbers do not necessarily directly drive cleaning costs upwards. The placement of cleaning staff is largely dependent on the terminal space that they can cover given travelling distances, rather than the volume of cleaning activity. It can be seen in Figure 4.29, that the ratio of cleaning cost to the number of square meters of terminal space has increased over the regulatory period.

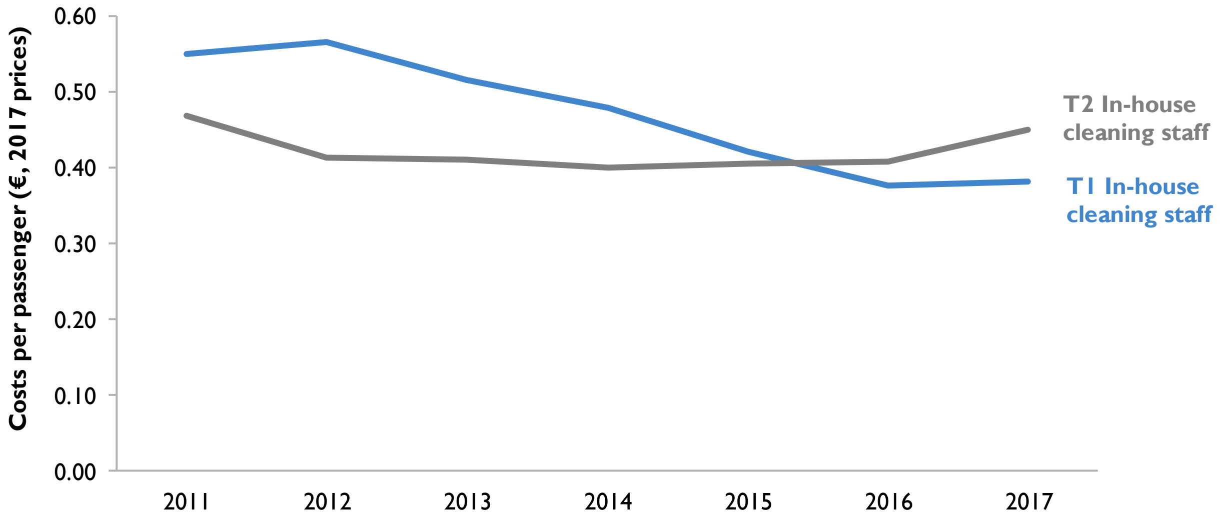
Figure 4.29: Cleaning payroll costs per square metre, 2010-2018 (€, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis;

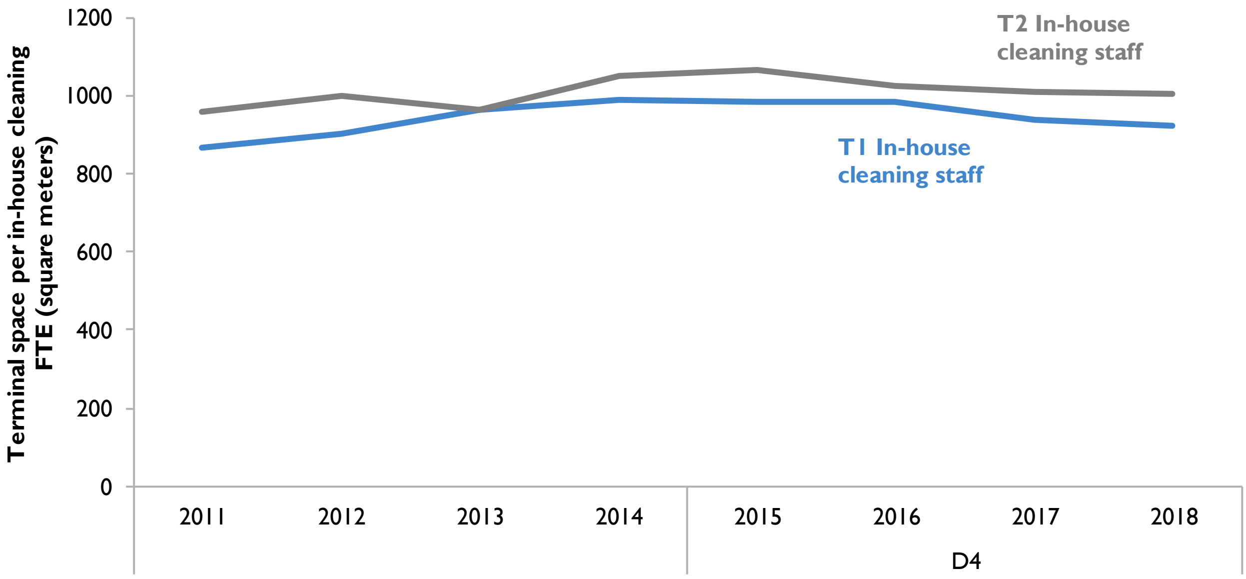
On a per passenger basis however (as shown in Figure 4.30), payroll costs at Terminal 2 have increased after a period of staying relatively constant, whereas Terminal 1 costs have reduced.

Figure 4.30: Cleaning payroll costs per passenger, 2011-2017 (€, 2017 prices)



When considering the ratio of the number of square metres of terminal space per cleaning FTE, we see a small decline in the current regulatory period (see Figure 4.31) implying that staff numbers have increased at a faster rate than the space that they are responsible for cleaning. We believe such a ratio is a good reflection of the productivity of staff as it better reflects the volume of cleaning required.

Figure 4.31: Terminal space per cleaning FTE, 2011-2018 (square metres)



Source: Dublin Airport; Taylor Airey analysis;

Terminal management and control centre staff numbers

Terminal management staff include terminal duty staff and customer service staff who are often deployed on the main passenger flow routes to manage any pinch points or queues which form and to provide passengers with information as needed. Again, Dublin Airport have stated that they have had to deploy greater numbers of staff in such roles as more passengers are processed through potentially sub-optimal facilities.

This staff group has increased in number throughout the current regulatory period and is forecast to have 130% more FTE in 2019 compared with 2014.

Staff in the terminal control centres and the airport control centre have increased though the current regulatory period and by 2019 are forecast to be 91% higher than the number of FTE employed in 2014. This rise in staff numbers is an example of an area where we believe Dublin Airport has been reliant on a managed solution, rather than considering alternative methods of operation. We have seen many airports consolidate control centres as a way of successfully achieving efficiencies. In the case of Dublin Airport, such a consolidation could have mitigated the increase in staff numbers.

Salary costs

The unit cost of staff involved specifically in cleaning activities (T1 cleaning and T2 facilities), shown in Figure 4.32 below, has risen throughout the current control period and in 2019 is forecast to be 19% higher than 2014 on a like for like basis. This increase is driving the average for cost per FTE for the overall Facilities and cleaning section.

Figure 4.32: Payroll costs per FTE by role, 2010-2019 (€, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis;

4.5.4. Future projections

Staff numbers

Table 4.7 summarises our approach to forecasting staff numbers by type of role and provides an explanation of the logic behind those forecasts.

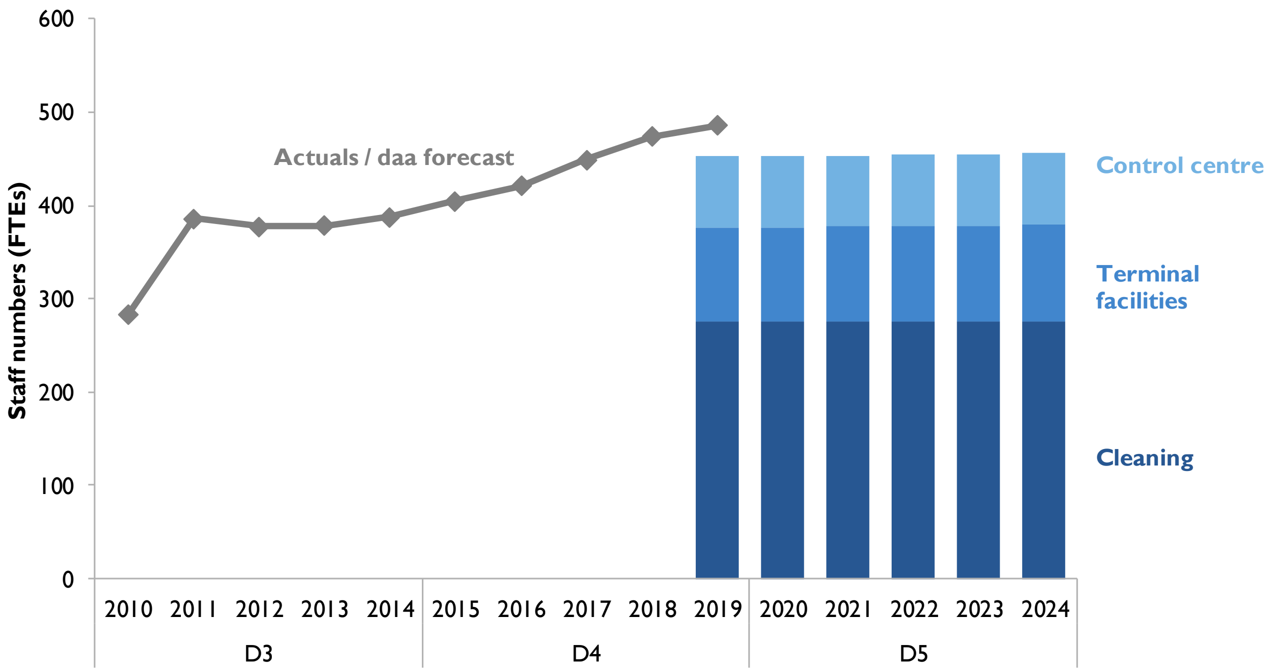
Table 4.7: Approach taken to produce forecasts for facilities and cleaning staffing levels

Staff category	Approach
Cleaning	*Baseline* – We set baseline staffing levels in line with Dublin Airport's estimate for 2017 full-time equivalent staff, uprated to consider increases in terminal floor space using the elasticity estimate below.

	Elasticity – We have modelled future cleaning staff FTE numbers as elastic to terminal square metres projected with an elasticity of 0.4.
Terminal services	A certain level of terminal services staff is required to ensure that the passenger experience is not reduced. However, our proposal is that it should be possible for Dublin Airport to reset the baseline number of FTE to a lower level and use physical signage and technology to improve wayfinding. Our future projections for these staff are based on the airport returning to the 2017 FTE levels before any new elasticities are applied. For terminal services staff we have modelled the future growth of FTE from the new baseline with an elasticity of 0.2 to passenger numbers.
Control centre	As we have seen delivered in other airports, consolidation of control centres would enable FTE reduction and our proposal is that such an initiative could be used to reset the baseline number of FTE for control centre staff to 2017 levels. For all other facilities and cleaning staff, we believe that it should be possible for Dublin Airport to maintain 2017 staffing levels despite volume increases and we are therefore not proposing any elasticities are applied to these staff.

We have observed that other airports or organisations apply tactics which we believe could be considered further. Dublin Airport themselves have highlighted how they have outsourced, where appropriate, cleaning contracts for newly added areas of the airport and the potential this brings for achieving better unit cost rates. We have also seen examples where airports tend to use non-directly employed staff with lower wage costs for routine 'customer service' tasks such as presenting passengers to immigration at the border. By comparison, this is a similar task to the presentation of passengers to US immigration, which Dublin Airport delivers with an outsourced provider.

Figure 4.33: Forecast growth in staffing levels compared with actuals, 2010-2024 (full-time equivalents)



Source: Dublin Airport; Taylor Airey analysis;

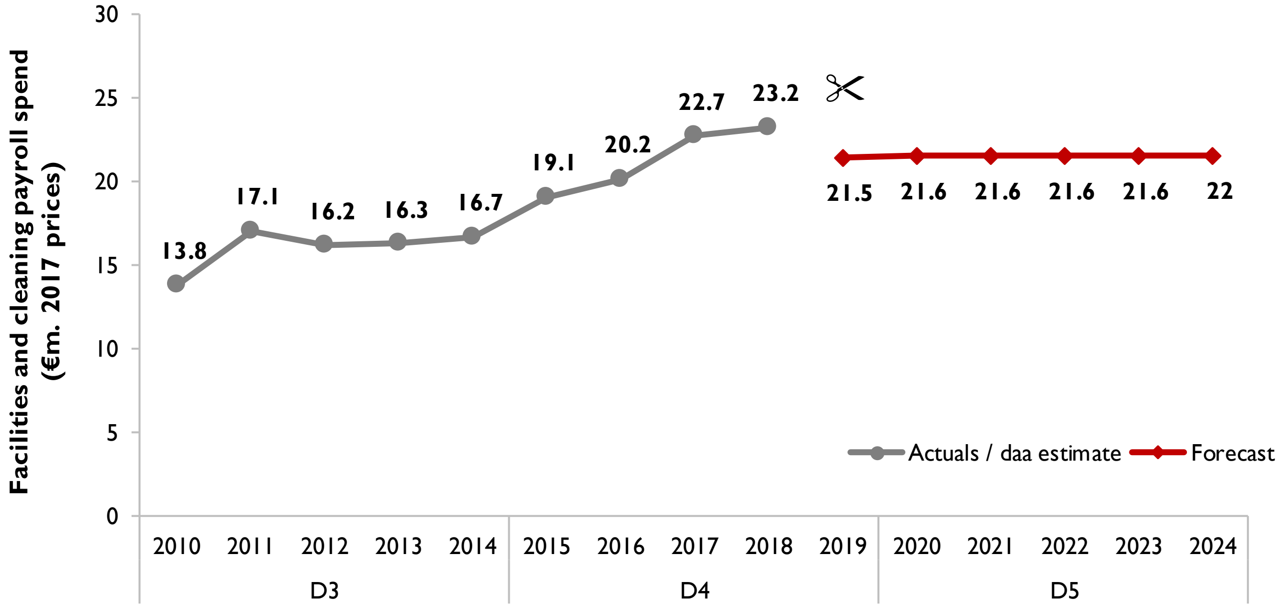
The terminal floor space added, hence the amount of cleaning work required, is dependent on the scope and types of projects agreed in the CIP for the coming regulatory period. This is explored further in

Section 6. Overall, our re-baselining means that we estimate an efficient staffing level of 451 FTE staff in 2019 (see Figure 4.33), which is 35 FTE lower than Dublin Airport's estimate for 2019.

Payroll costs

Figure 4.34 illustrates the overall impact of our forecasts on payroll expenditure. We estimate efficient payroll expenditure in 2019 to be €21.5 million compared with outturn expenditure of €24.7 million. We forecast payroll expenditure on facilities and cleaning to rise to €21.6 million by 2024. On a per passenger basis, our estimate of 2019 expenditure is €0.66 per passenger compared with Dublin Airport's 2019 estimate of ✂✂ per passenger. We forecast this to decline to €0.57 per passenger by 2024 as a result of passenger growth.

Figure 4.34: Forecast payroll costs for facilities and cleaning staff (€ million, 2017 prices)



Non-pay costs

With regard to non-pay costs, we note that there was a large increase in the size of the contract between 2017 and 2018, with costs rising from €3.3 million to €3.6 million. We take Dublin Airport's estimate of 2019 expenditure as we have no evidence to suggest the most recent retender was inefficient.

However, as each of the major facilities and cleaning contracts expires and is retendered, we would expect there to be opportunities for Dublin Airport to negotiate better deals. Given Dublin Airport's expanded procurement function, we judge that savings equivalent to 5% of 2019 non-pay expenditure should be achievable by 2024. We assume savings will increase linearly from 2020 to 2024. This implies a reduction in non-payroll expenditure from €3.7 million in 2019 to €3.5 million by 2024.

4.6. CAMPUS SERVICES

Summary

Over the current price control period, Dublin Airport's expenditure on campus services has exceeded the 2014 determination targets. Costs grew between 2014 and 2017 but are forecast to decline slightly by 2019. Throughout the period, wages for campus services staff have remained relatively constant with the growth in costs coming from an increase in staff numbers.

Our analysis suggests that this rise in payroll expenditure should be considered efficient. The largest driver of cost increases has been the growth in airport police staff. We expect this is reasonable given the growth in passenger numbers. We also note the increase in fire service staff are driven by the need to maintain the response capability for a Category 9 Aerodrome classification in order to comply with the Irish Aviation Authority licensing and the requirements of International Civil Aviation Organisation Annex 14 Airport Manual.

We expect campus services staffing requirements to increase as passenger numbers increase, and as such, we have applied an elasticity to our forecasts to reflect this. For each campus services staff category, we take the 2019 staffing and wage estimates as the baseline for our future projections. We then forecast future campus services expenditure using our elasticity and wage growth assumptions.

In total, our projections forecast expenditure on campus services rising from €21.9 million in 2019 to €23.8 million by 2024.

4.6.1. Introduction

Campus services is a staff area responsible for delivering several services that are spread across the entire campus of the airport rather than being specific to one of the two terminals. The main staff elements in Campus services are the Airport Police Force and the Airport Fire and Rescue Service. Each of these two areas individually accounted for 39% of the campus services staff cost in 2017 meaning that 78% of the staff costs are associated with these two areas combined.

The airport police are responsible for general policing and aviation security duties including the protection of civil aviation from unlawful acts of interference. Duties also include responding to emergency situations, traffic management and dealing with the preservation of good order to ensure users enjoy a safe environment while working or travelling through the airports. The airport police are "Authorised Officers" under the Airports and Aviation Acts 1936 to 2014 and as such have full policing powers within the State airports.

The Airport Fire and Rescue Service provide emergency response cover and specialise in fire-fighting skills required for a full-scale aircraft emergency.

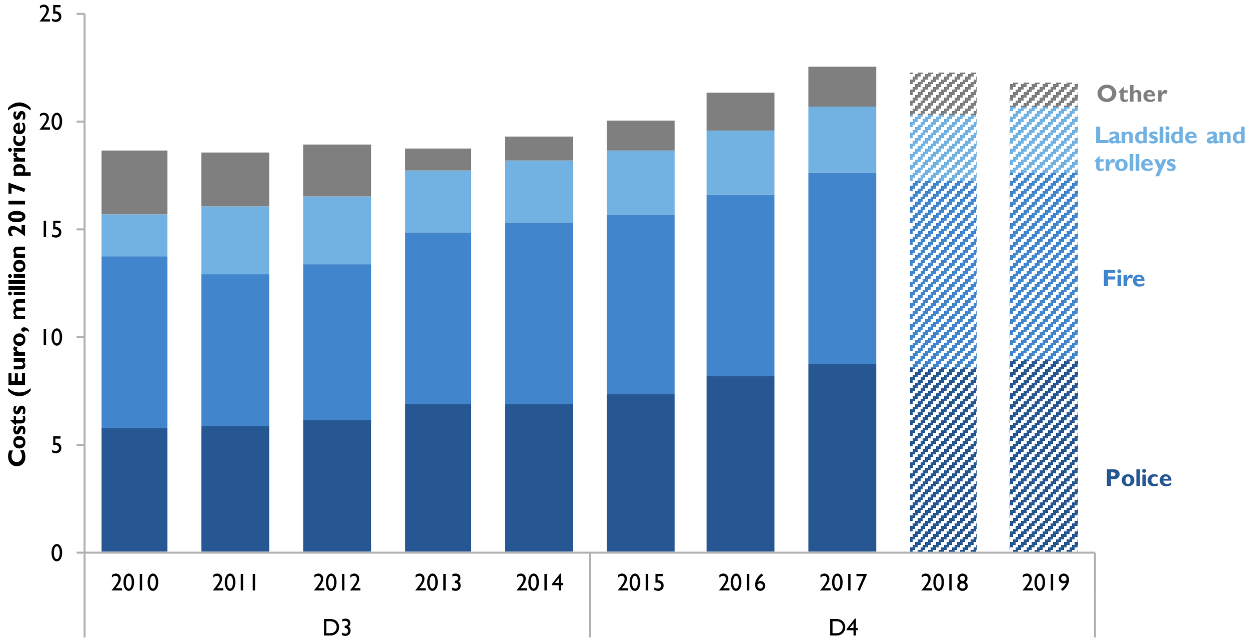
In addition to these two largest staff groups, landside services and trolley operations and other campus services staff make up the remainder of the numbers.

4.6.2. Historic expenditure

Overall

Campus services staff costs have continued to rise through the early years of the current regulatory period and by 2019 are forecast to be 13% higher than 2014 on a like for like basis. As seen in Figure 4.35, the largest component of this increased cost is the increase in police costs.

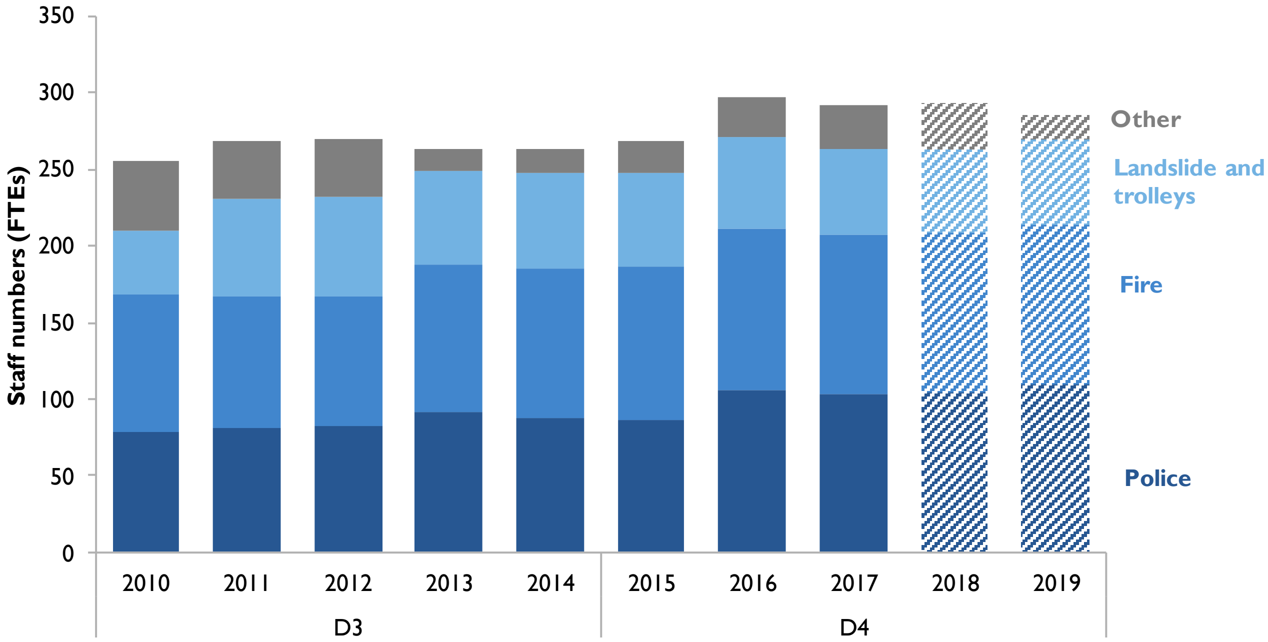
Figure 4.35: Payroll expenditure on campus services by type of role, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis;

The increases in staff costs in campus services are consistent with increases in FTE numbers, again, especially in airport police. Figure 4.36 illustrates the evolution of staff numbers between 2010 and 2019.

Figure 4.36: Staff numbers working in campus services by type of role, 2010-2019 (full-time equivalents)



Source: Dublin Airport; Taylor Airey analysis;

Despite some variation between the different staff areas, the average staff cost per FTE in campus services has been relatively controlled (see Figure 4.37), forecast to increase by 2% by 2019 when compared to 2014 levels on a like for like basis.

Figure 4.37: Unit payroll costs by role, 2010-2019 (€'000s, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis;

4.6.3. Analysis

Airport Police

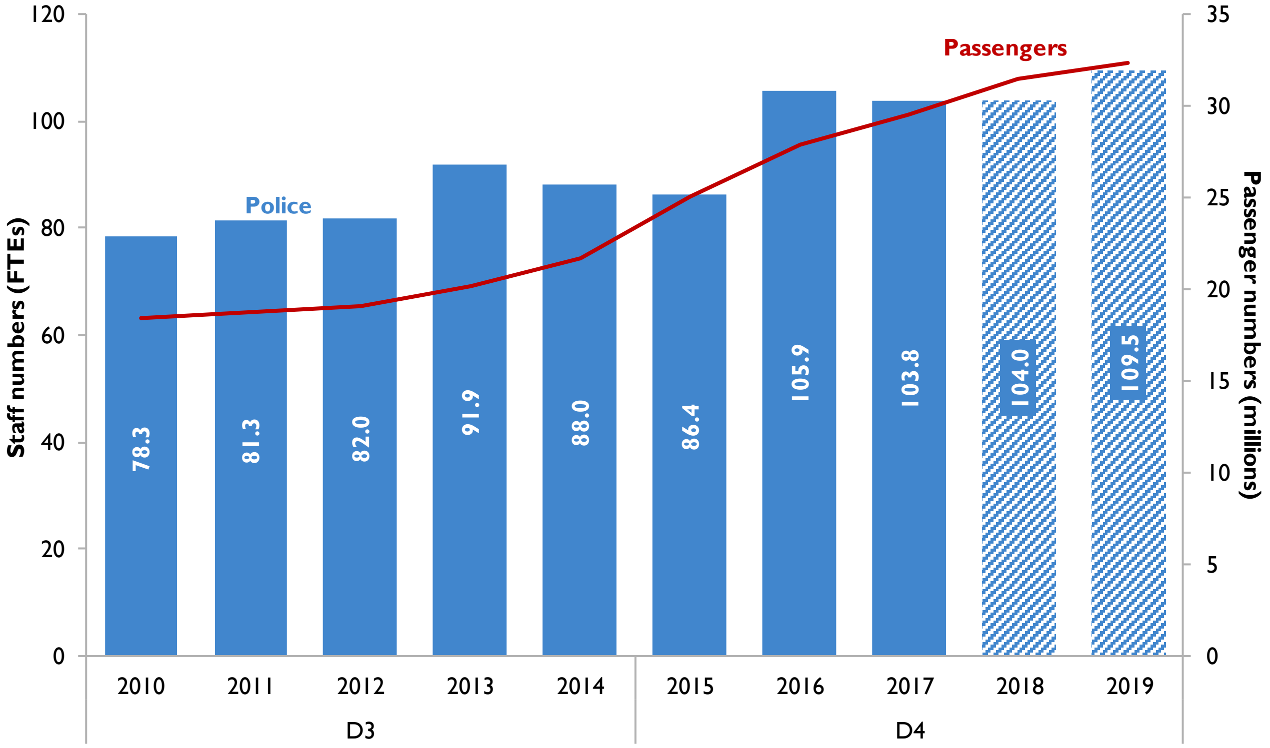
Figure 4.38: Unit payroll costs for Dublin Airport police against benchmark, 2010-2019 (€ million, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis; Central Statistics Office

As seen in Figure 4.38, trends in Dublin Airport police unit costs correlate with rates seen for the national police service, An Garda Síochána. These benchmark figures have been derived from the average weekly earnings of staff at An Garda Síochána as reported by the Central Statistics Office, with social insurance and pension costs added back to give an overall measure of average staff cost.

Airport police numbers have grown at a slower rate than total passenger growth indicating a weak elasticity to passenger growth (see Figure 4.39). This is to be expected as policing activities increase as the airport terminals and the landside road system become busier.

Figure 4.39: Airport police staffing levels compared with growth in passenger numbers, 2010-2019



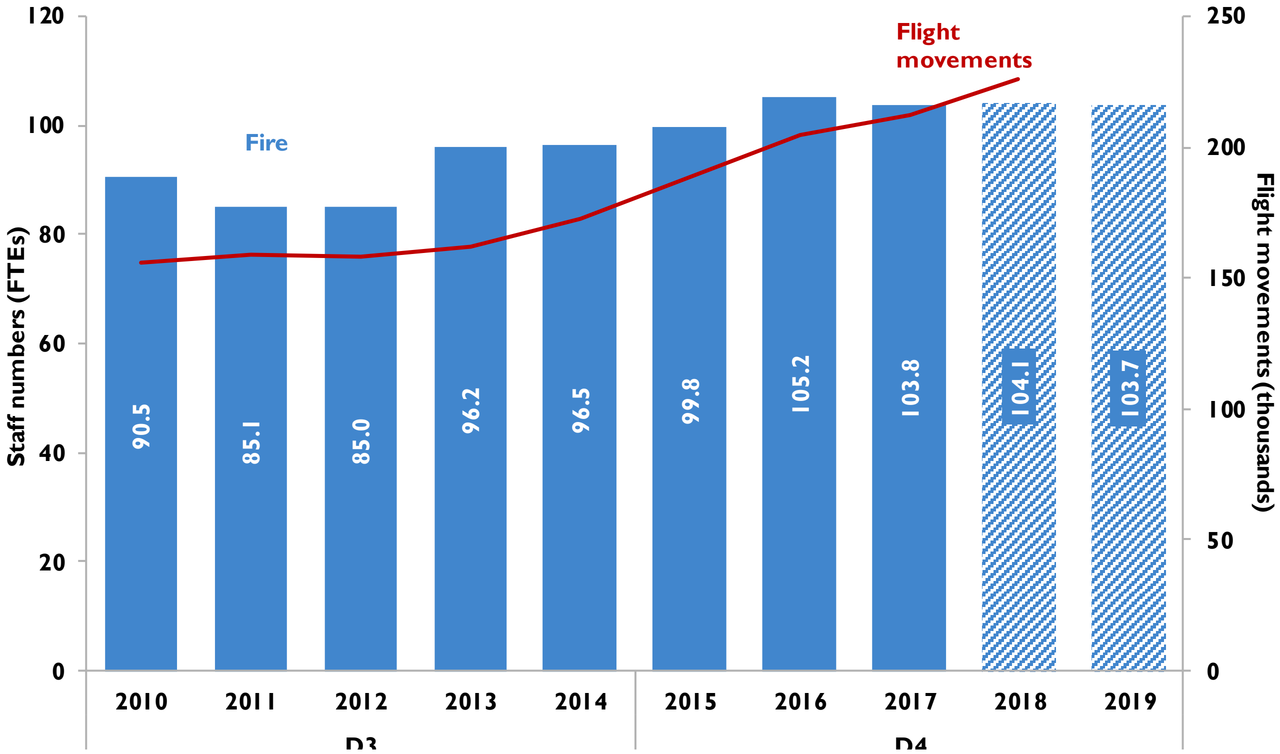
Source: Dublin Airport; Taylor Airey analysis;

Airport Fire Service

Dublin Airport Fire Service numbers are driven by the need to maintain the response capability for a Category 9 Aerodrome classification in order to comply with the Irish Aviation Authority licensing and the requirements of International Civil Aviation Organisation Annex 14 Airport Manual. It is also expected that Fire Service activities become busier as the number of flight movements handled at the airport increase and a weak elasticity to this driver has been identified from historic analysis. Figure 4.40 shows the growth in airport fire service staffing levels and flight movements.

There is clearly a relationship between the number of passengers at the airport and the number of flight movements handled. However, the number of passengers carried per air transport movement has increased by around 11% during the current regulatory period (2014 to 2017). Accounting for this factor, a loose historic elasticity between passenger numbers and the number of fire service FTE required can be also be derived.

Figure 4.40: Airport fire service staffing levels compared with growth in flight movements, 2010-2019



Source: Dublin Airport; Taylor Airey analysis;

4.6.4. Future projections

Staff numbers

For each part of the campus services section we propose taking the 2019 forecast number of FTE as the baseline for future projections. Whilst we believe there is some link between passenger volumes and the number of campus services required, we do not believe there exists a particularly strong link. For example, our econometric evidence found no strong link between police costs and passenger numbers. We therefore propose that the elasticity of campus services staff to passenger numbers should be 0.1 for all operational areas i.e. police services, fire services and landside services.

We do not foresee potential for significant further efficiencies in staff number although it would be expected that there would be some economies of scale from increasing volumes and marginal efficiencies may be possible for example by redefining scope. For example, we note activities relating to traffic management on airport landside roads are often carried out by civilian staff (with potentially lower unit costs) at other airports.

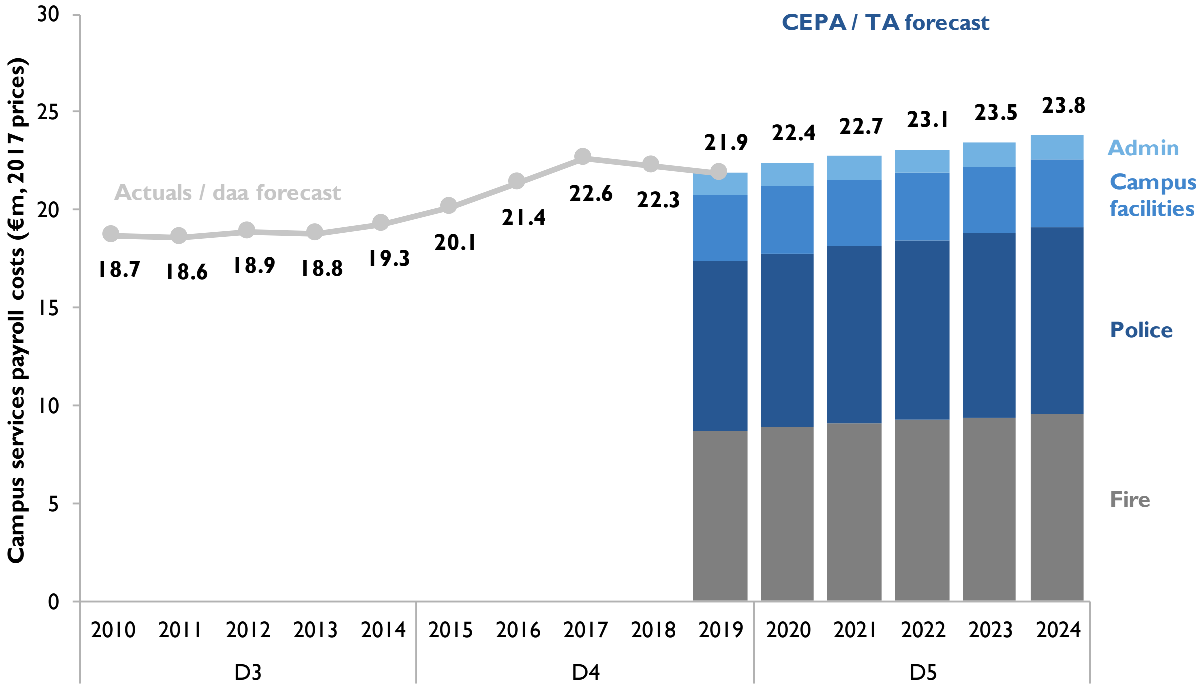
Our projections therefore estimate efficient staffing levels growing from 294 FTE in 2019 to 299 FTE in 2024.

We note that future airport expansion could impact on the future number of FTE required in campus services. The most significant example of this, which is likely to arise in the coming regulatory period is the future development of the airfield and apron areas in a two-runway configuration. Dublin Airport advised that it is currently evaluating potential fire response times from the current fire station location to serve the expanded area. If it is found that the current station location and equipment specification cannot deliver the required response times, a satellite fire station may be required with an associated one-off step change in fire service FTE.

Payroll costs

Our analysis has not been able to identify any specific areas of inefficiency in unit payroll costs. We therefore forecast unit payroll costs from 2019 levels for all staff based on our standard wage growth assumptions presented in Section 2.3. Figure 4.41 illustrates the overall impact of our forecasts on payroll expenditure. Our projections for payroll costs for campus services grow from €21.9 million in 2019 to €23.8 million by 2024. On a per passenger basis, this is a reduction from €0.68 per passenger to €0.63 per passenger.

Figure 4.41: Forecast payroll expenditure for campus services, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis;

4.7. Information Technology

Summary

Expenditure on IT has grown during the current price control period above the 2014 determination targets, with further growth expected by 2019.

We find that the main growth in IT payroll costs has been driven by higher than expected wage increases. We note that Dublin Airport has argued that attracting skilled individuals to work in airport IT has become increasingly challenging as the Irish economy recovers. We find however that from 2018, wage growth at Dublin Airport is forecast to exceed wage growth for IT workers across the Irish economy. Our analysis also fails to find justification for proposed increases to IT staff numbers after 2017. We therefore make adjustments to our 2019 baseline estimate of efficient payroll expenditure on IT.

We also fail to find justification for the large rises in non-pay related IT expenditure in 2018 and 2019. We make an efficiency adjustment to our 2019 baseline estimate by resetting expenditure estimates to 2017 levels. Over the duration of the next control period we believe that Dublin Airport's expanded procurement function should work to get better value by negotiating better deals as IT operation and maintenance contracts expire and are retendered. We suggest a saving equivalent to 5% of non-pay IT expenditure is achievable over the course of the next regulatory period.

In total, our projections forecast expenditure on IT costs rising from €15.9 million in 2019, to €16.3 million by 2024.

4.7.1. Introduction

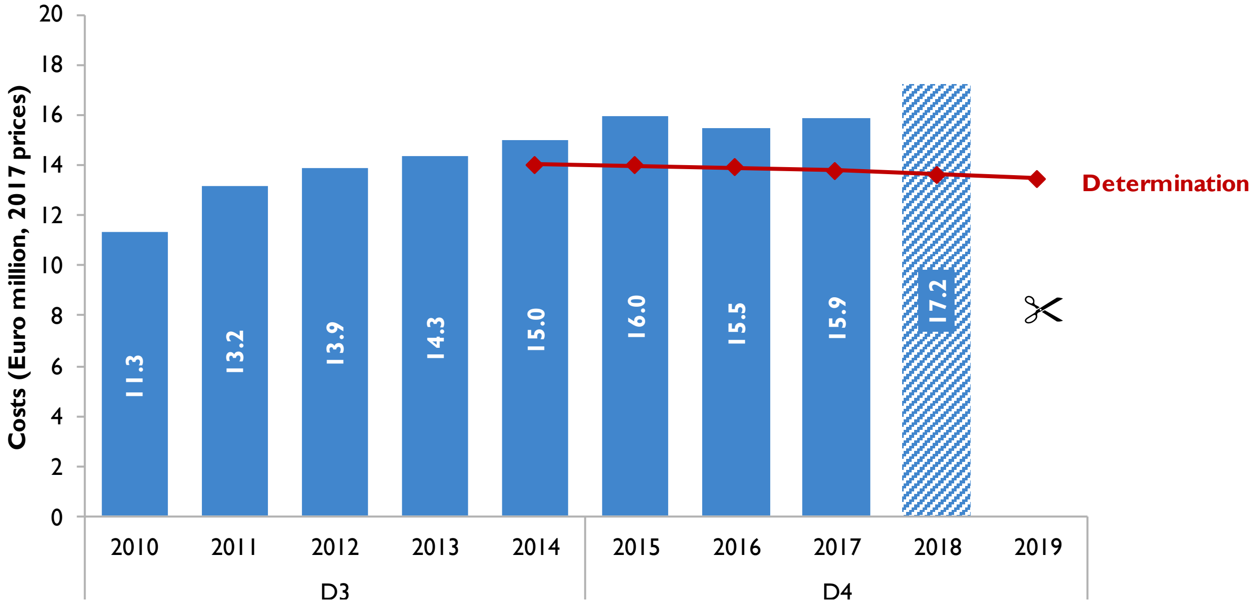
IT expenditure at Dublin Airport is made up of direct costs of employing in-house staff and indirect costs predominantly associated with operations and support contracts. In 2017, IT expenditure accounted for around 6.2% of total airport opex.

4.7.2. Historic expenditure

Dublin Airport has estimated IT spend in 2018 to be €17.2m with expenditure split between pay costs of in-house staff and non-pay costs relating to maintenance, operation and support of back office and operational systems.

Total IT costs have continued to rise, by 6.2% in real terms between 2014 and 2017 and are forecast to accelerate further in 2018 and 2019, as shown in Figure 4.42. By the end of the current regulatory period in 2019, total IT costs are forecast to be 26% higher than 2014. This contrasts with the assumptions made in the regulatory determination where FTE were assumed to be held flat and savings were delivered in non-pay costs through better procurement.

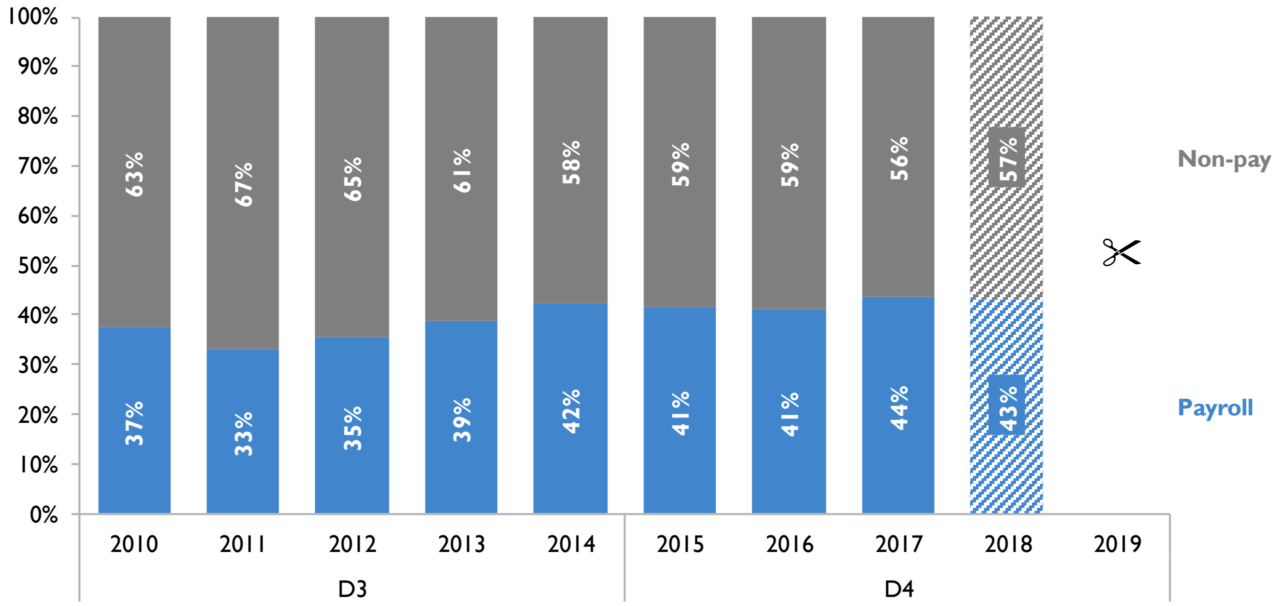
Figure 4.42: Expenditure on IT at Dublin Airport, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis; CAR determination

In 2018, Dublin Airport estimated approximately 43% of Dublin Airport's IT opex was attributable to pay costs whereas 57% was spent on contracted services. A similar split between in-house and external activities is apparent throughout the current and preceding regulatory periods (as seen in Figure 4.43). This suggests that Dublin Airport has not altered its sourcing strategy in this period or alternatively that savings delivered through new procurement have been offset by alterations in the sourcing strategy.

Figure 4.43: Proportion of payroll versus outsourced IT costs, 2010-2019



Source: Dublin Airport; Taylor Airey analysis;

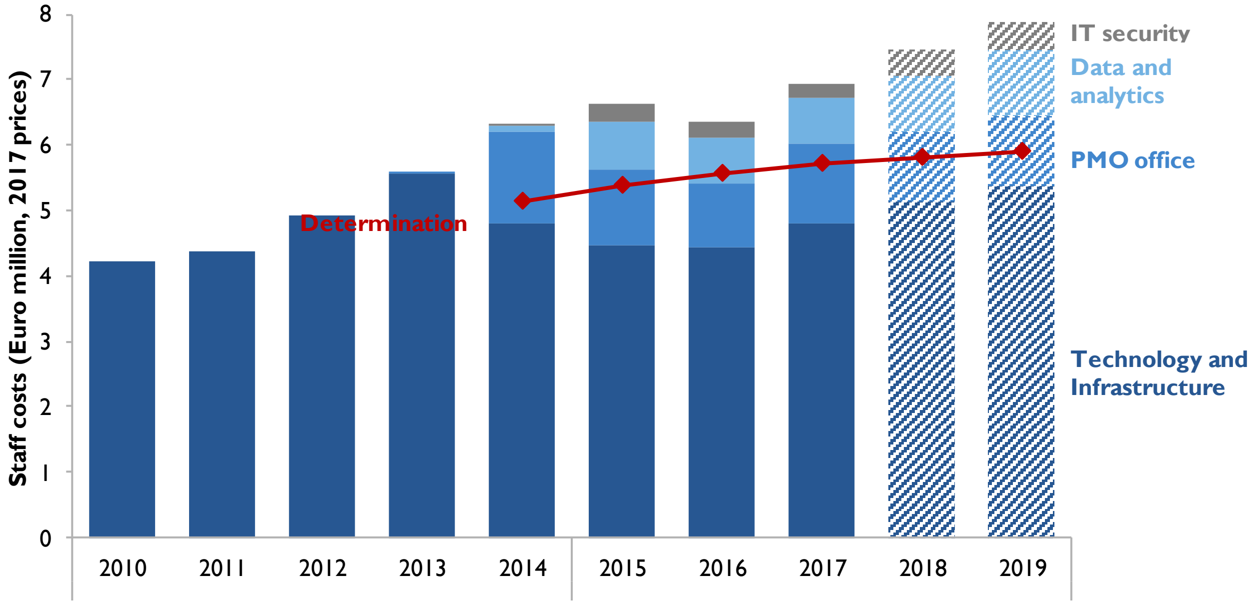
4.7.3. Analysis

Payroll costs

The IT organisation at Dublin Airport is split into four functions the largest of which: Technology and Infrastructure is responsible for operation and first line maintenance of the airport's systems, networks and data management. Figure 4.44 shows the payroll costs in these functions across the current determination period. Other functions have been separately accounted for in the IT organisation for the first time during the course of the current regulatory period covering capabilities such as Data and Analytics and IT Security.

Project Management staff are responsible for the delivery of IT capital projects. Dublin Airport has informed us that these staff include contract and agency staff which allow them to flex resource with the changing demands of project delivery. They also noted that the cost of these staff is partially capitalised.

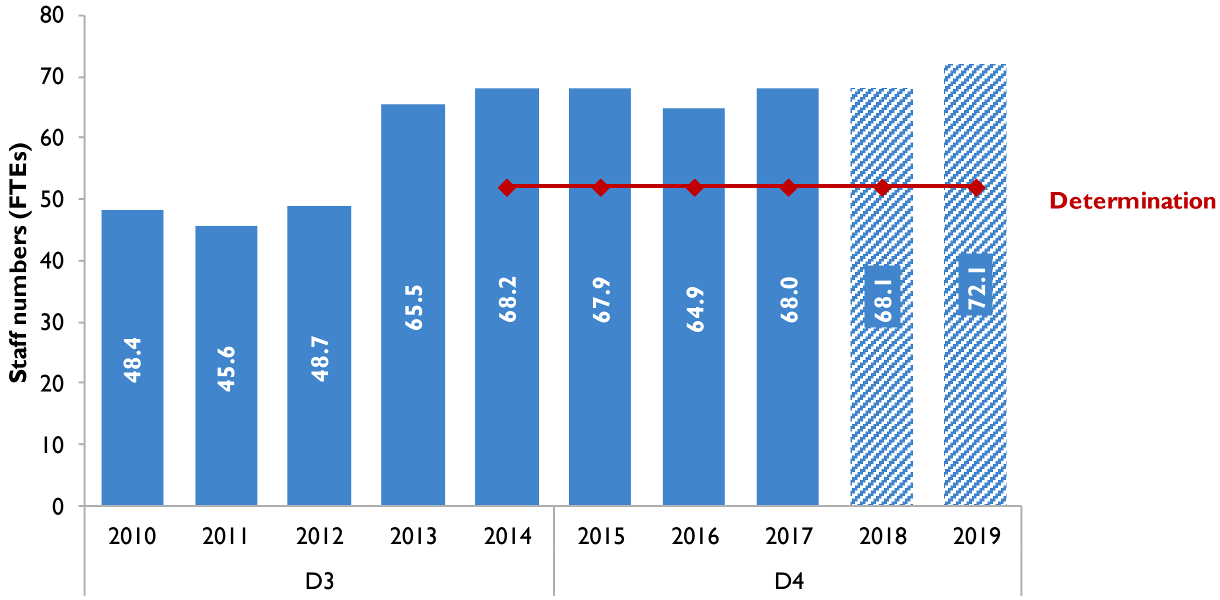
Figure 4.44: Payroll expenditure by type of activity, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis;

FTE numbers remained flat during the early years of the current regulatory period with the same total number of FTE employed in 2017 as 2014. However, as shown in Figure 4.45, the total number of FTE employed continues to be above the assumptions made in the previous determination process. Unit payroll costs are expected to rise by 12% in real terms by 2019, from 2014 levels.

