Assessment of the 2003/04 Handling Capacity of Dublin Airport

Report By

William Hynes & Associates Ltd

On behalf of the Commission for Aviation Regulation

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Executive Summary

The Commission for Aviation Regulation (the "Commission") has retained William Hynes & Associates Ltd. (WHA) to undertake a capacity assessment of the existing infrastructure at Dublin Airport. The methodology used to undertake this assessment is termed the '*Integrated Planning Methodology for Airport Capacity Assessment*', which consists of component models of the passenger terminal, airside and landside elements of the airport. The capacity assessment involved a detailed consultation process.

Based on the various output results of the capacity assessment of the three components, the following are the key capacity findings:

Terminal Capacity Assessment

Resulting from the terminal capacity analysis, the overall total annual terminal handling capacity is considered to be approximately 19-20 million passengers per annum (mppa), and therefore it is clear that the current capacity of the terminal is limited. Based on DAA's latest centreline forecast passenger movements, it is estimated that the hourly and annual capacities of the terminal will be reached by approximately mid-2006 to mid-2007, at which time it is estimated that additional terminal infrastructure will be required.

Airside Capacity Assessment

The aircraft stand capacity assessment has determined that, based on the year 2003, there is an overall stand capacity deficit, with a particular need for additional aircraft contact stands. Higher demand for stands in 2004 has made that deficit more acute.

Assuming mixed operations, Runway 10/28 has been assessed as having a capacity of 45 aircraft movements per hour. Based on the DAA's latest ATM forecasts, and an expected runway capacity increase due to operational alterations, the preliminary conclusion is that the capacity of Runway 10/28 will be reached by approximately 2013/14, at which time it is estimated that a second parallel runway will be required.

Analysis of the airside system indicates that, on both Runway 10 and 28, departure delays exceed the agreed acceptable delay of 8 minutes during some hours in the sample analysed. This suggests an airside infrastructure capacity deficit for departing aircraft, with the need for additional taxiway and aircraft holding infrastructure to accommodate the build-up and

queuing of departure aircraft. However, arrival delays appear to be low, with the sample indicating that the acceptable airside delay of 8 minutes is not being exceeded. This would imply that arriving aircraft are being readily accommodated on the taxiways and on approaching parking stands.

Landside Capacity Assessment

Analysis of the landside component has indicated that the Departures Landside Kerb, certain parts of the Arrivals Landside Kerb, Short-Term Car Parking and Coach Parking elements have varying levels of spare capacity. However, parts of the Arrivals Landside Kerb and Long-Term Car Parking have inadequate capacity.

Summary

Therefore, the initial assessment of the current handling capacity of Dublin Airport indicates that many elements of the airport complex are at, or near capacity. Consequently, infrastructure investment and development will be required in the near future to cater for the forecast demand for passenger and aircraft movements.

Section One

1. Introduction

This report sets out the findings of an initial capacity assessment of existing infrastructure at Dublin Airport by WHA on behalf of the Commission for Aviation Regulation (the "Commission"). It was undertaken to assist the Commission in making a determination specifying the maximum levels of airport charges that may be levied by Dublin Airport Authority at Dublin Airport. It is important to note that the findings and outputs are provisional and that the capacity analysis is subject to consultation and ongoing revision and refinement.

The methodology used to undertake this assessment is termed the "Integrated Planning Methodology for Airport Capacity Assessment" [1], which consists of component models of the passenger terminal, airside and landside elements of the airport. These are used to determine a handling capability of existing airport infrastructure.

The assessment commenced in October 2004, in parallel with the commencement of the Commission's determination process and has involved a consultation process with the relevant parties, consisting of methodological presentations and detailed meetings. The parties involved included the Dublin Airport Authority, the Irish Aviation Authority and the Airport Operators Committee. An integral part of the study has been the acquisition of information, including voluminous aircraft and passenger movement records, survey data in respect of usage patterns, as well as information necessary to include the precise physical characteristics of the airport in terms of space, facility location etc. in the analysis.

The purpose of the assessment is to estimate, based on current demand, the extent to which the current infrastructure is subject to capacity surpluses or deficits and, in the case of capacity surpluses, to estimate the likely duration of these surpluses based on forecasted future demand. Capacity deficits, on the other hand, require identification of the infrastructure investment necessary to address those deficits.

Since 2002, a number of capacity studies of Dublin Airport have been undertaken by various groups of consultants, namely, Dublin Airport Transport Study (2002)[2], Dublin Airport Runway

[1] The '*Integrated Planning Methodology for Airport Capacity Assessment'* has been developed by Dr. William Hynes through independent research at UCD. This '*Planning Methodology'* uses aviation industry standards and integrates these through a series of analytical models.

[2] Undertaken by Parsons Brinckerhoff on behalf of Aer Rianta.