Figure 4.45: Staff numbers in IT, 2005-2019



Source: Dublin Airport; Taylor Airey analysis; CAR determination

Dublin Airport suggest that attracting skilled individuals to work at the airport, particularly in the 'new' areas of data and analytics and cybersecurity, is becoming more challenging as the Irish economy rebounds. They state that there is strong competition in this part of the labour market particularly from other sectors such as financial services.

Figure 4.46: IT Staff cost per FTE compared with Industry Sector benchmarks for wage inflation, 2010-2019 (€, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis; CSO Statbank

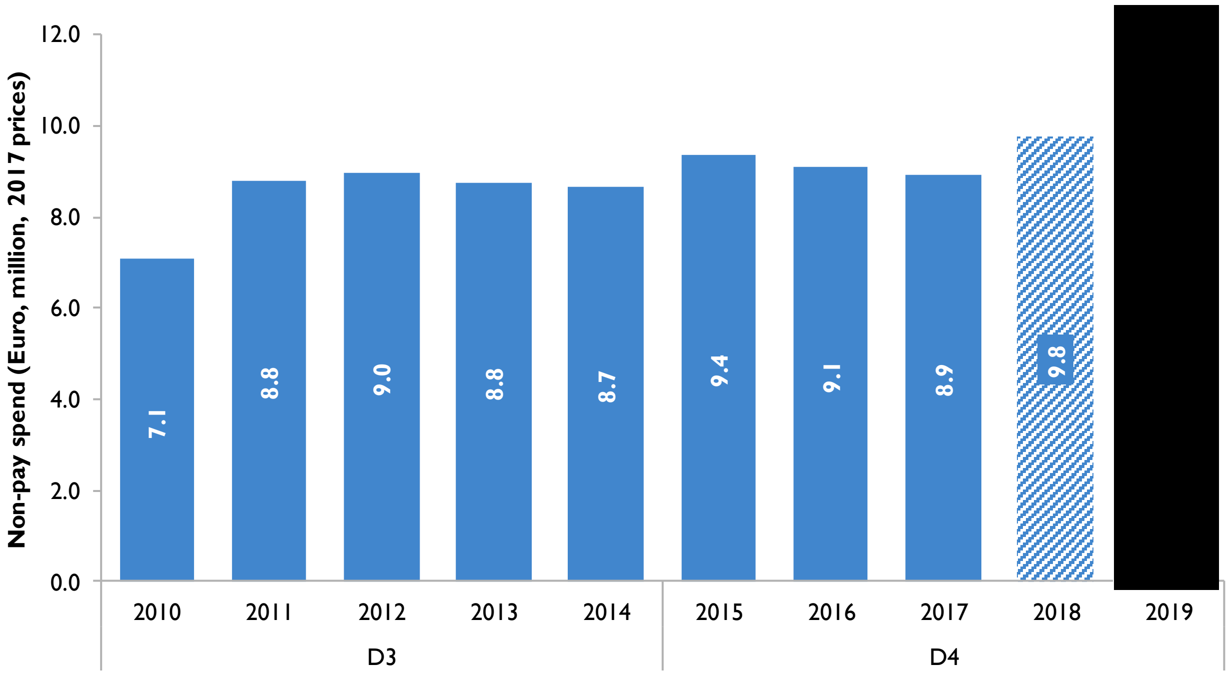
Figure 4.46 compares Dublin Airport's IT staff cost per FTE with the wage inflation index for information and communication staff. As shown, wage rises were in line with those seen elsewhere in the IT sector in the early years of the current regulatory period. However, from 2017 onwards, IT pay costs at Dublin Airport are increasing at a higher rate than comparable wages elsewhere.

We also note that a tightening of the IT labour market was anticipated in the consultancy study supporting the previous determination and wage increases were assumed to be 6% in 2014 declining to 3% in 2018.

Non-pay costs

Dublin Airport have informed us that around 65% of the value of non-pay costs is attributable to the ten highest value contracts. These include: the airport's service desk support provided by the supplier ESP Global Services, airport IT operational systems support provided by suppliers such as SITA and ARINC and also back office licencing and support from Oracle and HP.

Figure 4.47: Non-pay IT expenditure, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis

As seen in Figure 4.47, non-pay opex has risen by 3.4% from 2014 to 2017 in 2017 prices. However, a sharper increase in costs is forecast in the later years of the current regulatory period with Non-Pay costs for 2019 forecast to be 26.2% higher than 2014.

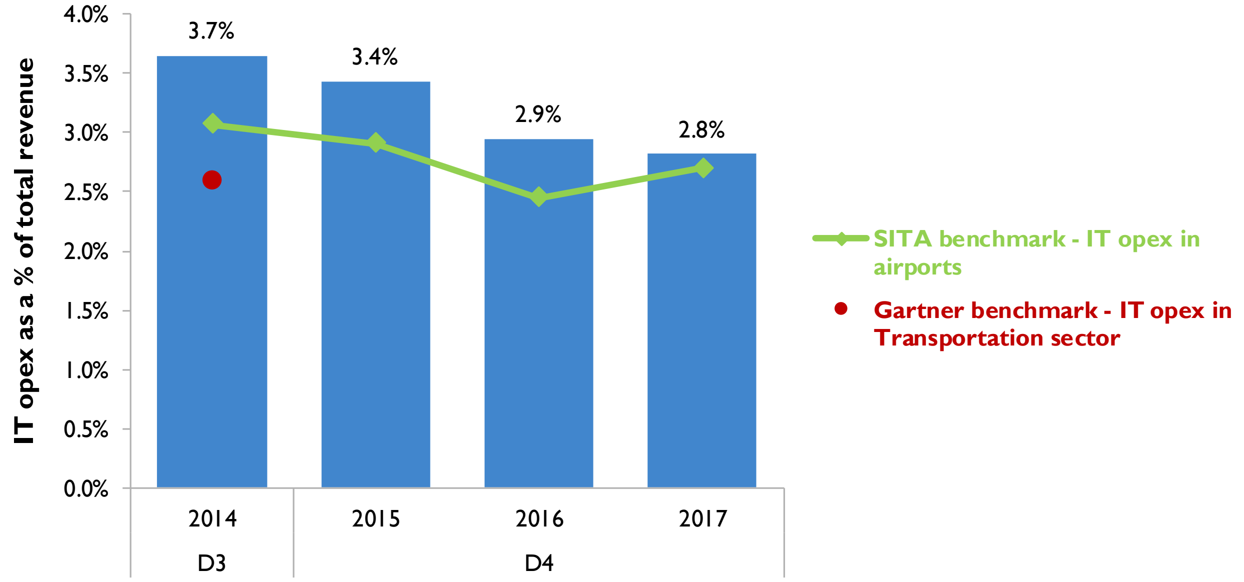
Overall expenditure

Movements in IT staff costs do not correlate with passenger increases over the current regulatory period and we would not expect there to be an elastic relationship between these factors. Instead, in order to benchmark IT staff costs, we have considered external benchmarks which consider IT spend as a % of revenue generated by an organisation.

The aviation industry IT provider SITA provides a benchmark for airline and airport IT in their annual "IT Insights" report, providing an average of the IT opex and capex as a proportion of the revenue of the aviation organisations that they survey. Gartner also provides a benchmark comparator for IT spend in the Transportation sector overall.

Analysis shows that Dublin Airport IT spend was higher than these benchmarks in the early years of the current regulatory period but in 2017 was converging to a similar level to that seen at other airports (as seen in Figure 4.48 below).

Figure 4.48: IT spend as a proportion of revenue, Dublin Airport compared against industry benchmarks, 2014-2017



Source: Dublin Airport; Taylor Airey analysis; Gartner (2015) IT Key Metrics Data: Key Industry Measures: Transportation Analysis, SITA (2018) Air Transport IT Insights

4.7.4. Future projections

Payroll

We do not believe that the large increase in IT FTE in 2018 and in the 2019 forecasts is justified, as it is unclear what additional activity is being undertaken by IT staff over this period. We therefore set our baseline estimate of 2019 staffing levels to be the same as 2017 at 68 FTE. The future elasticity of IT staff numbers to passenger numbers is assumed to be 0.1.

Our baseline estimate of payroll expenditure is €7 million, compared with a Dublin Airport estimate of ✂✂✂✂. We then forecast this to rise to €7.8 million by 2024. On a per passenger basis, this is a reduction from €0.22 per passenger to €0.21 per passenger.

Non-pay

We note that non-pay costs were estimated to have risen in 2018 and is expected to rise again in 2019. We propose to reset our baseline to 2017 levels of expenditure as these increases have not been justified. We also assume non-pay expenditure is not driven by passenger numbers.

Dublin Airport argue that there are factors regarding the scope of the maintenance contract for self-service kiosks which will lead to additional incremental costs on retendering in 2019 causing a step change in non-pay costs in the coming regulatory period. We would suggest that Dublin Airport's expanded procurement function should enable smarter procurement of this and the other contracts that will expire during the control period should yield savings to offset any uplift. We would therefore not propose to make a one-off adjustment for this factor.

As each of the major IT operation and maintenance contracts expires and is retendered, we would expect there to be opportunities to negotiate better deals and Dublin Airport should work to get better value from non-pay expenditure (which accounted for 56% of total IT spend in 2017). As with other areas of non-pay costs, we believe better procurement from Dublin Airport's expanded procurement function could lead to efficiency savings. We assume savings equivalent to 5% of our 2019 estimate of non-pay IT expenditure by 2024. This implies a reduction in non-pay IT costs from €8.9 million in 2019 to €8.5 million by 2024.

Other considerations

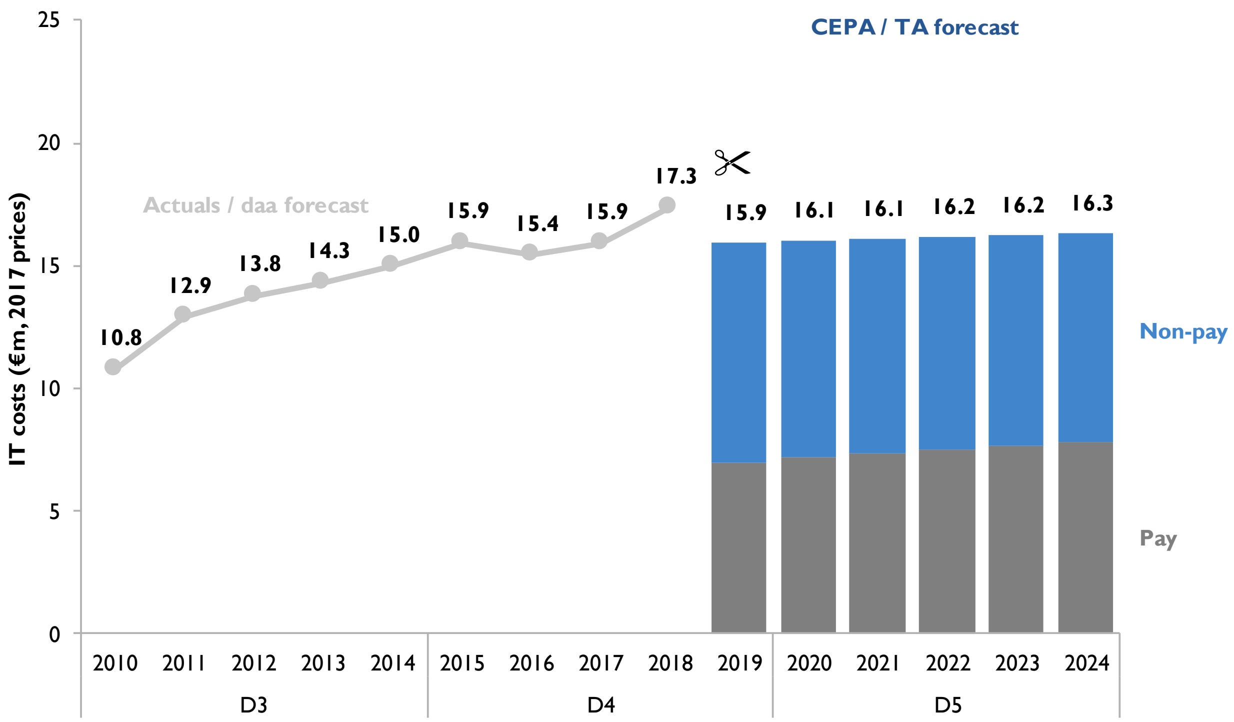
IT staff numbers in the PMO function may vary, dependent on the scope and types of projects agreed in the CIP for the coming regulatory period. This may lead to opportunities for savings or a requirement for additional contract project management staff costs (which might then be capitalised).

We also note that the future support and maintenance costs for IT may be impacted by any additional systems which are added to the estate as part of the CIP and any one-off adjustments may need to be made accordingly. This is explored further in Section 6.

Forecast summary

Figure 4.49 below shows our forecast for IT expenditure. We forecast lower levels of expenditure in 2019 compared with Dublin Airport's estimates, and we forecast total expenditure to rise only marginally in real terms to €16.3 million by 2024. On a per passenger basis however, this is a decline from €0.49 per passenger in 2019 to €0.43 per passenger by 2024.

Figure 4.49: Forecast IT expenditure compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; Taylor Airey analysis

4.8. Retail

Summary

Dublin Airport's retail strategy for Dublin has evolved since the start of the price control period, with a move towards more space dedicated to retail directly operated by daa group and less space for retail concessions. This has inevitably led to higher staffing levels than assumed in the CAR determination. We believe it is outside the scope of this study to consider the efficiency of such a strategy in significant detail, though we generally find Dublin Airport's rationale sensible.

Our analysis does find some evidence of inefficiency in staffing, regardless of the retail strategy, both when benchmarking staff productivity internally (between Dublin's two terminals) and externally (against another travel retailer). However, we also note that ARI is generally considered an effective retailer by airlines.

We expect staffing requirements to increase slightly as passenger numbers increase, and we apply an elasticity to reflect that. But we also expect improvements in staff productivity at Terminal 1 which more than offset this increase. The overall effect on our projections is that retail expenditure declines from €16.9 million per annum to €14.9 million per annum. We fully expect outturn expenditure to differ from this forecast, though we expect higher expenditure would need to be matched by higher retail revenues to be considered efficient.

4.8.1. Introduction

Retail expenditure consists entirely of payroll costs. Unlike many other airport operators, daa group directly operates many of its own retail stores at Dublin Airport, through its subsidiary ARI. The remaining stores, mainly specialist shops and food and beverage outlets, are let to concessionaires. As a result, Dublin Airport directly employs many shop floor retail staff.

Retail payroll costs largely comprise these shop floor staff, though other payroll costs exist for back-office staff working for Dublin Airport or for ARI. daa group recently went through a restructure resulting in all back-office staff being employed directly by ARI rather than by Dublin Airport.

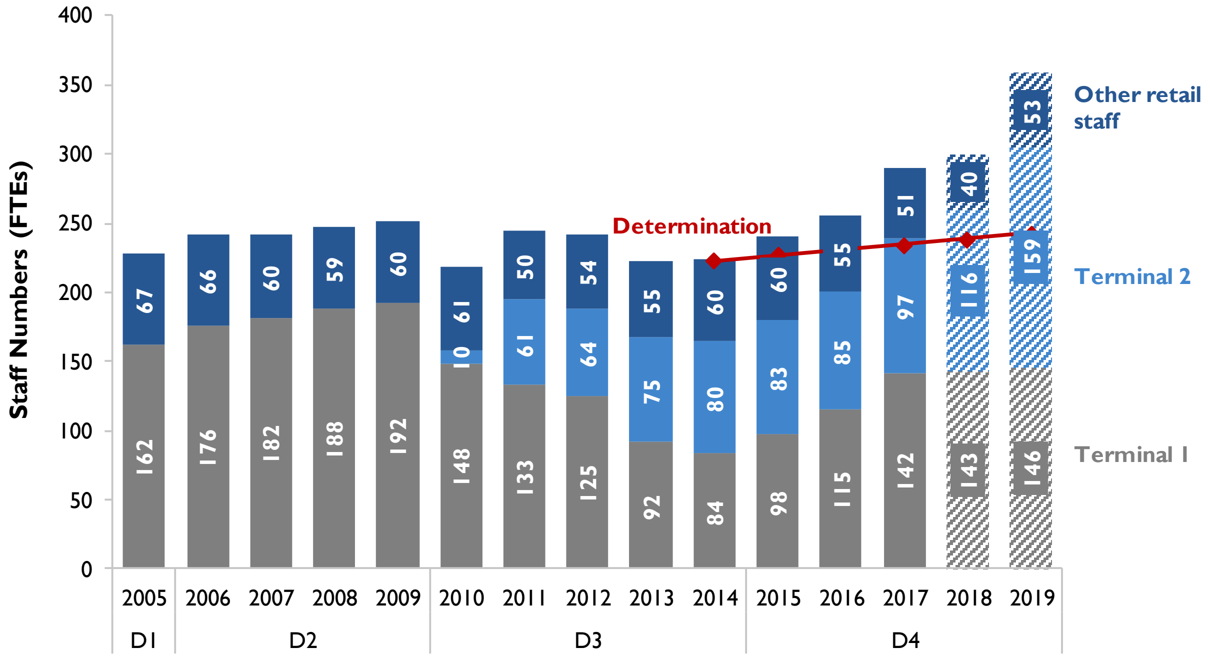
4.8.2. Historic expenditure

Staff numbers

Figure 4.50 shows how staff numbers have increased over the current price control period, with pronounced increases in the number of Terminal 1 and Terminal 2 retail staff. Overall 133 additional FTE staff are expected to be in post by the end of the price control period compared to 2014, split between 62 additional FTE in Terminal 1 and 77 additional FTE Terminal 2. These increases equate to a 59% increase in staffing levels. However, when considering staff numbers on a per passenger basis, retail staff per million passengers has declined from 10.4 in 2014 to 9.8 in 2017.

We understand from Dublin Airport, that the increase in retail staff in 2018 and 2019 is part of a strategy to bring certain retail facilities in-house rather than operate them as concessions. Direct retail space in Terminal 2 is set to increase from 1,441 square metres to 1,854 square metres at the expense of concessions, where floor space is set to decrease from 2,211 to 1,757 square metres. Dublin Airport believe that some of these retail facilities can be better managed directly, by daa group subsidiary ARI, where the company has experience running similar stores as concessions at other airports. Such a strategy inevitably means more staff but if the strategy is successful, we would expect it to deliver an increase in non-aeronautical revenues generated.

Figure 4.50: Maintenance related staff numbers, expressed in full-time equivalents at Dublin Airport, 2005-2019



Source: Dublin Airport; CAR determination

Payroll costs

While staff numbers have increased over the current price control period, unit payroll costs have remained largely constant. Overall, total payroll costs are forecast to increase by 65% over the price control period.

Figure 4.51: Unit payroll costs for retail staff based at Terminal 1, Terminal 2 and in back-office functions (€, 2017 prices)

Source: Dublin Airport; CAR determination; CEPA analysis

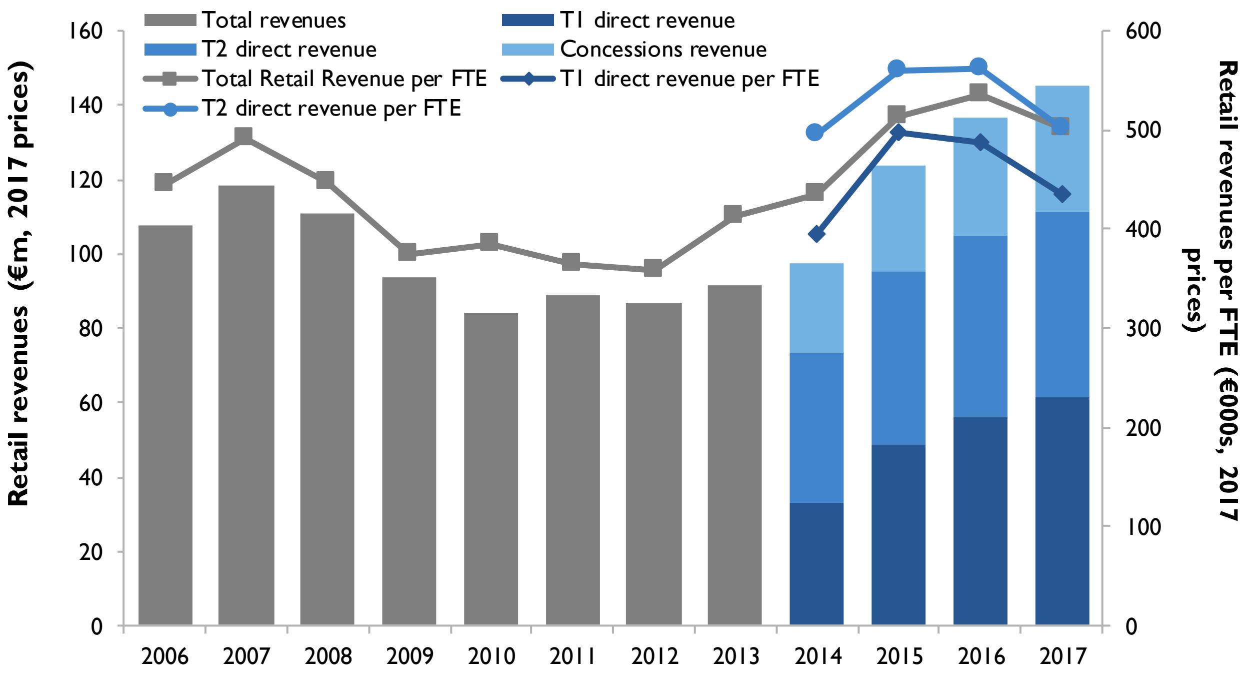
There remains a large variation in unit costs across both terminals and back-office staff. As shown in Figure 4.51 average wages for retail staff in Terminal 1 have been consistently higher than their Terminal 2 counterparts. While some convergence does appear to occur, a gap is expected to remain in 2019.

4.8.3. Analysis

For any efficiently-run airport, the primary purpose of retail expenditure is to maximise profit generated. It may be efficient for Dublin Airport to increase expenditure on retail, provided that this will lead to higher revenue such that profit is increased. We therefore consider how retail revenues and retail expenditure have varied over the current price control period.

Retail revenue has grown since 2014, as shown in Figure 4.52. Between 2014 and 2017, direct retail revenue rose by 49%, most of which was driven by higher revenues in Terminal 1 where they increased by 86%; during the same period revenue from concessions rose by 41%.

Figure 4.52: Retail revenues by terminal and by channel, 2006-2017 (2017 prices)



Source: Dublin Airport; Dublin Airport annual accounts; CEPA analysis

Real revenues have also increased on a per passenger basis between 2014 and 2017; by 20% in Terminal 1 and 7% in Terminal 2. This initially suggests that the increase in retail expenditure may be justified given the large increases in revenues generated. However, when looking at a longer period, total revenues generated per passenger are still lower in real terms than the levels seen in 2007 – €5.09 per passenger in 2007 compared with €4.91 per passenger in 2017.

When considering revenues generated per FTE, these initially increased between 2014 and 2015 but subsequently declined as the airport hired more staff. A similar trend can be seen when looking at the number of transactions processed per FTE over time, which increased in 2015 but has since declined.

There also continues to be a differential in the revenue generated by staff at Terminal 1 compared with Terminal 1. Terminal 2 staff generate approximately 15% more revenue than their Terminal 1 counterparts, though they also process 5% fewer transactions. Dublin Airport has suggested that this is as a result of differing passenger demographics between the two terminals, with Terminal 2 users made up of more high-spending long-haul passengers, compared with Terminal 1, which has more short-haul low-cost airline passengers. Dublin Airport do acknowledge some rostering inefficiency in Terminal 1, arising from the relative restrictiveness of the older contracts, which they plan to tackle over the next determination period.

The efficiency of Dublin Airport's retail operations can be assessed in part by comparing performance between terminals, but also by comparing performance against other private sector retailers. We use data from Dufry's 2017 annual report as an external benchmark of the allocation of retail staff across available retail floorspace.[16] Dufry is a Swiss-based travel retailer with operations in 2,200 duty-free and duty-paid shops in airports, cruise lines, seaports, railway stations and central tourist areas.

In 2017, across their UK, Central and Eastern European operations, Dufry had on average 6.7 FTE staff per 100 square metres of retail space. This compares with Terminal 1 and 2 at Dublin, which in 2017, stood 10.7 and 6.9 FTE respectively. Under the rearrangement of direct retail and concession floor space in Terminal 2 and estimated increases in staff numbers, by 2019, these figures are forecast to increase to 10.9 and 8.6 FTE. As a result, we conclude there is potential scope for efficiency from improved staff allocation at both terminals, particularly at Terminal 1.

In terms of unit payroll costs, our analysis in Section 4.1 identified a payroll cost differential between Terminal 1 and 2 staff. In this section, we have also identified a productivity differential between staff at the two terminals when considering revenues generated and retail space, though not when considering transactions processed. Therefore, we conclude that there is scope for efficiency by ensuring the performance of Terminal 1 more closely matches Terminal 2.

4.8.4. Future projections

Staff numbers

While we conclude from our analysis that there may be scope for staffing efficiencies in retail, we also note Dublin Airport's longer-term strategy with regards to retail. Given ARI's experience elsewhere, we believe the strategy is credible and can be reflective of an efficiently-run company but believe it is out of scope of this study to consider in detail whether it is appropriate. Provided the increase in staff numbers from more facilities being brought in-house is matched by an increase in revenues generated, the retail strategy can be considered efficient.

We have therefore decided to take Dublin Airport's 2017 estimate for FTE as our first baseline estimate, which implies 291 FTE in total. We note that Dublin Airport estimate an increase in staff numbers in 2019 to 359 FTE. However, we do not consider it appropriate to use this estimate without an associated increase in the non-aeronautical revenue target.

To the 2017 baseline, we apply an elasticity of 0.2 to reflect that retail floor staff numbers will partly increase as passenger numbers increase. We do not believe this to be a very strong link, as we believe the number of staff required is more closely related to the area of floor space dedicated to retail as well as passenger throughput. An increase in passenger numbers within the existing infrastructure is likely to require a less elastic response as peaks are more likely to be evened out.

If infrastructure constraints are lifted, such that passenger throughput and/or the volume of space dedicated to retail increases, increasing staff numbers is likely to be an efficient response. We therefore believe that

[16] Dufry AG (2017) Annual Report 2017. By using Dufry as a benchmark, we implicitly assume that it is operating at a point near to the efficiency frontier.

such an increase should be accommodated, provided that the non-aeronautical revenue target is also adjusted.

Our assumptions imply an additional 28 FTE in Terminal 2 by 2019. We do not assume any passenger volume driven growth for central retail staff.

In the longer term we believe there are efficiencies to be realised in the placement and rostering of Terminal 1 staff, so that the average number of Terminal 1 floor staff per 100 m² of retail space matches the average number of T2 floor staff per 100 m² of retail space. Under our forecast assumptions, this implies a reduction of 55 FTE in Terminal 1. This will require changes to rostering patterns, which for certain staff members cannot be realised without changes to terms and conditions or require more creative consideration of the placement and use of retail staff. As a result, we have allowed for a glide-path of five years to deliver these efficiency savings (i.e. up to 2024).

Table 4.8 shows the net effect of our baseline adjustments, volume-driven elasticities and one-off efficiency assumptions on our forecast staffing levels.

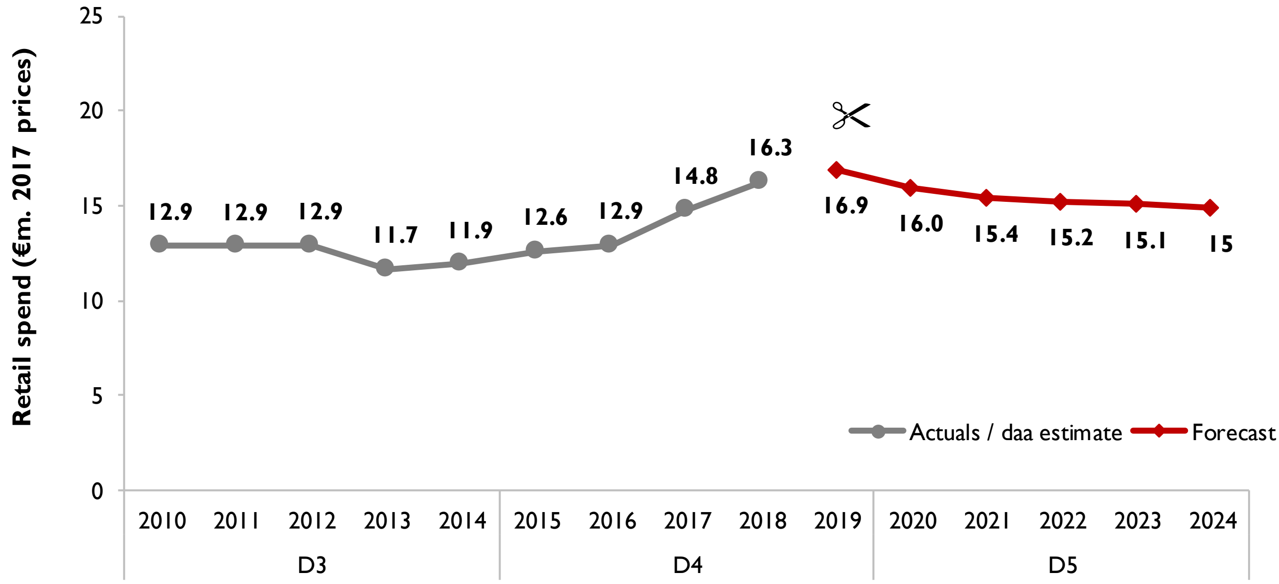
Table 4.8: Summary impacts of forecast assumptions on retail staffing levels.

	2019	2020	2021	2022	2023	2024
Baseline	325	325	325	325	325	325
Volume-driven elasticities	-	2	4	6	7	9
Cumulative one-off efficiencies	-	- 10	- 21	- 31	- 42	- 52
Forecast	**325**	**316**	**308**	**299**	**290**	**282**

Payroll costs

We forecast that payroll costs for retail staff will fall from €16.9 million in 2019 to €14.9 million in 2024. On a per passenger basis, this is a reduction from €0.52 to €0.39 per passenger. However, as stated previously, we believe there is a case for linking the opex allowance for retail with non-aeronautical revenues generated. The overall impact of our forecasts on payroll costs is illustrated in Figure 4.53.

Figure 4.53: Forecast retail expenditure, compared with historic/Dublin Airport estimates, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

4.9. Airside operations

Summary

The previous efficiency study projected Dublin Airport expenditure on airside operations staff to decline across the current price control period, but instead it has risen. By 2019, payroll expenditure is expected to be 69% higher than it was in 2014, the main driver being growth in FTE rather than salary costs.

Our analysis finds some evidence of inefficiency in airside operations expenditure. We find that over the regulatory period, the number of FTE employed has grown at a greater rate than the increase in flight movements at the airport.

To establish our own estimate of efficient expenditure in 2019, we use our elasticity assumptions to forecast 2019 FTE numbers from their 2017 level. Overall, we project airside operations staffing levels to increase from 87 FTE in 2019 to 88 FTE by 2024. The result of this assumption is that we estimate payroll costs in 2019 to be €6.5 million, compared with a Dublin Airport estimate of ✂✂✂✂. In our forecasts, this rises to €7.1 million by 2024.

4.9.1. Introduction

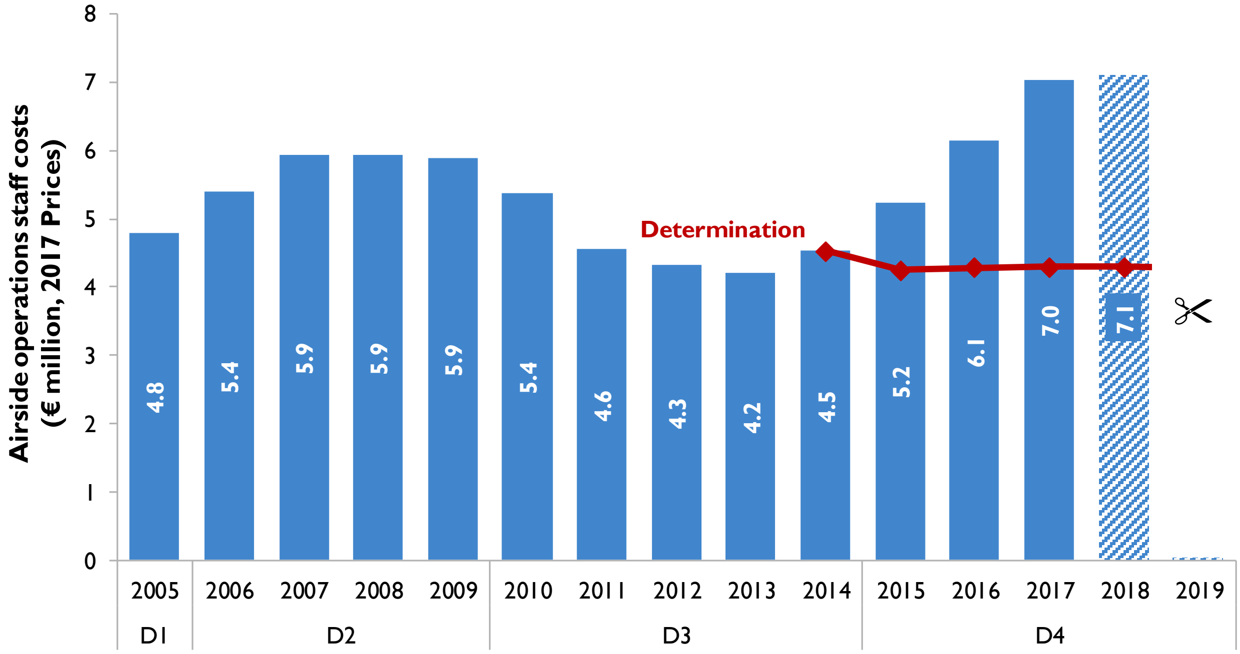
Airside Operations is an operational function which is staffed by directly employed Dublin Airport employees, who are responsible for maintaining the safe and efficient operation of the airfield. Roles include operational duty teams, responsible for patrolling and checking for foreign object debris (FOD), safety teams responsible for checking that safe working practices are being applied and operational planning staff managing stand and gate allocation. The airside operations function employed 86 FTE in 2017 with an associated total pay cost of around €7m per annum.

4.9.2. Historic expenditure

Payroll costs

As seen in Figure 4.54, staff costs have risen over the current regulatory period to a position where, by 2017 they are 55% higher than 2014 and by 2019 they are forecast to be 69% higher than 2014 on a like for like basis. This contrasts with the determination for this period which assumed that staff costs in this area would remain flat.

Figure 4.54: Airside operations payroll expenditure, 2010-2019 (€ million, 2017 prices)



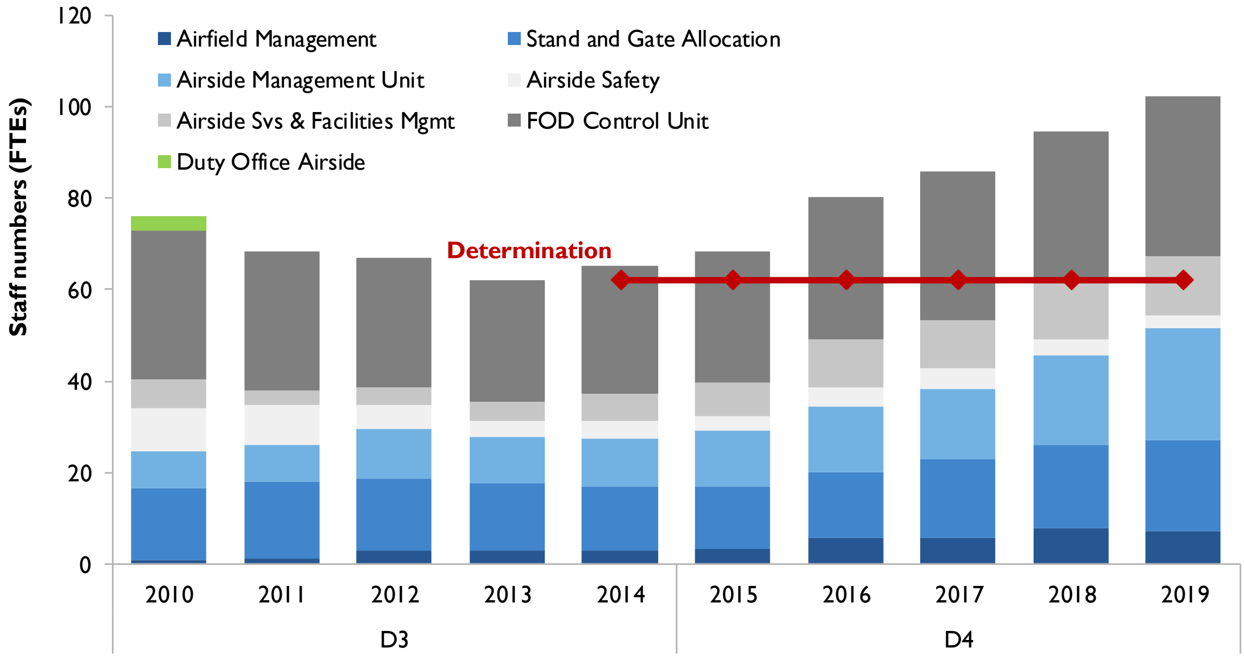
Source: Dublin Airport; CAR determination

Staff numbers

The main driver of the increase in staff costs in airside operations during this regulatory period is in the number of FTE employed. By 2017, airside operations employed 31% more FTE than in 2014 and this is forecast to rise further by the end of the current regulatory period to be 56% higher by 2019.

This growth in FTE is seen in all areas of the department but is most evident in the Airfield Management Unit and in the Airside Services and Facilities Management teams (as seen in Figure 4.55 below).

Figure 4.55: Airside operations staff numbers by role, 2010-2019 (full-time equivalents)



Source: Dublin Airport; CAR determination

Within these areas staff carry out specialist apron cleaning duties, for example removing FOD or responding to fuel spills or glycol recovery. They provide a focus on the safety management aspects of the airfield.

Dublin Airport state that the requirement for additional staff in these areas has been both; (a) volume-related – driven by more flight movements and, for example, more towed movements which require monitoring, and; (b) infrastructure-related – as additional stand capacity has been added.

Staff Unit Costs

At the end of the determination period, airside operations staff unit costs are forecast to be 8% higher than 2014 on a like for like basis (as seen in Figure 4.56) indicating that FTE growth is the key driver of the rise in overall staff costs.

As a department, airside operations employs the second highest level of staff on pre-2010 contracts of any grouping on the airport. At the end of December 2017, 67% of staff were on the older terms and conditions with just 33% on new terms. This implies that turnover of staff in this area of the operation is low and the relative cost differentials between this group and others are likely to remain into the next regulatory period.

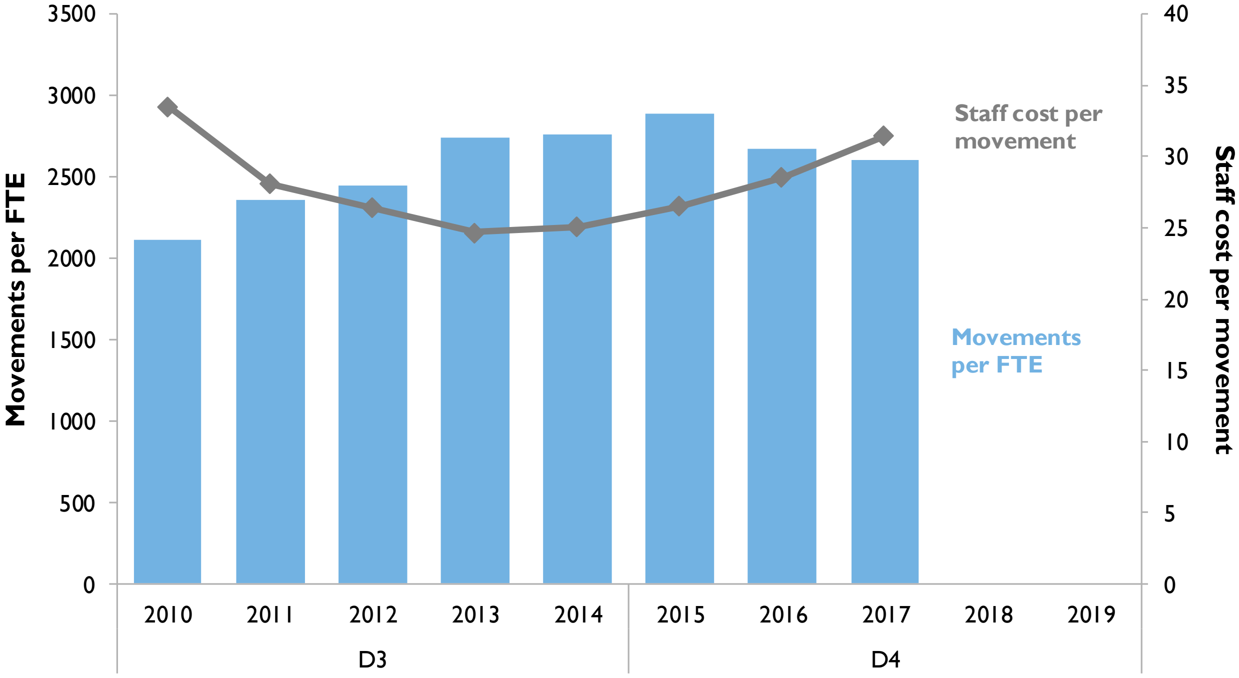
Figure 4.56: Airside operation staff costs per FTE, 2010-2019 (€'000s, 2017 prices)

Source: Dublin Airport; Taylor Airey analysis

4.9.3. Analysis

The number of flight movements at the airport has increased by 23% between 2014 and 2017. However, as seen in Figure 4.57, airside operations payroll expenditure has increased at a greater rate meaning that the staff cost per movement was 26% higher in 2017 when compared with 2014.

Figure 4.57: Airside operations staff productivity metrics, 2010-2017



Source: Dublin Airport; Taylor Airey analysis

The number of FTE has also grown at a greater rate than the increase in movements meaning that the number of movements processed per airside operations FTE has reduced by 6% over the same period. However, over a longer time period, the number of movements per FTE in 2017 is the same as the average over the period 2010-2017.

This is still more than we would expect as there are economies of scale in airfield operations, provided there is no expansion of apron area. Using the economies of scale achieved recently at Dublin Airport, we estimate efficient staffing levels in 2017 could be as low as 77 FTE, though it is likely to be higher given the increase in stand capacity in 2017.

4.9.4. Future projections

Our analysis leads us to conservatively conclude that although staffing levels in 2017 are likely to have a small element of inefficiency, they were broadly reasonable. However, there is little justification for further FTE growth from 2017 to 2019 and we use our own elasticity estimates to establish 2019 baseline FTE numbers.

We note that the management of the team and staff responsible for stand and gate allocation are unlikely to be elastic to growth in the future, though other parts of the airside operations function will have some elasticity to growth. Management and gate allocation staff represented 27% of the total FTE in airside operations in 2017. Assuming no growth in future stand numbers or expansion of apron area, we propose that the future elasticity of staff to passenger numbers should be 0.1 for all areas of airside operations.[17]

[17] Whilst the number of airside operations staff will be more closely linked with growth in flight movements, we do not have a separate forecast for movement growth. We therefore assume the growth in average aircraft sizes at Dublin Airport will continue its recent trend and set an elasticity based on passenger growth accordingly.

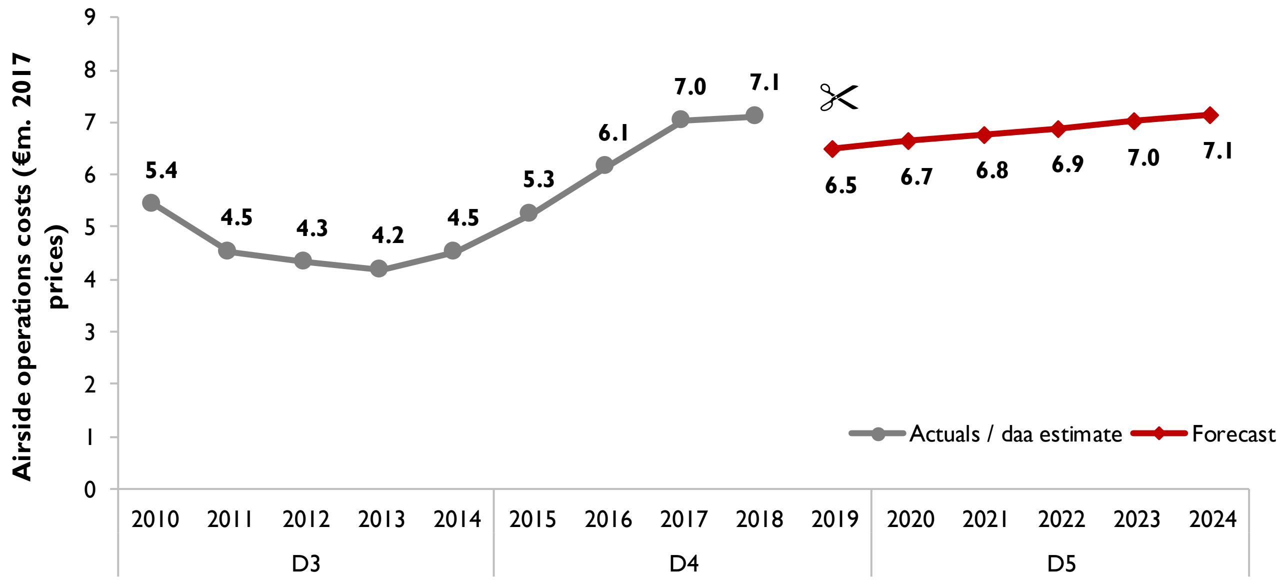
We would anticipate that efficiencies and economies of scale could enable the airport to maintain FTE growth to the levels described above. Whilst we have not identified any specific further efficiencies that we have built into our modelling, we would expect that there are improvements to ways of working and learning on managing a congested airport that could be taken from other European airports that face similar operating challenges.

Finally, we note that the CIP could impact on the future number of FTE required in Airside Operations, dependent on the extent of airfield development agreed. We consider this in further detail in Section 6. We suggest however that the addition of airfield infrastructure should not necessarily directly drive a step change in the number of FTE required as the additional work load for tasks may be absorbed by improved utilisation of existing staff rather than the addition of new staff.

Overall, we project airside operations staffing levels to increase from 87 FTE in 2019 to 88 FTE by 2024. The result of this assumption is that we estimate payroll costs in 2019 to be €6.5 million, compared with a Dublin Airport estimate of ✂✂✂✂ in 2019 and 2017 outturn costs of €7.0 million. We forecast expenditure to grow to €7.1 million by 2024. On a per passenger basis, this is a reduction from €0.20 per passenger to €0.19 per passenger.

The overall impact of our forecasts on payroll costs is illustrated in Figure 4.58.

Figure 4.58: Forecasts of airside operations expenditure compared with historic, 2010-2024 (€ million, 2010-2024)



Source: Dublin Airport; Taylor Airey analysis

4.10. Car parking

Summary

Expenditure on car parking has grown throughout the current regulatory period above the level forecast by the previous efficiency study. The growth in payroll costs has largely been driven by increased car parking operations staff as well as a growth in wages above anticipated levels. Non-pay related car parking expenditure also exceeded the 2014 determination target. This is mostly due to increases in costs associated with the landside bus contract.

Our analysis suggests that the increases in non-pay related expenditure can be considered efficient. We also believe that a certain proportion of the increases in payroll costs beyond the 2014 determination can be considered efficient. We note however, that while there has been a general tightness in the labour market, the increases in unit payroll costs are greater than those seen elsewhere in the economy.

Our analysis also suggests that car park expenditure does not increase with passenger numbers and so we have not applied any elasticity assumption to reflect this. Overall this means we estimate 2019 expenditure to be €6.6 million, compared with Dublin Airport's estimate of ✂✂✂✂. We forecast this to grow to €7.1 million by 2024.

4.10.1. Introduction

Car parking expenditure consists of both payroll and non-pay costs, with payroll expenditure comprising operations employees split between back office operational control and frontline security and customer service. Non-pay expenditure is largely made up of private security costs and a contract for a shuttle bus service from the car parks to the terminals (including staff car parks).

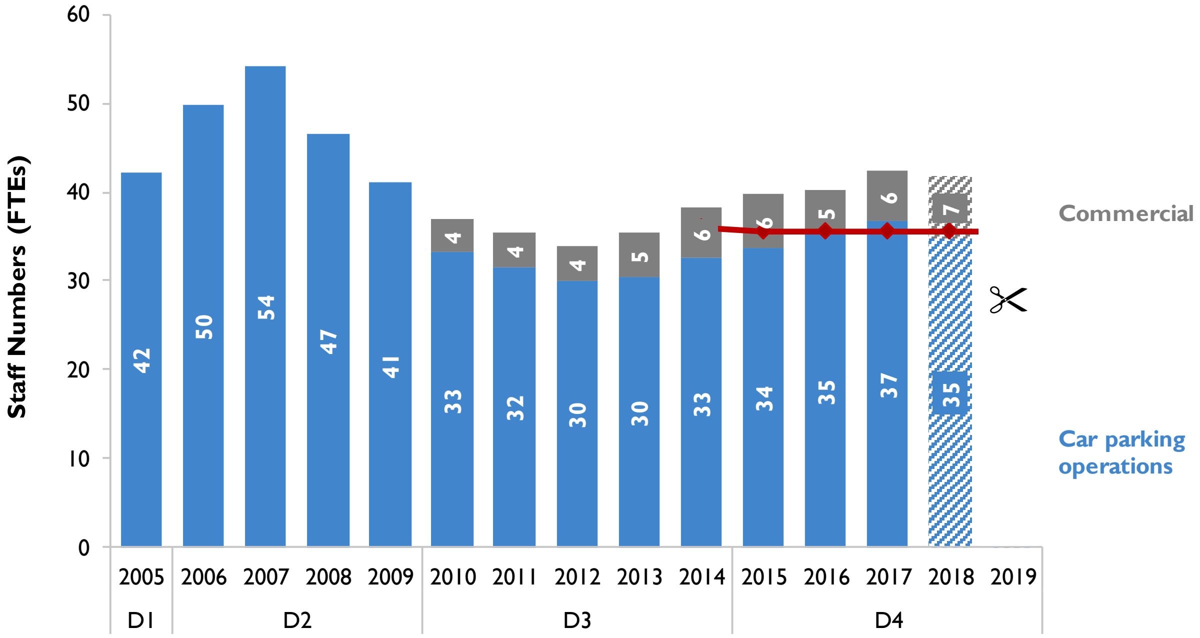
The broader car parking function also includes commercial staff who work solely on car parking (i.e. on car parking revenue generation) and staff who maintain and repair the airport's car parks. Dublin Airport have allocated these staff to Central Functions and Maintenance respectively, so they are included in their respective forecasts.

4.10.2. Historic expenditure

Staff numbers

Figure 4.59 shows that staff numbers have increased during the current price control period, exceeding CAR's determination target but not surpassing the historic levels seen before 2010. The increase is due to more operations staff, though Dublin Airport are expecting to employ 1 extra commercial FTE in 2018 and 2019.

Figure 4.59: Car parking related staff numbers, expressed in full-time equivalents at Dublin Airport, 2005-2019



Source: Dublin Airport; CAR determination

Payroll costs

Payroll costs for commercial staff have increased since 2013, as shown in Figure 4.60, and have increased more steadily for operations staff. In both areas, outturn unit payroll costs exceed CAR's determination, though to a lesser extent with operations staff.

Figure 4.60: Payroll costs, inclusive of bonuses, overtime and pension contributions, 2010-2019

Source: Dublin Airport; CAR determination; CEPA analysis

Non-pay costs

Figure 4.61 illustrates non-pay expenditure, which has also exceeded the 2014 determination target. This is mostly due to the landside bus contract, which was re-tendered in 2015 on a five-year basis with an option to extend. Costs have risen since as the contract was amended to additionally serve a new staff car park. The cost of the security contract has also increased from €0.28 million in 2014 to €0.42 million in 2017.

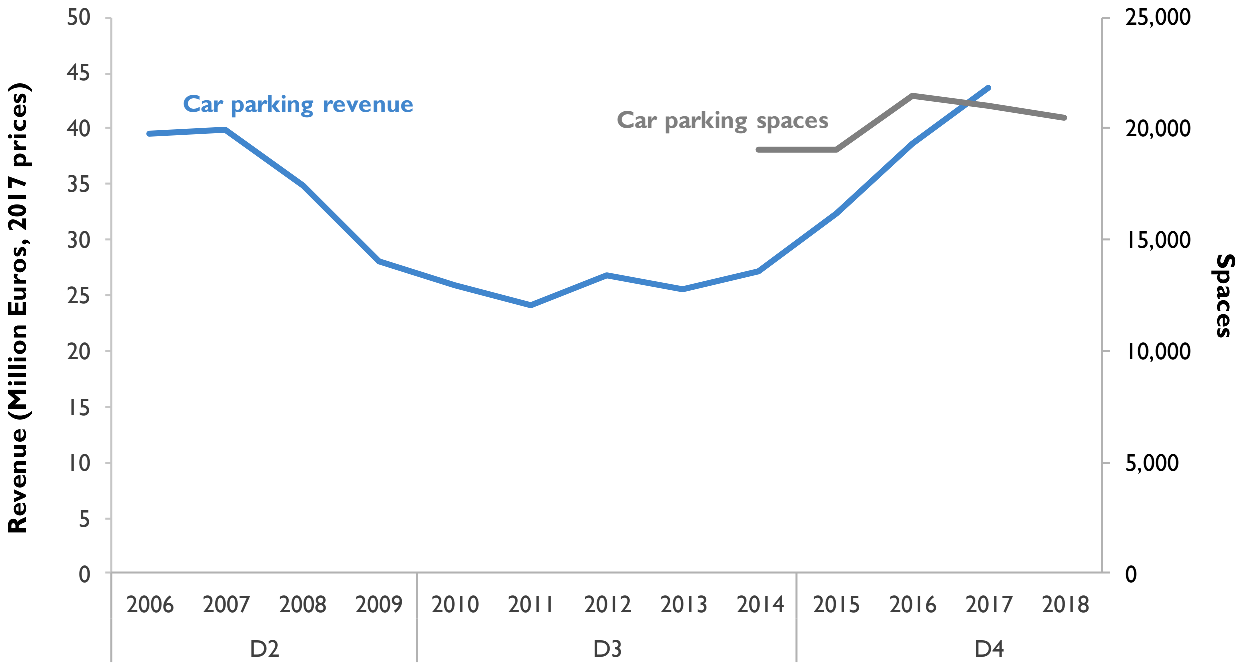
Figure 4.61: Non-pay car parking related expenditure, 2010-2019

Source: Dublin Airport; CAR determination

Overall expenditure

Dublin Airport's car parking spend is forecast to be €5.9 million higher, over the period, than was assumed in the 2014 determination. This is split roughly equally between higher outturn payroll costs and higher than expected non-pay costs. However, during this period Dublin Airport also experienced increased revenues from car parking and in the number of car parking spaces available, as shown in Figure 4.62.

Figure 4.62: Car parking revenue and car parking spaces, 2006-2018



Source: Dublin Airport; CEPA analysis

4.10.3. Analysis

Staffing levels

From our discussions with Dublin Airport, we note that the car park operational staff perform a dual function; both in a customer service role and to provide a visible on-site presence for users. Dublin Airport regard these operational staff as an important element of the value proposition which has enabled them to increase revenues. A number of commercial staff work full-time on car parking revenue generation, supported by a yield management model.

Staff productivity can be measured in a number of ways; we consider the number of car parking spaces managed per FTE, and car parking revenues per FTE.

- Car parking capacity has increased over the determination period, by approximately 1,500 spaces between 2014 and 2018. The increase in staff numbers has been roughly proportionate to the increase in capacity, suggesting that productivity has stayed relatively constant throughout this period.
- Revenue generation has increased consistently throughout the price control period so far, rising by 61% in real terms between 2014 and 2017, with revenues per FTE rising by 45% over the same period. This compares favourably against costs, which rose by 25% over the same period, and suggests that the increase in staff numbers (for commercial staff at least) may be efficient.

Dublin Airport have highlighted attempts at improving overall efficiency by streaming customers into different car parks depending on the length of stay, and therefore allowing certain car parks to be open, staffed and bussed on weekends only. However, while it is possible that these changes helped to drive increased revenue per FTE, we have not found any numeric evidence of efficiencies in terms of reducing expenditure.

Non-pay costs

With regards to non-pay costs, we note that these have also increased over the control period. As the bussing contract is a cost-plus contract, we would expect the increase in costs to be largely driven by wage increases and fuel price increases. As a proxy, we have multiplied 2014 and 2015 expenditure on the shuttle bus service by increases in diesel prices and wages. Using different assumptions around the relative weighting of fuel and wage costs, we estimate that the cost of the contract in 2017 and 2018 was between €0.2 and €0.4 million higher than it should be if bussing levels stayed the same.

However, we understand from Dublin Airport that they have set up the contract with a service level agreement to achieve a minimum wait time. We expect that the differential we have found, which equates to roughly 5% of the size of the contract, can be explained by improvements in the level of service. As revenues have consistently increased over this period, we believe this increase in spend can be justified.

Overall expenditure

Overall, we believe a certain proportion of the increase in car parking opex beyond what was assumed in the 2014 determination, has been efficient, given the related increase in revenues. However, as in other areas, we believe the increases in payroll costs are less justifiable. Whilst there has been a general tightness in the labour market, the increases in unit payroll costs are greater than those seen elsewhere in the economy.

4.10.4. Future projections

Staff numbers

The conclusions of our efficiency analysis suggest no inefficiency in staffing levels and as a result we have not made any baseline adjustment to staffing levels. As in previous studies, our analysis has shown no link between passenger numbers and staff numbers, and therefore we assume no elasticity. We do believe there is a strong link between the number of car parking spaces and the number of operational staff. Consequently, we consider the impact of the CIP on staffing requirements in Section 6.

In each year between 2020 and 2024, we forecast 37 operational staff leading to payroll expenditure of €1.7 million per annum between 2019 and 2024

Non-pay costs

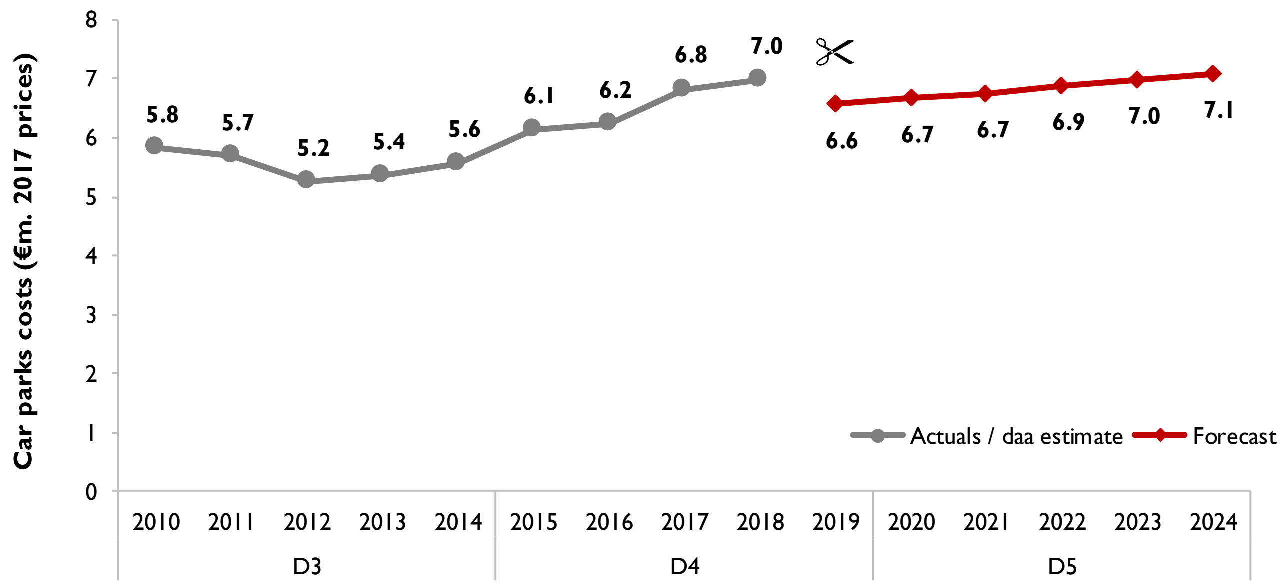
As we generally found 2017 outturn non-pay costs to be efficient, we tested whether the additional expenditure Dublin Airport expect between 2017 and 2019 could be justified based on increased input costs and additional requirements. We conclude that Dublin Airport's 2019 estimate is appropriate and use that as the basis of our baseline estimate of 2019 expenditure.

For non-pay costs, we do not apply a passenger volume-based elasticity, as the shuttle service nature of car park buses means that it is relatively unaffected by passenger growth in the short term. Security and ticketing costs are also relatively unaffected by passenger growth.

For our forecasts we assume security and ticketing costs stay constant at baseline levels. For the bussing contract we assume expenditure will increase based on an average of fuel price and wage growth. For fuel price growth, we use the BEIS forecasts of oil prices as a proxy, whilst for wages we use our core assumption for wage growth. We forecast non-pay expenditure to rise from €4.8 million in 2019 to €5.2 million in 2024.

Overall this means we estimate 2019 expenditure to be €6.6 million, compared with Dublin Airport's estimate of ✂✂✂✂. We forecast this to grow to €7.1 million by 2024, as illustrated in Figure 4.63.

Figure 4.63: Forecast car park expenditure compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

4.11. Capital projects

Summary

Between 2014 and 2017, expenditure on non-capitalised capital project staff remained broadly below the 2014 determination targets. This is despite there being a large increase in capital project staff above the forecast in the previous efficiency study.

Staff in this category are split between capitalised and non-capitalised staff. Most of the increase in both capitalised and non-capitalised staff numbers is due to an expansion of the asset management department. The number of capitalised staff in particular, has grown from 34 to 89 FTE between 2014 to 2017. Our analysis fails to find any statistical link between the number of capital project FTE and the level of capex spend in subsequent years, though we believe this is due to different planning horizons for different capital projects.

Our analysis above does not identify any specific areas where efficiency savings could be made and so we do not make any efficiency adjustments to the 2019 capital projects expenditure estimates. We do not believe that capital project expenditure is more closely linked to the scale of capex than passenger numbers.

Overall, we forecast the number of non-capitalised FTE working on capital projects to increase from 2019 levels to 30 FTE by 2021, staying constant thereafter. Overall, this means that payroll expenditure is forecast to be €1.9 million in 2019 and €2.9 million in 2024.

4.11.1. Introduction

Dublin Airport's operational expenditure on capital projects covers payroll spending on its asset management department (AMD) as well some payroll expenditure on staff involved in the airport's runway projects. Whilst a large proportion of such costs are capitalised and are therefore out of scope of this study, a small proportion is considered within operating expenditure.

4.11.2. Historic expenditure

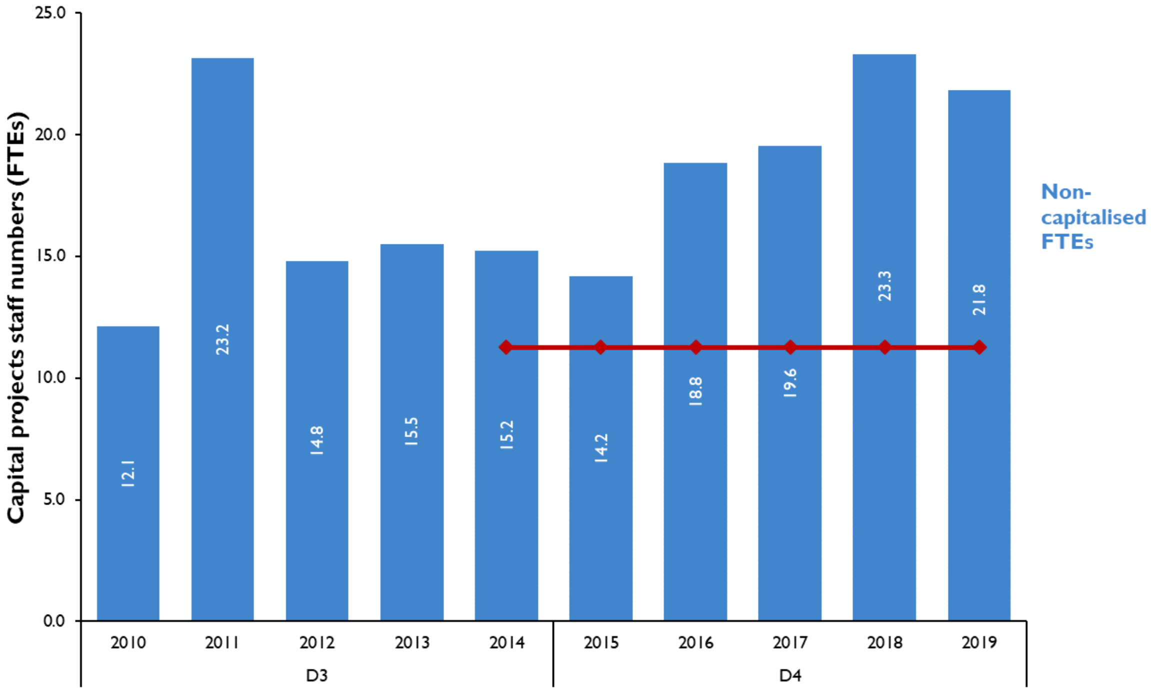
Between 2014 and 2017, the number of non-capitalised staff working on capital projects increased from 15 to 20, as shown in Figure 4.64. Over the same period however, capitalised staff allocated to the same accounting line have increased from 34 FTE to 89 FTE. The number of staff working on capital projects is lower than the period prior to 2010, owing to lower capex spend.

Most of the increase in both capitalised and non-capitalised staff numbers is due to an expansion of the AMD. This expansion is expected to continue to 2019, when Dublin Airport estimate there will be 116 FTE working in the AMD, of which 22 will be non-capital. The runway project team was established in 2016 with 6 FTE staff, and is expected to increase to 7 FTE staff by 2019.[18] On average 1 FTE has been non-capitalised over this period.

Throughout the price control period, capital project staffing levels remained above the target set in the CAR determination. In 2017, Dublin Airport had 20 non-capital FTE working on capital projects, compared with a determination assumption of 11 FTE.

[18] We expect this team will be disbanded once the new runway is delivered

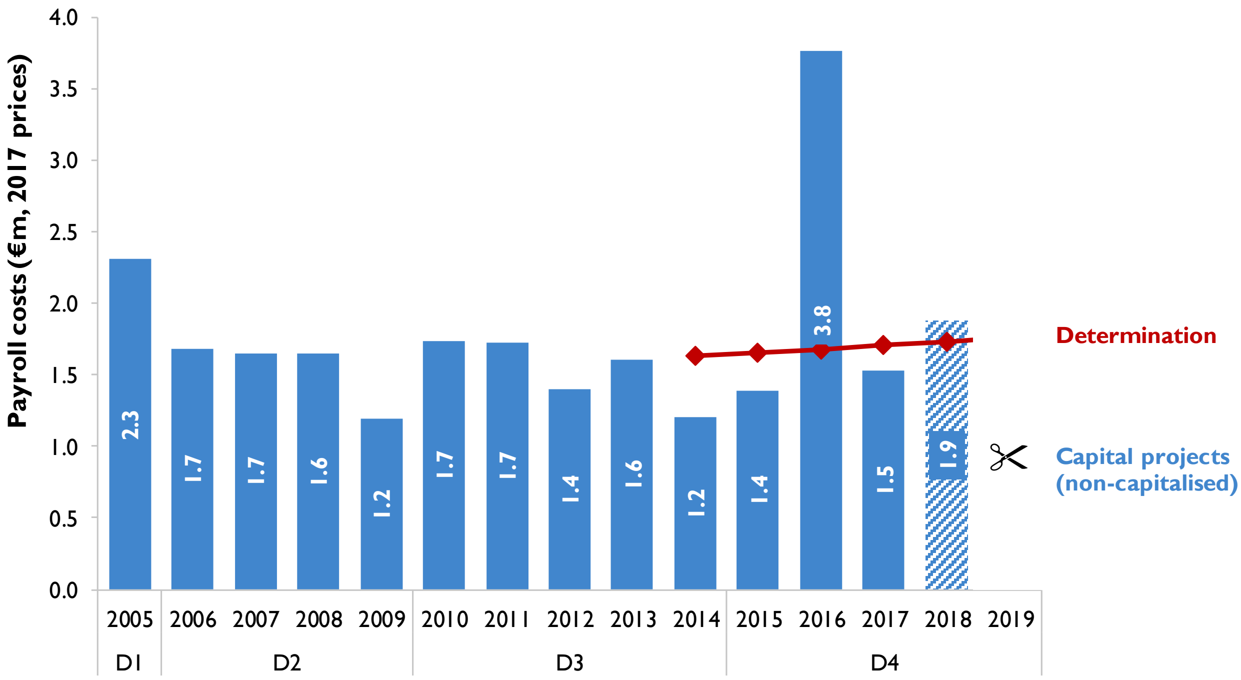
Figure 4.64: Capital project related staff numbers, expressed in full-time equivalents at Dublin Airport, 2005-2019



Source: Dublin Airport; CAR determination

Figure 4.65 shows how payroll costs for capital projects have changed over time. Over the whole period between 2014 and 2017, real payroll costs have increased by 28%. Dublin Airport currently forecast payroll expenditure increasing by a further 22% in 2018 and remaining at that level in real terms for 2019. Despite the increase in payroll costs, expenditure has remained below CAR target levels (except for 2016).

Figure 4.65: Payroll costs for capital project staff (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

The CAR determination projected a 1.6% year on year increase in costs and was set based on 2013 levels of spend. In 2014 however, there was a 25% reduction in payroll costs, largely as a result of a reduction in unit payroll costs. Except for 2016, unit payroll costs have not recovered to 2013 levels. The large increase in payroll expenditure in 2016 was due to one-off severance payments of approximately ✂✂✂✂.

4.11.3. Analysis

As discussed in the previous section, there is a difference between the growth in capitalised and non-capitalised staff working on capital projects. This suggests that the number of FTE in this area are not affected by the scale of capex. This is confirmed when we consider how operating expenditure relates to capex spend. Using information on Dublin Airport's real capital expenditure between 2011 and 2017 we looked at the correlation between this spend and AMD FTE. Whilst we find a positive correlation of 0.54 between FTE and capex spend between these years, it is not significant.

Whilst the number of AMD FTE are loosely linked to infrastructure development plans, we do not find any statistical link between the number of FTE in one year, and the level of capex spend in subsequent years. We believe this is most likely due to different capex projects having different lead-in times and the level of capex spend not being completely reflective of the amount of planning effort required.

4.11.4. Future projections

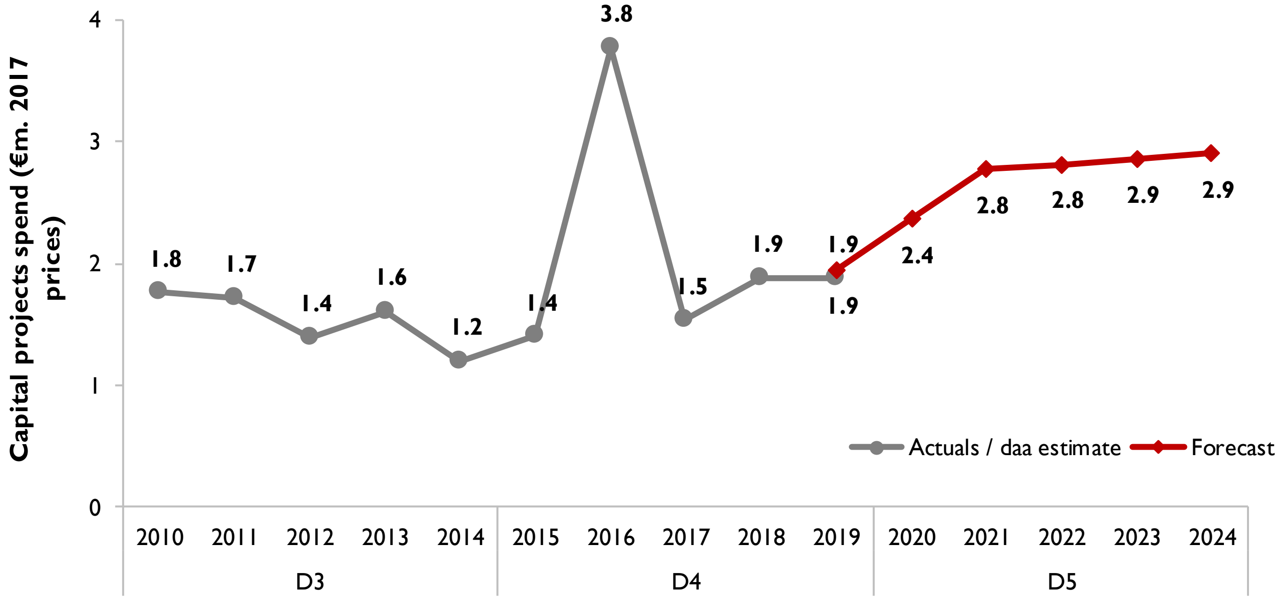
Our analysis above does not identify any specific areas where efficiency savings could be made. Although Dublin Airport has exceeded the number of FTE assumed in CAR's determination, since the determination was set, the scale of passenger growth has compelled Dublin Airport to rapidly develop the scale of its expansion plans. Therefore, we consider the growth in FTE an appropriate response and do not include any baseline efficiency adjustment.

Our analysis also suggests that no relationship exists between passenger numbers and payroll spend on capital projects, although we believe there is some link to scale of future capex spend. In the absence of any statistical evidence on the quantitative link between staffing levels and capex spend, we use historic levels as an indicator. The scale of capex spend is expected to increase substantially under the new CIP and plans for the second runway. We expect that by 2024, capex spend will broadly match, in real terms, the scale of spend prior to the opening of Terminal 2 in 2010. Over the period from 2005 to 2009, on average 30 FTE staff were allocated to capital projects.

Based on the above, we forecast the number of FTE working on capital projects to increase from 2019 levels to 30 FTE by 2021, staying constant thereafter. This matches the timing of Dublin Airport's hiring plans as stated in the Frontier report.[19] Overall, this means that payroll expenditure is forecast to be €1.9 million in 2019 and €2.9 million in 2024, as illustrated in Figure 4.66.

[19] Frontier Economics (2019) *Dublin Airport Operating Expenditure Review*

Figure 4.66: Forecast payroll expenditure for capital projects compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

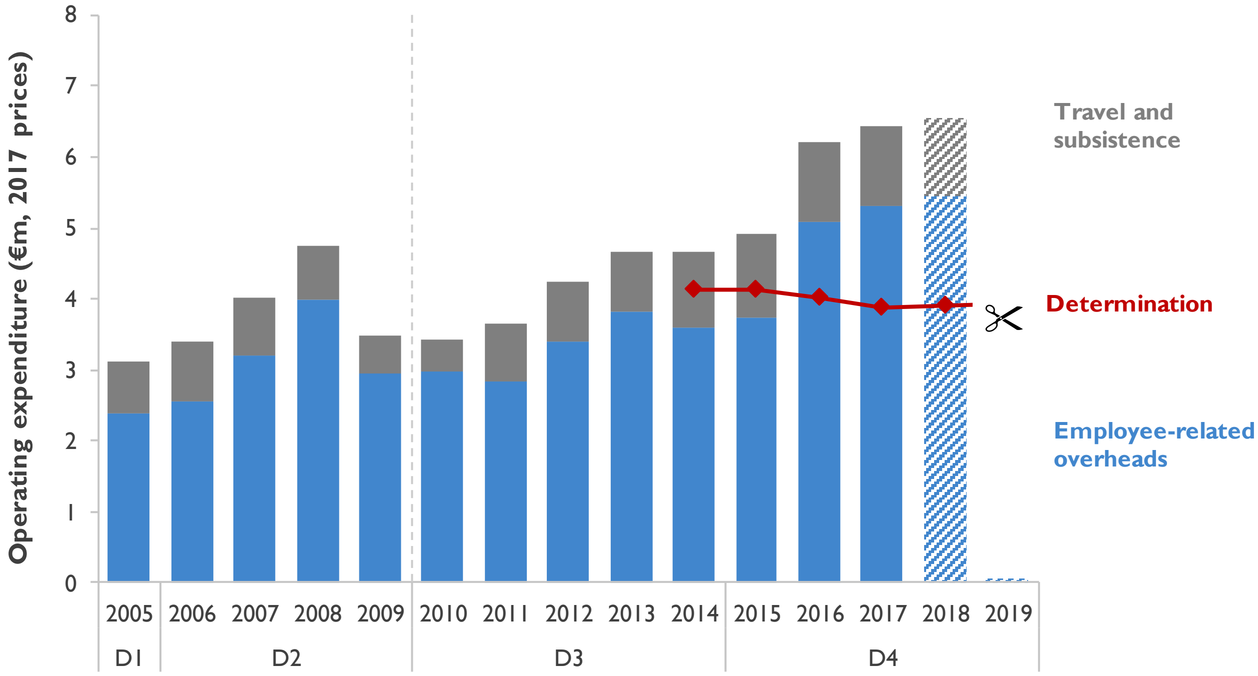
4.12. Other non-pay staff costs

This category consists of all employee-related overheads such as:

- Travel and subsistence;
- Training and development;
- Recruitment costs;
- Uniforms and protective clothing; and
- Staff transport subsidies.

The 2014 CAR determination assumed a reduction in other non-pay staff costs linked to the target reduction in FTE. Figure 4.67 shows how outturn expenditure has increased over the current control period, with a particularly large increase in 2016. This is largely as a result of increased expenditure on training and on the use of external recruitment agencies. In 2017, outturn expenditure was €2.5 million higher than CAR's determination and is expected to be €3.2 million higher by 2019.

Figure 4.67: Historic expenditure on employee-related overheads, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

Expenditure on a per FTE basis has also increased in real terms, rising from approximately €2,282 per FTE in 2014, to €2,567 per FTE in 2017. This is largely down to increased spend on employee-related overheads, with spend on travel and subsistence declining on a per-FTE basis. Given the large increase in staff numbers over the current determination, it is surprising that expenditure on overheads has increased by an even greater percentage. We would expect there to be economies of scale related to key areas of expenditure, such as training.

As a result, we have adjusted the baseline to reflect our estimate of staff numbers. We assume baseline expenditure on employee related overheads per-FTE is €2,351, the average between 2010 and 2017 (a reduction of 8% from 2017 levels). This removes some of the year-to-year fluctuation in annual employment costs and removes some of the inefficiency we have seen in recent years. We then forecast this forward assuming an elasticity of 0.95 with respect to staff numbers, to reflect an expectation of some economies of scale.

Our baseline estimate of staff-related non-pay expenditure for 2019 is €6.0 million, compared with a 2017 outturn of €6.4 million and a 2019 Dublin Airport estimate of ✂✂✂✂. We forecast baseline expenditure to rise in line with staff numbers to €6.1 million by 2024.

5. EFFICIENCY OF NON-STAFF EXPENDITURE

5.1. RENT AND RATES

Summary

We generally find rent and rates cost to be efficient. Outturn costs are below CAR's determination target. We project expenditure to continue at current levels in real terms, though we separately assess in Section 6 whether the expansion proposed in the CIP will lead to higher rental costs.

In our analysis, we consider changes to the Annual Rate on Valuation (ARV) and how this would impact on the rates payable by Dublin Airport to Fingal County Council. Our analysis also considers the impact of other developments on Dublin Airport rates – namely the opening of a new multi-story car park in 2018 and the opening of a new aircraft stand. We understand from Dublin Airport that the airport's rateable value is expected to increase in 2020. However, our analysis suggests that it does not follow that this will lead to an increase in rates.

Our analysis does not suggest any areas where efficiency savings can be made and we make no baseline adjustment to rent and rates costs. Our analysis also suggests no relationship between passenger numbers and rent and rates and so we do not apply any volume-driven elasticity to expenditure. Overall, we forecast that expenditure on rent and rates will remain constant at €14.2 million across the determination period from 2019 to 2024.

5.1.1. Introduction

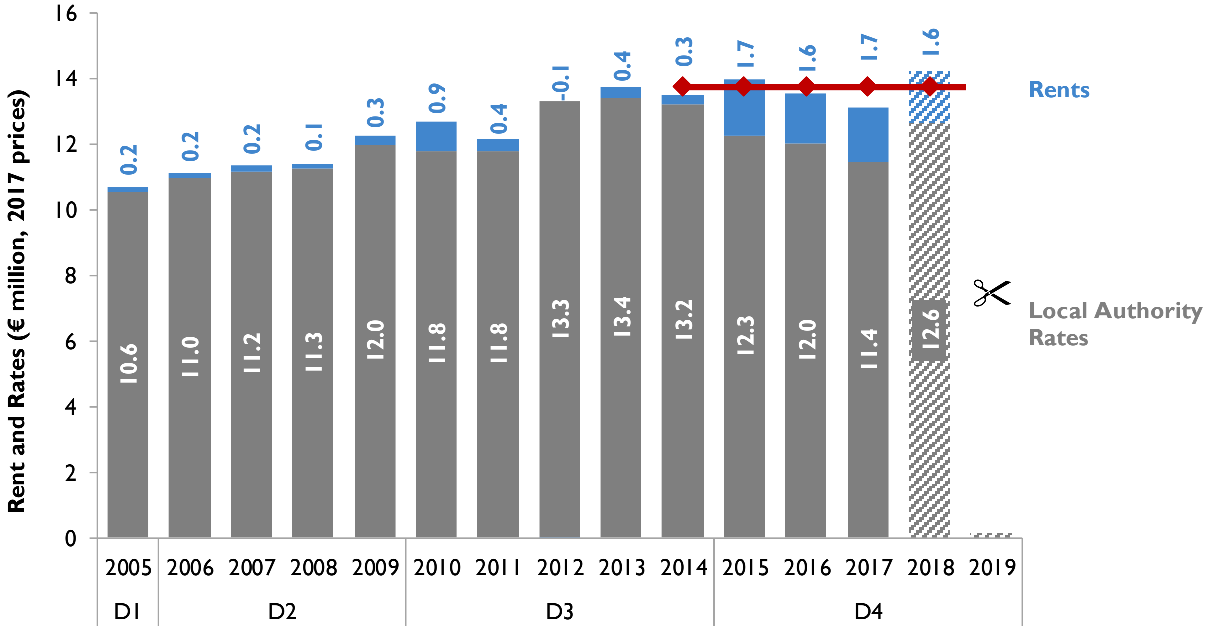
Most of Dublin Airport's rent and rates expenditure can be attributed to local authority rates. Net rental expenditure includes cross-charges between the regulated entity and daa group, where daa group assets are used by Dublin Airport.

5.1.2. Historic expenditure

Between 2014 and 2017, total rent and rates costs for Dublin Airport fell in real terms, with rates costs falling year-on-year by a total of 14%. Although rental costs make up a small proportion of expenditure, there was a step increase in these costs between 2014 and 2015, remaining constant subsequently. Overall, the reduction in rates has meant that in 2017, Dublin Airport's expenditure was below CAR's determination. Dublin Airport expect rates to increase in 2018, due to the opening of additional rateable infrastructure and an increase in general rate costs. Figure 5.1 illustrates the expenditure on rent and rates between 2005 and 2019.

Dublin Airport pays the rates charges for all commercial property it owns, but will recharge a certain proportion to tenants and concessionaires. The figures included in this section are presented as net of recharges.

Figure 5.1: Expenditure on rent and rates, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

5.1.3. Analysis

Dublin Airport rates are payable to Fingal County Council annually. The charge is calculated as a multiple of the valuation of the property in question and the Annual Rate on Valuation (ARV). While the valuation remains constant over a ten-year period, the ARV can change on an annual basis. The current valuation for Dublin Airport was last completed in 2010. A revaluation that will take effect from 2020 is currently under way and expected to conclude in the summer of 2019. The purpose of this revaluation is to redistribute the commercial rates liability in a more equitable manner between ratepayers, rather than to increase the total amount of commercial rates collected by the local authority.

Applying the 2017 multiplier of 0.132 to the 2017 rates paid by Dublin Airport, suggests that in 2017, Dublin Airport had a rateable valuation of €86.64m. However, since then two developments have led to increased expenditure on local authority rates. The opening of a new multi-story carpark for terminal two added €0.6 million of new rates per year from 2018, while new aircraft stands led to an increase in rates of €0.8 million per year. In addition, in 2018, Fingal Council increased the ARV from a base of 0.132 to 0.147 and in November of 2018, the council determined that the ARV would increase further to 0.15 for 2019.

Rents paid by Dublin Airport for the use of certain office space increased in 2015. This is partly due to a new rental charge following daa group's Dublin Airport City development moving from the regulated entity to the non-regulated part of daa. The development comprises roughly 70 acres of land adjacent to the terminals at Dublin Airport containing office accommodation. As Dublin Airport use some of the office space in the development, they now pay a cross-charge from the regulated entity to the non-regulated part. We note that Dublin Airport are being charged rent of €161 per sqm, a rate that is based on a previous study commissioned by CAR.[20] It is likely that these rates are now below market rates. We also note that

[20] Lisney (2014) Valuation Report: 20.32 acres Inner Zone, 25.25 acres Middle Zone and 18.86 acres Outer Zone, Dublin Airport, Co. Dublin

net rental costs are expected to stay relatively constant since 2015. We therefore conclude that rental costs are generally efficient.

5.1.4. Future projections

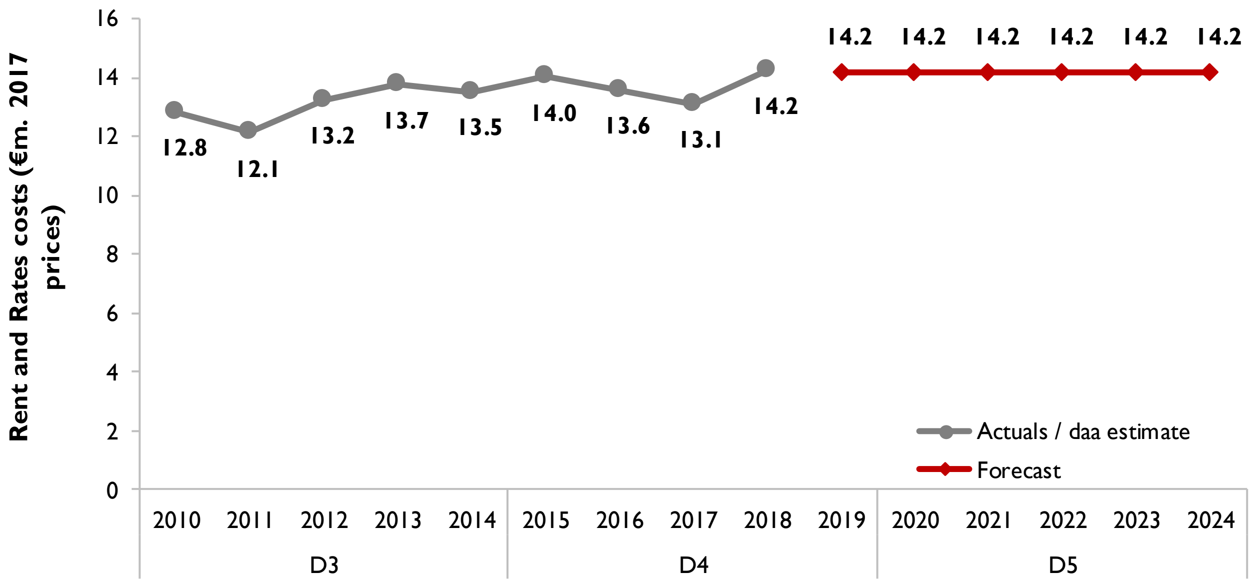
Our analysis above does not suggest any areas where efficiency savings can be made for Dublin Airport. Therefore, we do not apply any baseline adjustment for rent and rates costs. Our analysis also suggests no relationship between passenger numbers and rent and rates and so we do not apply any volume-driven elasticity to expenditure.

We understand from Dublin Airport that they expect expenditure on rates to increase in 2020 following the revaluation of the airport's rateable value. However, whilst the airport's rateable value may increase following the revaluation, it does not directly follow that rates will increase. There are three reasons why we believe rate costs will not increase following the revaluation:

- The most significant investments that affect the airport's rateable value have already been priced in, through mid-period valuations of additional infrastructure (such as the multi-storey car park).
- Although there have been some investments in other parts of the airport, rates for some of these such as retail outlets, will be paid by concessionaires rather than Dublin Airport. Others are no longer part of the Dublin Airport estate, such as Dublin Airport Central.
- More fundamentally, as the purpose of the revaluation is to ensure rates are equitably distributed across a local authority area, there would only be an increase if Dublin Airport's rateable value has increased by a greater percentage than commercial properties elsewhere in Fingal. Given the area surrounding Dublin Airport is largely reliant on aviation growth, it is likely that rateable values elsewhere in Fingal County Council will have increased by similar amounts.

It is also not clear to us at present what would lead to a change in rents. We therefore assume both rental costs and expenditure on rates will stay constant at 2019 levels, as illustrated in Figure 5.2.

Figure 5.2: Forecast of Rents and Rates expenditure, compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

5.2. Consultancy services

Summary

Spend on consultancy services has exceeded the forecast in CAR's determination, particularly in 2016 and 2017. Spend is expected to decline by 2019 however to a level we believe is only marginally inefficient, once input cost increases have been taken into consideration. Our forecasts account for this inefficiency, but also account for expected real cost growth in future.

We consider that an efficient outturn spend on consultancy services costs should be expected to increase in line with wage growth for professional staff. We make an efficiency adjustment to 2019 consultancy services spend by adjusting the 2014 determination forecast for skilled wage growth. This gives a baseline cost of €6.1 million compared to Dublin Airport's forecast of ✂✂✂✂. For our projections, we assume that expenditure will continue to grow in line with skilled wage growth. This gives a forecast expenditure of €6.6 million on consultancy services in 2024.

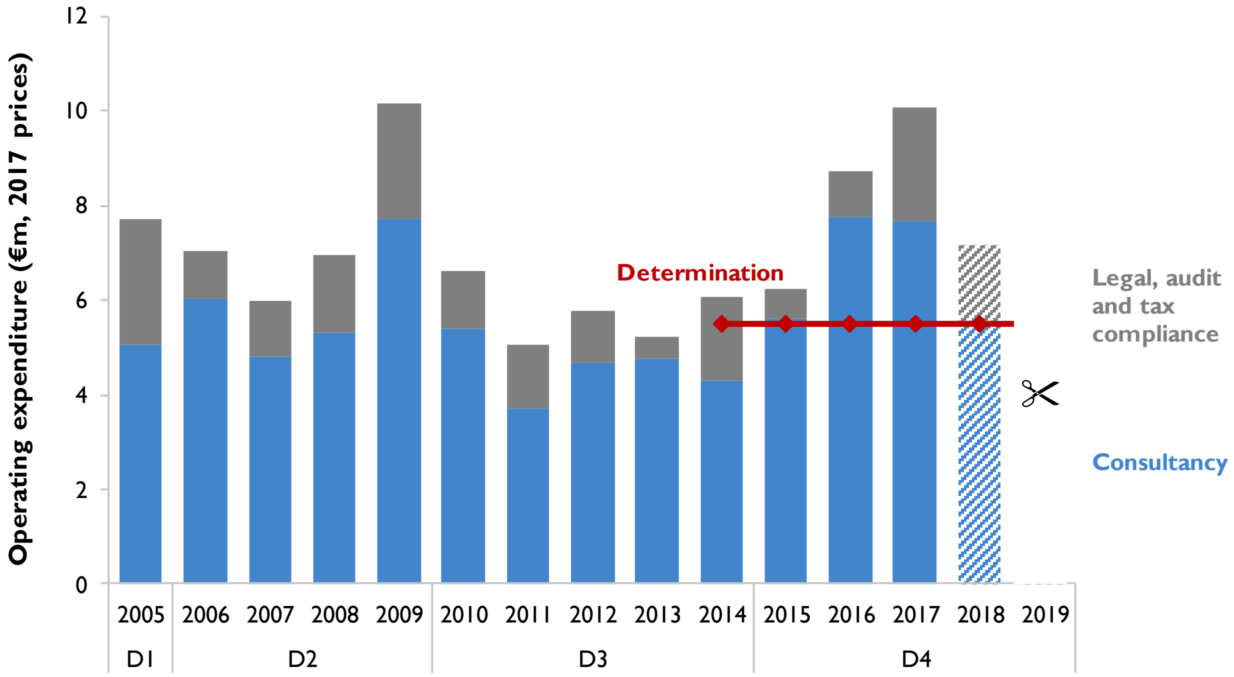
5.2.1. Introduction

Consultancy services expenditure relates to spend on external advice at Dublin Airport, comprising consultancy services, legal, audit and tax compliance advice.

5.2.2. Historic expenditure

Figure 5.3 shows expenditure has exceeded forecasts for each year of the current price control period so far and is expected to exceed forecasts for 2018 and 2019. However, spend over the last two years of the determination period is expected to reduce from current levels. Over the five-year determination period, Dublin Airport are expected to exceed forecasts by €11 million.

Figure 5.3: Expenditure on consultancy services, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

5.2.3. Analysis

As spending on external professional advice tends to be ad-hoc, no single activity explains the increase in expenditure. Whilst the 2014 determination assumed that costs would stay the same in real terms, we believe the labour-intensive nature of such activities means that costs are more likely to increase in line with wage growth for professional staff.