Capacity Study (2003)[3], Dublin Airport Baseline Report (2003)[4] and Dublin Airport Capacity Study (2004)[5]. A summary of the overall capacity findings of these studies, together with the related findings of WHA, is set out in Appendix 1.

The remainder of this report is structured as follows. Section Two sets out a brief description of the Integrated Planning Methodology for Airport Capacity Assessment. Section Three details the findings of this initial assessment, while Section Four sets out the next steps for the study.

[3] Undertaken by National Air Traffic Services Ltd. (NATS) on behalf of Aer Rianta.

[4] Undertaken by Project Management International (PM) in association with Skidmore Owings Merrill (SOM) and TPS Consult (TPS) on behalf of Aer Rianta.

[5] Undertaken by Alan Stratford & Associates on behalf of the Commission for Aviation Regulation.

Section Two

2. Capacity Assessment Methodology

2.1 Introduction

As part of the consultation process, the Integrated Planning Methodology for Airport Capacity Assessment was presented by WHA Ltd. at a workshop on 7th October 2004 at the Great Southern Hotel, Dublin Airport and at further meetings with interested parties. Two follow up presentations were made to Dublin Airport Authority on 2nd November 2004, and to the Airport Operators Committee on 7th December 2004.

2.2 Summary of Capacity Assessment Methodology[6]

The methodology assesses airport capacity based on the provision of a certain pre-defined level of service (by reference to the IATA Level of Service framework) and is designed to determine capacity deficits or surpluses, based on current levels of demand, in each of the three components of the airport system, i.e. Terminal, Airside and Landside. This is achieved through the development of a series of individual analytical models.

However, the methodology allows for an integrated approach to the analysis of the individual components by linking the hourly flow rates through the airport system, i.e., of aircraft through the airside, of passengers through the terminal, and of passengers and surface vehicles through the landside. The levels of demand used in the assessment are based on the idea of choosing typical peaks according to the Busy Hour Rate (BHR) and variations thereof. [7]

The methodology employs detailed analytical mathematical capacity assessment calculations and is based on extensions, modifications and advancements of existing capacity models/methods (Hynes, 2003).

The following sub-sections set out briefly the three separate component models of the Integrated Planning Methodology:

[6] A detailed technical summary of the methodology to be used for the assessment of the current handling capacity of Dublin Airport was posted on the Commission's web site on 1st October 2004, and is available for consultation.

[7] Busy Hour Rate (BHR) – this is a modification of the Standard Busy Rate (SBR) (Ashford, Stanton and Moore, 1997), and is the hourly traffic rate (generally passenger traffic) at or below which 95% of the annual traffic can be handled at an airport without overcrowding and, therefore, at which passengers experience an acceptable '*level of service*'. The BHR method is at present widely used by the British Airports Authority (BAA).

2.2.1 Terminal Component Model

The Terminal Component Model assesses the capacity of the areas and processes of the airport terminal component in relation to their handling capability based on a certain level of passenger demand movement rates, over a sustained hourly time period.

2.2.2 Airside Component Model

The Airside Component Model determines the capacity of the airport airside component in relation to aircraft handling capability based on a certain level of aircraft demand movement rates, over a sustained hourly time period.

The Airside Component Model itself consists of three sub-models, namely:

- Airside Stand Capacity Model;
- Airside Runway Capacity Model, and;
- Airside Delay and Capacity Model.

2.2.3 Landside Component Model

The Landside Component Model assesses the capacity of certain elements of the landside of the airport in relation to their handling capability based on a certain level of vehicular and passenger demand movement rates, over a sustained hourly time period. This is related to the determination of typical busy hour passenger and vehicle flow rates. The landside assessment includes kerb requirements for departures and arrivals, car parking for short- and long-term requirements, as well as parking space for coaches.

2.3 Summary

The Integrated Planning Methodology for Airport Capacity Assessment is used to assess the current handling capacity of Dublin Airport. Three component models' outputs give both capacity demand and capacity supply figures, which allow for the determination of a capacity shortfall or surplus. Based on these outputs it is possible to determine which component, or element of a component, may be restricting the capacity of the overall airport system. Terminal and landside outputs are generally analysed on an hourly basis. However, airside outputs are also analysed on a daily basis as the characteristics of the users are constantly changing on the airside.

Section Three

3 Initial Findings of the Capacity Assessment Study

3.1 Introduction

The preliminary findings outlined in this section of the report are primarily based on the use of 2003 passenger, aircraft and vehicular data (both actual and sample surveys). However, due to insufficient or unavailable data for 2003, 2004 data was used for car parking assessment.