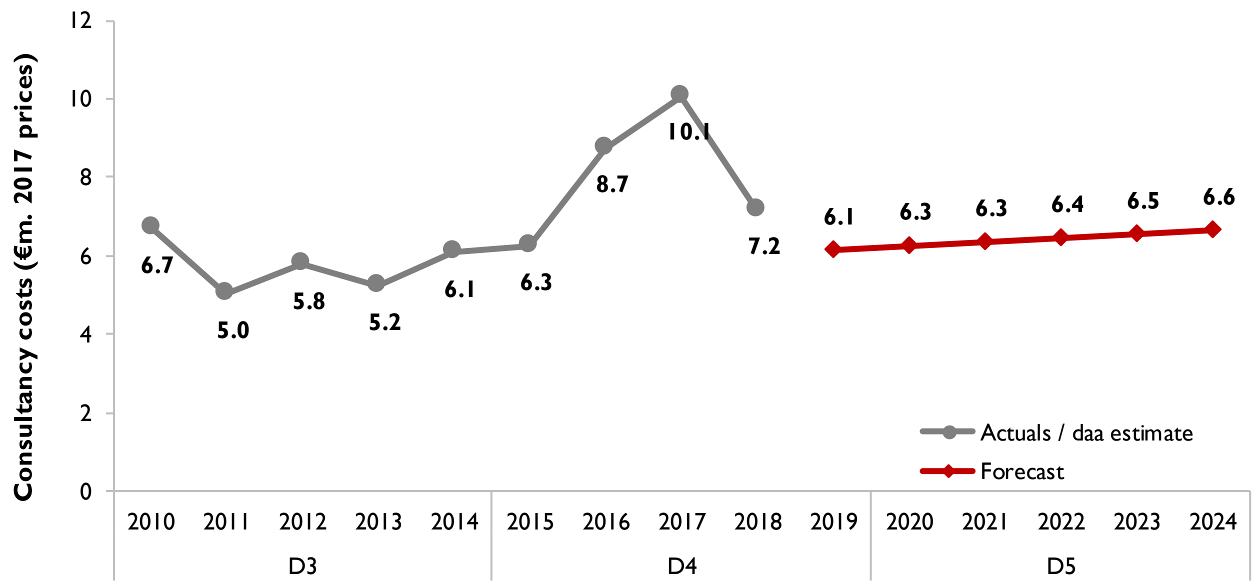
However, over the current determination period the level of consultancy spend has increased by more than can be explained by input cost growth alone. In 2017, outturn consultancy spend was €4.6 million higher than forecast in the determination. If the forecast was adjusted in line with economy-wide wage growth for workers in professional, scientific and technical occupations, outturn spend would still be €4.2 million higher.

5.2.4. Future projections

We have used the determination forecast, adjusted for skilled wage growth for our baseline. Although Dublin Airport forecast a decline in consultancy spend in 2019 to ✂✂✂✂, our baseline reduces this estimate to €6.1 million.

For our projections, we assume expenditure will grow in line with skilled wage growth, resulting in expenditure growing from €6.1 million in 2019 to €6.6 million in 2024. This is illustrated in Figure 5.4 below.

Figure 5.4: Forecast of consultancy spend against historic and Dublin Airport estimated spend, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

5.3. MARKETING AND RELATED COSTS

Summary

We find Dublin Airport's marketing spend over the current determination period to have been higher than we consider efficient. However, it is expected to reduce by 2019 to levels we consider to be more efficient. We have therefore not made any efficiency adjustment in our forecasts. We project that expenditure will increase in the future, linked to overall passenger growth.

A large proportion of the increase in marketing costs has been due to marketing support given by Dublin Airport for airlines starting operations at the airport or launching new routes from the airport. We consider that some of this increase could have been met by reprioritising existing spend.

Our 2019 estimate of efficient expenditure is €7.4 million. We expect that spend will increase as passenger numbers grow and we apply an elasticity of 0.4 with respect to passenger numbers. This leads to a forecast spend of €7.9 million by 2024.

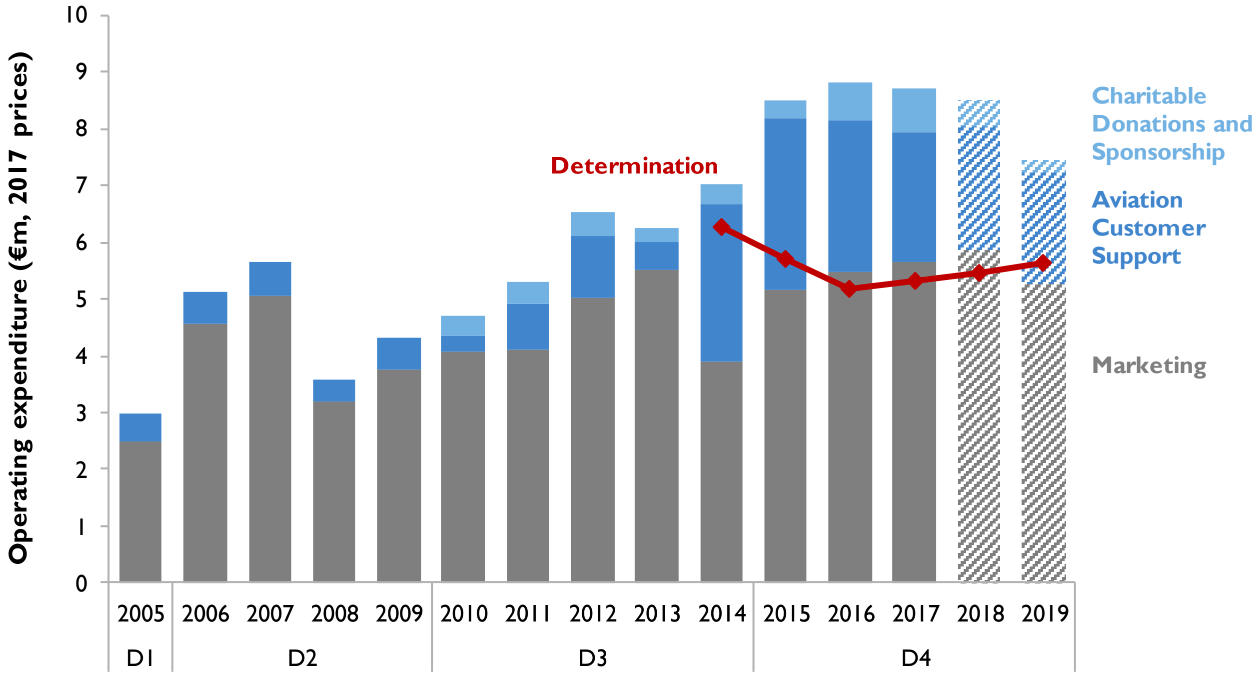
5.3.1. Introduction

Costs in this category consist of both marketing for services provided directly to passenger by Dublin Airport, such as car parking, as well as marketing support on behalf of airlines. It also includes miscellaneous costs such as market research and charitable donations.

5.3.2. Historic expenditure

The 2014 determination forecast that marketing spend would fall for the first two years of the period before rising due to increased passenger numbers. Outturn expenditure has been higher than forecast for the years 2016 and 2017, and whilst expenditure is expected to decline in 2019, Dublin Airport still estimate an overrun of [redacted]. This is shown in Figure 5.5 below.

Figure 5.5: Historic expenditure on marketing, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

5.3.3. Analysis

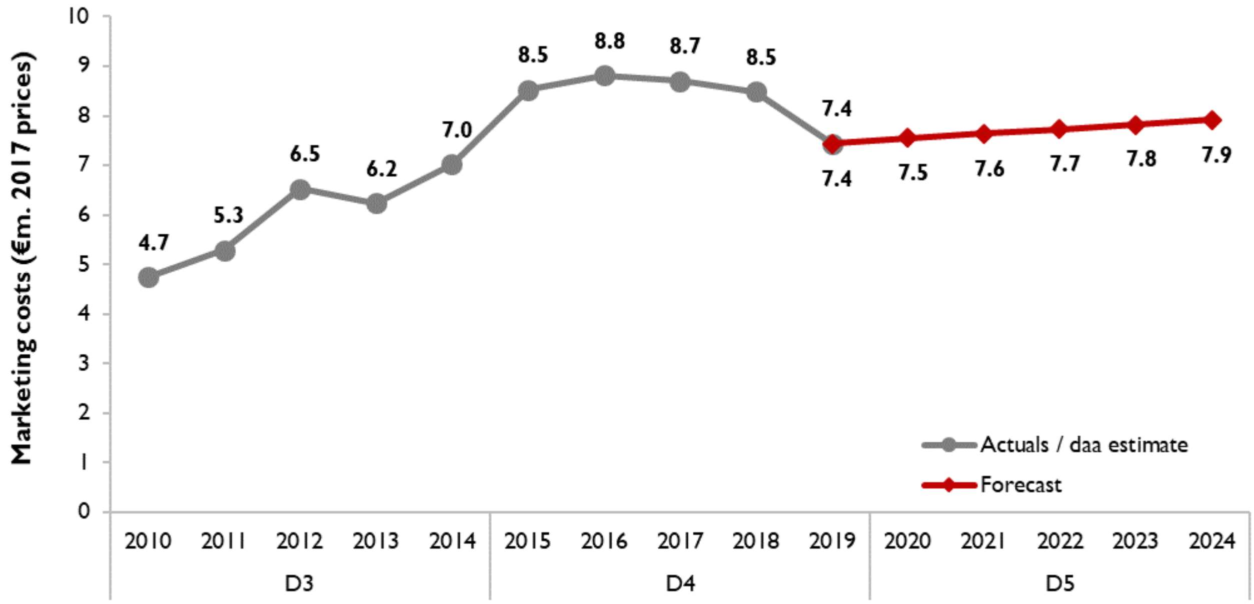
A large proportion of the increase in marketing costs has been due to Dublin Airport providing marketing support for airlines starting operations at the airport or launching new routes from the airport. We believe that whilst this is a sensible way of growing traffic, Dublin Airport have not justified why this strategy required increases in marketing expenditure rather than a reprioritisation of existing marketing spend. It is unclear to us that the increases in expenditure seen in the early years of the determination period have been efficient.

5.3.4. Future projections

We note that Dublin Airport forecast a reduction in marketing spend in 2019. We also note that although capacity constraints have meant a reduced need for marketing spend, Dublin Airport are progressively reducing these constraints. As a result, we have used Dublin Airport's estimate of 2019 spend as our baseline.

To forecast marketing spend, we apply an elasticity of 0.4 with respect to passenger growth. We note Dublin Airport's ambitions continue to grow, which would be partially reliant on marketing. As a result, we believe increasing marketing spend in line with passenger volumes is appropriate. We forecast spend to grow from €7.4 million in 2019 to €7.9 million in 2024, as shown in Figure 5.6.

Figure 5.6: Forecast marketing expenditure compared with historic and Dublin Airport estimates, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

5.4. Passengers with Reduced Mobility

Summary

The passengers with reduced mobility (PRM) service is outsourced at Dublin Airport. Contract costs have increased over the current determination period, though at rates in line with our expectations given increases in passenger numbers and the changing demographic of passengers. Dublin Airport have recently retendered the contract to provide PRM services at a cost of ✂✂✂✂in 2019. We have used the cost of this contract in our forecasts.

The PRM service costs have been broadly in line with the 2014 determination assumptions for the current regulatory period. However, we note that it is forecast to be €1.4 million above the determination value for 2019. While Dublin Airport have stated that this is due to an uplift to account for wage growth, we note that the 2014 determination had already built in a 'catch-up' uplift.

We have not made any efficiency adjustment to 2019 PRM expenditure. We understand that the recently let contract fixes prices for the duration of its term. Overall, we forecast PRM costs to be €8.16 million per annum from 2019 to 2024.

5.4.1. Introduction

Under European Union regulation (EC) 1107/200,[21] airports are obliged to provide passengers with assistance services to support and facilitate their journey. Services can range from helping the passenger to board the aircraft to accompanying the passenger from arrival at the airport to the flight.

Provision of these services at Dublin Airport is outsourced to OCS whose three-year tender was awarded in 2013 and then extended by two years in 2016. It expired in 2018. Following retendering, a new contract was recently agreed with OCS for the provision of PRM services from 2019 until 2023 with an option to extend by another two years.

5.4.2. Historic expenditure

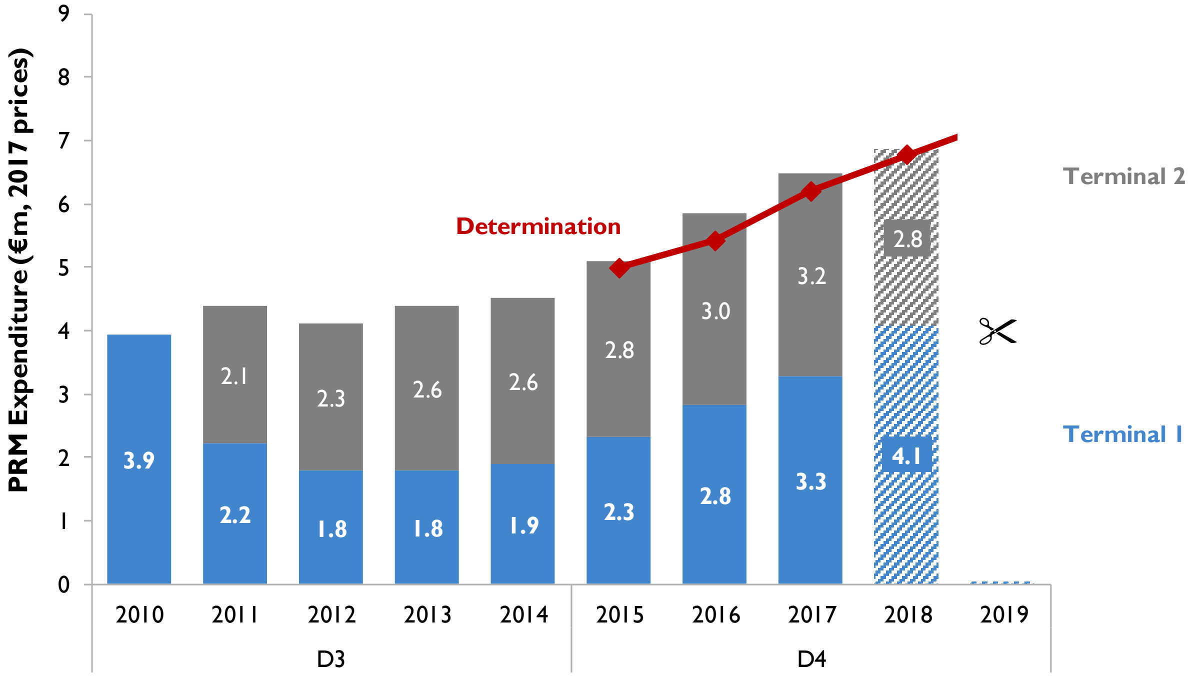
Dublin Airport's expenditure on PRM services has risen steadily since 2010 and is forecast to reach ✂✂✂✂ and ✂✂✂✂ for Terminal 1 and 2 respectively in 2019 (as shown in Figure 5.7). At this level, the 2019 cost is forecast to be 80% higher than the 2014 level on a like-for-like basis.

Increased spending on PRM services is driven by growing passenger numbers year on year. This was stimulated by the opening of Terminal 2 in 2010. Expenditure on PRM services at each terminal has increased at a similar rate to the growth in passenger numbers at the terminals.

The actual PRM cost has tracked broadly in line with the determination assumptions for the current regulatory period, although it is forecast to be above the determination value in 2019. Dublin Airport state that this is partially due to an uplift to account for wage costs, although we note that the determination assumptions already included a wage uplift between 2016 and 2017 (when it was assumed that retendering would take place).

[21] Regulation EC No (1107/2006) concerning the rights of disabled persons and persons with reduced mobility when travelling by air

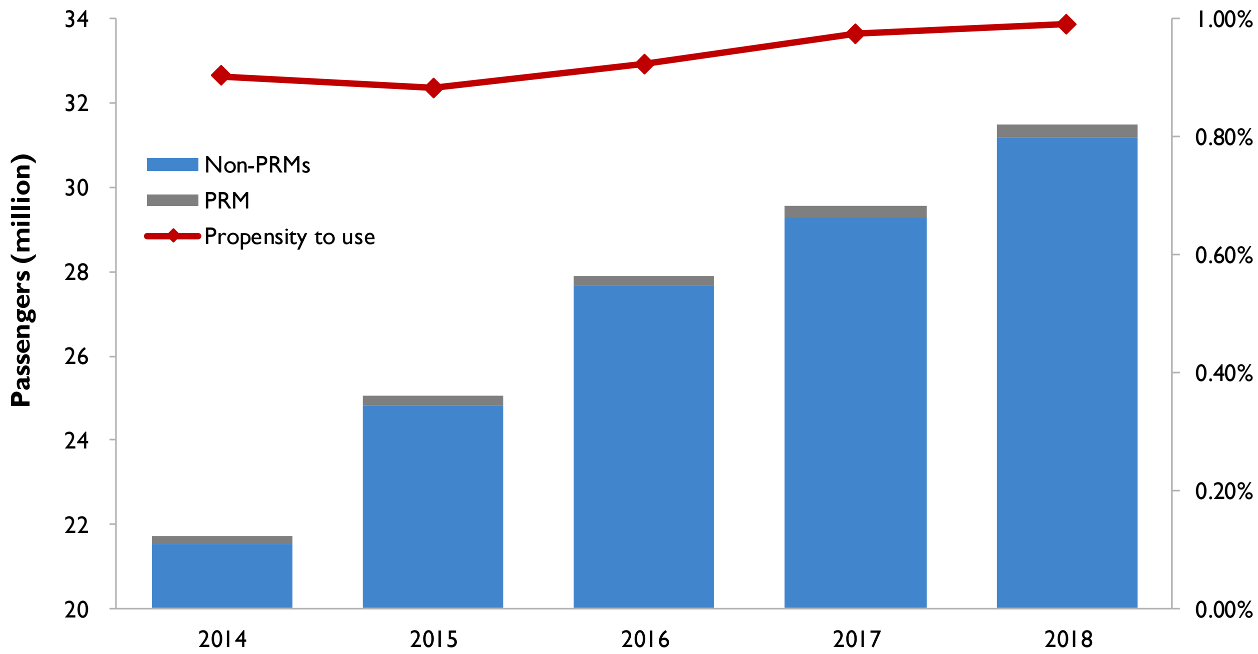
Figure 5.7: PRM expenditure at Dublin Airport, 2010-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

The relationship between passenger numbers and PRM usage is also dependent on the passenger demographic which will vary by destination and over time. An ageing population and higher traffic between Dublin and the United States are considered the main drivers behind the increased propensity to use PRM services. Improved accessibility to a wider range of services at the airport has also contributed to this higher propensity to use the service.

Figure 5.8: Passenger numbers at Dublin Airport and propensity to use PRM services, 2014-2018



Source: Dublin Airport; CAR determination; Taylor Airey analysis

We observe that the propensity to use PRM services (PRM users as a proportion of total passengers) has risen by 10% during the current regulatory period to date (as seen in Figure 5.8). Whilst departing passenger numbers have grown by 46% between 2014 and 2018, PRM numbers have grown by 59% for the same period.

5.4.3. Future projections

As noted above, Dublin Airport's 2019 projection for the cost of the PRM service is a step increase from 2018 levels. Dublin Airport states that this is partially due to wage costs but mainly driven by a requirement for additional resources to enable more stringent service level agreement targets to be met as part of the new contract. Dublin Airport states that these targets have been agreed with the airline community as part of a consultation process on the contract award.

To date, we have not had sight of the supporting information to justify this increased contract value and are therefore unable to comment on its appropriateness. We understand that the recently let contract fixes prices on a per passenger basis for the duration of its term. As the propensity to use PRM services has increased over the current determination period, we use an elasticity of 1.01. Our resultant forecast for PRM expenditure rises from €8.2 million per annum in 2019 to €9.5 million by 2024.

5.5. Utilities

Summary

Our analysis does not identify any inefficiency in expenditure on utilities. Utility costs over the current price control have remained consistently below the target set in CAR's determination. We believe the most significant explanatory factor is the unanticipated decline in energy costs, rather than a significant decline in usage. We however note several capex investments during the control period that have led to a reduction in utility consumption, including the adoption of LED lights.

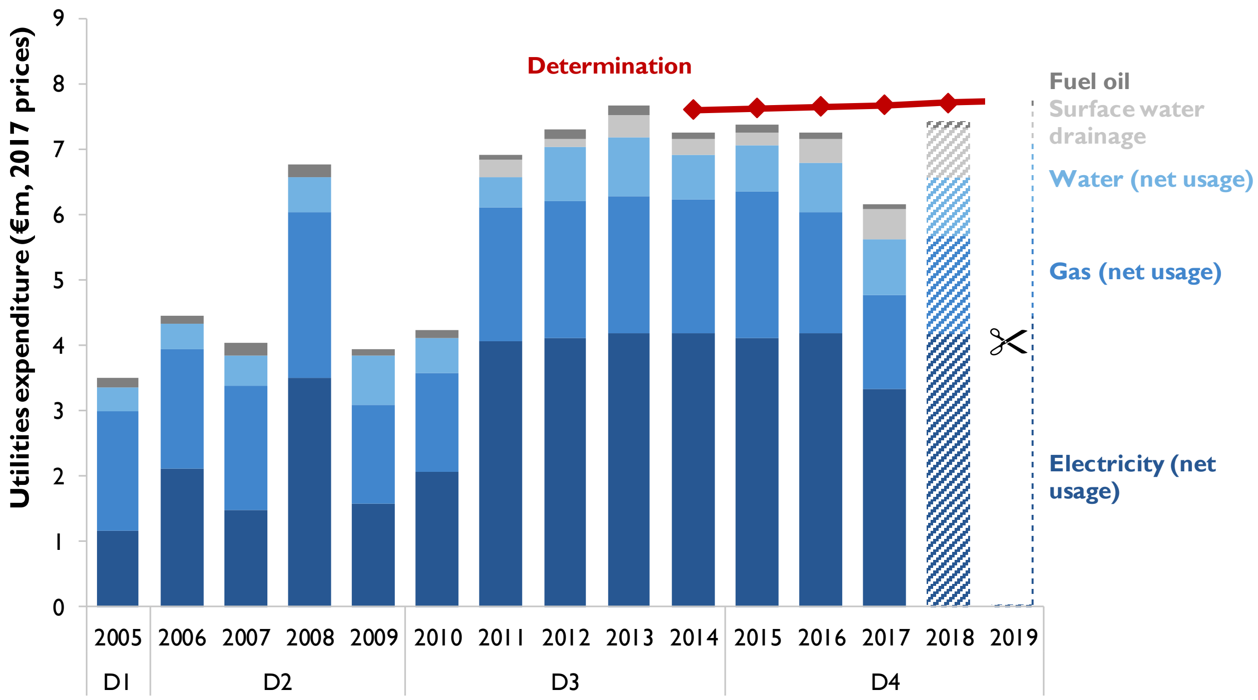
To forecast future expenditure on utilities, we assume the consumption of utilities will remain constant for the next control period from 2019 to 2024. Our analysis also suggests that utility consumption is related to the scale and complexity of the airport infrastructure, rather than passenger levels. We forecast future utility spend based on expected changes in price. Overall, our projections forecast utility costs rising from €7.4 million in 2019 to €8.4 million in 2024.

5.5.1. Introduction

Dublin Airport's expenditure on utilities covers six separate sub-categories. It includes energy costs, comprising electricity, gas, and fuel oil; costs of water usage and surface water drainage; and emissions trades. We do not have information on how these cost categories are distributed between Dublin Airport's terminals or central functions and so this analysis focuses on the efficiency of expenditure on utilities on an aggregate basis.

5.5.2. Historic expenditure

Figure 5.9: Expenditure on utilities at Dublin Airport, 2005-2019 (€ million, 2017 prices)



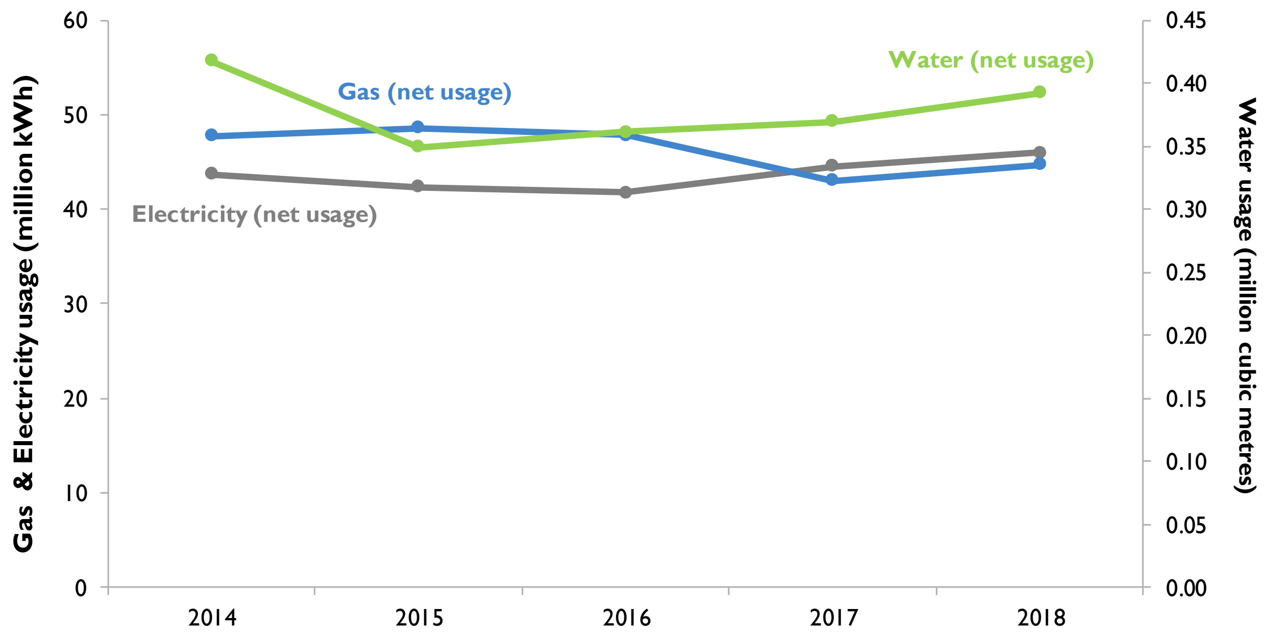
Source: Dublin Airport; CAR determination

Between 2014 and 2017, Dublin Airport's expenditure on utilities declined by 15% in real terms. Electricity and gas are the two largest components of utility costs, and they are collectively responsible for a large proportion of the decline in historic expenditure. The reduction in expenditure can be largely attributed to the wider decline in energy costs. Net electricity usage (exclusive of usage by concessionaires and renters) has increased slightly between 2014 and 2018, whilst gas usage has declined by 6%.

As shown in Figure 5.9, between 2014 and 2018 Dublin Airport's expenditure on water rose by just over 32%. At the same time net water consumption fell by 6% (25,000 cubic metres). This is largely driven by a decline in water consumption between 2014 and 2015. Expenditure on surface water drainage also increased significantly, which we believe is due to severe winter weather in 2016/17 and 2017/18. The smallest area of spend, fuel oil, has stayed relatively constant throughout the regulatory control period.

Dublin Airport are expecting expenditure on utilities to increase after 2017, due to both an increase in usage and a recovery in energy costs. However, overall spend is still expected to be lower than CAR's determination. By the end of the determination period, net expenditure on electricity is expected to be 6% above 2014 levels. The large decline in both gas costs and gas usage, mean that net spend on gas is expected to be 19% less in 2019 than 2014 levels. Spend on water is also expected to continue to grow significantly, largely due to an increase in water rates. Figure 5.10 below shows net gas, electricity and water consumption across the current determination period.

Figure 5.10: Net gas, electricity, water consumption, 2014-2018



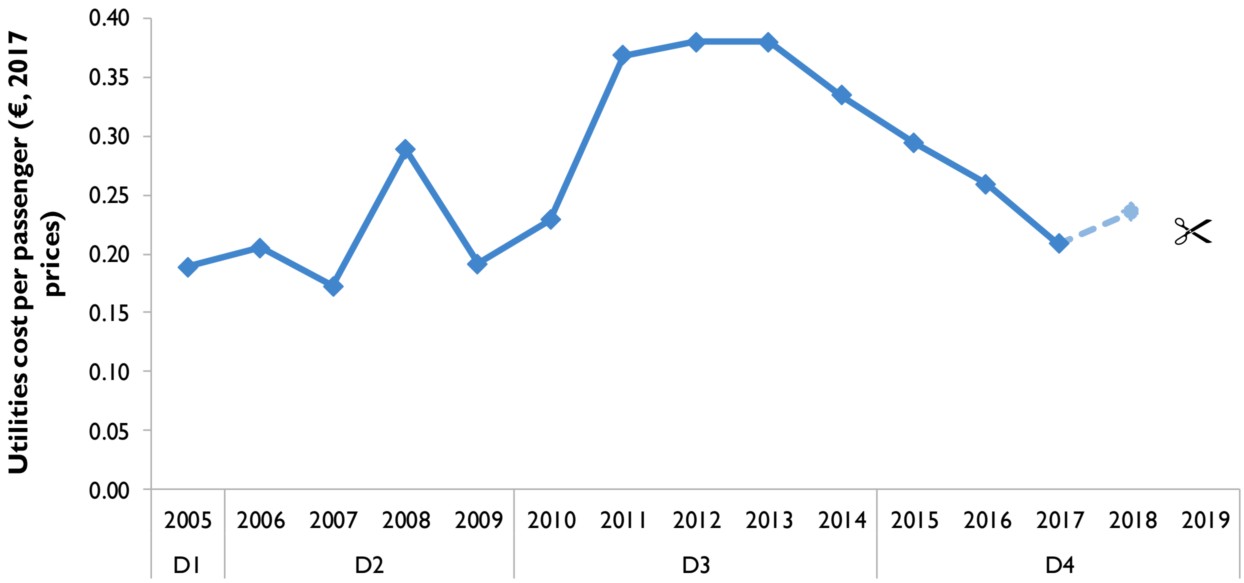
Source: Dublin Airport; CEPA analysis

5.5.3. Analysis

Utility costs over the current price control have remained consistently below the target set in CAR's determination. However, we believe the most significant explanatory factor is the unanticipated decline in energy costs, rather than a significant decline in usage.

One way in which the efficiency of Dublin Airport's expenditure can be assessed is by looking at utility costs on a per passenger basis (as seen in Figure 5.11). Under this measure, costs fell by 38% between 2014 and 2017, though this came on the back of a large increase in per-passenger expenditure between 2009 and 2013. The increase in expenditure over this earlier period is down to the opening and ramp-up in the operation of Terminal 2.

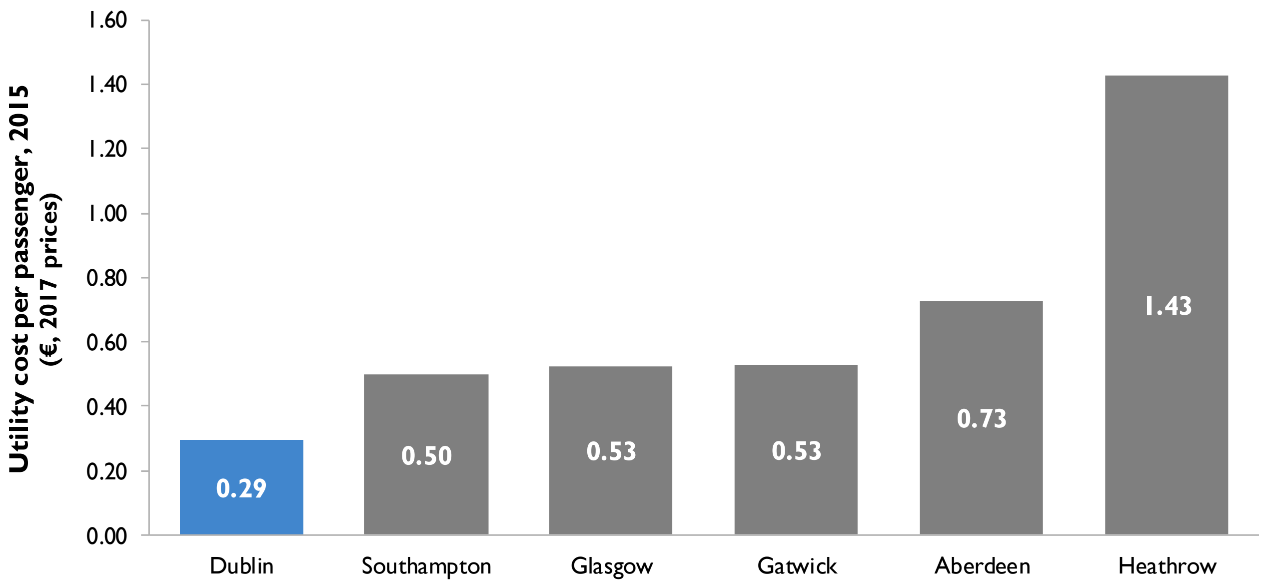
Figure 5.11: Expenditure on utilities on a per passenger basis, 2005-2019 (€, 2017 prices)



Source: Dublin Airport; CEPA analysis

The evolution of Dublin Airport's per-passenger expenditure on utilities can be put in better perspective with comparison to other airports. Benchmarks for per-passenger expenditure on utilities is presented in Figure 5.12 below. By analysing Dublin Airport's expenditure on utilities in 2015,[22] it appears that Dublin Airport performs well in comparison to available benchmarks.

Figure 5.12: Benchmark utility costs per passenger, 2015 (€, 2017 prices)



Source: Dublin Airport; airport annual accounts

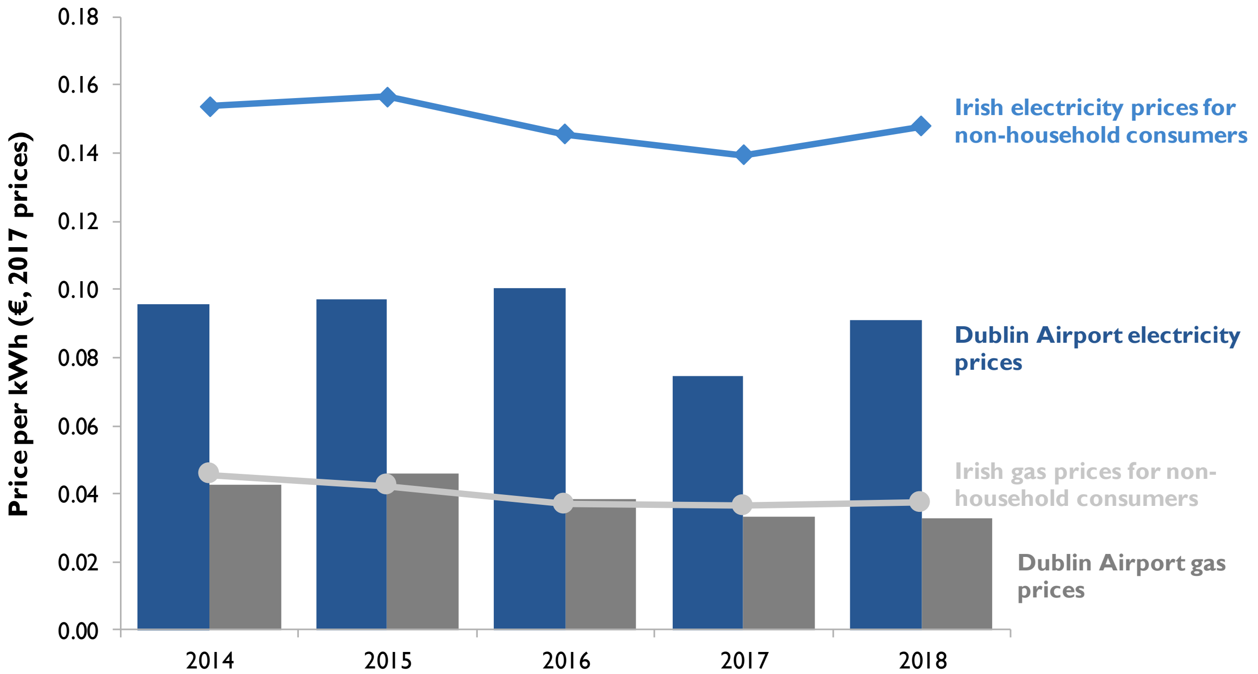
One final way in which the efficiency of Dublin Airport's expenditure on utilities can be assessed is by looking at the utility price paid on a per-unit basis. As a large consumer of utilities, we should expect Dublin Airport to be able to take advantage of some economies of scale and to be able to achieve some efficiency savings on the price paid for utilities relative to the average market price. Throughout the current price

[22] 2015 was the most recent year in which data was available for a broad selection of airports.

control period Irish real electricity prices for non-household consumers remained relatively stable between €0.14 and €0.16 per kWh in real terms. As shown in Figure 5.13, over the same period the unit cost for electricity at Dublin Airport was between €0.07 and €0.10 per kWh. This differential represents a per-unit saving of between 31-38% by Dublin Airport relative to Irish non-household electricity prices. However, we expect some of this will be as a result of the airport's on-site combined heat and power (CHP) generation, which allows it to generate its own electricity at lower cost than purchasing it from the market.

No such savings are observed for the price paid by Dublin Airport for gas. Over the period from 2014 to 2018, Irish gas prices fluctuated between €0.04 and €0.05. During the same period, the price paid by Dublin Airport fluctuated between €0.03 and €0.05. In 2015 and 2016 the price paid by Dublin Airport was between 8-4% *higher* than Irish non-household prices. However, in 2018, Dublin Airport estimated that the price paid for a kWh of gas would be 12% below Irish non-household gas prices. We understand that Dublin Airport hedges its utilities costs up to one year ahead, which may account for the differential between prices paid by the airport, and typical prices paid by industry.

Figure 5.13: Unit electricity and gas costs compared with typical prices, 2014-2018 (€, 2017 prices)



Source: Dublin Airport; CEPA analysis; Central Statistics Office

5.5.4. Future projections

Our analysis above does not identify any specific areas of inefficiency. We note that several capex investments during the control period have already led to a reduction in utility consumption, including the adoption of LED lights and the introduction of a medium temperature hot water system. Our thinking also acknowledges that Dublin Airport's utility spend is below CAR's determination which we outline in our analysis above.

Our analysis above suggests consumption is more closely related to the scale and complexity of airport infrastructure, rather than passenger levels. Therefore, we assume consumption for existing infrastructure will stay constant, and we separately consider the impact of further expansion in Section 6.

We use the BEIS fossil fuel price forecasts to project real growth in unit costs. We forecast:

- Electricity expenditure to grow from €4.2 million in 2019 to €4.9 million by 2024;

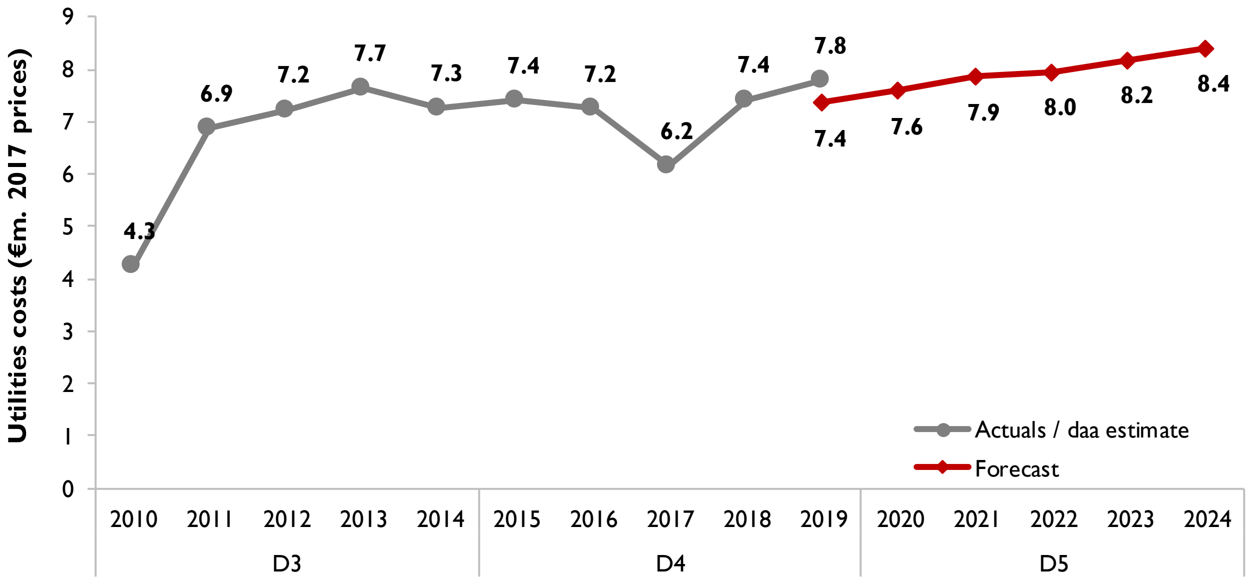
- Gas expenditure to grow from €1.5 million in 2019 to €1.9 million by 2024; and
- Fuel oil expenditure to grow from €0.11 million in 2019 to €0.13 million in 2024.

As expenditure on surface water drainage is largely linked to the number of severe snow incidents, a single year is unlikely to be reflective of typical costs. We therefore forecast expenditure based on the average spend between 2014 and 2018, €0.4 million.

For water expenditure, we expect consumption will be partially driven by passenger volumes. We assume an elasticity of 0.5, taking into consideration historic growth in consumption and on-going efficiency initiatives. For the forecast of unit water costs, we consider that water prices are due to rise from €2.21 to €2.64 per cubic metre on a phased in 3-year basis from Q4 of 2019.[23] We assume costs will stay constant thereafter. This results in our estimate of water expenditure rising from €0.9 million in 2019 to €1.1 million by 2024.

In total, our forecasts predict utility costs rising from €7.4 million in 2019 to €8.4 million in 2024, as illustrated in Figure 5.14.

Figure 5.14: Forecast expenditure on utilities, compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

[23] Frontier Economics (2019) *Dublin Airport Operating Expenditure Review*

5.6. Insurance

Summary

With the exception of 2015, expenditure on insurance has remained consistently above the 2014 determination forecast. Dublin Airport have forecast additional increases in costs over 2018 and 2019 which we do not find to be justified.

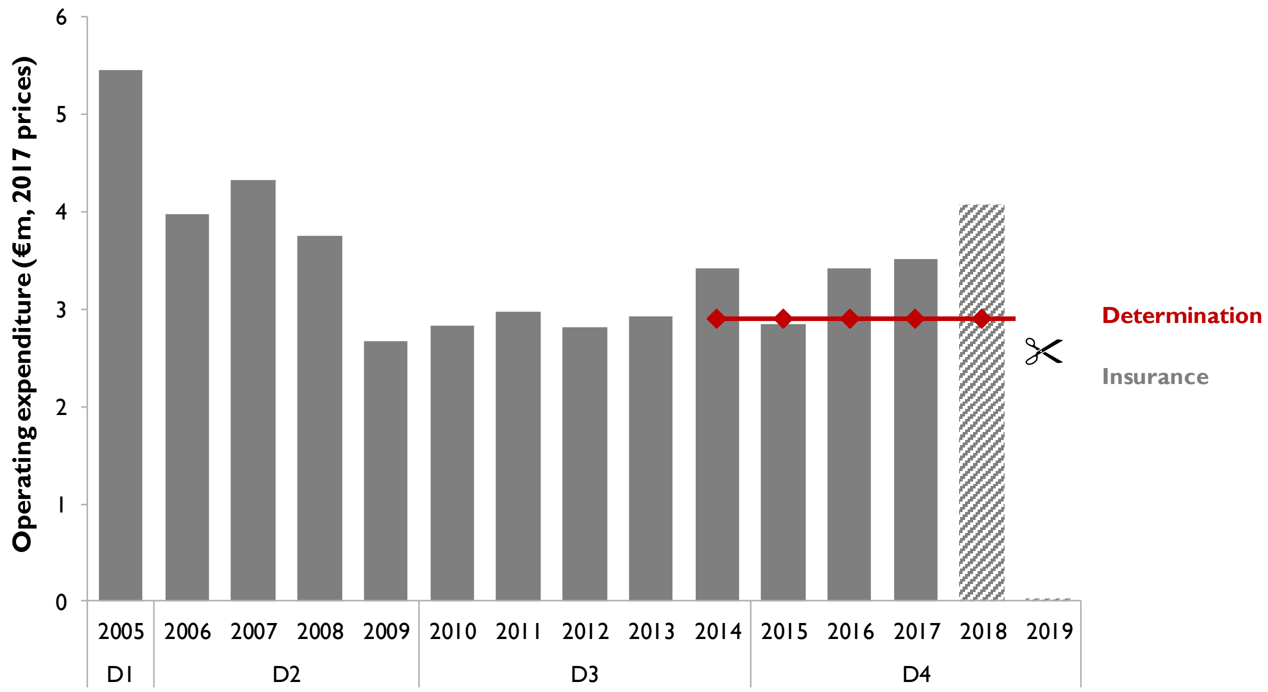
On a per-passenger basis, our analysis finds that spend on insurance is still below comparators used in the previous efficiency study. Insurance costs on this basis have fallen from €0.16 in 2014 to €0.12 in 2017, and overall, we find that they are at levels which can be deemed efficient. We do not consider that the increases in insurance costs in 2018 and 2019 can be justified. While we note that Dublin Airport suggest that the increase in 2018 is due to more claims being made by both passengers and employees, we do not believe that it would be efficient to allow a pass-through of these additional costs.

Our analysis assumes that public liability insurance will increase with passenger numbers while employer liability insurance will increase with staff numbers. To forecast future expenditure on insurance, we apply an elasticity to reflect this.

Overall, we take the 2017 outturn insurance expenditure as efficient, and uprate it using our cost elasticities to create our baseline estimate of efficient expenditure. We forecast insurance expenditure to rise from €3.7 million in 2019 to €4.1 million in 2024.

5.6.1. Historic expenditure

Figure 5.15: Insurance expenditure against the CAR determination, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

As Figure 5.15 shows, insurance expenditure in 2017 was slightly higher in real terms than it was in 2014. However, Dublin Airport are estimating an increase in premia in 2018 and 2019, largely driven by higher costs for employer and public liability cover. By 2019, this would mean Dublin Airport's expenditure on insurance exceeds the determination target by €1.9 million (in 2017 prices).

On a per passenger basis, insurance costs have fallen from €0.16 in 2014 to €0.12 in 2017. In particular, public liability costs per passenger have fallen from €0.09 in 2014 to €0.05 in 2017.

5.6.2. Analysis

Dublin Airport's insurance costs on a per passenger basis are still below the comparators used in the previous efficiency study, suggesting that overall, costs remain reasonable. However, it is less clear that the expected increase in costs in 2018 and 2019 are justified. For example, employer liability costs are expected to increase from €275 per FTE in 2017 to ✂✂✂✂ in 2019 (in 2017 prices). Dublin Airport suggest the increase in 2018 is due to more claims being made by both passengers and employees, though we do not consider that it would be efficient to allow a pass-through of these additional costs.

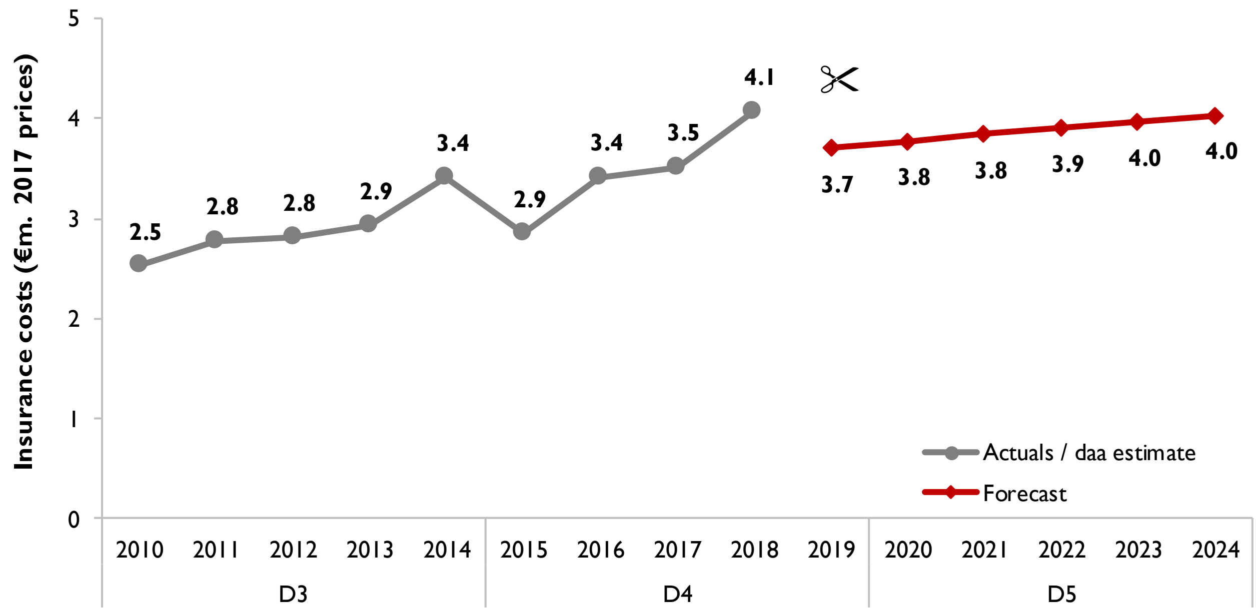
5.6.3. Future projections

Based on our analysis above, we propose to take 2017 outturn expenditure and uprate it using our cost elasticity, to create our baseline estimate of 2019 efficient expenditure. This equates to €3.7 million, compared with Dublin Airport's estimate of ✂✂✂✂ in 2019.

We model our cost elasticity to be approximately 0.55. The largest component of Dublin Airport's insurance costs is public liability, which makes up between 40-60% of insurance expenditure. We would therefore expect approximately half of insurance expenditure to be driven on a one-for-one basis by passenger volumes. Another 10-20% of spend is on employer liability insurance which we would expect to be driven by staff numbers, and therefore indirectly driven by passenger numbers. Weighting these two together gives an overall elasticity of 0.55 with respect to passenger numbers.

Under our elasticity assumptions, we forecast insurance expenditure to rise from €3.7 million in 2019 to €4 million in 2024, as illustrated in Figure 5.16.

Figure 5.16: Forecast expenditure on insurance, compared with actuals and Dublin Airport estimates, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

5.7. OTHER EXPENDITURE (INCLUDING NEW COST ITEMS)

Summary

From 2016, outturn expenditure has exceeded CAR's determination target and is forecast to rise further in 2018 and 2019. We note however that this overrun is largely due to new cost items. To determine efficient spend in this category, we consider new and existing cost items separately as well as by evaluating each cost item individually.

In our analysis we note that Dublin Airport has limited control over many of the existing cost areas, such as CAR costs and bank charges. For these cost items we do not make any significant efficiency adjustments to baseline spend. Overall, we find that expenditure on new cost items in this section is efficient. However, we feel that the scale of expenditure increases in 2019 has not been adequately justified and so for these items we use 2018 as the starting basis for our estimate of efficient expenditure.

We believe banking and related costs will be directly linked with passenger numbers, and so we apply an elasticity to reflect this. For all other cost lines we assume that they will be unaffected by passenger growth. Overall, we forecast expenditure rising from €19.3 million in 2019, to €20.7 million in 2024.

5.7.1. Introduction

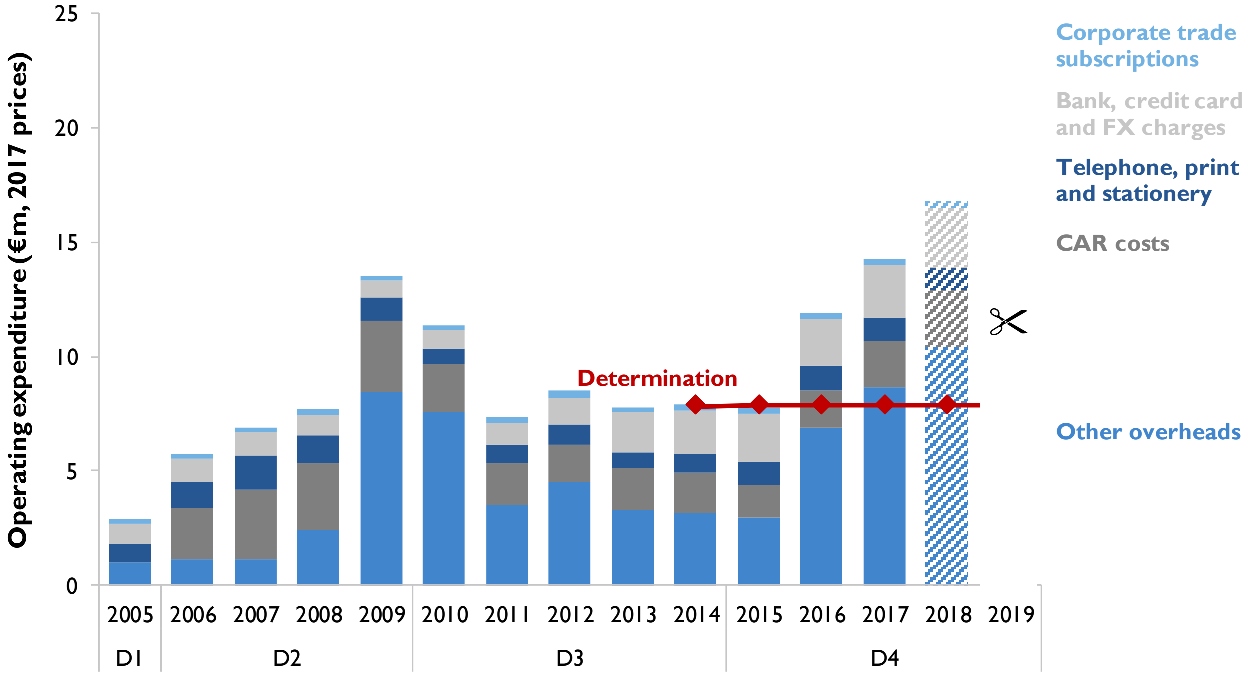
The remaining category of costs covers several miscellaneous areas of expenditure, including:

- CAR costs charged back to Dublin Airport;
- Telephone, print and stationery costs;
- Bank, credit card and foreign exchange costs; and
- New cost lines that have not yet been allocated to other categories such as costs for outside security contractors and for running executive lounges.

5.7.2. Historic expenditure

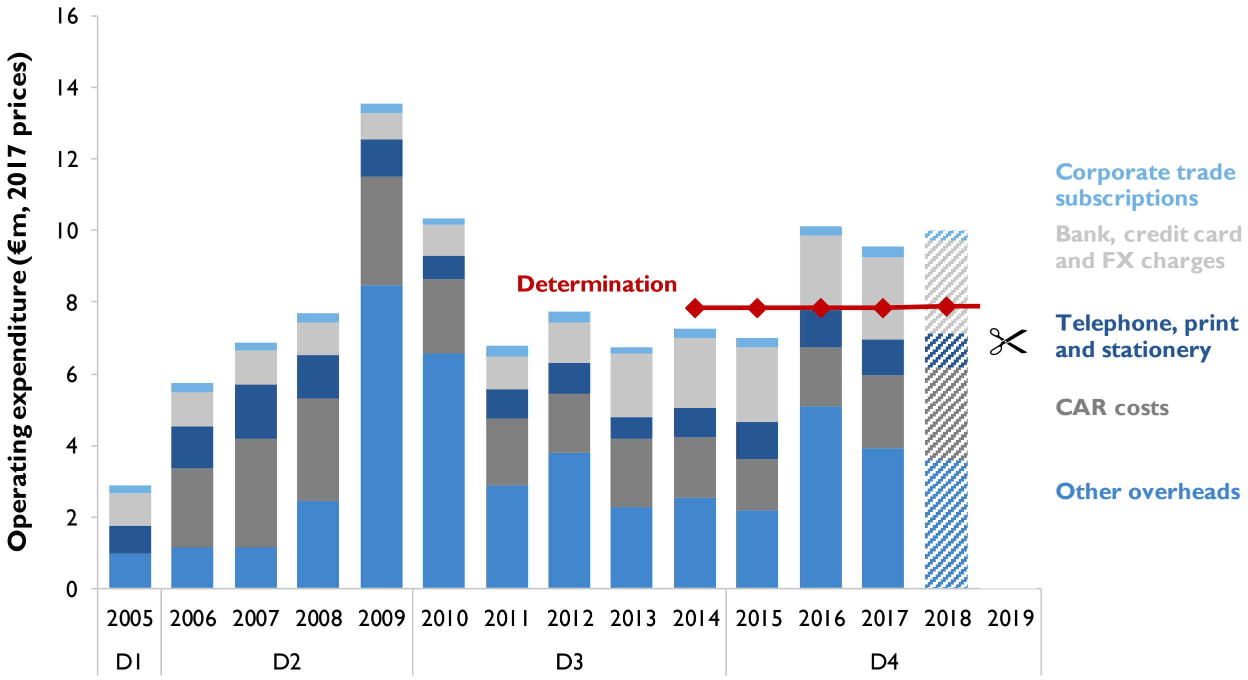
Outturn expenditure in this category has increased year-on-year since 2015, exceeding CAR's determination target in 2016 and 2017. This is illustrated in Figure 5.17. However, this overrun in expenditure is largely due to new cost items, accounting for approximately €4.7 million in expenditure in 2017 and expected to rise to ✂✂✂✂ by 2019). Excluding these additional cost items (as shown Figure 5.18), Dublin Airport's outturn expenditure has exceeded the determination target by €1.7 million in 2017, and is expected to rise to ✂✂✂✂ by 2019.

Figure 5.17: Miscellaneous non-pay operating expenditure including new cost items, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

Figure 5.18: Miscellaneous non-pay operating expenditure excluding new cost items, 2005-2019 (€ million, 2017 prices)



Source: Dublin Airport; CAR determination

5.7.3. Analysis

We begin by analysing expenditure excluding the additional cost items. Dublin Airport have limited control over many of these cost areas, such as CAR costs and bank charges. These costs have increased by 18% in real terms between 2014 and 2017, compared with a determination assumption that they would largely remain constant. For other costs, the figures reflect one-off areas of expenditure we would not expect to be repeated, such as impairment charges or written off expenses.

For our baseline, we assume that 2017 CAR costs; telephone, print and stationery costs; and bank, credit card and foreign exchange costs, are reflective of efficient expenditure in that year, given Dublin Airport's limited ability to control such costs. For the remaining categories, we assume that average expenditure over the period 2015 to 2017 is reflective of efficient expenditure, noting that spend in any one year will tend to fluctuate.

New cost items include:

- Security contracting costs for hold baggage screening,
- Executive lounge running costs, and
- The cost of a shuttle bus servicing the new South Gates boarding area.

The security contracting costs relate to additional activities that Dublin Airport are now required to undertake, and as such we believe it is appropriate for there to be additional expenditure in this area. We also note that the executive lounge running costs are likely to have positive revenue implications.

Finally, we note that the additional cost of the bussing contract is an example of an area where Dublin Airport have favoured a solution to additional traffic with opex implications, by creating a remote boarding facility with a bussing service.

5.7.4. Future projections

Overall, we conclude that additional expenditure in these areas is reflective of an efficient company, though we do not yet have confidence that the scale of expenditure is efficient. In particular, the anticipated scale of additional expenditure in 2019 has not been adequately justified (beyond certain additional areas of expenditure described below). As a result, we have used estimated expenditure for 2018 as the starting basis for our estimate of efficient expenditure. We then project forwards for 2019 assuming most areas of expenditure are inelastic with respect to passenger numbers, except banking and related costs, which has an elasticity of 1.

This means our baseline estimate of efficient expenditure in 2019 is €16.9 million compared with Dublin Airport's estimate of ✂✂✂✂. To project forwards, we assume the same elasticities, resulting an estimated €17.3 million expenditure in 2024.

We then consider additional cost items identified by Dublin Airport. These are:

- ✂✂✂✂ in 2020 and 2021, and ✂✂✂✂✂✂, to pay for the running costs of a newly established competent noise authority;
- ✂✂✂✂ per annum in relation to noise mitigation activities; and
- ✂✂✂✂ per annum from 2019 onwards for an additional ✂✂✂✂✂✂✂✂✂✂✂✂✂✂ ✂✂✂✂✂✂✂✂✂, with a further increase anticipated following the proposed expansion of the CBP facility.
- ✂✂✂✂ from 2019 in additional security contracting costs related to hold baggage screening

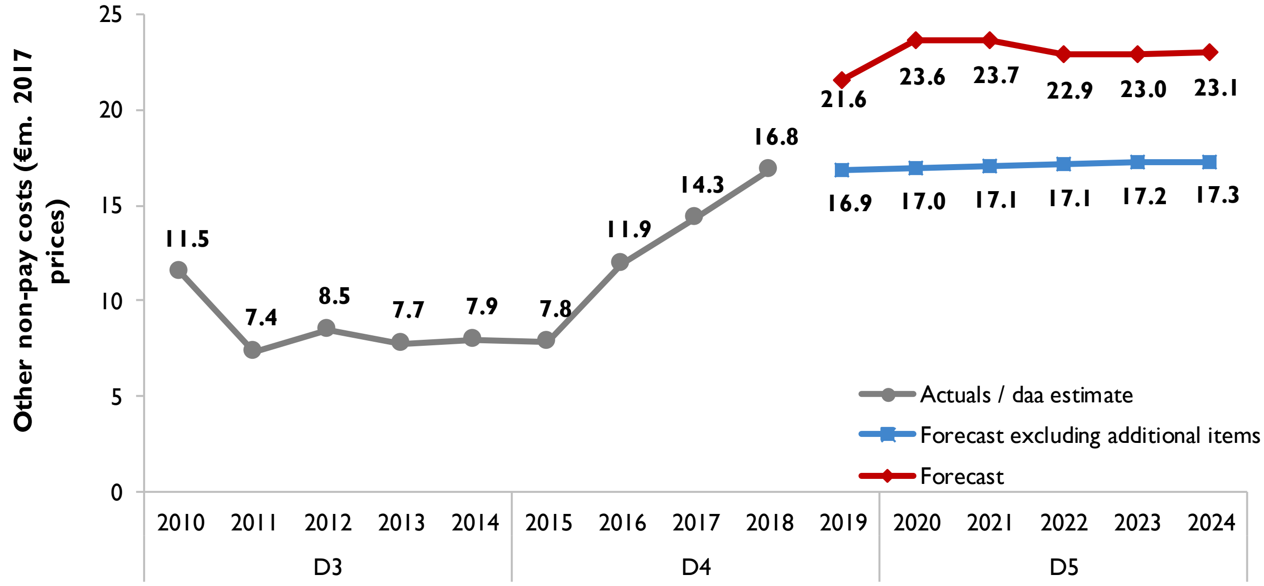
We have reviewed the benchmarks used by Dublin Airport to estimate the costs of the noise mitigation activities and find them to be reasonable. However, we find the estimated ✂✂✂✂ per annum for the establishment of a noise authority to be higher than we would expect; the estimated ✂✂✂✂ for on-going running costs is closer to what we would expect.

For the other additional cost items, we believe these are appropriate. The transatlantic market is a strong area for growth for Dublin Airport, and is supported by airlines, and as such we believe the additional ✂ ✂✂✂ for CBP Officers is justified. The additional security contracting costs relate to additional activity Dublin Airport is required to undertake.

In Section 6, we also consider further increases to fund additional CBP officers associated with capital projects, and additional costs from replacing hold baggage screening equipment.

These additional areas of expenditure lead to a forecast of €21.6 million in 2019, reducing to €23.1 million in 2024, as shown in Figure 5.19.

Figure 5.19: Forecast miscellaneous non-pay expenditure compared with historic, 2010-2024 (€ million, 2017 prices)



Source: Dublin Airport; CEPA analysis

6. CAPITAL INVESTMENT AND OPEX IMPLICATIONS

Summary

Dublin Airport has indicated that there are 60 projects in the Capital Investment Plan (CIP) which they expect will have a direct impact on opex costs over the next regulatory period. Dublin Airport have anticipated that the total impact of these projects will increase opex by ✂✂✂✂ between 2020 and 2024.

Dublin Airport have taken a high-level approach to estimating the impact of the CIP on opex costs. We follow a similar approach and look in more detail only at projects which we expect to have a substantial impact on opex over the next regulatory period. In general, we are satisfied with the approach taken by Dublin Airport and in addition, we find that most of these costs have not already been accounted for in our core forecasts.

Overall, we make some adjustments to the anticipated impact of the CIP on opex within the security capex category of the CIP. We also conclude that some of the impacts anticipated in the capacity, security and IT capex categories of the CIP, have already been accounted for in our core forecasts. In total, we estimate the impact of the CIP over the course of the next regulatory period to be €51.6 million.

6.1. Introduction

In the following sections, we review the opex impacts of the Capital Investment Plan (CIP) for Dublin Airport, for the period 2020-2024. Specifically, we look at Dublin Airport's estimates of how capex projects will affect future opex and assess whether its estimates can be considered reasonable. Our scope is limited to considering the efficiency of opex estimates, not considering whether the content of the CIP itself is appropriate.

6.2. Approach taken to reviewing the CIP

The final CIP, as submitted to CAR in February 2019, contains a list of 118 projects. Of these, 58 are deemed by Dublin Airport to have no significant opex impact.

We note that Dublin Airport have taken a relatively high-level approach to estimating the opex impacts, focusing on those projects where the impact is expected to be most significant. For many projects a granular, quantified analysis of opex impacts is not available. As a result, we have taken a similarly high-level approach to assessing the appropriateness of Dublin Airport's estimates:

- We began by taking a holistic look at the stated impact of the CIP on opex over the next regulatory period. From that, consider whether the overall anticipated impact compares reasonably against historic and forecast future opex.
- We then conducted a sense check against the full list of CIP projects, to see whether the description of the project and the rationale behind the project matched the stated opex impacts. We made an assessment of whether all potential opex impacts have been considered by Dublin Airport.
- We then considered whether the projects in the CIP are routine enhancements whose resulting opex impacts are already captured within our existing price control forecasts. For example, some of the capital projects in the CIP are small-scale investments designed to accommodate additional

passengers. In most circumstances, the incremental opex associated with these projects may already be captured within our forecasts. Conversely, certain capital projects may be associated with opex savings that are already assumed in our elasticity estimates or one-off savings. In such instances, accounting for these opex impacts separately would be double-counting and we therefore exclude this impact from our forecasts. We only include opex impacts in our forecasts where they are unlikely to be captured within our elasticity estimates, either because the project involves a step-change in infrastructure, or because we assumed no volume driven elasticity.

- Finally, we undertook a more thorough review of a subset of 20 projects. In general, we selected projects which have a large anticipated impact on opex over next regulatory period. For these projects, we considered whether our core forecasts have already accounted for their anticipated impact on opex. We also considered whether we think the anticipated impact of these projects on opex is reasonable. For certain projects, this step may involve independently estimating their impact on opex spend.

Given the high-level analysis that Dublin Airport has carried out, there is a greater degree of judgement in this work than in the analysis contained in other chapters of this report. As a result, we have been cautious about adjusting opex impacts, doing so only where we consider that there is strong case to do so.

The CIP is split into capacity enhancing projects and 'core' capex, which refers to more routine commercial, IT, security and asset care driven projects. In the following sections we assess each of these capex categories in turn.

6.3. ANALYSIS

6.3.1. Overall CIP

Dublin Airport's estimates of the impact of the CIP on opex is shown in Table 6.1, split by project type.[24]

Table 6.1: Expected increase in operating costs due to CIP projects by capex category, 2020-2024 (€ million, 2017 prices)

Capex category	2020	2021	2022	2023	2024	Total
Capacity	✂	✂	✂	✂	✂	✂
Commercial	✂	✂	✂	✂	✂	✂
Security	✂	✂	✂	✂	✂	✂
IT	✂	✂	✂	✂	✂	✂
Asset Care	✂	✂	✂	✂	✂	✂
Hold Baggage Screening	✂	✂	✂	✂	✂	✂
Total	✂	✂	✂	✂	✂	✂

**Dublin Airport's estimates were provided in 2018 prices. We have deflated them to 2017 prices to make all figures consistent with the rest of this report.*

[24] We have moved 'CIP.20.03.004 – Gate Post 9 Expansion', 'CIP.20.03.012 – Terminal 1 Central Search – Relocation to Mezz level', 'CIP.20.03.021 – Terminal 2 Central Search Area Expansion' from the Capacity capex category of the CIP into the Security capex category of the CIP. This change is purely for convenience as all of these projects have a security focus and are therefore better considered alongside the other security projects. It does not affect the overall impact of the CIP, or how that impact is distributed across CAR opex categories. The impact of this change is already reflected in Table 6.1.

Overall, Dublin Airport anticipate that the CIP will increase opex by ✂✂✂✂ across the next price control period. Capacity enhancing projects account for 57% of this increase, while commercial investments e.g. in retail, account for a further 35% of the expected increase. The other 'core' capex categories collectively account for the remaining 8% of anticipated opex increases.

Table 6.2 outlines the anticipated impact of the CIP on opex for each CAR cost category, as well as for overall pay and non-pay cost categories. For all CAR categories not listed, Dublin Airport anticipates that the CIP will have no impact on opex. Table 6.2 also outlines the total efficient opex spend that we have forecast for each CAR category over the next price control period (2020-2024). CIP impacts deemed to be efficient will be added to this total.

Table 6.2: Dublin Airport estimated increase in opex due to the CIP, by CAR category, 2019-2024 (€ million, 2017 prices)

Opex category	2020	2021	2022	2023	2024	Total	CEPA forecast
Retail	✂	✂	✂	✂	✂	✂	✂
Other overheads	✂	✂	✂	✂	✂	✂	✂
IT	✂	✂	✂	✂	✂	✂	✂
Rent and Rates	✂	✂	✂	✂	✂	✂	✂
Campus services	✂	✂	✂	✂	✂	✂	✂
Facilities and cleaning	✂	✂	✂	✂	✂	✂	✂
Maintenance	✂	✂	✂	✂	✂	✂	✂
Security	✂	✂	✂	✂	✂	✂	✂
Insurance	✂	✂	✂	✂	✂	✂	✂
Car parking	✂	✂	✂	✂	✂	✂	✂
Airside operations	✂	✂	✂	✂	✂	✂	✂
Marketing	✂	✂	✂	✂	✂	✂	✂
Utilities	✂	✂	✂	✂	✂	✂	✂
Totals							
Payroll	✂	✂	✂	✂	✂	✂	✂
Non-pay	✂	✂	✂	✂	✂	✂	✂
Total	✂	✂	✂	✂	✂	✂	✂

Relative to our forecasts, the overall impact of the CIP on opex is low. The anticipated increase in opex over the next regulatory period as a result of the CIP, equates to 4% of the overall opex spend implied by our forecasts.[25] The scale of this impact is similar across both the pay and non-pay categories; equating to

[25] We note that the anticipated impact of the CIP is increasingly significant across the next regulatory period. By 2024, the anticipated impact represents 7% of what we have forecast as total efficient opex spend for that year alone. The impact of the CIP on opex may be more significant for future regulatory periods which are outside the scope of this report.

3% and 4% respectively. As shown in Table 6.2, three cost categories - retail, other non-pay costs and IT - are anticipated to account for 67% of the total impact of the CIP on opex over the next control period.

We also consider the anticipated increase in opex as a result of the CIP relative to our 2019 efficient baseline. Figure 6.1 shows what the percentage increase in opex in 2024 only would be, if the sole increase in costs was due to the anticipated impact of the CIP.

Figure 6.1: Dublin Airport estimates of CIP-related opex in 2024, as a proportion of CEPA estimates of efficient 2019 opex (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

Across all categories, the total anticipated impact of the CIP in 2024 equates to 7% of our estimate of efficient opex in 2019. This shows the scale of the potential increase in opex costs as a result of the CIP between 2019 and 2024. By contrast, our volume driven estimates lead to a 6% increase in opex by 2024, from 2019 levels.

We understand that Dublin Airport have not attempted to estimate every conceivable impact of the CIP on opex; Dublin Airport's high-level approach has been to identify areas where the CIP will have a significant impact on opex and estimate these impacts. One danger with this approach is that it could lead to a systematic overestimation of opex impacts through a failure to report efficiencies that the CIP could generate. In our review however, we have found no evidence to suggest that this is the case.

The subsections which follow consider the opex impacts of the CIP by capex cost category.

6.3.2. Capacity

Projects in this category are designed to increase the number of passengers and the amount of freight Dublin Airport can handle. Examples of projects include relocating and increasing the capacity of drop-off kerbs; constructing a new pier; and redeveloping security screening areas and departure lounges. As shown in Figure 6.2, Dublin Airport anticipate that the projects in this category will increase opex by ✂✂✂✂ over the next regulatory period.

Figure 6.2: Expected increase in operating costs due to capacity-related projects, 2020-2024 (€ million, 2017 prices)

Source: Dublin Airport, CEPA analysis

Dublin Airport do not anticipate any significant opex efficiencies arising from these projects. As shown in Figure 6.3, Dublin Airport expect this category of capex projects to lead to an 18% increase in retail payroll costs and a 12% increase in non-pay IT costs relative to our efficient 2019 baseline. The remaining costs are an uplift of between 2% and 11% from 2019 levels. This compares with an increase in the terminal space of 12%.

Figure 6.3: Percentage change in 2024 opex from 2019 outturn levels, resulting from capacity-related CIP projects

Source: Dublin Airport, CEPA analysis

Dublin Airport generally estimate the incremental impact of these projects by considering the scale of expansion and then undertaking a bottom-up assessment of the resources necessary to operate the additional infrastructure. We understand from discussions with the airport that there has not been any detailed consideration of whether alternate working practices would reduce the resourcing requirements from a staffing perspective. There has been some consideration of whether existing staff could be used on the expanded infrastructure but for parts of the campus that are relatively isolated, the Dublin Airport believes this would be difficult. Utilities expenditure has been estimated using consumption patterns for recent additions to the airport campus such as the South Gates pre-boarding zone.

At an overall level, we consider the magnitude of the anticipated opex impacts of these projects to be in line with expectation. Overall, this category of CIP projects will increase the terminal footprint by 32,432 square metres. By dividing the anticipated increase in opex resulting from this category of projects by the increased terminal footprint, we get an implied opex of €345 per square meter by 2024. In comparison, Terminals 1 and 2 in 2017 had an opex per square meter of €360.

This assessment is supported by our more detailed review of two projects within this category. They are:

- CIP.20.03.013 – Terminal 1 Departure Lounge (IDL) Reorientation and Rehabilitation
- CIP.20.03.029 – New Pier 5 (Terminal 2 and CBP Enabled)

Collectively, Dublin Airport anticipate that these projects will increase opex by ✂✂✂✂ by 2024 and by ✂✂✂✂ over the next regulatory period. These projects constitute 55% of the anticipated impact of all CIP projects in this capex category. We analyse each project in turn below.

CIP.20.03.013 – Terminal 1 Departure Lounge (IDL) Reorientation and Rehabilitation

- Dublin Airport anticipate that the future capacity requirements of the IDL in terms of area, will exceed the current IDL capacity. This project will extend the IDL and offer additional space for new business lounges, circulation, orientation, food and beverage and retail offerings. Dublin Airport expect the project will increase retail payroll costs by ✂✂✂✂ per annum from Q1 of 2022, leading to an overall impact of ✂✂✂✂ over the next control period. This is from an increase in retail footprint of 700 square meters, which Dublin Airport estimate will require 50 retail FTE to operate. In addition, Dublin Airport also anticipate that a further 25 retail FTE will be required to meet the increase in passenger numbers.

- We believe that this project is likely to result in more staff being required above those accounted for in our passenger driven elasticities, as it results in an increase in the amount of retail floor space. The 50 additional FTE is broadly comparable to our estimate of efficient staffing levels given the increase in retail space, as presented in Table 6.3. We also believe that the unit payroll cost assumptions used by Dublin Airport are broadly appropriate. However, we believe that the additional 25 FTE that Dublin Airport have included due to additional passenger volumes is overestimated. It is higher than our estimate using our passenger elasticity.

- While we consider that there is a potential for the project to have an impact on opex other than through retail payroll costs (for example through increased cleaning costs), we do not consider that such an impact is significant.

- As a result of the above, we include the impact of this project in our forecasts, though we make a downward adjustment to exclude the 25 retail FTE related to passenger volumes.

Table 6.3: Forecast opex associated with the Terminal 1 Departure Lounge (IDL) Reorientation and Rehabilitation

CIP.20.03.013 Terminal 1 Departure Lounge (IDL) Reorientation and Rehabilitation: CEPA assessment
• We found there to be a variation in the retail staffing efficiency achieved by Terminal 1 and Terminal 2 across the current regulatory period. We believe that the new IDL retail facility should at least be able

to achieve the staffing efficiency of Terminal 2 in 2017 (6.9 FTE per 100 square meters of retail floor space). This implies an efficient increase in 48 retail FTE per year from 2022 as a result of the IDL expansion.

- Dublin Airport anticipate that these staff will on average be paid ✂✂✂✂ per annum. In real terms, by multiplying the efficient FTE requirement by expected wage, we estimate an opex impact of €1.9 million per annum between 2022 to 2024. In total, this implies an efficient opex impact of ✂✂✂✂ over the next regulatory period. Our estimate is 4% below the real opex impact that has been anticipated by Dublin Airport.
- Overall, we conclude that our estimate is not sufficiently different from the impact anticipated by Dublin Airport to justify making an adjustment to the opex impact of this project.

CIP.20.03.029 – New Pier 5 (Terminal 2 and CBP Enabled)

- This project proposes the construction of a new Pier 5 as part of South Apron Development. Dublin Airport anticipate that the project will lead to an additional ✂✂✂✂ in opex across the next regulatory period in the following CAR categories: facilities and cleaning, campus services, maintenance, rent and rates, insurance, utilities and IT. The project is anticipated to lead to an increase in opex from Q4 of 2022 to the end of the regulatory period.
- The construction of Pier 5 has not been anticipated in our core forecasts and we do not consider that our current core forecasts have already accounted for any of the opex increases that will result from this project. We also do not consider the project to have a significant impact on CAR cost categories other than those already considered by Dublin Airport. In Table 6.4, we present our own bottom-up estimate of the opex impact of the project, with results that are very similar to those presented by Dublin Airport.
- We therefore include the Dublin Airport's estimates of this project in our forecasts.

Table 6.4: Forecast opex associated with the construction of Pier 5 and the CBD expansion

CIP.20.03.029 – New Pier 5 (Terminal 2 and CBP Enabled): CEPA assessment
• We make an assessment of the opex associated with this project based on the opex per square meter of terminal space that has currently been achieved by Dublin Airport. Where possible, we use data from terminal 2 only (which on average we consider to be more efficient) to do this. The construction of Pier 5 will increase the airport terminal footprint by 27,459 square meters. • For all CAR categories in which we consider that the project will lead to increased staffing requirements (facilities and cleaning, campus services and maintenance staff), we first estimate the implied increase in staff numbers based on current staffing levels per square meter. To estimate the impact of this increase on opex, we then multiply the estimated increase in FTE by the appropriate wage forecasts. • For non-pay maintenance, IT, and rent and rates costs, we estimate the increase in costs based on current opex per square meter of terminal space. We take the anticipated impact of the project on insurance and utilities[26] as given, and do not attempt to re-estimate this ourselves. • In all cases, we estimate efficient opex costs for this project for 2023, which is the first full year in which Pier 5 is expected to be fully operational.

[26] We note that a number of projects in the CIP are designed to increase airport energy efficiency and to reduce third-party utility costs by generating electricity in-house. Current energy consumption per square meter is therefore not an appropriate metric to estimate future utility costs. We therefore take the impact anticipated by Dublin Airport as given.

- Overall, we forecast that this project will lead to an efficient increase in opex of €4 million in 2023. The breakdown of this forecast is:
  - €1 million in facilities and cleaning payroll costs;
  - €0.4 million in campus services payroll costs;
  - €0.4 million in non-pay maintenance costs;
  - €0.5 million in payroll maintenance costs;
  - €0.8 million in rent and rates costs;
  - €0.5 million in utility costs;
  - €0.3 million in non-pay IT costs;
  - €0.2 million in insurance costs.
- In comparison, Dublin Airport have anticipated that this project will lead to an increase in real opex costs of ✂✂✂✂ in 2023, ✂✂ below our forecast impact. Overall, we conclude that our estimate is not sufficiently different from the impact anticipated by Dublin Airport to justify making an adjustment to the opex impact of this project.

Our assessment is that the projects in this category do not in general constitute investments which we would have accounted for in our volume-driven elasticities. For the two projects we considered in detail, we made downward adjustments to Dublin Airport's opex estimates for one of them (CIP.20.03.13) relating to the retail element as we believe these were overestimated. We found that the remaining estimates for the two projects were reasonable. As the other capacity projects do not have any retail elements and all have opex impacts that were estimated using similar assumptions, we believe the figures provided are broadly reasonable. The impact of this category of the CIP on opex that we have forecast is shown in Table 6.5.

Table 6.5: CEPA estimated opex due to capacity-enhancing CIP projects, by CAR category, 2020-2024 (€ million, 2017 prices)

CAR category	2020	2021	2022	2023	2024	Total
Retail – payroll			2.0	2.0	2.0	**6.0**
Campus Services – payroll		0.3	1.0	1.4	1.6	**4.3**
Rent and Rates			0.6	1.2	1.3	**3.0**
Facilities & Cleaning – payroll			0.3	1.1	1.3	**2.6**
IT – non-pay			0.2	0.9	1.1	**2.1**
Utilities			0.4	0.7	0.8	**1.9**
Maintenance Staff – non-pay			0.3	0.6	0.6	**1.5**
Other – non-pay			0.2	0.2	0.7	**1.0**
Maintenance Staff – payroll			0.1	0.2	0.3	**0.7**
Insurance			0.1	0.2	0.2	**0.4**
Airside Operations - payroll					0.3	**0.3**
Total	**0.0**	**0.3**	**4.9**	**8.4**	**10.2**	**23.8**

6.3.3. Commercial

Projects in this category are all designed to increase the commercial and retail revenue of the airport. Examples of projects in this category include the development of new car parking spaces and new airport lounges. As shown in Figure 6.4, Dublin Airport anticipate that Commercial CIP projects will increase real operating costs by ✂✂✂✂ in 2024. We understand from conversations with Dublin Airport that the business cases (including revenue targets) for this category of CIP projects have been reviewed by CAR.

Figure 6.4: Dublin Airport expected increase in operating costs due to commercial and retail related CIP projects, 2020-2024 (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

The expected increase in opex is net of all opex efficiencies and savings that are anticipated by Dublin Airport. For example, CIP.20.07.010 – Office Consolidation and Refurbishment is anticipated to lead to savings of ✂✂✂✂ per annum by 2023. As shown in Figure 6.5, Dublin Airport expects a 23% increase in retail payroll costs and a 9% increase in other non-pay costs relative to our efficient 2019 baseline. The other impacts range between a reduction of 3% and an uplift of 4%.

Figure 6.5: Percentage change in 2024 opex from 2019 outturn levels, resulting from commercial related CIP projects

✂

Source: Dublin Airport, CEPA analysis

Dublin Airport have generally estimated the incremental impact of these investments by undertaking a bottom-up assessment of the resources necessary to operate the additional commercial and retail facilities.

Overall, we conclude that the anticipated opex impact of the CIP projects in this section should be added to our forecasts for the coming regulatory period. The investments in this category of capex are not volume-driven and rather are designed to maintain or increase commercial revenues at Dublin Airport. We understand that all projects in this category of capex investments have favourable net present values and relatively short periods of return.

Reaching this conclusion is in part the result of undertaking a more thorough review of two projects within this capex category. They are:

- CIP.20.08.001 – Retail Refurbishments, Upgrades and New Developments
- CIP.20.04.005 - Long Term Car Parking - Eastland's (2000 spaces)

Collectively, Dublin Airport anticipate that these projects will lead to ✂✂✂✂ in additional opex by 2024 and ✂✂✂✂ in additional opex over the full regulatory period. These projects constitute 63% of the anticipated impact of all CIP projects in this category.

CIP.20.08.001 – Retail Refurbishments, Upgrades and New Developments

- This project provides for the refurbishment, upgrade and expansion of existing retail offerings at Dublin Airport across both terminals and associated piers. The project includes a store expansion and redevelopment at Pier 100, a store upgrade at Terminal 2 Arrivals, a new retail store for the Pier 400 transfer route and a new retail store at Southern gates. Dublin Airport anticipate that the project will lead to ✂✂✂✂ in retail staff costs over the next regulatory period. Dublin Airport also anticipate a further ✂✂✂✂ in variable costs for logistics, credit card fees, uniforms and retail bags. Once fully operational, the project is anticipated to generate ✂✂✂✂ in opex costs and ✂✂✂✂ in revenue per annum between 2022 and 2024. The net present value (NPV) of the project is forecast to be ✂✂✂✂.

- We believe the opex impact of these projects is additional to our core forecasts. A short consideration of the anticipated retail staffing costs associated with this project is presented in Table 6.6. Given the increase in retail floor space from these projects, we conclude that Dublin Airport's estimates of additional staffing requirements is efficient.

- Dublin Airport do not anticipate any other increases in opex, such as through increased cleaning costs, as a result of their expanded retail operations. We believe that given the scale of the expansion, this may be an oversight.

- Although it is possible the retail payroll figures have been overestimated, the lack of cleaning and maintenance costs mean that overall, the costs are likely to be reasonable. We therefore include Dublin Airport's estimates of the opex impacts of these projects in our forecasts.

Table 6.6: Forecast opex associated with Retail Refurbishments, Upgrades and New Developments

CIP.20.08.001 – Retail Refurbishments, Upgrades and New Developments
• We find that the anticipated opex impact of this project implies an average of 72 additional retail FTE per annum between 2022 and 2024. • We understand from discussions with Dublin Airport, that no new FTE are anticipated for both the Pier 400 CBP store and Terminal 2 arrivals shop, while 5 new FTE are anticipated for each of the new retail stores at the Southern Gates and the Pier 400 transfer route. This implies an estimated increase of 68 FTE across the new ARI terminal concept stores and the Pier 100 store expansion and redevelopment. • We do not have an estimate of the expected increase in the retail footprint as a result of these projects. As a result, we are not able to directly assess the efficiency of the anticipated staffing arrangements as part of these developments. The retail staffing efficiency achieved by Dublin Airport

for Terminal 2 in 2017 (6.9 FTE per 100 square meters), suggests the project would require an increase in retail floorspace of 1,058 square meters or more to be considered efficient.

- Although we cannot definitively assess the efficiency of the retail staff estimates, we note that Dublin Airport do not expect there to be a significant requirement for additional cleaning or maintenance staff. This suggests that overall, the opex estimates are likely to be reasonable even if the retail FTE requirements are overstated.
- We also note that our analysis for CIP.20.03.013 (Terminal 1 Departure Lounge Reorientation and Rehabilitation), concluded that 33% of retail FTE anticipated by Dublin Airport were passenger driven. We assumed that these FTE have already been accounted for in our regulatory forecasts. We do not have direct evidence that this is also the case for this project, and so make no further adjustments to the additional opex impact of this project.

CIP.20.04.005 - Long Term Car Parking - Eastland's (2,000 spaces)

- The project proposes the construction of 2,000 new car parking spaces on a greenfield site. This car park will be situated parallel to the existing red car park. Dublin Airport anticipate that the car park will be operational from Q1 of 2022 and is expected to increase opex by ✂✂✂✂ per annum from 2022 to 2024. Dublin Airport expect that overall, the project will increase non-pay car park costs by ✂✂✂✂ and rent and rates by ✂✂✂✂ over the next regulatory period. The non-pay costs are related to increased bussing requirements at the car park. Once fully operational, the project is expected to generate revenue of ✂✂✂✂ per annum.

- From our discussions with Dublin Airport, we understand that these costs have been estimated based on the experience of running other car parks. We previously concluded that the cost of these were efficient. We also understand that an effort has been made to not overestimate the cost of bussing requirements at the airport. Dublin Airport expect that an additional bus will be required to maintain the current contracted service level agreement journey time, only during the four peak months of the year (June to September). We also note that Dublin Airport has not included an allowance for operations, cleaning and maintenance staff for this project, believing such impact to be marginal.

- We include the estimated impact of this project, without any adjustment to Dublin Airport's figures, in our forecasts.

Our assessment is that the projects in this category of capex do not constitute investments which we would have accounted for in our price control forecast. For the projects that we considered in detail, we made no downward adjustment to Dublin Airport's opex estimate. For CIP.20.08.001, we lack adequate information on the expansion in retail floorspace associated with this project to make a definitive assessment of the efficiency of this project. As such, we do not adjust the anticipated impact of the project on opex. We find that the anticipated impact of the other projects in this category are reasonable and make no downward adjustment to Dublin Airport's opex estimate. The impact of this category of the CIP on opex that we have forecast is shown in Table 6.7.

Table 6.7: CEPA estimated opex due to commercial CIP projects, by CAR category, 2020-2024 (€ million, 2017 prices)

CAR category	2020	2021	2022	2023	2024	Total
Retail - payroll	✂	✂	✂	✂	✂	✂
Other - non-pay	✂	✂	✂	✂	✂	✂
Rent and Rates	✂	✂	✂	✂	✂	✂

Facilities & Cleaning - payroll	✂	✂	✂	✂	✂	✂
Car Parks - non-pay	✂	✂	✂	✂	✂	✂
Marketing	✂	✂	✂	✂	✂	✂
Maintenance - non-pay	✂	✂	✂	✂	✂	✂
Facilities & Cleaning - non-pay	✂	✂	✂	✂	✂	✂
Utilities	✂	✂	✂	✂	✂	✂
Maintenance - payroll	✂	✂	✂	✂	✂	✂
Total	✂	✂	✂	✂	✂	✂

6.3.4. IT

Projects in this category are all designed to maintain and develop the IT infrastructure at Dublin Airport. Examples of projects in this category include airfield optimisation and new cyber security support. As shown in Figure 6.6, Dublin Airport anticipate that by 2024, this category of CIP projects will increase real operating costs by ✂✂✂✂ per year.

Figure 6.6: Dublin Airport anticipated increase in operating costs due to IT related CIP projects, 2020-2024 (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

We understand from our discussions with Dublin Airport that they do not anticipate large additional costs and savings in any other CAR opex category. All costs in this section are contained within the non-pay IT & Technology CAR cost category. The increase in costs anticipated in 2024 equates to a 7% uplift in costs relative to our 2019 efficient baseline. We understand that Dublin Airport has estimated the impact of these projects on opex, by assuming that their current contractual arrangements for outsourced IT work will not change from what they have presently achieved. They have considered any efficiencies that could be achieved in the retendering of IT contracts for this work.

Overall, we determine that the anticipated opex impact of the CIP projects in this section should already have been accounted for in our core forecasts for the next regulatory period. Our understanding is that the capex projects in this category are designed to satisfy IT needs for existing infrastructure. We are not convinced that additional outsourced IT staff beyond our forecasts are required to satisfy these needs.

This judgement is supported by a more detailed review of three projects within this capex category. They are:

- CIP.20.05.001 – Airfield Optimisation
- CIP.20.05.007 – Reliability, Safety, Security and Compliance
- CIP.20.05.010 – Passenger Processing

Collectively, Dublin Airport anticipates that these three projects will increase opex by ✂✂✂✂ by 2024 and ✂✂✂✂ over the next regulatory period. These projects constitute 68% of the anticipated impact of all CIP projects in this category. We analyse each project in turn.

CIP.20.05.001 – Airfield Optimisation

- This project proposes that Dublin Airport participate in further SESAR (Single European Sky ATM Research) initiatives to drive additional efficiencies and release more capacity. The project is expected to generate efficiencies for airlines and ground handling agents, but not lead to any specific opex savings for the airport itself. The project is expected to be phased-in from 2020 and generate additional opex costs through software and system support requirements. Dublin Airport anticipate that the per annum impact of the project is expected to marginally increase from ✂✂✂✂ in 2020 to 2024. Overall, Dublin Airport expect the project to increase total opex costs by ✂✂✂✂ between 2020 and 2024.
- We consider that software optimisation such as that specified by this project is likely to be an on-going area of investment by Dublin Airport and something which should be considered implicit in our core forecasts. Consequently, we do not include Dublin Airport's opex estimates for this project in our forecasts.

CIP.20.05.007 – Reliability, Safety, Security and Compliance

- This project seeks to improve the safety, security and reliability of IT infrastructure and services to all users of Dublin Airport. Areas of investment under this project include CCTV, access control systems, queue management systems and cyber security. The project is expected to be phased-in from 2020. Dublin Airport however anticipate the project having a marginal impact on opex across 2020 and 2021. The project is anticipated to increase opex costs by ✂✂✂✂ in 2024 and by ✂✂✂✂ across the total regulatory period.
- We consider that similar investments are likely to be on-going at Dublin Airport. As such, we believe that our core forecasts are likely to have implicitly accounted for this project. Consequently, we do not include Dublin Airport's opex estimates for this project in our forecasts.

CIP.20.05.010 – Passenger Processing

- This project identifies necessary IT upgrades to existing passenger processes as well as making provision for future self-service passenger processes. The key passenger processes at Dublin Airport (check-in, bag drop and boarding) are supported by Common Use Passenger Processing (CUPPS) and Common Use Self-Service (CUSS) platforms. Dublin Airport anticipate that the project will increase opex costs by ✂✂✂✂ per annum between 2021 and 2024. Overall, the project is anticipated to increase opex costs by ✂✂✂✂ across the regulatory period.

- We consider that similar investments are likely to be on-going at Dublin Airport. As such, we believe that our core forecasts are likely to have implicitly accounted for this project. Consequently, we do not include Dublin Airport's opex estimates for this project in our forecasts.

Our assessment is that projects in this category in general constitute areas of on-going investment for Dublin Airport. As such, we are not convinced that these projects will lead to additional non-pay IT expenditure beyond what is already included in our forecasts. We therefore do not include the estimated opex impacts of any of the IT projects in our forecasts. We note that this represents a challenging forecast for non-pay IT spend, as our core forecast also includes an efficiency target over the determination period. We believe there may be a case for revising our assessment if further evidence is provided to justify the additionality of this expenditure.

6.3.5. Asset care

Projects in this category are all designed to upgrade or replace physical assets at the airport. These investments can be broadly split into two categories: civil structural and fleet (CSF) investments and mechanical and electrical (M&E) investments. Examples of CSF investments include the replacement of airport heavy and light fleets and a skybridge rehabilitation. M&E CIP projects include investments in fixed electrical ground power (FEGP) and some small energy projects. As shown in Figure 6.7, Dublin Airport anticipates that asset care CIP projects will reduce real operating costs ✂✂✂✂ by 2024.

Figure 6.7: Anticipated increase in operating costs due to Asset Care CIP projects, 2020-2024 (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

Dublin Airport anticipate that this category of CIP projects will increase non-pay IT costs and non-pay maintenance costs by ✂✂✂✂ and lead to savings of ✂✂✂✂ of opex spend on utilities by 2024. As shown in Figure 6.8, these impacts equate to a 3.3% uplift in non-pay maintenance costs and a 12.6% decrease in utility costs relative to our efficient 2019 baseline.

Figure 6.8: Percentage change in 2024 opex from 2019 baseline levels, resulting from asset care related CIP projects

✂

Source: Dublin Airport, CEPA analysis

The reduction in utility costs is anticipated to be achieved by investments that improve the energy efficiency of Dublin Airport as well as projects that will generate electricity on-site at the airport. Our forecasts assume that utility consumption will remain unchanged over the next control period. As such, we adjust our core forecasts to reflect this anticipated reduction in opex spend.

We understand from our discussions with Dublin Airport, that the other investments in this category of capex projects are not a means to reduce costs. Rather, they view the investments in this category as a means to avoid future cost increases in a scenario where assets are not upgraded or replaced.

We undertake a more thorough review of four projects within this capex category. They are:

- CIP.20.02.004 – Passenger Boarding Bridges and Fixed Electrical Ground Power (FEGP)
- CIP.20.01.065 – Airport Heavy Fleet and Equipment Replacement
- CIP.20.02.013 – Small Energy Projects
- CIP.20.07.030 – Large Photovoltaic Farm

Dublin Airport anticipate that these projects will lead to a reduction in opex of ✂✂✂✂ by 2024 and a ✂✂✂✂ reduction over the next regulatory period. For the asset care category as a whole, there are eight projects that collectively increase opex by ✂✂✂✂ over the full regulatory period, and four projects that collectively reduce opex by ✂✂✂✂.

CIP.20.02.004 – Passenger Boarding Bridges and Fixed Electrical Ground Power (FEGP)

- This project relates to the refurbishment of Passenger Boarding Bridges (PBB's), the provision of a dual airbridge on Pier 3 and the expansion of FEGP at Dublin Airport. Dublin Airport anticipate that this project will impact on opex through maintenance requirements for the FEGP as well as through its increased energy consumption. This impact of this project is expected to increase across the regulatory period to ✂✂✂✂ in 2024. Overall Dublin Airport anticipate that the project will increase opex costs by ✂✂✂✂ between 2020 and 2024.
- We do not consider that our core forecasts for the next regulatory period have taken the expansion of FEGP at Dublin Airport into account. We also find no reason to make an adjustment to the opex impact of this project anticipated by Dublin Airport. We understand from our

discussions with Dublin Airport that maintenance and energy costs for FEGP are first borne by Dublin Airport and then charged back to the airlines through the FEGP charge. These costs should therefore have a net neutral effect on the price cap.

- Consequently, we incorporate Dublin Airport's estimate of the opex impact of this project into our forecasts.

CIP.20.01.065 – Airport Heavy Fleet and Equipment Replacement

- This project proposes to expand the Heavy Vehicle Fleet as well as replace some end-of-life vehicles. Dublin Airport consider there to be a requirement for an increased fleet in order to service the northern parallel runway, new apron infrastructure and increased passenger growth. The airport expects this project to be phased-in between 2020 and 2024. The project is not anticipated to generate significant opex costs in 2020 and 2021. Dublin Airport anticipate that the project will increase non-pay maintenance costs by ✂✂✂✂ each year from 2022 and 2023. Overall, Dublin Airport expect this project to increase opex by ✂✂✂✂ across the next regulatory period.

- We consider that our forecasts may have already accounted for a small proportion of the anticipated impact of this project on opex. However, the main motivation behind the increased fleet is the delivery of the new runway, which we have not explicitly considered in our core forecasts.

- We therefore accept Dublin Airport's estimates of the opex impact of this project and include the estimates in our forecasts.

CIP.20.02.013 and CIP.20.07.030 – Small Energy Projects and Large Photovoltaic Farm

- This group is made up of a number of small projects that aim to reduce utilities consumption. Most are similar to other schemes that have delivered savings to other parts of the airport campus, such as installation of LED lighting, replacement of boilers, introducing water metering, etc. The installation of a solar photovoltaic array is expected to provide Dublin Airport and its tenants with cheaper electricity.

- Dublin Airport's estimates of the opex savings from these projects are all derived from the savings experienced from previous projects. Where such historic estimates are not available, Dublin Airport have sought out estimates from industry. The projects are expected to reduce opex by ✂✂✂✂ in 2020 and by ✂✂✂✂ in 2021. Dublin Airport anticipate that these projects will lead to a reduction in opex of ✂✂✂✂ by 2024, and a ✂✂✂✂ reduction over the next regulatory period.

- We believe the methods used by Dublin Airport to estimate the impact of these projects are sensible. We have therefore included the estimates in our forecasts.

Our assessment is that these projects do not constitute investments which we would have accounted for in our price control forecast. As such, we add the estimated opex impact of these projects to our forecasts, without any adjustment to the figures provided by Dublin Airport. The impact of this category of the CIP on opex that we have forecast is shown in Table 6.8.

Table 6.8: CEPA estimated opex due to asset care CIP projects, by CAR category, 2020-2024 (€ million, 2017 prices)

CAR category	2020	2021	2022	2023	2024	Total
Maintenance – non-pay	0.1	0.2	0.3	0.4	0.4	**1.5**
IT – non-pay					0.1	**0.1**
Utilities	0.0	-0.2	-0.2	-0.4	-0.9	**-1.7**
Total	**0.1**	**0.0**	**0.1**	**0.0**	**-0.4**	**-0.1**

6.3.6. Security

Projects in this category are designed to maintain and upgrade Dublin Airport as a safe and secure environment for passengers, staff and the general public. These projects will provide improved passenger experience as well address regulatory requirements. Examples of projects in this category include the provision of an additional automatic tray return system (ARTS) lane in Terminal 1, cabin baggage x-ray replacement and EDS upgrade. As shown in Figure 6.9, Dublin Airport anticipate that by 2024, this category of CIP projects will increase real operating costs by ✂✂✂✂ per year.

Figure 6.9: Anticipated increase in operating costs due to Security CIP projects, 2020-2024 (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

Dublin Airport anticipate that this category of CIP projects will lead to some security payroll efficiencies over the next regulatory period. As shown in Figure 6.10, Dublin Airport expect this category of CIP will reduce security payroll costs by 1% in 2024, relative to our 2019 efficient baseline.

We believe that the nature of airport security requires taking a more holistic approach to assessing the impact of the CIP on opex than we have undertaken for other capex categories. For example, the provision of an additional ATRS lane in Terminal 1 (CIP.20.06.009) is designed to be in operation until Terminal 1 central search can be relocated to the mezzanine level (CIP.20.03.012). The interlinkages between these CIP projects means that a pure project-by-project based analysis is inappropriate.

Figure 6.10: Anticipated increase in operating costs due to Security CIP projects, 2020-2024 (€ million, 2017 prices)

✂

Source: Dublin Airport, CEPA analysis

Overall, we undertook a review of six general areas where we believe that security investments will have an impact on opex over the next regulatory period. The six areas, and the CIP projects which we believe will have an impact on each area, are as follows:

- Changes to central search facilities at Terminals 1 and 2.
- CIP.20.06.009 – Provision of an additional ATRS lane in Terminal 1
- CIP.20.03.021 – Terminal 2 Central Search Area Expansion
- CIP.20.06.042 – ARTS – Central Search Areas (Terminal 1 and Terminal 2)
- CIP.20.06.001 – Cabin-Baggage X-Ray Replacement & EDS Upgrade
- Replacement of the Autopass system in Terminal 1 and implementation of Autopass in Terminal 2.
- CIP.20.06.031 – Terminal 1 Replacement and Terminal 2 Install
- Phased implementation of full body scanners at Dublin Airport.
- CIP.20.06.007 – Full body scanners
- Increased customer service staff requirement associated with the relocation of Terminal 1 central search
- CIP.20.03.012 – Relocation of Terminal 1 central search to the mezzanine level
- VCP Gate expansion
- CIP.20.03.004 – Gate Post 9 Expansion (West Lands)
- Development of the Airport Screening and Logistics Centre
- CIP.20.06.014 – Screening and Logistics Centre

Collectively, Dublin Airport anticipate that these projects will increase opex by ✂✂✂✂ over the next regulatory period. This figure is the sum of an overall anticipated increase of ✂✂✂✂ in non-pay costs, and a ✂✂✂✂ net increase in security payroll costs. These projects constitute 80% of the anticipated increase in opex as a result of investments in this category of capex.

In the following sections, we develop a brief overview of these projects and their anticipated impact on opex over the next regulatory period. We then give a total assessment of the extent to which we believe that these costs have been included in our core forecasts. We finally undertake an independent analysis of the impact of these projects on security payroll costs.

Changes to central search facilities at Terminals 1 and 2 (CIP.20.03.021, CIP.20.06.001, CIP.20.06.009, CIP.20.06.042)

- These projects implement 11 25-meter ATRS screening lanes with EDS-CB C3 cabin baggage screening systems in the Terminal 1 mezzanine area. Once the new systems have been commissioned, Terminal 1 security screening will transition from the departures level to the mezzanine level. The staffing requirement of the new screening system in the Terminal 1 mezzanine level is eight staff for one lane and 13 staff for a pair of lanes. This requirement is slightly higher than that of the existing Terminal 1 system, which is seven staff for a single lane and 12 staff for a pair of lanes. This increase in staffing requirement is planned to be offset by a greater throughput per lane delivered by a combination of:
    - a reduced number of x-ray images per passenger (IPP) enabled by the C3 baggage screening system. The original estimate of this reduction was from 1.9 IPP at present to 1.2 IPP with new system. This estimate has since been revised to 1.5 IPP based on operational experience at other airports.
    - faster throughout enabled by the longer ATRS lanes. The capacity of each lane, with the C3 screening system, is estimated by Dublin Airport to be approximately 440 images per hour, compared to 420 with the current system.
- The capacity of the new screening area with 11 lanes ranges from approximately 3230 passengers per hour with an IPP of 1.5 to approximately 4030 passengers per hour with an IPP of 1.2. The opex implications of the new Terminal 1 Central Search Area are as follows:
    - While the Terminal 1 mezzanine screening area is commissioned, operations will transition from the departure level to the mezzanine level and the existing screening lanes will be decommissioned. 14 of the current lanes will be removed with the two remaining lanes retained as a fast track facility. The opex impact of this fast track facility will be immaterial as it will be funded by airlines.
    - The decommissioned Terminal 1 ATRS lanes will be reconfigured to 17 meters in length and installed, one-by-one into the Terminal 2 central search area whilst retaining full operational screening service in Terminal 2. In total 12 ATRS lanes will be installed in Terminal 2 with a staffing requirement of six FTE for a single lane and 10 FTE for a pair of lanes. This is compared to the current staffing requirement of five FTE staff for a single lane and eight FTE staff for a pair of lanes. The increased staffing requirement will be offset by an anticipated improvement in throughput per lane from 315 to 370 images per hour. The changes to Terminal 2 security screening have already been included in our opex estimates and are, therefore, not addressed further. There is not expected to be any material impact on maintenance costs for the Terminal 2 screening equipment.
    - Remote screening will be introduced in Terminal 1 and Terminal 2 subject to regulatory approval. Dublin Airport anticipate that this will not have any material impact on staffing requirements as the increased processing capability of the x-ray will be balanced by increased staffing requirements for bag search or walk-throughs due to the increased passenger flow.
- The sequencing of the projects are as follows:
    - the new ATRS lanes in Terminal 1 at Q2 2022

  - the relocated ATRS lanes in Terminal 2 when the Terminal 2 central search area expansion project is complete in Q1 2023 (note that the CIP states completion of both Terminal 1 and Terminal 2 upgrades by Q2 2022, before the Terminal 2 expansion project is completed)
  - the new Cabin baggage x-ray replacement and EDS upgrade is planned for rollout in Terminal 1 by Q2 2024 and in Terminal 2 by Q1 2024.

- Dublin Airport anticipate that the new ATRS lanes (CIP.20.06.042) will lead to net opex saving of ✂✂✂✂ over the next regulatory period. The cabin baggage x-ray replacement and EDS upgrade (CIP.20.06.001) is anticipated to save a further ✂✂✂✂ opex over the period. Dublin Airport anticipate a further ✂✂✂✂ in non-pay IT access control costs associated with the expansion of the central search area at Terminal 2 (CIP.20.03.021). While the new Terminal 1 mezzanine extension is being implemented, Dublin Airport have also anticipated a cost associated with the planned conversion of the existing Terminal 1 Departures staff lane into a dual-purpose passenger/staff ATRS lane (CIP.20.06.009). This lane can be activated for passenger screening should passenger levels reach the point that they threaten to exceed the capability of the existing lanes. This non-pay cost is anticipated to be below ✂✂✂✂ across the entire regulatory period.

Replacement of the Autopass system in Terminal 1 and implementation of Autopass in Terminal 2 (CIP.20.06.031)

- This project will replace the end-of-life Autopass system in Terminal 1 and implement Autopass in Terminal 2. The project will deliver five additional Autopass gates in Terminal 1 and 10 new Autopass gates in Terminal 2, giving an overall complement of 25 Autopass gates between the two terminals (15 in Terminal 1 and 10 in Terminal 2). Dublin Airport anticipate that the additional gates will lead to ✂✂✂✂ in IT maintenance costs. There will be no staffing impact in Terminal 2 as staff will be transferred from existing duties, but an additional three staff will be required to supervise the additional gates in Terminal 1. These additional staff are not included in Dublin Airport's assessment of opex impact reported in the CIP.

Phased implementation of full body scanners at Dublin Airport (CIP.20.06.007)

- This project proposes a phased implementation of full body scanners at Dublin Airport as a pilot project. There will be four full body scanners in total, two in each of the central search areas in Terminal 1 and Terminal 2. The Terminal 1 facility is planned for delivery in Q1 2022 and the Terminal 2 facility is planned for rollout in Q4 2022.The full body scanners are not expected to impact on passenger throughput but are expected to improve screening functionality. Dublin Airport anticipate that the project will increase staff costs by ✂✂✂✂ over the regulatory period. Over the same period, Dublin Airport anticipate a further ✂✂✂✂ in maintenance costs.

Increased customer service staff requirement associated with the relocation of Terminal 1 central search (CIP.20.03.012)

- This project delivers the actual structural implementation of the Terminal 1 mezzanine extension and refurbishment. The existing Terminal 1 Central Search Area on the departures level, including the additional lane above, will remain operational until the mezzanine extension is completed. Once fully operational, Dublin Airport anticipate that this project will increase payroll costs by ✂✂✂✂ per annum, resulting from additional customer service assistants to support operation on the mezzanine level.

VCP Gate Expansion (CIP.20.03.004)

- There are currently two lanes at this gate; one inbound and one outbound. This project will deliver three additional inbound lanes: one for cargo and the other two for construction traffic. The two lanes allocated to construction traffic are capitalised and therefore have no associated opex. The other lane, for cargo, requires an additional 12 full time equivalents to staff it. Dublin Airport anticipate that the project will increase staff costs by ✂✂✂✂ over the next regulatory period.

Development of the Airport Screening and Logistics Centre (CIP.20.06.014)

- The Screening and Logistics Centre will enable the rationalisation of airside logistics. The Centre will reduce the number of vehicles required to present at the gateposts by providing a facility where goods can be stored in advance of screening, and subsequently scheduled for delivery airside on vehicles which are optimally loaded. It will be preceded by two Construction Consolidation Centres to facilitate the transport of construction goods airside. Dublin Airport forecast that during the CIP period, construction movements through VCP posts will reach a peak of 300% of normal background movements. The Construction Consolidation Centres will enable this traffic volume. As these Centres are associated with the CIP, they are capitalised and have no opex impact. The Screening and Logistics Centre will increase the efficiency of the landside-airside logistics process and may result in avoided costs at Control Posts. Dublin Airport anticipate that this project will increase non-pay logistical support costs by ✂✂✂✂ over the next regulatory period.
- Discussions with Dublin Airport indicates that staffing the Screening and Logistics Centre will require an additional 12 security FTE. It is expected that this cost will be offset by avoided opex at individual gate posts enabled by increased efficiency at those posts – however, it is expected that these avoided costs would accrue sometime after the Screening and Logistics Centre becomes operational. Additional benefits to be delivered by the Screening and Logistics Centre are expected to improve customer service through reduced delays, reduce the number of vehicles operating airside reducing collision risk and CO_2 emissions.

In general, we do not consider that our core forecasts for the next regulatory period have accounted for the impact of these projects. Table 6.9 shows the impact that Dublin Airport anticipate that these projects will have on security payroll costs over the next regulatory period. We can see that Dublin Airport anticipate a large decrease in payroll costs associated with the Central Search function as a result of investments in this category of the CIP.

Table 6.9: Dublin Airport estimated increase in security payroll opex due to the CIP, 2020-2024 (€ million, 2017 prices)

Project category	2020	2021	2022	2023	2024	Total
Central Search	✂	✂	✂	✂	✂	✂
Autopass	✂	✂	✂	✂	✂	✂
Full body scanners	✂	✂	✂	✂	✂	✂
Additional customer service staff	✂	✂	✂	✂	✂	✂
VCP Gate Expansion	✂	✂	✂	✂	✂	✂
Screening and Logistic Centre	✂	✂	✂	✂	✂	✂
Total	✂	✂	✂	✂	✂	✂

We independently estimate the impact of these projects on security payroll costs using a simple throughput model for security screening. We do not estimate the non-pay costs associated with these projects and assume they are as anticipated by Dublin Airport. A detailed discussion of the methodology behind this model is presented below in Table 6.10. Overall, we find that Dublin Airport have overstated the opex benefits that will arise from the capex projects in this category. We also find two areas in which we believe that the CIP has not adequately accounted for the impact of these projects on payroll costs. We find that the Screening and Logistics Centre will require an additional 12 FTE in 2023 and 2024. We also find that the replacement of the Autopass system will require an additional 3 FTE to supervise the additional gates in Terminal 1. We do not believe that our core forecasts have already accounted for these costs.

Table 6.10: Taylor Airey forecast opex associated with the security investments in this section

Security throughput model: Taylor Airey assessment

- We independently estimate the payroll security costs associated with the CIP using a simple throughput model for security screening. This model allows for the anticipated throughput improvements delivered by the CIP and has taken into account of any additional staffing requirements at central search for each capital project.
- The analysis for both Terminal 1 and 2 central search units is based on simple flow modelling (see Appendix B for details) with actual passenger numbers and empirical show-up profiles to determine the number of security lanes needed. We use lane staffing profiles to determine the number of staff required in order to process passengers with a 15 minute queue length.
- We use the different processing capabilities associated with the capital projects and the current situation to estimate staffing requirements with traffic levels at the point of introduction of each capability: current situation, and ATRS at each terminal followed by the cabin baggage x-ray replacement and EDS upgrade.
- The different staffing levels for each of the capabilities are then used to scale the costs for central search. Based on our price determination cost estimates, we build a profile for the opex impact of these capital projects.
- The additional staffing requirements associated with the Screening and Logistics Centre as well as the Autopass system replacement are then added to the forecast opex impact using the average wage costs appropriate for each year.
- Over the next regulatory period, our model forecasts a requirement for an additional 110 security FTE as a result of the investments in this category. On a year-by-year basis, the model predicts that this requirement will peak in 2022, where 39 security FTE beyond what had been anticipated by Dublin Airport will be required.
- The impact of the increase in security FTE are to increase security payroll costs by ✂✂✂✂ over the regulatory period. Around ✂✂✂✂ of this increase is forecast for 2022.
- Overall, our throughput model forecasts that security payroll costs will be €3.6 million above the impact anticipated by Dublin Airport. Our figures differ because:
  1. We take into account the phasing of the introduction of the C3 EDS system into Terminal 1 by the end of Q2 2024 and into Terminal 2 by the end of Q1 2024 as indicated in the CIP document;
  2. We exclude the impact of the ARTS on Terminal 2, which is already included in our initial determination;
  3. We include the expected staffing requirement at the Screening and Logistics Centre. This increases payroll costs by €1.6 million over the regulatory period.
  4. We include the expected staffing requirement associated with the Autopass gates at Terminal 1. This adds an additional €0.5 million in payroll costs over the next regulatory period; and
  5. We estimate the impact of staffing requirements on opex using our own forecast security staff payroll costs. Our forecast wage is above is anticipated by Dublin Airport. This adds an additional €0.7 million in payroll costs over the regulatory period.

Overall, we forecast that the CIP will lead to an increase of €5.7 million in security payroll costs over the next regulatory period. This is a ✂✂✂✂ uplift on the impact that is anticipated by Dublin Airport. The overall impact of our model is presented in Table 6.11. We adjust the opex impact calculated by Dublin Airport to reflect the impacts forecast in our throughput model.

Table 6.11: Taylor Airey estimated increase in security payroll opex due to the CIP, 2020-2024 (€ million, 2017 prices)

Project area	2020	2021	2022	2023	2024	Total
Central Search			-0.4	-0.8	-3.8	**-5.0**
Autopass			0.2	0.2	0.2	**0.5**
Full body scanners			0.4	0.5	0.5	**1.3**
Additional customer service staff		0.2	0.9	0.9	0.9	**2.8**
VCP Gate Expansion	0.3	0.6	0.6	0.6	0.6	**2.8**
Screening and Logistic Centre			0.3	0.6	0.6	**1.6**
Total	**0.3**	**0.8**	**2.0**	**1.9**	**-1.0**	**4.0**

In general, our assessment is that the projects in this category do not constitute investments which we have accounted for in our price control forecasts. The exception to this is the anticipated impact of changes to Terminal 2 security screening. As such, we include the impact of these projects (with the exception of the Terminal 2 security screening) in our forecasts. We adjust the figures provided by Dublin Airport to reflect the findings of our throughput analysis presented in Table 6.11. The impact of this category of the CIP on total opex that we have forecast is shown in Table 6.12.

Table 6.12: Taylor Airey estimated opex due to security CIP projects, by CAR category, 2020-2024 (€ million, 2017 prices)

CAR category	2020	2021	2022	2023	2024	Total
Security – payroll	0.3	0.8	2.0	1.9	-1.0	**4.0**
Other – non-pay	0.1	0.4	0.7	1.2	1.2	**3.7**
IT – non-pay	0.0	0.1	0.1	0.4	0.4	**1.1**
Total	**0.4**	**1.3**	**2.8**	**3.6**	**0.6**	**8.8**

6.3.7. Hold Baggage Screening (HBS)

Under European Regulations, Dublin Airport is required to upgrade its hold baggage screening capabilities to Standard 3 by 2020 at the latest. The new equipment is expected to have a lower throughput than existing Standard 2 equipment and would therefore require an increase in the physical area within the baggage sorting areas to accommodate it without reducing the overall efficiency of the airport's baggage handling facility.

Dublin Airport expect the running costs of the new machine to be as follows:

Table 6.13: Dublin Airport estimated Hold Baggage Screening Standard 3 running costs, (€ million, 2017 prices)

CAR category	2020	2021	2022	2023	2024	Total
Hold Baggage Screening S3 machine	0.0	0.3	0.5	0.7	0.7	**2.2**

6.4. Impact on Projections

In the preceding sections, we reviewed the impact of the CIP on opex for the period between 2020-2024. Overall, we consider the impacts anticipated by Dublin Airport to be reasonable, and do not consider that our core forecasts have in general already taken these impacts into account. We have however made three key exceptions:

- We consider that the volume driven retail FTE associated with the IDL expansion have already been accounted for in our core forecasts.
- We adjust the estimated impact of the CIP on security payroll costs, to reflect our throughput analysis of staffing requirements.
- We consider that the investments in the IT category of the CIP constitute areas of on-going investment. We are not convinced that these projects should lead to an increased requirement for outsourced IT staff beyond what we have made an allowance for in our existing forecast.

The overall impact of the CIP on opex by capex category is presented in Table 6.14 below. We forecast the overall additional impact of the CIP to be €51.6 million across the regulatory period. This compares with the impact of ✂✂✂✂ anticipated by Dublin Airport.

Table 6.14: Forecast impact of the CIP on opex, 2020-2024 (€ million, 2017 prices)

Capex category	2020	2021	2022	2023	2024	Total
Capacity	0.0	0.3	4.9	8.4	10.2	**23.8**
Commercial	0.0	1.5	6.4	5.6	6.1	**19.5**
Security	0.4	1.3	2.8	3.6	0.6	**8.8**
IT	0.0	0.0	0.0	0.0	0.0	**0.0**
Asset Care	0.1	0.0	0.1	0.0	-0.4	**-0.1**
HBS S3 machine	0.0	0.3	0.5	0.7	0.7	**2.2**
Total	**0.5**	**3.4**	**14.7**	**18.3**	**17.2**	**54.1**

7. CONCLUSIONS AND FORECAST SUMMARY

Our analysis leads us to believe that higher than anticipated increases in passenger volumes, created an immediate pressure on Dublin Airport to maintain service quality, but in this environment the airport gave less consideration to the efficiency of expenditure. As the previous price cap was set based on lower passenger forecasts, Dublin Airport were able to spend more while maintaining profitability. The increase in passengers has in effect reduced the impact of inefficient levels of opex on the airport's profitability.

We consider that some of the additional staff were necessary to accommodate additional passengers, particularly those staff hired into operational roles. The cost elasticities used to inform the 2014 determination were less suitable in the context of higher passenger growth, where infrastructure constraints necessitated the use of additional staff.

Overall, our conclusions generally support the views presented by airlines around the relative efficiency of operational staffing levels and relative inefficiency of administrative staffing levels. Non-pay expenditure on the whole has been reasonable, though some of the increases in recent years appear less justifiable.

As a result, our estimate for 2019 expenditure is higher than CAR's 2014 determination target, but approximately ✂✂✂✂ lower than Dublin Airport's budgetary estimate for the year. Our forecasts assume a steady increase in staff numbers over the next determination period but starting from a lower base than assumed in Dublin Airport's budgetary forecast. Under our forecasts, headcount per passenger reduces from 78 per million passengers, to 69 per million passengers between 2019 and 2024, bringing it into line with other similarly sized airports.

Table 7.1 and Table 7.2 below summarise our projections of staffing levels and opex, split by category of cost.

Table 7.1: Summary of forecast staffing levels at Dublin Airport, 2019-2024 (full-time equivalents)

	2019	2020	2021	2022	2023	2024
Security	765	778	788	799	809	820
Maintenance	220	222	223	229	231	232
Central functions	277	277	277	273	269	264
Facilities and cleaning	451	452	453	453	454	455
Campus services	294	295	296	297	298	299
IT	69	69	69	69	69	70
Retail	325	316	308	299	290	282
Airside operations	87	87	87	87	88	88
Car parking	37	37	37	37	37	37
Capital projects	22	26	30	30	30	30
Total *Dublin Airport estimate**	**2,545** ✂✂	**2,559**	**2,568**	**2,574**	**2,574**	**2,576**

** Dublin Airport's estimate of 2019 expenditure differs from what is included in the Frontier report. The figure quoted here is from the budget estimates provided to us in Autumn 2018*

Table 7.2: Summary of forecast opex at Dublin Airport, 2019-2024 (€ million, 2017 prices)

	2019	2020	2021	2022	2023	2024
Payroll						
Security	37.8	39.0	39.9	40.9	41.8	42.8
Maintenance	15.3	15.5	15.6	16.0	16.1	16.2
Central functions	23.1	23.6	24.0	23.9	23.8	23.8
Facilities and cleaning	21.5	21.6	21.6	21.6	21.6	21.6
Campus services	21.9	22.4	22.7	23.1	23.5	23.8
IT	7.0	7.2	7.3	7.5	7.7	7.8
Retail	16.9	16.0	15.4	15.2	15.1	14.9
Airside operations	6.5	6.7	6.8	6.9	7.0	7.1
Car parking	1.7	1.8	1.8	1.7	1.7	1.7
Capital projects	1.9	2.4	2.8	2.8	2.9	2.9
Non-pay						
Maintenance	13.1	13.1	13.2	13.4	13.4	13.4
Facilities and cleaning	3.7	3.6	3.6	3.6	3.5	3.5
IT	8.9	8.9	8.8	8.7	8.6	8.5
Car parking	4.8	4.9	5.0	5.1	5.2	5.3
Employee-related overheads	6.0	6.0	6.0	6.0	6.0	6.1
Rent and rates	14.2	14.2	14.2	14.2	14.2	14.2
Consultancy services	6.1	6.3	6.3	6.4	6.5	6.6
Marketing	7.4	7.5	7.6	7.7	7.8	7.9
Insurance	3.7	3.8	3.8	3.9	4.0	4.0
PRM	8.2	8.5	8.7	9.0	9.3	9.5
Other overheads	21.6	23.6	23.7	22.9	23.0	23.1
Utilities	7.4	7.6	7.9	8.0	8.2	8.4
Totals						
Pay	153.8	156.0	157.8	159.6	161.1	162.8
Non-pay	105.2	108.0	108.9	109.0	109.7	110.6
Total opex (excluding CIP) *Dublin Airport estimate**	**258.9** ✂✂	**264.1**	**266.7**	**268.6**	**270.9**	**273.3**
CIP		0.5	3.4	14.7	18.3	17.2
Total opex (including CIP)	**258.9**	**264.6**	**270.1**	**283.3**	**289.1**	**290.5**
Opex per passenger, excl. CIP (€)	8.0	7.9	7.7	7.5	7.4	7.2
Opex per passenger, incl. CIP (€)	8.0	7.9	7.8	7.9	7.9	7.7

** Dublin Airport's estimate of 2019 expenditure differs from what is included in the Frontier report. The figure quoted here is from the budget estimates provided to us in Autumn 2018*

APPENDIX A COMPARISON OF CEPA AND FRONTIER FORECASTS

Below in Table A.1 and Table A.2, we compare our forecasts with those produced by Frontier Economics on behalf of Dublin Airport.[27] The figures in each category are not strictly comparable as Frontier Economics has applied a broad productivity assumption of 0.6% per annum to the overall forecast, whereas our forecasts have considered efficiency separately for each cost category.

Table A.1: CEPA estimated summary of forecast staffing levels at Dublin Airport, 2019-2024 (full-time equivalents)

	2019	2020	2021	2022	2023	2024
Security	765	778	788	799	809	820
Maintenance	220	222	223	229	231	232
Central functions	277	277	277	273	269	264
Facilities and cleaning	451	452	453	453	454	455
Campus services	294	295	296	297	298	299
IT	69	69	69	69	69	70
Retail	325	316	308	299	290	282
Airside operations	87	87	87	87	88	88
Car parking	37	37	37	37	37	37
Capital projects	22	26	30	30	30	30
Total	**2,545**	**2,559**	**2,568**	**2,574**	**2,574**	**2,576**

Table A.2: Frontier Economics estimated summary of forecast staffing levels at Dublin Airport, 2019-2024 (full-time equivalents)

	2019	2020	2021	2022	2023	2024
Security	804	814	823	837	846	853
Maintenance	244	246	248	250	252	253
Central functions	349	349	350	351	351	351
Facilities and cleaning	476	482	486	494	499	503
Campus services	295	296	297	299	301	302
IT*	72	72	72	72	72	72
Retail	304	307	310	314	317	319
Airside operations	100	101	102	104	105	106
Car parking	35	35	35	35	35	35
Capital projects*	21	22	24	24	24	24
Total	**2,700**	**2,724**	**2,747**	**2,780**	**2,802**	**2,818**
Additional Security FTE	6	12	12	12	12	12
Additional Retail FTE	55	56	56	57	57	58
Total incl. additional FTE	**2,761**	**2,792**	**2,815**	**2,849**	**2,871**	**2,888**

[27] Frontier Economics (2019) *Dublin Airport Operating Expenditure Review*

**Frontier Economics report these series inclusive of capitalised FTEs. We have accordingly adjusted these series to reflect non-capitalised FTEs only. The non-capitalised IT FTE series is reported based on discussions with Dublin Airport. Frontier Economics report 120 out of 139 Capital Project FTEs were capitalised in 2018. We report the non-capitalised Capital Project FTE series on the assumption that capitalised and non-capitalised staff grow at the same rate from 2018.*

The forecast estimates produced in this document are on average 263 FTE per-year lower than the estimates produced by Frontier Economics. We understand that this difference is primarily driven by the efficiency adjustments made to the 2019 staffing requirements. Overall, Frontier forecast a 5% increase in FTE between 2019 and 2024 in comparison to the 1% increase forecast by this report.

A similar pattern can be observed when comparing CEPA and Frontier estimates of expenditure for the next determination period. The estimates produced in this document are generally at a much lower rate than those developed by Frontier Economics. A comparison is presented in Table A.3 and Table A.4.

Table A.3: CEPA estimated summary of forecast opex at Dublin Airport, 2019-2024 (€ million, 2017 prices)

	2019	2020	2021	2022	2023	2024
Total - payroll & non-pay						
Security	37.8	39.0	39.9	40.9	41.8	42.8
Central functions	23.1	23.6	24.0	23.9	23.8	23.8
Maintenance	28.4	28.6	28.7	29.4	29.5	29.7
Facilities and Cleaning	25.2	25.2	25.2	25.1	25.1	25.1
Campus services	21.9	22.4	22.7	23.1	23.5	23.8
Retail	16.9	16.0	15.4	15.2	15.1	14.9
IT	15.9	16.1	16.1	16.2	16.2	16.3
Other overheads	21.6	23.6	23.7	22.9	23.0	23.1
Rent and Rates	14.2	14.2	14.2	14.2	14.2	14.2
Marketing	7.4	7.5	7.6	7.7	7.8	7.9
Airside operations	6.5	6.7	6.8	6.9	7.0	7.1
PRM	8.2	8.5	8.7	9.0	9.3	9.5
Utilities	7.4	7.6	7.9	8.0	8.2	8.4
Car parking	6.6	6.7	6.7	6.9	7.0	7.1
Consultancy Services	6.1	6.3	6.3	6.4	6.5	6.6
Employee-related overheads	6.0	6.0	6.0	6.0	6.0	6.1
Insurance	3.7	3.8	3.8	3.9	4.0	4.0
Capital Projects	1.9	2.4	2.8	2.8	2.9	2.9
Total	**258.9**	**264.1**	**266.7**	**268.6**	**270.9**	**273.3**
CIP		0.5	3.4	14.7	18.3	17.2
Total opex (including CIP)	**258.9**	**264.6**	**270.1**	**283.3**	**289.1**	**290.5**

Table A.4: Frontier Economics estimated summary of forecast opex at Dublin Airport, 2019-2024 (€ million, 2017 prices)

	2019	2020	2021	2022	2023	2024
Security Staff	✂	✂	✂	✂	✂	✂
Central Functions Staff	✂	✂	✂	✂	✂	✂
Maintenance Staff	✂	✂	✂	✂	✂	✂
Facilities & Cleaning	✂	✂	✂	✂	✂	✂
Campus Services Staff	✂	✂	✂	✂	✂	✂
Retail Staff	✂	✂	✂	✂	✂	✂
IT & Technology	✂	✂	✂	✂	✂	✂
Other – Non-pay	✂	✂	✂	✂	✂	✂
Rent & rates – Non-pay	✂	✂	✂	✂	✂	✂
Marketing & Related Costs	✂	✂	✂	✂	✂	✂
Airside Operations Staff	✂	✂	✂	✂	✂	✂
PRM – Non-pay	✂	✂	✂	✂	✂	✂
Utilities – Non-pay	✂	✂	✂	✂	✂	✂
Car Parks	✂	✂	✂	✂	✂	✂
Consultancy Services	✂	✂	✂	✂	✂	✂
Other Staff Costs – Non-pay	✂	✂	✂	✂	✂	✂
Insurance	✂	✂	✂	✂	✂	✂
Capital Projects	✂	✂	✂	✂	✂	✂
Total – excl. productivity	✂	✂	✂	✂	✂	✂
Productivity saving (0.6%)	✂	✂	✂	✂	✂	✂
Base case	✂	✂	✂	✂	✂	✂
Base case + ICs + Core CIP	✂	✂	✂	✂	✂	✂

**For the purposes of comparison, all prices have been converted from the 2018 real prices used by Frontier Economics to 2017 real prices used in this report*

Overall, CEPA has a consistently lower estimate of efficient expenditure over the determination period. We believe that this should reflect some of the efficiency adjustments we made to our 2019 baseline cost estimates. Overall, Frontier Economics forecasts an 15% growth in operating expenditure over the next determination period from 2019 to 2024. This compares to the 12% growth forecast (inclusive of the CIP) developed in this report.

APPENDIX B DETAILED SECURITY EFFICIENCY ANALYSIS

B.1. TERMINAL SECURITY

B.1.1. Overview

Security within the terminal buildings is managed separately for Terminal 1 and Terminal 2, with separate staff allocation and rosters. The functions within each terminal are similar, however, and comprise:

- **Passenger and hand baggage screening using the familiar archway metal detectors and X-ray screening machines.** The infrastructure used for passenger security screening in Terminal 1 comprises 12 document check lanes, nine archway metal detectors and 15 x-ray lanes using an automatic tray return system (ATRS). The infrastructure used for passenger security screening in Terminal 2 comprises 12 document check lanes, 10 archway metal detectors and 18 manual return (conventional) x-ray lanes. In both cases, in terms of the number of baggage trays that can be processed per hour it is the X-ray machines that provide the capacity limit for each lane. Supply is adjusted to meet projected demand by adjusting the number of lanes that are open to maintain acceptable queue lengths. Regulatory penalties are imposed if the queue length exceeds the targets on any given day. The rosters, separate for Terminal 1 and 2, are designed to optimise staffing levels, driven by the number of lanes that need to be open, minimising periods of over- or under-staffing.
- **Fixed post check-points**, which include:
    - staff security screening on the landside-airside boundary for arriving and departing staff;
    - transfer passenger screening, which is only applied when carriers from countries that are not part of the One Stop Security Programme[28] are on-stand. In this case, it is necessary to re-screen all transfer passengers as those that do not require re-screening are mixed with those that do;
    - passenger automatic ticket presentation at the front of central search, to address situations where tickets are rejected by the automatic gates;
    - queue preparation;
    - security (third State) sweeps of piers when carriers of certain nationalities are on-stand;
    - fast-track (where costs are off-set against the revenues generated);
    - VIP screening; and
    - general trouble-shooting.

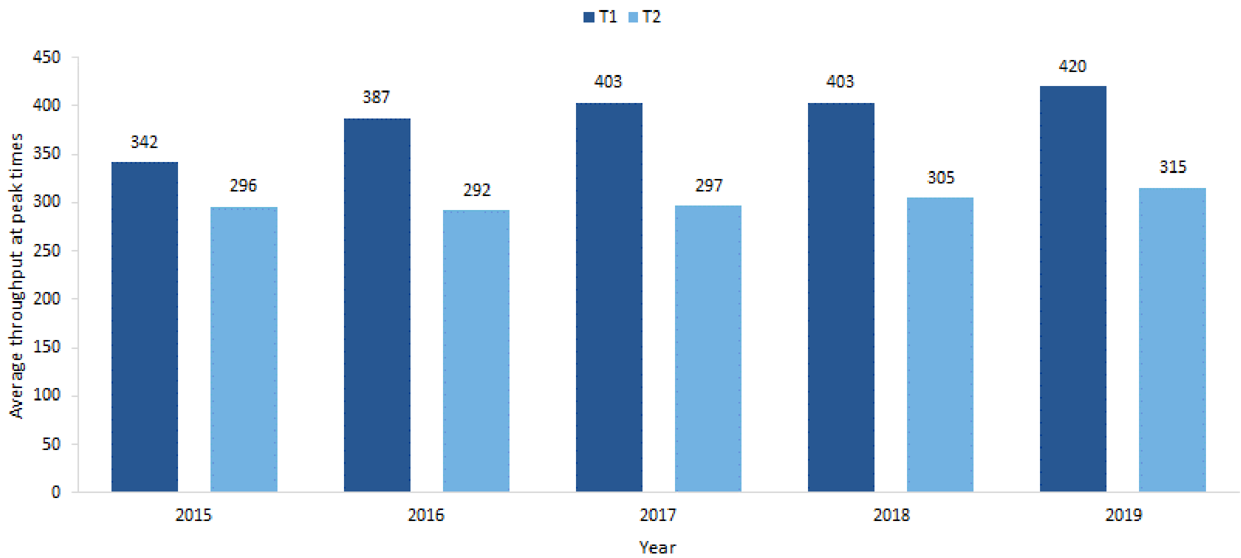
B.1.2. Providing efficient capacity at central search

The throughput of the X-ray machines is the constraining capacity factor at the central search locations where passenger and hand baggage security screening occurs. The capacity of the X-ray machines is measured as the throughput of trays in which passengers place their hand-baggage, coats, jackets and belts,

[28] The One Stop Security Programme principally applies to passengers originating from airports within EU countries

transparent bags containing liquids and gels, and laptops and larger hand-held electronic devices. Figure B.1 below shows how the throughput of the X-ray machines have evolved since 2015.

Figure B.1: Evolution of X-ray machine tray throughput



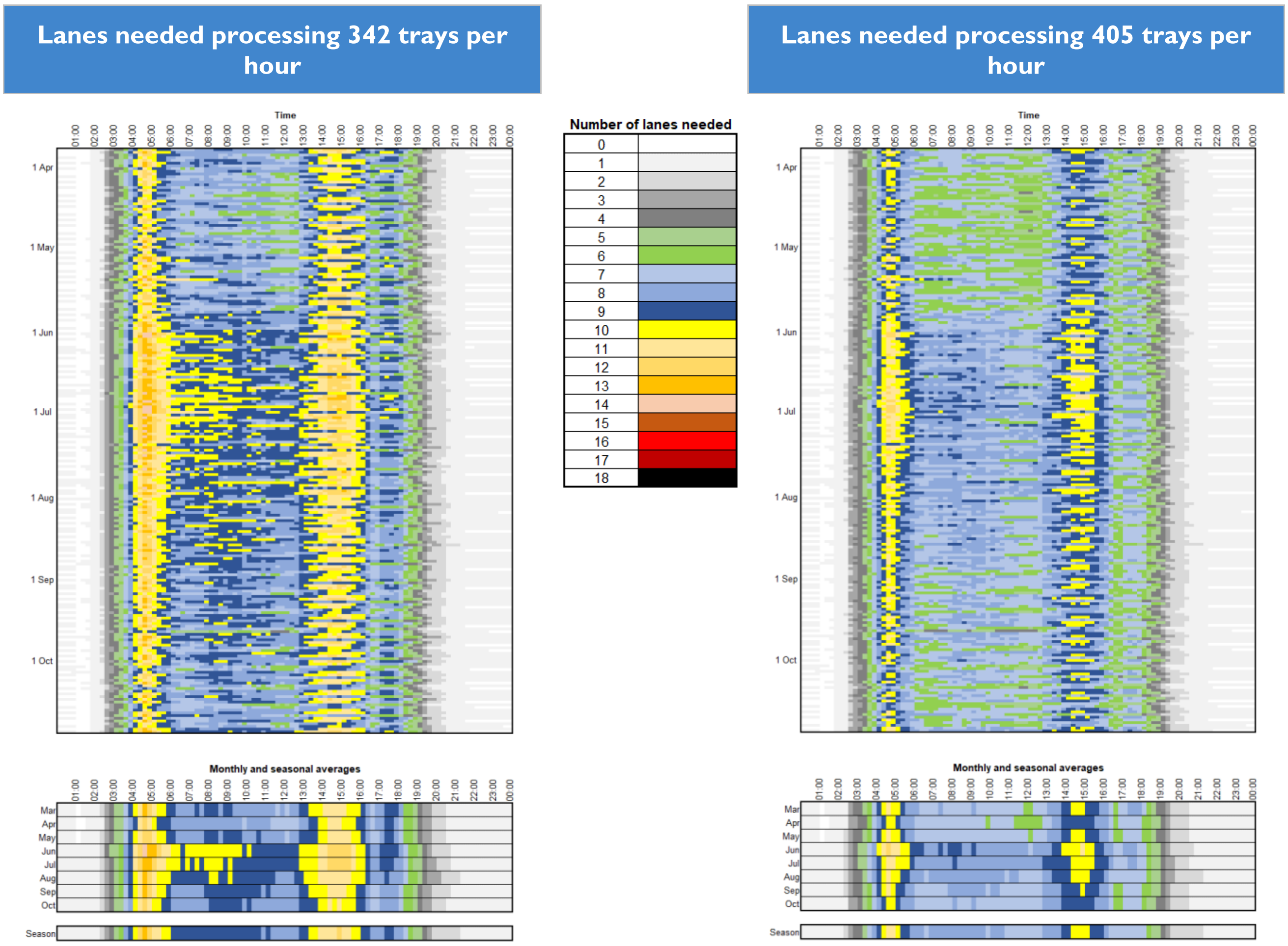
Source: Dublin Airport

The throughput of the Terminal 1 X-ray machines is higher that Terminal 2 X-ray machines because Terminal 1 uses ATRS whereas Terminal 2 does not. Terminal 1 throughput has improved from 342 trays per hour per machine in 2015, and is projected to reach the likely maximum sustainable throughput of 420 trays per machine per hour in 2019. In Terminal 2, throughput has increased from 296 trays per hour per machine in 2015 and is projected to reach 315 trays per hour per machine in 2019.

The search areas are managed by matching throughput capacity to demand by opening and closing X-ray lanes to meet forecast and actual demand. The additional capacity provided by increasing throughput rates can be used to improve service quality and/or to defer opening lanes (thereby saving on staffing requirements). The heatmaps[29] shown in Figure B.2 illustrate the saving in open lanes for Terminal 1 that could be achieved for 2018 traffic levels all else being equal by increasing X-ray machine throughput from 342 trays per hour per machine (the 2015 value) to 403 trays per machine per hour (the 2018 value). The heatmaps clearly show the reduced need for X-ray lanes. The heatmaps have been derived using actual passenger figures, adjusted using an empirical show-up profile, that has been validated against a sample of operational data.

[29] The main panel of the heatmap shows the minimum number of X-ray lanes needed to handle passenger volumes in 15-minute intervals. The horizontal axis shows the time across the day and the vertical axis represents the day of the summer season, which extends from the last weekend in March to the last weekend in October). The lower panel shows the average number of lanes, in 15-minute intervals across the day, that need to be open for each month, with the very bottom panel showing the average across the season in its entirety.

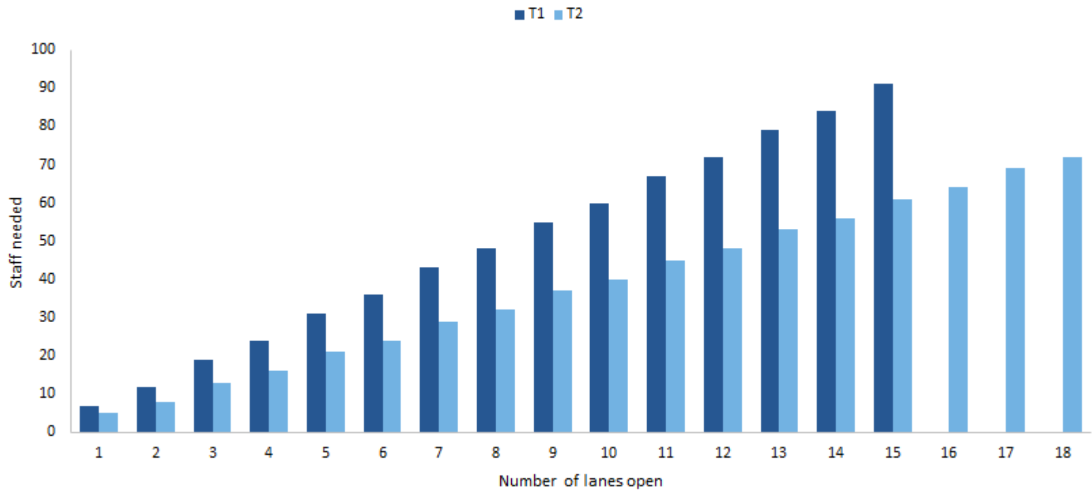
Figure B.2: Heatmaps comparing Terminal 1 X-ray lane requirements with different throughput rates for summer 2018 traffic



Source: Dublin Airport, Taylor Airey analysis

Central search in both Terminal 1 and Terminal 2 is organised such that there is one archway metal detector (AMD) shared between two X-ray machines, reflecting the fact that it is the X-ray machine that is the capacity constraint. Staffing requirements are slightly different at Terminal 1 and Terminal 2, with more staff needed at Terminal 1, where there is higher X-ray machine throughput, to ensure the log-jams do not occur because of trays that are referred to hand search. In Terminal 1, the first lane opened require seven staff and the second an additional five staff (i.e. 12 staff for two lanes), the third lane opened would require an additional seven staff and the fourth, five more staff, and so on. In Terminal 2, the first lane opened requires five staff and the second requires an additional three staff (i.e. eight staff for two lanes), the third lane. The following figure, Figure B.3, illustrates variation of the number of staff needed to operate Terminal 1 and Terminal 2 central search as the number of lanes open increases.

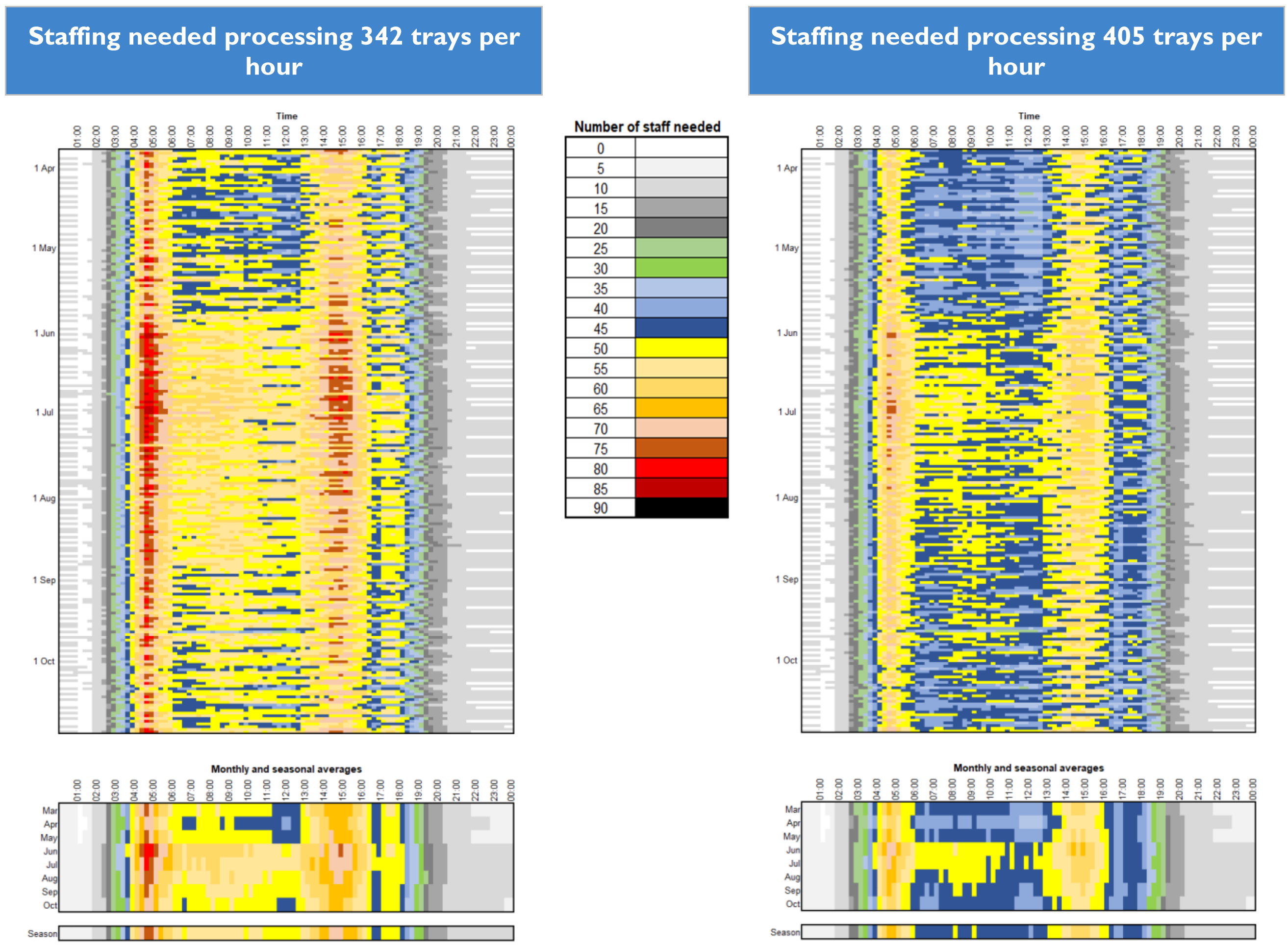
Figure B.3: Staffing requirements for Terminal 1 and Terminal 2 central search lanes



Source: Dublin Airport

Figure B.4 heatmaps, derived from actual passenger numbers using an empirical show-up distribution, combine the number of lanes needed (Figure B.2) with lane staffing profiles (Figure B.3) to show how reductions in Terminal 1 staffing requirements have been enabled by throughput improvements.

Figure B.4: Heatmaps comparing Terminal 1 X-ray lane staffing requirements with different throughput rates for summer 2018 traffic



Source: Dublin Airport, Taylor Airey analysis

Table B.1 illustrates the level of staff saving in the winter 2017-18 and summer 2018 seasons potentially enabled by the improvement of throughput from 2015 levels. The potential savings are higher in Terminal 1 than in Terminal 2 because of the greater throughput improvement in Terminal 1 than in Terminal 2.

Table B.1: Potential staff savings enabled by throughput improvements

Season	Terminal 1	Terminal 2
Winter 2017-18	13%	-
Summer 2018	14%	3%

Improved throughput does not deliver efficiency savings in itself. To deliver these savings, the Terminal 1 and Terminal 2 Airport Search Unit rosters need to be adapted to the evolving demand profile to realise the level of potential staff savings illustrated in the above table.

Box 1: Observations on providing efficient capacity at Central Search

Over the past three years, Dublin Airport has improved the throughput of the X-ray machines used for hand baggage screening at Terminals 1 and 2. The improvements, which are more marked for Terminal 1, have the potential to enable a reduction in staffing requirements of approximately 14% in Terminal 1 and 3% in Terminal 2, compared to the scenario in which the improvements had not been made. It is not clear whether this potential has been realised over the past three years.

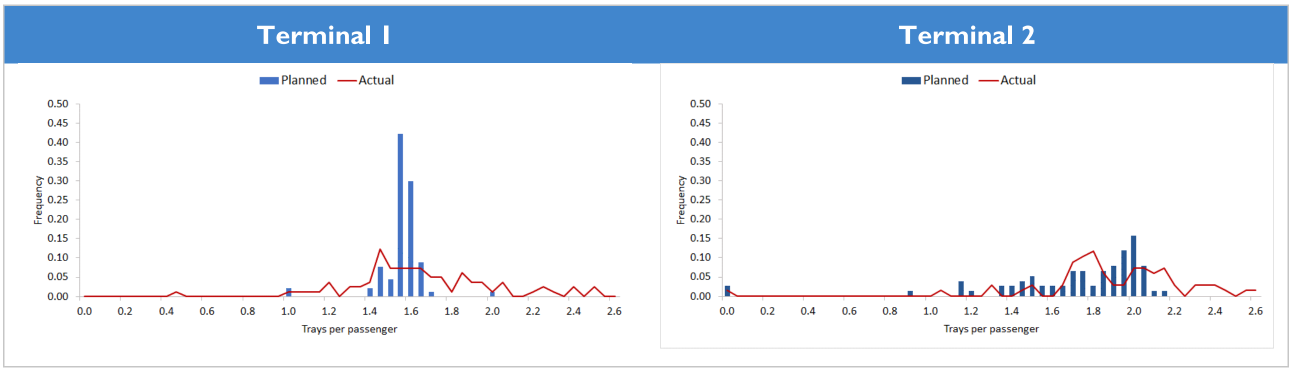
Further throughput improvements are planned for 2019. These and those that could have been achieved by 2018, should be factored into the forward opex projections.

B.1.3. Planning process

The principal objective of the central search planning process is to match the supply of staff, defined through the rosters, with the demand arising from the passenger volume and presentation profile and the number of X-ray machine trays per passenger. Roster planning occurs twice per year, corresponding to the summer and winter scheduling seasons

Dublin Airport bases the planning process on a trays-per-passenger profile to determine the number of lanes needed at 15-minute intervals across the day and, hence, the number of staff needed to resources the lanes. Figure B.5 compares the trays-per-passenger distribution used for planning with that actually experienced for a sample busy day on 27 July 2018.

Figure B.5: Planned and actual distributions of trays per passenger at Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Table B.2 compares the means and standard deviations of the planning and observed trays-per-passenger distributions for Terminal 1 and Terminal 2, albeit with the caveat that the analysis is based on a very small sample, the table and figure show that the distributions used for planning purposes, especially for Terminal 1, are much narrower than those observed in reality which are more or less random around an average value.

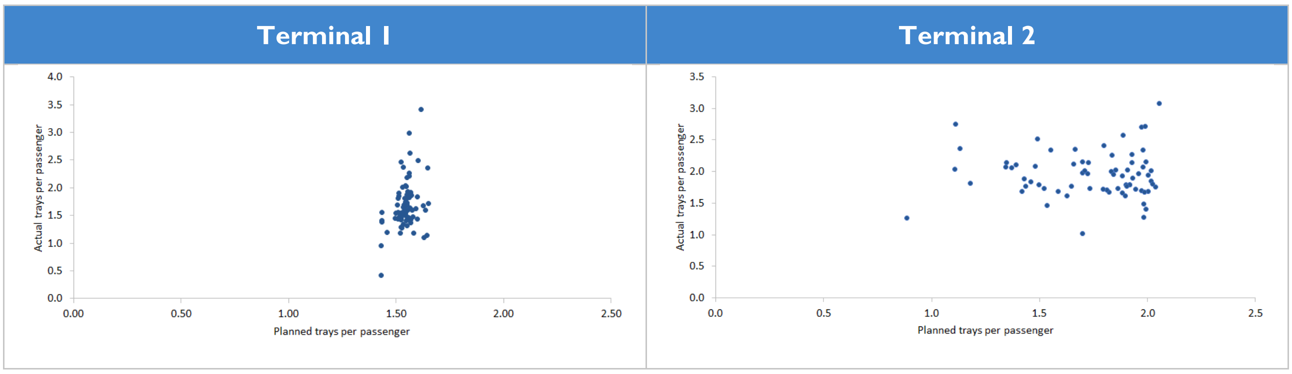
Table B.2: Means and standard deviations of planned and actual trays per passenger distributions on 27 July 2018

Distribution	Parameter	Terminal 1	Terminal 2
Planned trays per passenger	Mean	1.543	1.696
	Standard deviation	0.048	0.388
Actual trays per passenger	Mean	1.673	1.922
	Standard deviation	0.431	0.424

Source: Dublin Airport, Taylor Airey analysis

As an illustration of the effectiveness of the trays-per-passenger planning assumptions, Figure B.6 illustrates the correlation between the planned and actual trays-per-passenger for Terminal 1 and Terminal 2 on the sample day. Each data point covers a 15-minute period. Statistical tests show that a high confidence correlation between planned and actual trays-per-passenger for Terminal 1 but that there is not a correlation for Terminal 2.

Figure B.6: Correlation between planned and actual trays per passenger at Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Box 2: Observations on the central search staff planning process

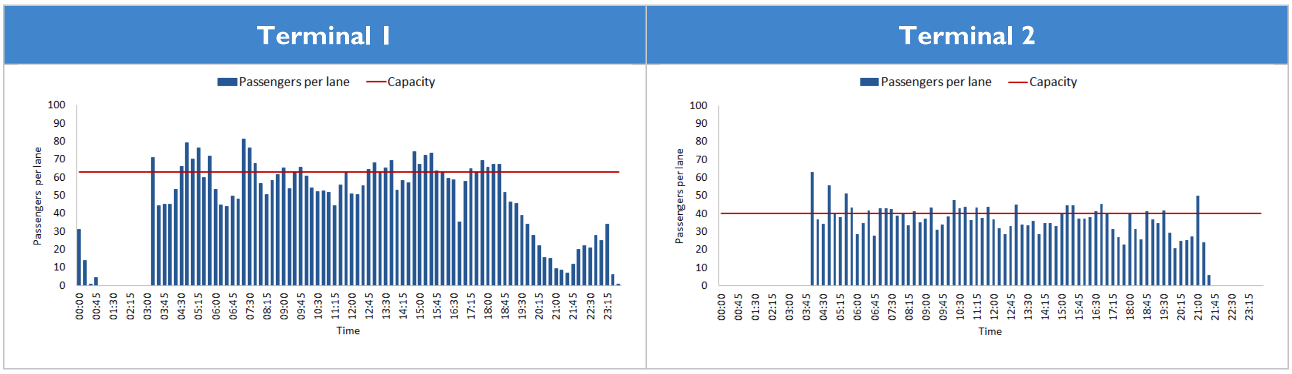
The staff planning process has evolved to be based on baggage tray processing through the Central Search X-ray machines rather than simple passenger numbers. This has the advantages of accounting for the capacity constraint in the system as well as accommodating differences between summer and winter through the variation of the ratio of trays to passenger. However, there is a only weak correlation between the planning assumptions on trays per passenger made for Terminal 1 and the distribution observed on the day. There is no correlation between the planning assumptions made for Terminal 2 and observations on the day. With the caveat that this analysis is based on very small sample, Dublin Airport should consider simplifying or refining its planning assumption, especially for Terminal 2.

B.1.4. High-level efficiency indicators

The following figures illustrate some high-level indicators for central search at Terminal 1 and Terminal 2 derived from performance data provided by Dublin Airport for the sample busy day of 27 July 2018.

Figure B.7 shows the evolution of the ratio of the number of passengers to open X-ray lanes (passengers-per-lane) in 15-minute intervals for Terminal 1 and Terminal 2 across the sample day, also indicating the lane capacity. The profiles across the day are as would be expected with passengers-per-lane oscillating slightly above and below the capacity figure, indicating efficient use of capacity. The main exception to this is the large fall-off in the passengers-per-lane ratio for Terminal 1 after approximately 18:45 hours, indicating that more lanes than needed are open. there is a similar but less-pronounced fall-off in the Terminal 2 profile from around 19:30 hours.

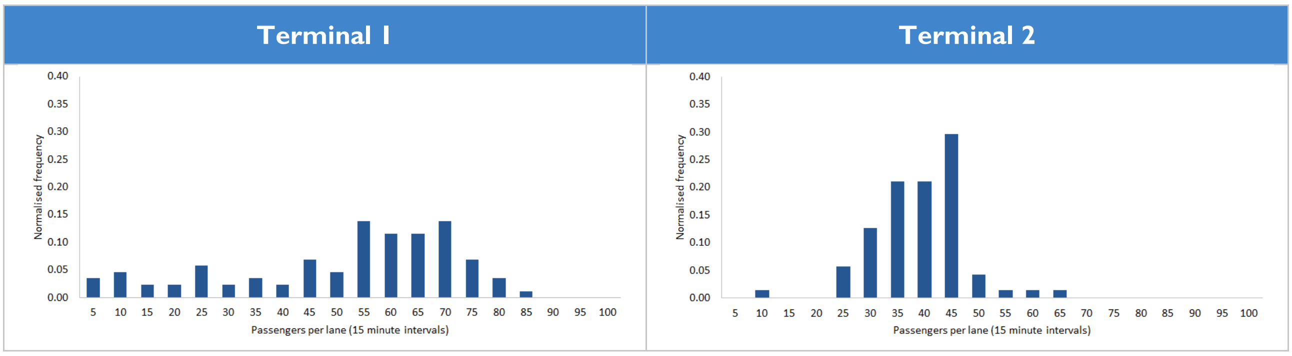
Figure B.7: Passenger throughput per security lane across the day at Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Figure B.8 shows the passenger-per-lane distribution for Terminal 1 and Terminal 2 for the sample day. The figure shows that the spread in passengers-per-lane for Terminal 1 is far greater than that for Terminal 2. This suggests that opening and closing of Terminal 1 lanes could be done more efficiently to narrow the distribution and match supply and demand better.

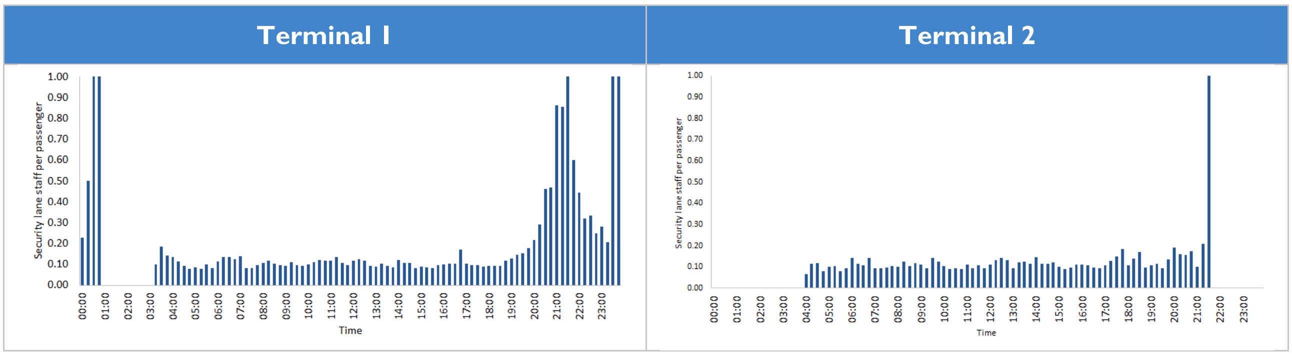
Figure B.8: Passenger per security lane distributions for Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Figure B.9 shows the simple metric of security staff deployed at central search per passenger processed (staff-per-passenger) in 15-minute intervals over the sample day for Terminal 1 and Terminal 2.

Figure B.9: Evolution of security staff per passenger across the day at Terminal 1 and Terminal 2 central search on 27 July 2018

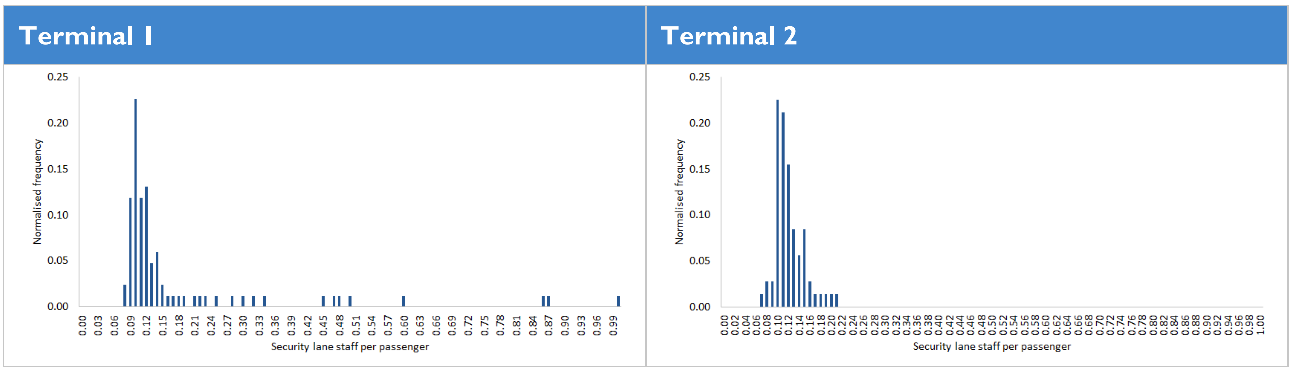


Source: Dublin Airport, Taylor Airey analysis

Figure B.9 indicates that for most of the day the number of security staff deployed per passenger oscillates slight around the value of 0.1 for both Terminal 1 and Terminal 2. However, in the evening, this ratio rises for Terminal 1 at around 19:30 hours, reaching a peak at 21:00 and then decreasing again, indicating over-staffing in the period from approximately 19:30 to 23:15 hours, corresponding to the period shown in Figure B.8 when the passenger-per-lanes ratio is low. This does not occur for Terminal 2, where there is a single 15-minute period at 21:30 hours where the staff to passenger ratio is high. For Terminal 1, in the early morning and late at night, when passenger demand for security screening is low, the staff to passenger ratio is high because there is a minimum number of staff that must be deployed to operate a single security lane.

Figure B.10 shows the distribution of security staff per passenger at Terminal 1 and Terminal 2 central search for the sample day with the averages and standard deviations of the distributions (excluding late night, early morning outliers) shown Table B.3.

Figure B.10: Distribution of security staff per passenger at Terminal 1 and Terminal 2 central search on 27 July 2018



Source: Dublin Airport, Taylor Airey analysis

Table B.3: Mean and standard deviation of staff per passenger distributions on 27 July 2018

Parameter	Terminal 1	Terminal 2
Mean	0.1711	0.1164
Standard deviation	0.1752	0.0272

Source: Dublin Airport, Taylor Airey analysis

The statistics, albeit based on a small sample, suggest that:

- Staff productivity is higher in Terminal 2 where the mean staff per passenger over the day is lower than for Terminal 1 by approximately 0.05. This is driven by the overstaffing, observed, between 19:30 and 22:30 hours for Terminal 1. If this peak is removed from the average, the mean staff per passenger ratio in Terminal 1 reduces to 0.1060.
- The matching of staff to demand, indicated by the standard deviation of the staff per passenger distribution, is better for Terminal 2, where the standard deviation is 0.0272, much lower than for Terminal 1 where the standard deviation is 0.1752. When the 19:30 to 23:30 hour peak in staff to passenger ratio is removed from the sample, the standard deviation is reduced to 0.0208, similar to that observed for Terminal 2.

Box 3: Observations on high level efficiency indicators

Based on the detailed data for the single sample day provided, Terminal 2 operations appear more controlled than those at Terminal 1 evidenced by narrower distributions for both passenger-per-X-ray lane and passenger-per-security officer deployed. In terms of staff per passenger as a productivity measure, Terminal 2 is more efficient than Terminal 1 despite faster flows through the Terminal 1 system, albeit with higher staffing per lane in Terminal 1

B.1.5. **Terminal 1 summer security roster efficiency**

Figure B.11 compares the number of staff rostered for the Terminal 1 Airport Security Unit (blue line) with the actual demand (red line) derived from passengers and flight data extracted from Dublin Airport operational data base (AODB) for the 2018 summer season. As the roster and demand profile vary by the day of the week, the figure compares supply and demand for each week-day for a busy summer week.

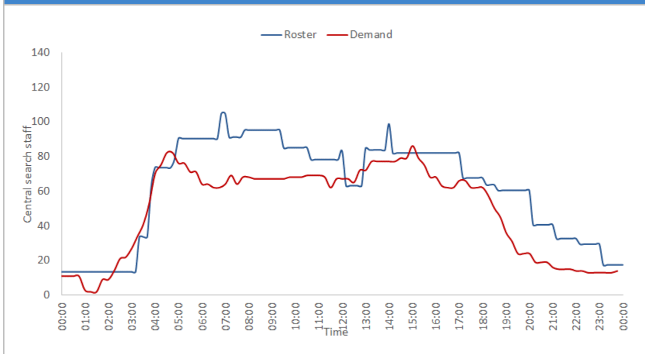
The following assumptions have been used to derive the demand profile:

- the X-ray lane throughput is assumed to be that for 2018 (403 trays-per-machine-per-hour), shown in Figure B.2.
- the staffing requirement per lane is as shown in Figure B.3
- staffing for the static posts[30], including transfer passenger security is fixed and does not vary with passenger numbers
- the average number of trays per passengers is approximately 1.6
- passengers present themselves at security at a time before the scheduled departure time of their flight according to a simple empirical distribution, similar to that used at other airports and validated against the sample day data provided by Dublin Airport.

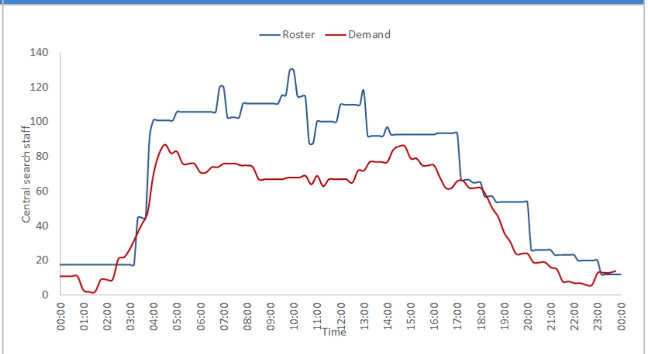
The number of staff on duty has been derived directly from the summer 2018 roster.

Figure B.11: Comparison of central search staffing requirements and rostered staff for Terminal 1in a busy week in summer 2018

Sunday 1 July 2018



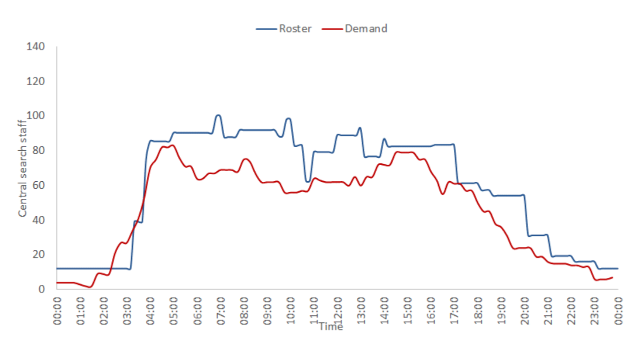
Monday 2 July 2018

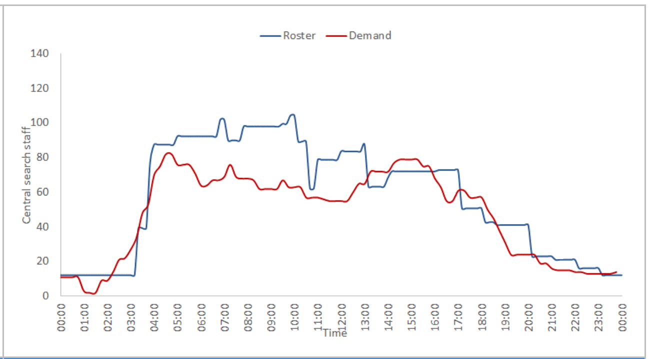


Tuesday 3 July 2018

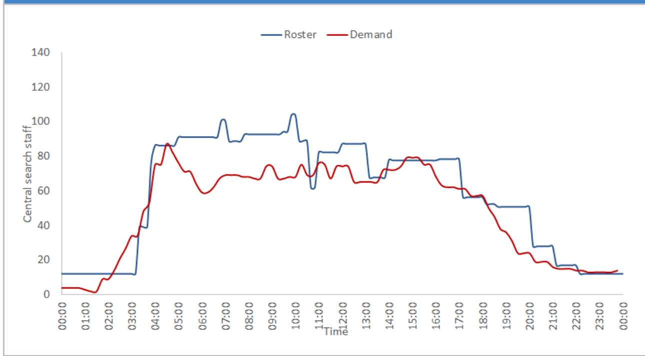
Wednesday 4 July 2018

[30] Dublin Airport has provided the staffing profile for the static posts

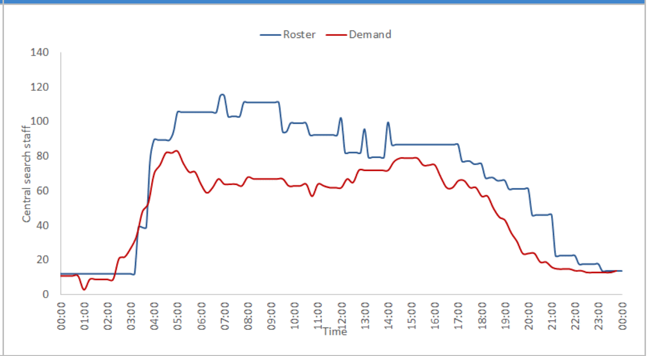




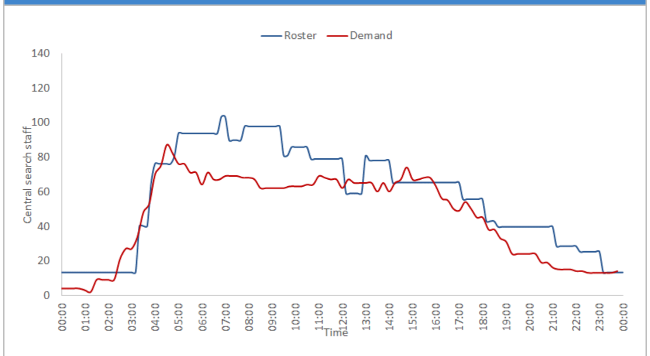
Thursday 5 July 2018



Friday 6 July 2018



Saturday 7 July 2018



Source: Dublin Airport, Taylor Airey analysis

Figure B.11 above shows mainly over-provision, particularly in the period following the morning peak, from around 05:30 to around 10:00 hours, although this varies from day-to-day. There is also over-provision during the evening, after around 18:30 hours on some, but not all, days. It is also noteworthy that demand rises faster than supply in the early morning. This is due to passengers arriving early for their early flights but the first non-night shift in the roster only starting at 03:20 hours. This has the potential to create long queues immediately as central search is opened. In the roster pattern shown above, these queues can be dissipated after the peak, where supply exceeds demand and do not necessarily propagate through the day. With current staffing agreements it Is not possible to start early shifts earlier but these would have to be implemented as night shifts which could result in further over-provision after the early morning peak.

There is slight mismatch between headcount and full-time equivalent figures derived from the roster and those stated in Dublin Airport human resources (HR) data. The roster implies a headcount of 422 with 358 FTE whereas HR data suggests a headcount of 443 with 352 FTE. The discrepancy may be due to a number of factors, including factors such as sickness and maternity leave.

The roster is complicated. On the summer 2018 roster, there are 19 separate rosters with six different combinations of shift length, ranging from six to 11 hours, as shown in Table B.4. The short, six-hour shifts are applied during the week on to Monday, Tuesday, Wednesday and Thursday. There are relatively few seven-hour shifts with the majority of shifts (>80%) being eight hours or longer. There are also short-shifts of four hours present in the roster but it is understood that these are facilitation shifts to transition staff back to duty after long-term absence. the number of shifts per day varies from 50 to 57.

Table B.4: Number of shifts by shift length from the Terminal 1 summer 2018 roster

Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
≤4	0	2	2	2	2	0	0
>4, ≤5	0	0	0	0	0	0	0
>5, ≤6	0	10	10	10	10	0	0
>6, ≤7	5	1	2	1	1	6	3
>7, ≤8	16	7	5	6	6	12	16
>8, ≤9	19	8	8	8	8	18	19
>9, ≤10	5	12	12	12	12	11	5
>10, ≤11	12	15	12	11	12	10	12
>11, ≤12	0	0	0	0	0	0	0
>12, ≤13	0	0	0	0	0	0	0
Total shifts	57	55	51	50	51	57	55

For a busy week, Table B.5 compares the hours needed derived from the demand profile with the available hours derived from the rostered hours, including work breaks and the approximate 9% absenteeism rate currently being experienced. The table indicates the over-provision comparing rostered hours with the minimums needed to meet the demand. the average over-provision over the week is approximately 32%. Note that over-rostering does not necessarily imply short queues because the over-rostering occurs at off-peak times when queue length is not an issue.

Table B.5: Comparison of staff hours rostered with staff hours needed for Terminal 1 in a busy week in summer 2018

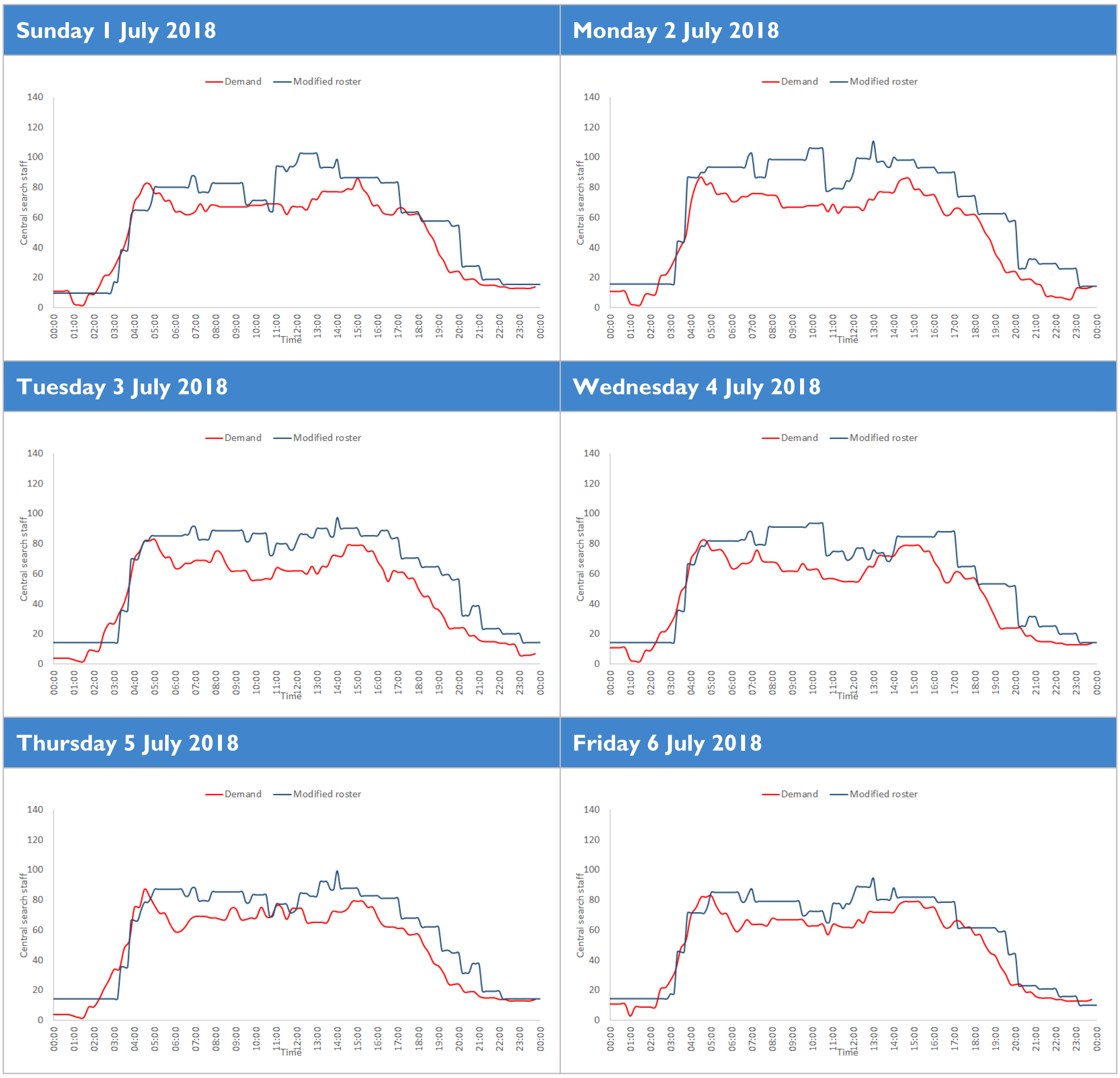
Day	Hours needed	Available hours	Hours rostered with 9% absence rate	Overprovision – roster vs demand
Sunday 1 July	1191	1496	1644	28%
Monday 2 July	1214	1701	1876	35%
Tuesday 3 July	1130	1451	1832	38%
Wednesday 4 July	1143	1379	1631	30%
Thursday 5 July	1179	1419	1603	26%
Friday 6 July	1184	1632	1794	34%
Saturday 7 July	1109	1384	1521	27%

Source: Dublin Airport, Taylor Airey analysis

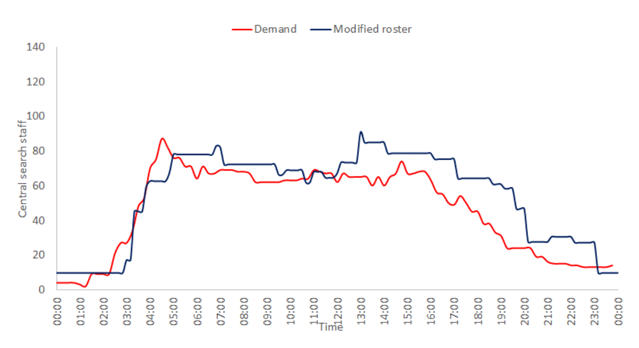
Although it is not possible to create an ideal roster that matches supply to demand perfectly, it may be possible to match supply and demand better than achieved with the existing roster. To test this, we have adjusted shift start times but maintained shift lengths manually to match the roster better to the demand profile as well as adjusting the number of staff assigned to each roster line.

It is relatively straightforward to achieve a better match on a single day but this is not realistic because the roster and its shift patterns needs to be optimised to the varying day-by-day demand over the whole week. The results of the manual adjustment are shown in Figure B.12 for each day-of-the week. The figure shows a better match between rostered supply and demand than achieved by the original roster, although there is some slight under-provision in the early morning peak.

Figure B.12: Comparison of central search staffing requirements and amended roster for Terminal 1in a busy week in summer 2018



Saturday 7 July 2018



Source: Dublin Airport, Taylor Airey analysis

Table B.6 illustrates the potential savings made by adjustment to the roster and reducing the absenteeism rate from approximately 9% to 5.5%, which is Dublin Airport's target level and appears a reasonable target compared to those applied by other airports. The table shows that efficiency savings of between 6% and approximately 19% should be possible, translating to requirements for between 12 and 42 FTE per day.

Table B.6: Illustration of staff savings potential with amended roster for Terminal 1 in summer

Day	Rostered hours on existing roster	Rostered hours on amended roster	Efficiency saving	FTE staff saving on roster
Sunday 1 July	1644	1501	8.7%	18
Monday 2 July	1876	1714	8.6%	20
Tuesday 3 July	1832	1567	14.5%	33
Wednesday 4 July	1631	1498	8.2%	17
Thursday 5 July	1603	1505	6.2%	12
Friday 6 July	1794	1456	18.8%	42
Saturday 7 July	1521	1395	8.3%	16

Source: Dublin Airport, Taylor Airey analysis

Adjustment of the roster reduces the over-provision averaged over the week from just over 32% to approximately 23% with an average efficiency saving of approximately 10%.

Box 4: Observations on Terminal 1 summer rostering efficiency

The Terminal 1 roster is very complex, with 19 different rosters being applied. Over a busy week, the roster over-provides on the staffing level required by approximately 32%. Although it is not possible to match the roster to the demand profile exactly, improvements can be made by adjusting the current roster to match demand and supply better over each of the days of the week and reduce the absence rate from the 9% at present to the target of 5.5%. This results in a staffing reduction of approximately 10% across the summer roster.

Complete redesign of the roster might result in higher savings.

B.1.6. Terminal 1 winter security roster efficiency

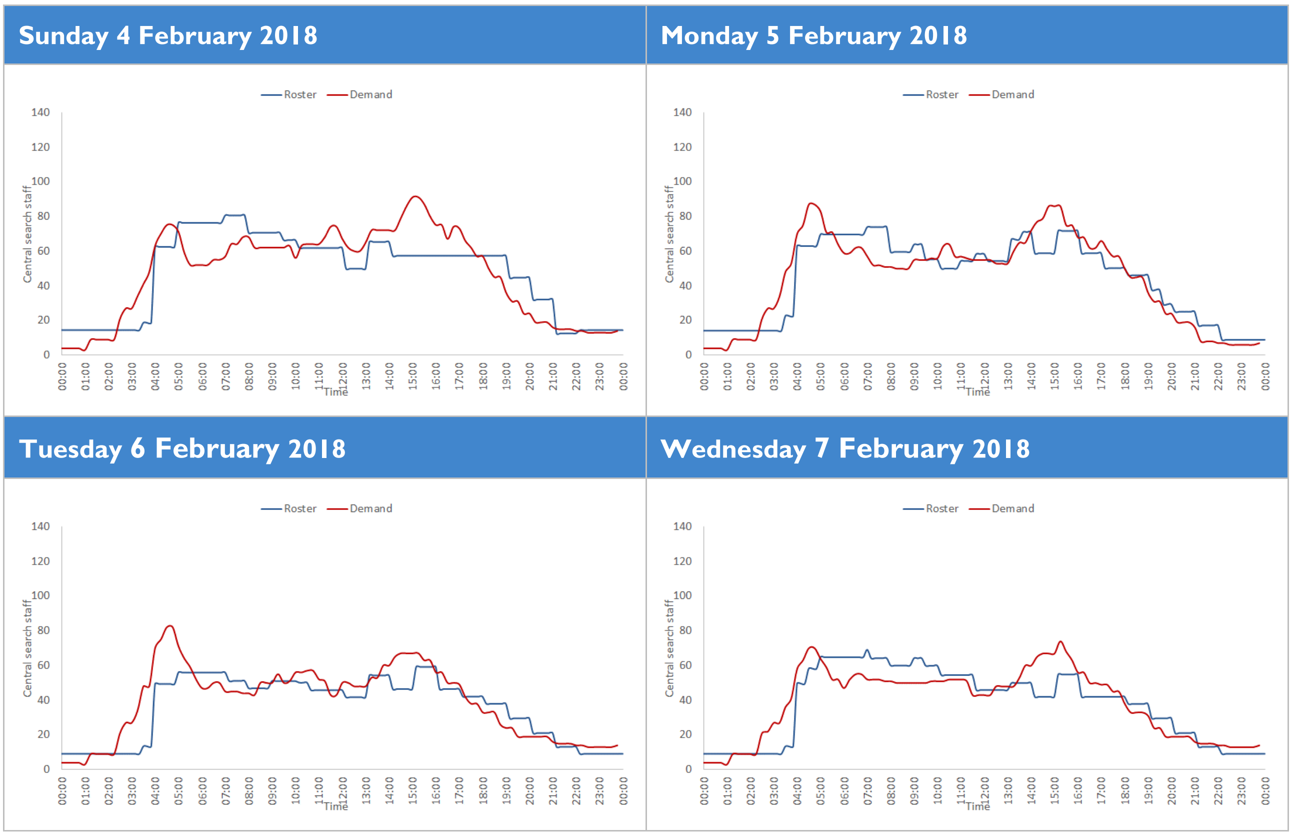
Figure B.13 compares the number of staff rostered for the Terminal 1 Airport Security Unit (blue line) with the actual demand (red line) derived from passengers and flight data extracted from Dublin Airport operational data base (AODB) for the winter 2017-18 season. The same approach has been applied as for analysis of the summer 2018 Terminal 1 roster with the following assumptions.

The following assumptions have been used to derive the demand profile:

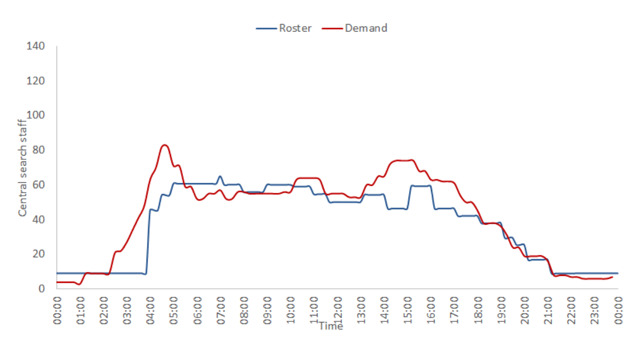
- the X-ray lane throughput is assumed to be that for 2018 (403 trays-per-machine-per-hour), shown in Figure B.2.
- the staffing requirement per lane is as shown in Figure B.3.
- staffing for the static posts, including transfer passenger security is fixed and does not vary with passenger numbers
- the average number of trays per passengers is approximately 2.1. This is based on the figures in Table B.2 increased by 0.5 trays per passenger to reflect additional trays are likely to be needed in winter due to the greater propensity for coats. This assumption is based on discussions with Dublin Airport and observations at other airports.
- passengers present themselves at security at a time before the scheduled departure time of their flight according to a simple distribution.

The number of staff on duty has been derived directly from the winter 2017 roster.

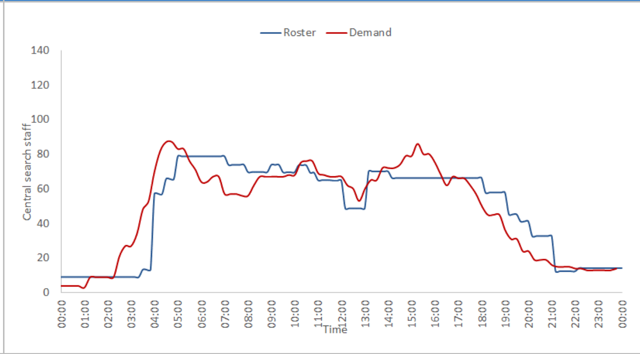
Figure B.13: Comparison of central search staffing requirements and rostered staff for Terminal 1in a week in winter 2017-2018



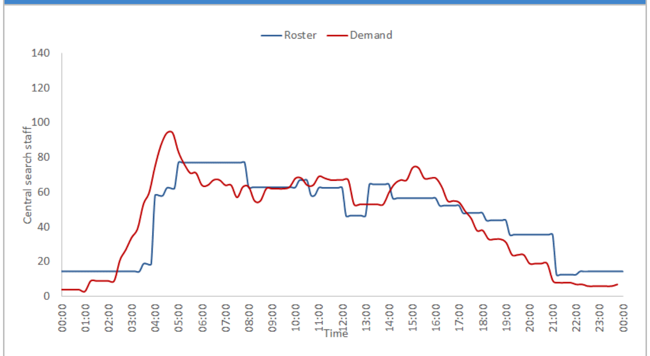
Thursday 8 February 2018



Friday 9 February 2018



Saturday 10 February 2018



Source: Dublin Airport, Taylor Airey analysis

The roster implies a headcount of 375 with 296 FTE. Headcount data from Dublin Airport is not available for winter 2017-18 but HR data indicates a 324 FTE, with the roster therefore representing 91% of the FTE on the staff roll.

The alignment of the roster and demand profiles in the charts above is much tighter for the Terminal 1 winter roster than the summer. There is evidence of under-provision in the early morning and afternoon peaks.

As with the summer 2018 roster, the winter 2017 roster is complicated. There are 18 different rosters and constrained by working agreements. There are more shifts (421) across the week in the winter roster than in the equivalent summer roster (376). Figure B.13 shows the daily shift pattern across the winter roster.

There are many more shorter shifts in the winter roster than in the summer roster, with more than a quarter of shifts being shorter than six hours and these shifts being distributed across the week rather than being focused on mid-week as in the summer roster. Approximately 90% of the winter roster shifts are nine hours or shorter.

As with the summer roster there are a few four hour shifts in the winter roster to facilitate staff returning from long-term absence. Table B.7 lists the number of shifts and their length from the Terminal 1 winter 2017-2018 roster.

Table B.7: Number of shifts by shift length from the Terminal 1 winter 2017-2018 roster

Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
≤4	0	2	2	2	2	0	0
>4, ≤5	0	0	0	0	0	0	0
>5, ≤6	11	23	20	22	20	7	7
>6, ≤7	4	2	4	3	5	8	3
>7, ≤8	27	4	2	2	4	24	27
>8, ≤9	18	24	18	20	20	19	20
>9, ≤10	5	7	8	8	7	5	5
>10, ≤11	0	0	0	0	0	0	0
>11, ≤12	0	0	0	0	0	0	0
>12, ≤13	0	0	0	0	0	0	0
Total shifts	65	62	54	57	58	63	62

Table B.8 compares the number of staff hours needed with the number of staff hours available for the sample week in winter 2017-18 accounting for breaks and the current absenteeism rate.

Table B.8: Comparison of staff hours rostered with staff hours needed for Terminal 1 for a week in winter 2017-2018

Day	Hours needed	Available hours	Hours rostered with 9% absence rate	Overprovision – roster vs demand
Sunday 4 February	1145	1120	1231	7%
Monday 5 February	1074	1053	1157	7%
Tuesday 6 February	942	844	927	-2%
Wednesday 7 February	935	900	989	5%
Thursday 8 February	1025	892	980	-5%
Friday 9 February	1174	1155	1270	8%
Saturday 10 February	1075	1068	1174	8%

Source: Dublin Airport, Taylor Airey analysis

The table shows a very close match between supply and demand, with an average over-provision over the week of 5% but with some days showing potential under-provision, although queue lengths do not appear to be prejudiced. There is no scope for additional efficiency in the winter roster. The match between supply and demand is so close that additional staffing may be required.

Box 5: Observations on Terminal 1 winter rostering efficiency

The Terminal 1 winter roster is very closely aligned to demand with very little over-provision. Adequate queue lengths indicate that it is not yet necessary to increase the staffing levels in the Terminal 1 winter roster. However, there appears to be no scope for efficiency savings in this roster.

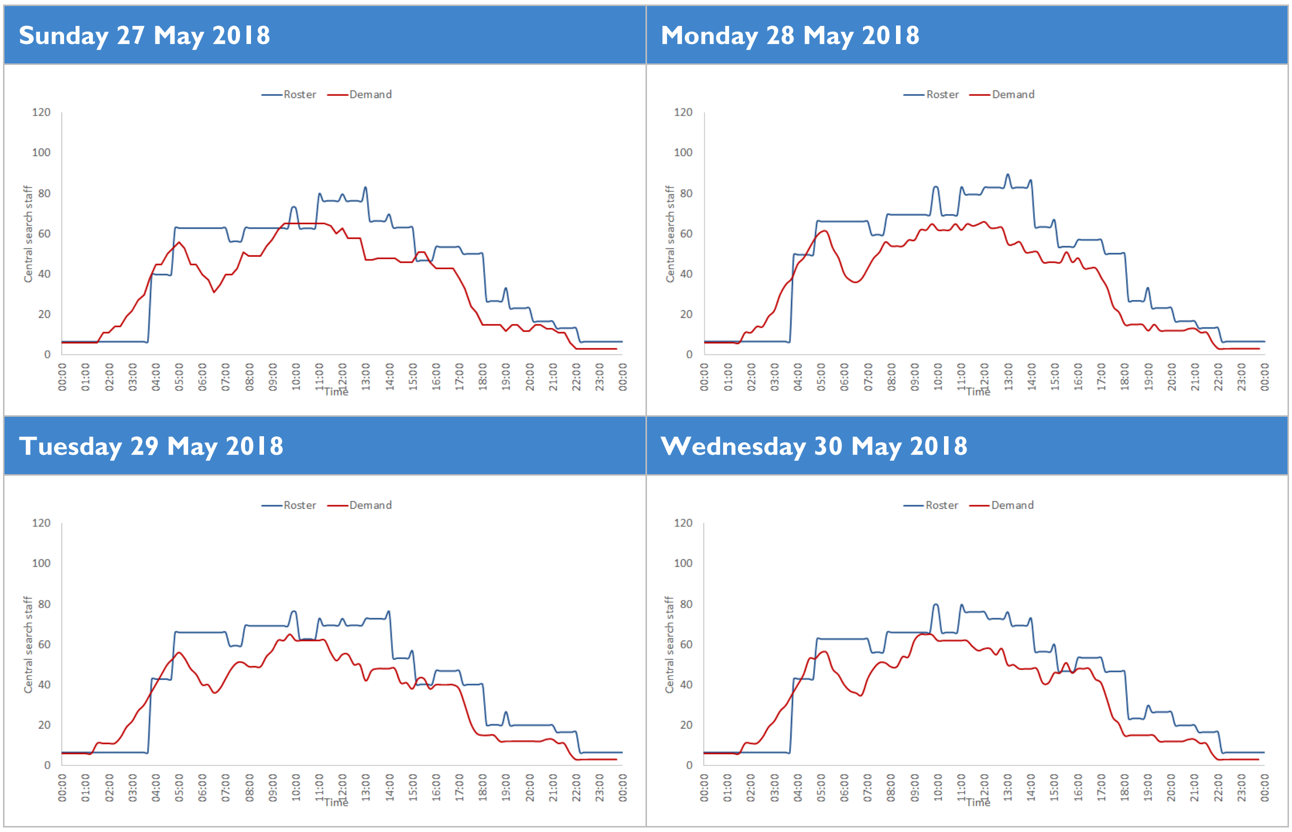
B.1.7. Terminal 2 summer roster efficiency

Figure B.14 compares the number of staff rostered for the Terminal 2 Airport Security Unit (blue line) with the actual demand (red line) derived from passengers and flight data extracted from Dublin Airport operational data base (AODB) a busy week in the summer 2018 season. Terminal 2 ASU roster efficiency has been analysed using the same approach as that described above for Terminal 1. The assumptions underpinning the analysis are:

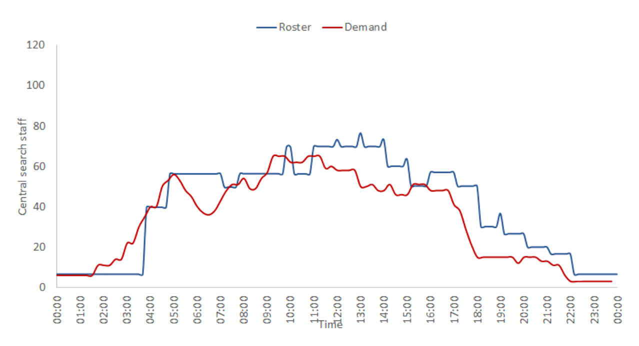
- the X-ray lane throughput is assumed to be that for 2018 (305 trays-per-machine-per-hour), shown in Figure B.1
- the staffing requirement per lane is as shown in Figure B.3
- staffing for the static posts, including transfer passenger security is fixed and does not vary with passenger numbers
- the average number of trays per passengers is approximately 1.9 as shown in Table B.2
- passengers present themselves at security at a time before the scheduled departure time of their flight according to a simple distribution.

The number of staff on duty has been derived directly from the summer 2018 roster.

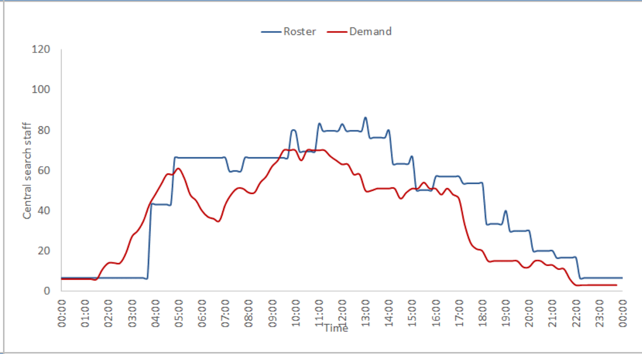
Figure B.14: Comparison of central search staffing requirements and rostered staff for Terminal 2 in a busy week in summer 2018



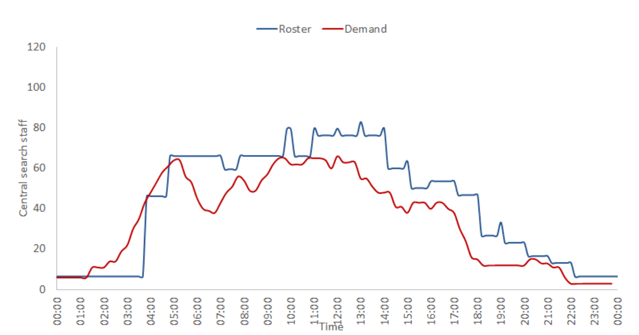
Thursday 31 May 2018



Friday 1 June 2018



Saturday 2 June 2018

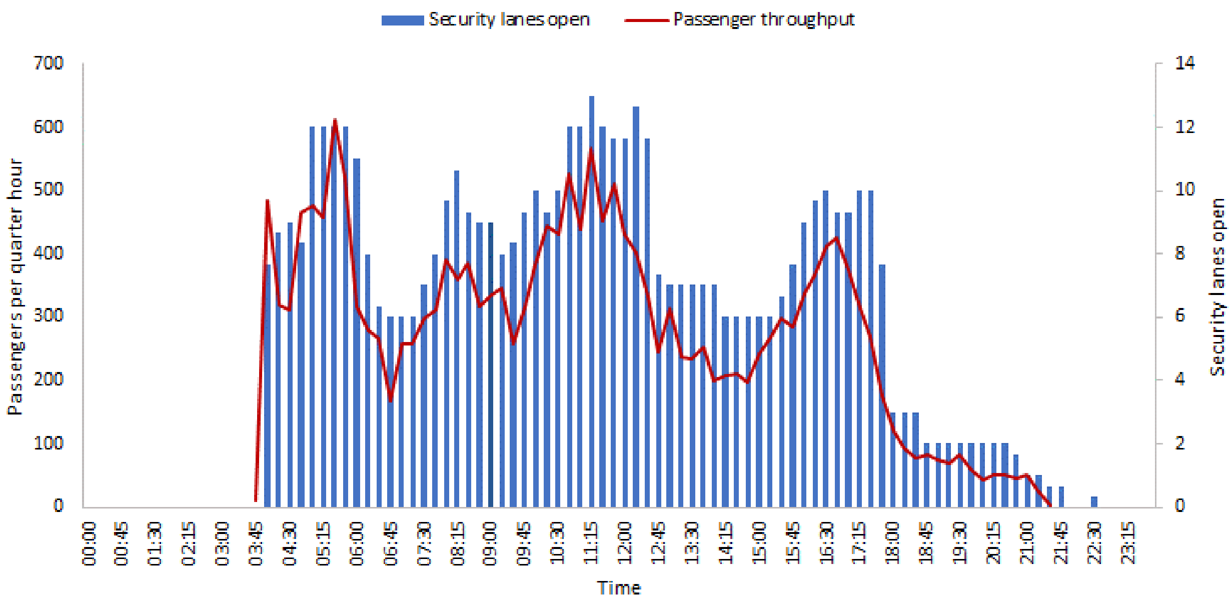


Source: Dublin Airport, Taylor Airey analysis

For Terminal 2 there is a close match between the headcount and FTE derived from the roster, 280 and 229 respectively, with those reported from the staff roll, 280 and 234 respectively.

The figure shows a reasonably close correlation between supply and demand although the demand starts to build up before the day shifts start in the early morning. The impact of this is shown in Figure B.15 below, derived from actual throughput on the sample day, 27 July 2018.

Figure B.15: Comparison of passenger throughput and Terminal 2 security lanes open on 27 July 2018



The figure shows a spike in throughput in the early morning at 03:45 caused by the build-up of passengers arriving earlier than the security lanes are opened. It is likely that this surge in demand is handled and prevented from propagating through the day by the over-provision of staff after the early morning peak.

The Terminal 2 roster is much simpler than the Terminal 1 roster. There are only three different rosters with a shift pattern as shown in Table B.9. The roster comprises mainly a combination of seven and eight hours shifts with10- and 11-hour shifts, with a few long night-shifts. There are no short shifts.

Table B.9: Number of shifts by shift length from the Terminal 2 summer 2018 roster

Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
≤4	0	0	0	0	0	0	0
>4, ≤5	0	0	0	0	0	0	0
>5, ≤6	0	0	0	0	0	0	0
>6, ≤7	9	9	9	9	9	9	9
>7, ≤8	10	10	10	10	10	10	10
>8, ≤9	0	0	0	0	0	0	0
>9, ≤10	5	2	0	2	3	3	3
>10, ≤11	12	17	16	15	14	16	15
>11, ≤12	0	0	0	0	0	0	0
>12, ≤13	2	2	2	2	2	2	2
Total shifts	38	40	37	38	38	40	39

Table B.10 compares the hours needed derived from the demand profile with the available hours derived from the rostered hours, including work breaks and the approximate 9% absenteeism rate currently being experienced. The table indicates the over-provision comparing rostered hours with the minimums needed to meet the demand. the average over-provision over the week is approximately 27%.

Table B.10: Comparison of staff hours rostered with staff hours needed for Terminal 2 in a busy week in summer 2018

Day	Hours needed	Available hours	Hours rostered with 9% absence rate	Overprovision – roster vs demand
Sunday 27 May	808	996	1095	26%
Monday 28 May	839	1073	1179	29%
Tuesday 29 May	778	977	1074	28%
Wednesday 30 May	809	1006	1105	27%
Thursday 31 May	820	962	1057	22%
Friday 1 June	863	1070	1175	27%
Saturday 2 June	831	1030	1132	27%

Source: Dublin Airport, Taylor Airey analysis

The Terminal 2 roster is well-aligned to demand. Adjusting the roster and reducing the absenteeism rate only produces small savings as shown in Table B.11.

Table B.11: Illustration of staff savings potential with amended roster for T2

Day	Rostered hours on existing roster	Rostered hours on amended roster	Efficiency saving	FTE staff saving on roster
Sunday 27 May	1095	1082	1.2%	1
Monday 28 May	1179	1144	3.0%	4
Tuesday 29 May	1074	1062	1.1%	1
Wednesday 30 May	1105	1096	0.8%	1
Thursday 31 May	1057	1054	0.3%	0
Friday 1 June	1175	1158	1.5%	2
Saturday 2 June	1132	1126	0.5%	0

Source: Dublin Airport, Taylor Airey analysis

The amended roster has overprovision of approximately 26% with an average saving over the week of approximately 1%.

Box 6: Observations on Terminal 2 summer rostering efficiency

The Terminal 2 roster is simple compared to Terminal 1, comprising only three separate rosters. Over a busy summer week, the roster over-provides on the staffing level required by approximately 26%. Unlike the Terminal 1 roster, it does not appear possible to make substantial savings by making simple adjustments to the roster. By adjusting the current roster to match demand and supply better over each of the days of the week (including an increase in staffing levels early in the morning to cater for that demand when it occurs) and reduce the absence rate from the 9% at present to the target of 5.5%, it is possible to reduce the staffing level by approximately 1%.

B.1.8. Terminal 2 winter security roster efficiency

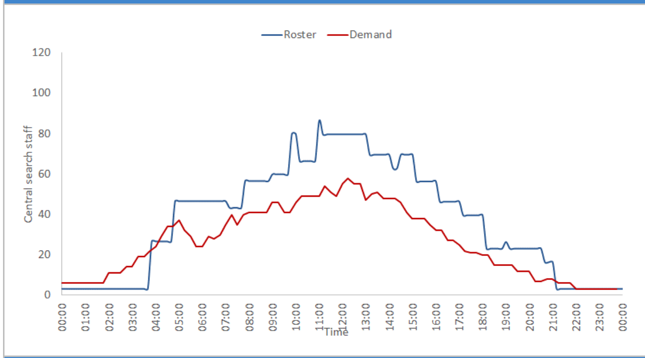
Figure B.16 compares the number of staff rostered for the Terminal 2 Airport Security Unit (blue line) with the actual demand (red line) derived from passengers and flight data extracted from Dublin Airport operational data base (AODB) an off-peak week in the 2017-18 winter season. Terminal 2 ASU roster efficiency has been analysed using the same approach as that described above for Terminal 1. The assumptions underpinning the analysis are:

- the X-ray lane throughput is assumed to be that for 2018 (297 trays-per-machine-per-hour), shown in Figure B.1
- the staffing requirement per lane is as shown in Figure B.3
- staffing for the static posts, including transfer passenger security is fixed and does not vary with passenger numbers
- the average number of trays per passenger is approximately 2.4 with 0.5 being added to the 1.9 shown in Table B.2 to account for additional tray requirements in winter, e.g. associated with coats
- passengers present themselves at security at a time before the scheduled departure time of their flight according to a simple distribution.

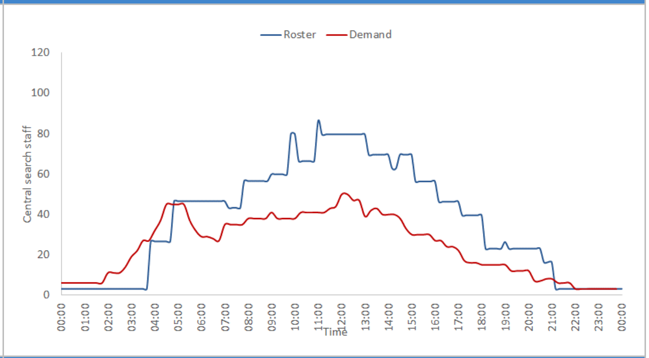
The number of staff on duty has been derived directly from the winter 2017 roster.

Figure B.16: Comparison of central search staffing requirements and rostered staff for Terminal 2 in a week in winter 2017-2018

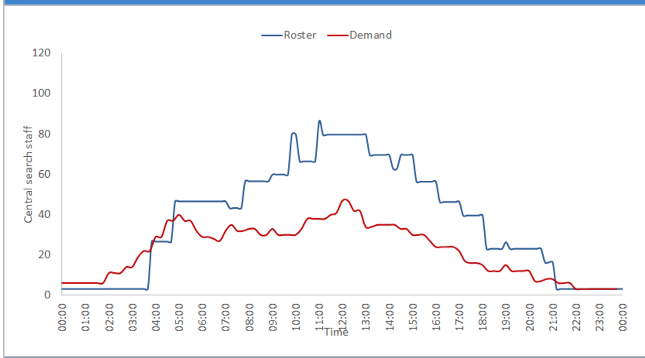
Sunday 28 January 2018



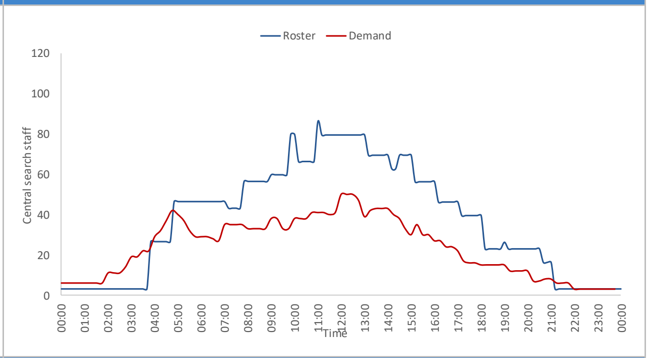
Monday 29 January 2018



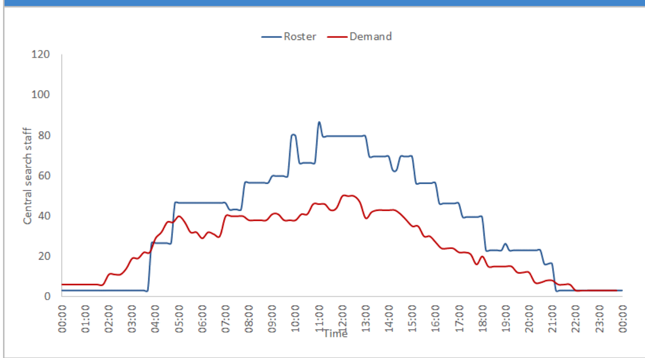
Tuesday 30 January 2018



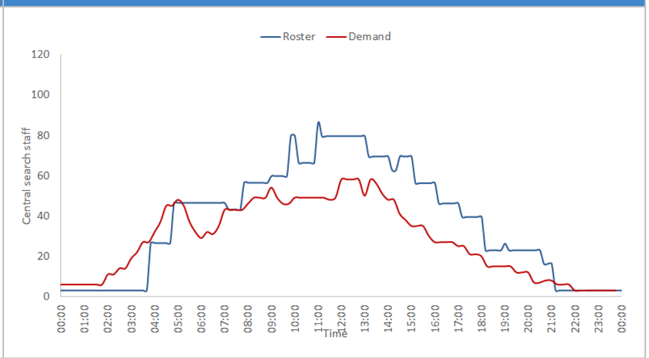
Wednesday 31 January 2018



Thursday 1 February 2018



Friday 2 February July 2018



Saturday 3 February 2018

Source: Dublin Airport, Taylor Airey analysis

For Terminal 2 there is a close match between the headcount and FTE derived from the roster, 280 and 229 respectively, with those reported from the staff roll, 280 and 228 respectively.

Figure B.16 shows that there is generally over-provision in the roster across the week expect for the early morning peak. As with the other rosters, demand starts to build up before central search is opened and, on some days, the early morning peak exceeds demand. However, for the rest of the day supply is well above demand. However, it should be noted that at peak periods during the winter, particularly in the week following Christmas and at the end of March 2018 during the Easter period, there is much closer alignment between supply and demand.

The Terminal 2 winter roster is relatively simple and has the shift pattern shown in Table B.12 below. The majority of shifts are 7-hours long with a mix of shifts of 10 hours 10 minutes and a few long night-shifts.

Table B.12: Number of shifts by shift length from the Terminal 2 winter 2017-2018 roster

Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
≤4	0	0	0	0	0	0	0
>4, ≤5	0	0	0	0	0	0	0
>5, ≤6	0	0	0	0	0	0	0
>6, ≤7	17	18	20	21	20	22	19
>7, ≤8	0	0	0	0	0	0	0
>8, ≤9	3	1	1	3	3	2	2
>9, ≤10	3	3	3	3	3	3	3
>10, ≤11	11	13	10	9	11	10	9
>11, ≤12	0	0	0	0	0	0	0
>12, ≤13	2	2	2	2	2	2	2
Total shifts	36	37	36	38	39	39	35

Table B.13 compares the number of staff hours needed with the number of staff hours available and rostered for the sample week in winter 2017-18 accounting for breaks and the current absenteeism rate.

Table B.13: Comparison of staff hours rostered with staff hours needed for Terminal 2 in a week in winter 2017-2018

Day	Hours needed	Available hours	Hours rostered with 7% absence rate	Overprovision – roster vs demand
Sunday 28 January	643	946	1017	37%
Monday 29 January	599	942	1013	41%
Tuesday 30 January	540	919	988	45%
Wednesday 31 January	578	914	983	41%
Thursday 1 February	608	992	1067	43%
Friday 2 February	688	966	1039	34%
Saturday 3 February	582	842	905	36%

Source: Dublin Airport, Taylor Airey analysis

The table shows that the average over-provision during this off-peak week is approximately 40%. Analysis of peak winter periods shows that over-provision during the Christmas period was approximately 24% and at the end of March leading up to Easter was approximately 21%.

Box 7: Observations on Terminal 2 winter rostering efficiency

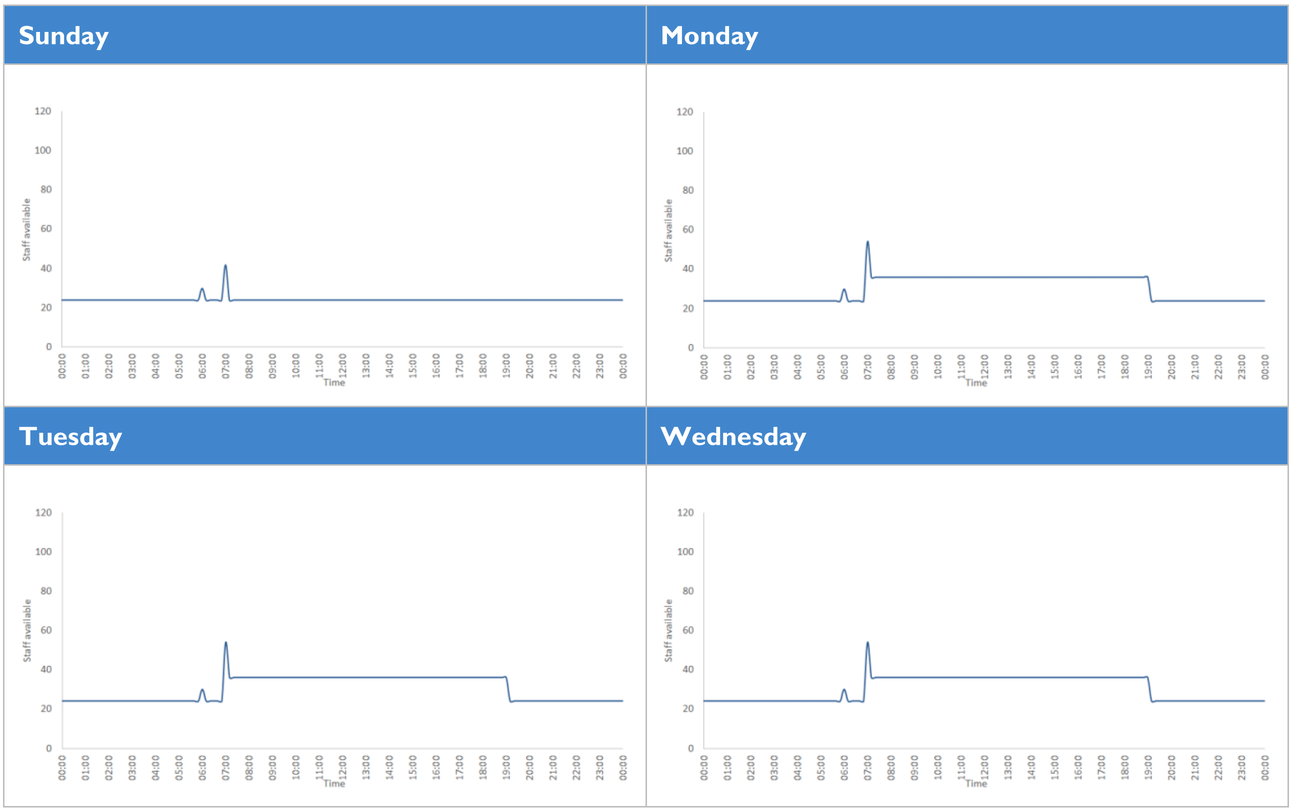
By adjusting the winter roster to match demand and supply better over each of the days of the week (including an increase in staffing levels early in the morning to cater for that demand when it occurs) and reduce the absence rate from the 9% at present to the target of 5.5%, it is possible to reduce the staffing level by approximately 10% to 15% over the winter period. This would require special provisions to be made at peak winter times around Christmas and Easter.

B.2. VEHICLE CONTROL POSTS

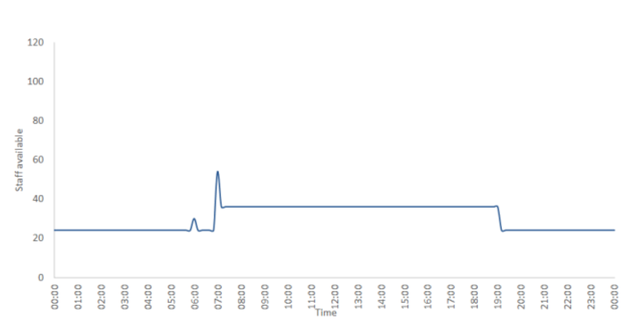
B.2.1. Staffing profile

The staffing profile derived from the summer 2018 Vehicle Control Post (VCP) roster is illustrated in Figure B.17. There is little variation from day-to-day across the roster, which is the same shape for each weekday and for each weekend day.

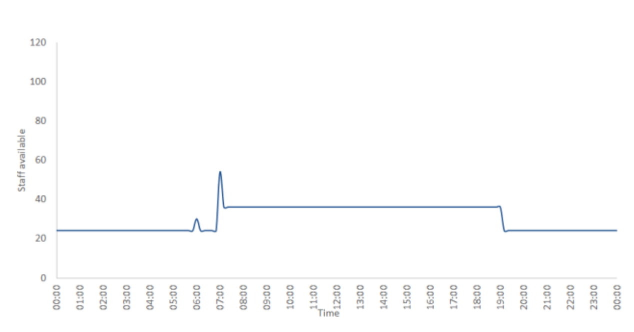
Figure B.17: Staff on the VCP roster for summer 2018



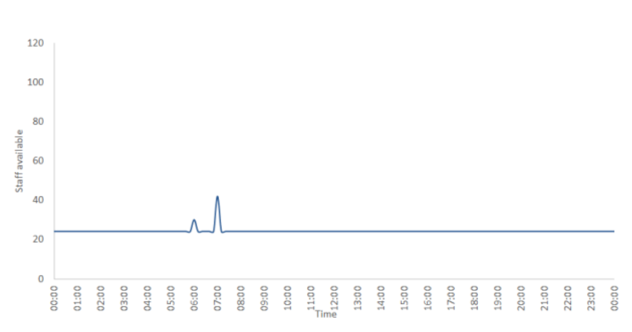
Thursday



Friday



Saturday



Source: Dublin Airport, Taylor Airey analysis

Staffing levels derived from the roster indicate a headcount of 150 with an FTE level of 143. The staff roll indicates a headcount of 159 and an FTE level of 152. VCP duties are spread over a number of locations and functions, with categories including:

- Fire Station
- Gate 1A
- Gate 32
- Post 4
- Westlands
- Split 2 and Split 4, which are assumed to be shifts split across different duties
- MBASE
- spare.

The report by Frontier Economics, commissioned by Dublin Airport has identified a potential efficiency saving of five VCP FTE based on a VCP efficiency initiative.

B.2.2. Shift lengths

The VCP shift pattern, shown in Table B.14 below, indicates an identical shift pattern each day with predominantly long, fixed shifts. Together with the uniform roster pattern this suggest that the requirement for VCP staffing is inelastic to traffic.

Table B.14: Number of shifts by shift length from the VCP summer 2018 roster

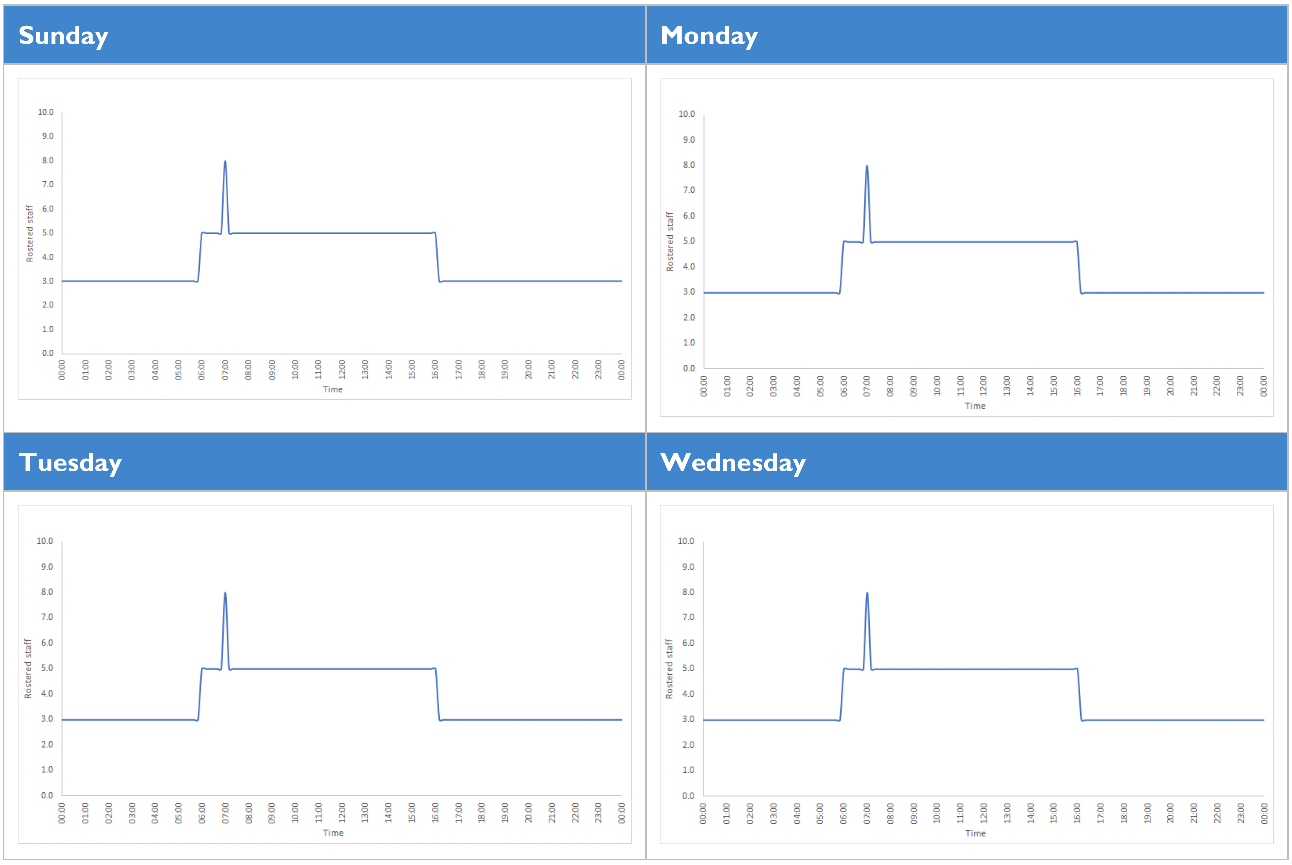
Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
≤4	2	2	2	2	2	2	2

Shift length (hours)	Sun	Mon	Tue	Wed	Thu	Fri	Sat
>4, ≤5	0	0	0	0	0	0	0
>5, ≤6	0	0	0	0	0	0	0
>6, ≤7	0	0	0	0	0	0	0
>7, ≤8	0	0	0	0	0	0	0
>8, ≤9	0	0	0	0	0	0	0
>9, ≤10	2	2	2	2	2	2	2
>10, ≤11	2	2	2	2	2	2	2
>11, ≤12	18	18	18	18	18	18	18
>12, ≤13	0	0	0	0	0	0	0
Total shifts	24	24	24	24	24	24	24

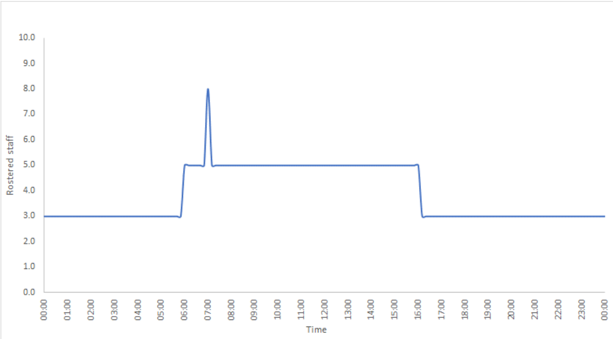
B.2.3. **Staff rostered as spare**

Figure B.18 shows the profile of staff rostered as spare on the VCP roster. This shows that three staff are on duty as spare outside of office hours and that five staff are rostered as spare during office hours.

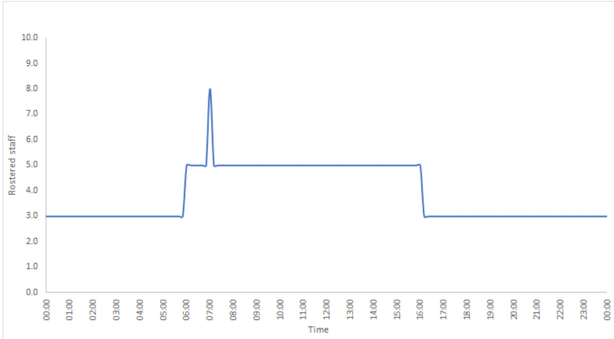
Figure B.18 Profile of staff rostered as spare on the summer 2018 VCP roster



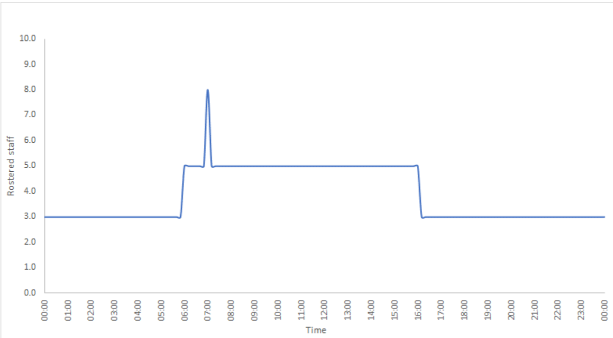
Thursday



Friday



Saturday



Source: Dublin Airport, Taylor Airey analysis

The staff rostered as spare amount to approximately 11 FTE per day and are used to cover absence. A reduction in the absence rate from 9% to 5.5% would potentially reduce the spare requirement from 11 to 7 FTE.

APPENDIX C **ELASTICITY BENCHMARKING**

C.1. **RESULTS**

This section presents the results of our analysis into how opex respond to changes in passenger traffic for a panel of twelve airports[31] between the years 2000 and 2017. We derive elasticities which we use to form benchmark estimates of how we expect Dublin Airport's opex to evolve in response to future passenger traffic.

We estimate cost elasticities of total opex, police costs, maintenance costs and utility costs with respect to passenger traffic. We perform this analysis under the assumption that the unit costs in each of these areas are comparable across all airports in our analysis.

We estimate opex elasticities using two separate econometric models. The first model assumes that the response of opex to passenger numbers is independent of airport size. The second model allows elasticities to vary with size. A more detailed discussion of the data and methodology used in this analysis can be found in Appendix C.2.

C.1.1. **Total operating expenditure**

We estimate the elasticity of total real opex to passenger traffic using data from all airports in our sample as well as from two sub-samples of airports. Airports which have an excess of 20 million passengers in 2017 are included into a 'large airport' sample[32], while all airports which do not meet this criteria are included in a 'small airport' sample. Our analysis suggests that larger airports may be able to take advantage of some scale efficiencies. The large airport sub-sample most closely matches Dublin Airport in terms of size. In 2017, the large airport sub-sample of airports had an average of 30.1 million passengers, while Dublin Airport had 29.6 million passengers over the same period.

One potential issue with estimating the elasticity of operating costs to passenger numbers is that we may be capturing dynamics other than the short-term relationship between costs and passenger numbers. The period between 2000 and 2009 was one of expansion for a large number of airports in our sample. We would expect that on average, airport expansions would be followed by a ramp-up of costs in the short-term. If such a ramp up in costs occurred during a time of increasing passenger numbers, we could econometrically obtain upwardly-biased elasticity estimates. One way to avoid this problem is to include time-variable controls as explanatory variables in our econometric methodology. The inclusion of time controls should de-trend our elasticity estimates from longer-term fluctuations in operating costs which are independent of passenger numbers. We finally also split our analysis into two time periods and independently estimate cost elasticities for the period from 2000 to 2009 and from 2010 to 2017. Table C.1 presents the econometric results of our first econometric model.

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[31] The airports under analysis are Aberdeen, Birmingham, Copenhagen, Dublin, Edinburgh, Gatwick, Glasgow, Manchester, Munich, Luton, Southampton, Stansted, and Zurich.

[32] In our sample this is Copenhagen, Dublin, Gatwick, Manchester, Munich, Stansted, and Zurich.

Table C.1: Total opex-passenger elasticities (Model 1)

Data Sample	2000-2017	2000-2009	2010-2017
Full Sample	0.37***	0.45***	0.43***
Large Airport Size Sample	0.28***	0.3***	0.42*
Small Airport Size Sample	0.46***	0.65***	0.44***

** indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*
Source: CEPA estimates

For the entire period between 2000 and 2017 we estimate the elasticity of total real opex to passenger numbers to be 0.37. We find a smaller elasticity estimate for our large airport size sample, suggesting that larger airports can maintain more stable costs in response to changes in passenger traffic. One explanation of this observation is that larger airports are able to take advantage of some scale efficiencies. We empirically test this by estimating the elasticity of opex to passenger numbers under a second econometric model (outlined in detail in section C.2.2), where elasticity is estimated as a function of airport size (measured in terms of annual passenger volume).

The estimates obtained under this econometric model also indicates that elasticity decreases with size. Table C.2 presents the results of this analysis under three hypothetical scenarios where annual passenger traffic ranges from 25 to 35 million passengers. The scenario with 30 million passengers most closely matches the passenger traffic experienced by Dublin Airport in 2017 and so forms our central scenario.

Table C.2: Total opex-passenger elasticities. (Model 2)

Data Sample	2000-2017	2000-2009	2010-2017
25 million annual passengers	0.29*	0.46	0.61**
30 million annual passengers	0.26*	0.47	0.65**
35 million annual passengers	0.24*	0.47	0.69**

Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.

For the time sample between 2000 to 2017, our elasticity estimates fall from 0.29 to 0.24 as passenger numbers rise from 25 to 35 million annual passenger numbers.

C.1.2. Police costs

Table C.3 illustrates the elasticities of police costs to passenger numbers under our first econometric model. For our entire airport sample between 2000 and 2017, we estimate the elasticity of total real police costs to passenger traffic to be 0.64. Over this time period we estimate elasticities of 0.42 for the large airport size sample and a higher elasticity of 0.99 for the small airport size sample. While we find similar results under all airport size sample for the period between 2000 and 2009, we find negative and insignificant elasticity estimates for the sample period between 2010 and 2017.

Between 2010 to 2017, recorded police costs fell across our airport sample. One possible explanation for this is that certain police functions may have been taken over to be directly run by the airports in our sample. This scenario would explain how airport expenditure on police services could fall, while passenger numbers rise.

Table C.3: Total Police Costs-Passenger elasticities (Model 1)

Data Sample	2000-2017	2000-2009	2010-2017
Full Sample	0.64***	0.52***	-0.67**
Large Airport Size Sample	0.42***	0.32**	-0.26
Small Airport Size Sample	0.99***	1.06***	-0.6

*Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*

Table C.4 outlines the elasticities of police costs to passenger numbers under our second econometric model where we allow the elasticity to change with passenger numbers. We estimate elasticities decreasing with airport size. With 25 million passengers we estimate an elasticity of 0.45 which falls to 0.41 and 0.36 as annual passengers rise to 30 and 35 million respectively.

Table C.4: Total Police Costs-Passenger elasticities (Model 2)

Data Sample	2000-2017	2000-2009	2010-2017
25 million annual passengers	0.45*	0.27**	-0.29***
30 million annual passengers	0.41*	0.2**	-0.21***
35 million annual passengers	0.36*	0.15**	-0.13***

*Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*

C.1.3. **Maintenance costs**

Table C.5 illustrates the elasticities of maintenance costs to passenger numbers under our first econometric model. For our entire airport sample between 2000 and 2017 we fail to find any significant relationships in the elasticity of maintenance costs to passenger numbers. We only find significant elasticity estimates for our small airport size sample.

Table C.5: Total Maintenance Costs-Passenger elasticities (Model 1)

Data Sample	2000-2017	2000-2009	2010-2017
Full Sample	0.07	0.18	-0.3
Large Airport Size Sample	-0.14	0.01	0.04
Small Airport Size Sample	0.41*	0.91***	0.85***

*Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*

As illustrated in Table C.6, we also fail to find any convincing elasticity estimates of maintenance costs to passenger numbers under our second econometric model. For all time periods we find negative and significant elasticity estimates.

Table C.6: Total Maintenance Costs-Passenger elasticities (Model 2)

Data Sample	2000-2017	2000-2009	2010-2017
25 million annual passengers	-0.28***	-0.09*	-0.47*
30 million annual passengers	-0.37***	-0.16*-	-0.58*
35 million annual passengers	-0.45***	-0.21*	-0.67*

*Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*

C.1.4. Utility costs

In this section we present elasticity estimates of real utility costs to passenger traffic. We note that given the potential variation in utility unit costs between the UK, Denmark, Germany, Switzerland, and Ireland, the estimates presented here can form only a rough benchmark of how we expect Dublin Airport's utility costs to evolve in response to future passenger traffic. A better measure that could be reported would be the elasticity of utility *units* used by airports. The estimates presented in this section are therefore listed as the best available benchmark elasticities for real utility costs that can be formed from available data.

Table C.7 illustrates the elasticity of utility costs to passenger numbers under our first econometric model. For our entire airport sample between 2000 and 2017 we estimate the elasticity of total real utility costs to passenger traffic to be 0.35. Over this time period we find some evidence that larger airports are more efficient in how their real utility expenditure reacts to passenger growth. We find elasticities of 1.04 and of 1.3 for our respective large and small airport size samples. Between 2010 and 2017 however, we find a negative elasticity estimate of -0.74 for our full airport sample. Without further information on airport utility unit usage, it's not clear to what extent this estimate is driven by a combination of a decline in utility unit usage and a decline in utility prices.

Table C.7: Total Utility Costs-Passenger elasticities

Data Sample	2000-2017	2000-2009	2010-2017
Full Sample	0.35*	0.35*	-0.36*
Large Airport Size Sample	0.16	1.1***	-0.74***
Small Airport Size Sample	0.5**	1.16***	-0.29

*Source: CEPA estimates; * indicates an estimate obtained at a 10% significance level, ** at a 5% level and *** at a 1% level.*

Under our second econometric model where we allow elasticity to vary with airport size, we fail to find any significant results.

C.2. METHODOLOGY

C.2.1. Data Used

We gathered all operational cost data directly through each airports annual reports and financial statements. The analysis covers the period between the years 2000 and 2017.

To obtain real operating costs, prices are first converted to average 2017/18 prices using national gross domestic product deflators. All prices are then converted into euro using 2017/18 exchange rate.

C.2.2. Estimation Methodology

Opex elasticities are obtained by ordinary-least-squared (OLS) fixed-effect (FE) regression analysis. All dependent and independent variables are first converted into logarithmic form. The dependent variable is our logarithmic measure of opex while the independent variable is the logarithm of passenger traffic.

Empirical Strategy 1

In our first empirical strategy, short-term scale elasticity (captured by the β coefficient in equation 1) is assumed to be the same for all airports in our sample. This in effect implies that regardless of the size of the airport in question, the response of opex to passenger traffic should be the same. There is no scope for economies or diseconomies of scale.

1. $log(Opex_{it}) = \alpha + \beta\, log(Pax_{it}) + \mathrm{T_t} + f_i + \varepsilon_{it}$

This econometric model includes a fixed-effect coefficient, f_i, which captures airport-specific time-invariant factors that could influence the observed elasticity values. The model also includes a time-trend component, $\mathrm{T_t}$, in order to capture medium term changes in opex which are not related to short-term passenger variation. The final term ε_{it} captures deviations from the model which are assumed to be independent of observed airport traffic in each given time period.

Empirical Strategy 2

One potential issue with the first empirical strategy is that there is no scope to assess how the *response* of opex might change. Intuitively, it can be imagined that larger or smaller airports may experience economies (or diseconomies) of scale which could influence how opex respond to changes in passenger traffic. In order to capture this potential effect, model 2 includes an additional quadratic term as an explanatory variable.

2. $log(Opex_{it}) = \alpha + \beta_1\, log(Pax_{it}) + \beta_2(log(Pax_{it}))^2 + \mathrm{T_t} + f_i + \varepsilon_{it}$

Under model 2, the elasticity of opex becomes a function of the number of passengers the airport has. The estimated sign of β_2 indicates whether elasticity is increasing or decreasing with passenger traffic.

$$\text{Model 2 Elasticity Estimate: } \beta_1 + 2\beta_2 \log(\text{Pax}_{\text{it}})$$

This specification gives a unique elasticity estimate for any specific number of airport passengers. One potential issue with this model is that it may poorly describe elasticities for passenger number outside of the inputted sample range. In other words, if model 2 is estimated using a data sample where passengers vary between 10 and 20 million per year, the functional form of elasticities within this range will be well defined. It can make no prediction on what the functional form of what opex elasticities are outside of this range and should not be used to do so.

C.2.3. Sample Selection

Models 1 and 2 are estimated using six separate data samples.

Full Airport Sample, 2000-2017	All available data for the airports between 2000 and 2017.
Large Airports, 2000-2017	Data from airports which have an annual excess of 20 million passengers in the last year of observation between 2000 and 2017. In our sample this is Copenhagen, Gatwick, Manchester, Munich, Stansted, and Zurich.

Small Airports, 2000-2017	Data from all airports which had fewer than 20 million annual passengers in the last year of observation between 2000 and 2017. In our sample this is Aberdeen, Birmingham, Edinburgh, Glasgow, Luton, and Southampton.
Full Airport Sample, 2000-2009	Data from the all airports between 2000 and 2009.
Large Airport Sample, 2000-2009	Data from all 'large airports' between 2000 and 2009.
Small Airport Sample, 2000-2009	Data from all 'small airports' between 2000 and 2009.
Full Airport Sample, 2010-2017	Data from the all airports between 2010 and 2017.
Large Airport Sample, 2010-2017	Data from all 'large airports' between 2010 and 2017.
Small Airport Sample, 2010-2017	Data from all 'small airports' between 2010 and 2017.

We estimate airport opex elasticities using three separate samples based on airport size. Intuitively we can imagine that larger (or smaller) airports may experience efficiency gains, or losses in terms of how their opex expenditure reacts to changes in passenger traffic. By estimating elasticity using restricted 'large' and 'small' airport size samples, we can see if our estimated elasticity differs between larger and smaller airports. The 'large' airport size sample has a mean number of passengers of 30.1 million in 2017, just over the 29.6 million passengers for Dublin Airport in the same time period. In contrast our small airport size sample has an average of 12 million passengers in 2017. Of our two sub-samples, the large airport size sample can be understood to closer reflect the scale of Dublin Airport and so more weight may be placed on estimates derived from this sample.

One potential issue with our elasticity estimates, is that between 2000 and 2010 UK airports undertook a large series of expansions. What we are interested in is the short-term elasticity of opex to passengers traffic. Since we would expect airport expansions to be associated with a large ramp-up in opex this expenditure could distort and bias our elasticity estimates. For example, Heathrow opened Terminal 5 in 2008 which we would expect to be associated with a large increase in opex which is not due to any short-term relationship to passenger traffic. The period from 2000 to 2010 on average saw fewer airport expansions and so we estimate separate elasticities for this period in order to more accurately estimate cost elasticities. We therefore estimate elasticities under our three airport size specifications for the time period from 2000 to 2017 and also from 2010 to 2017.

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