3.2 Terminal Capacity Assessment

The **Terminal Component Model** enables the capacity of Dublin Airport's terminal to be determined. The following is an outline of the steps involved in the development of the Terminal Component Model:

- Establish demand by selecting the typical peak (or busy) departing and arriving passenger hourly movement/flow rates through the various areas and processes of the terminal building. Table 3.1 below shows the passenger Busy Hour Rates, together with the annual terminal passenger throughput rates, for departures and arrivals at Dublin Airport for the year 2003.

Table 3.1: Passenger Busy Hour Rates and Annual Terminal Throughput Rates - Dublin Airport (2003).

	Departures BHRs	Departures Annual Terminal Throughput Rates (mppa)	Arrivals BHRs	Arrivals Annual Terminal Throughput Rates (mppa)	Total Annual Terminal Throughput Rates (mppa)
Terminal	2,491	7.89	2,290	7.88	15.77
Pier A	1,178	3.60	1,112	3.56	7.17
Pier B	1,058	2.35	961	2.29	4.64
Pier C	868	1.87	821	1.87	3.75

- The measurement of the departure and arrival areas and processes (see Table 3.2 and Table 3.3). These areas and processes are the individual elements involved in processing passengers through the terminal as a whole. [They are divided as follows: general departures, pier departures, pier arrivals and general arrivals.]
- The capacity assessment mathematical calculations for each of the departure and arrival areas and processes, which make use of principal airport terminal capacity parameters and area parameters. These parameters are based on survey data, measurement analysis and the application of best practice, and are incorporated into the mathematical calculations
- The drawing together of the various departures and arrivals operational areas and associated capacity assessments. This will highlight the demand/supply balance in the different parts of the airport terminal, and thus assess where there are capacity shortfalls and surpluses.
- Tables 3.2 and 3.3 below illustrate, respectively, the departures and arrivals areas and processes analysed, and the associated hourly and annual handling capacities based on the mathematical calculations. Note that the annual handling capacities where applicable relate to both total terminal passenger throughput (departures and arrivals) for general terminal areas and processes, and total pier throughput (departures and arrivals) for pier areas and processes. For the purposes of this analysis it has been assumed that the conversion of hourly capacities to annual capacities is based on a constant relationship. This assumption is based on 2003 data, from which a constant ratio between throughput BHRs and annual throughput rates was calculated. However, this relationship is not expected to remain so into the future, and therefore, a more detailed analysis of this relationship will be required based on forecast passenger demand at Dublin Airport.
- Based on the analysis set out in Tables 3.2 and 3.3, and with reference to Table 3.1, the following are the key findings:
    - Based on current passenger demand a number of the terminal areas and processes have spare capacity, albeit this is limited for most. These areas and processes are Departures Concourse, Check-In, Boarding-Card Check and Passenger Search, Departures Airside Street, Departures Airside Lounge/Gate – Piers' A and C, Departures Airside Customs & Border Protection (CBP) - Pier B, Arrivals Through-Routes – Piers' A, B and C, Arrivals Baggage Reclaim, Arrivals Customs and Arrivals Concourse (based on observation of the process by WHA). The capacity of the Arrivals Concourse is extremely high due to the surveyed (DAA, 2004) passenger dwell time of 1.4 minutes, which is considered an underestimate.

  - However, some areas and processes have a capacity deficit, namely, Departures Airside Lounge/Gate - Pier B and Arrivals Immigration – Piers' A, B and C.
  - Therefore, the overall total annual terminal handling capacity is considered to be approximately 19-20mppa, based on the core critical areas and processes.

- Based on the above findings, and analysing the DAA's latest forecast passenger movements (Dublin Airport Passenger & Aircraft Movements Demand Forecast Report – March 2005), it is clear that the current capacity of the terminal is limited, and an initial assessment indicates that the hourly and annual capacities of the terminal will be reached by approximately mid-2006 to mid-2007, at which time additional passenger terminal infrastructure will be required.

Table 3.2: Analysis of Departures Hourly and Total Annual Handling Capacities – Dublin Airport (2003).

Terminal	Hourly Handling Capacity (pax/hr)	Total Annual Terminal Handling Capacity - Terminal (mppa)	Total Annual Pier Handling Capacity - Terminal (mppa)	Total Annual Throughput Rates – Terminal (mppa)
Departures				
Departures Concourse	3,251	20.58	-	15.77
Check-In (Business, Economy, including SSKs)	4,368	27.65	-	15.77
Boarding-Card Check	Incorporated into Pax Search	Incorporated into Pax Search	-	15.77
Departures Passenger Search	2,904	18.39	-	15.77
Departures Airside Street (Centralised)	3,772	21.28	-	15.77
Departures Airside Lounge/Gate - Pier A	1,465	-	8.91	7.17
Departures Airside Lounge/Gate - Pier B	1,051	-	4.61	4.64
Departures Airside Lounge/Gate - Pier C	1,469	-	6.35	3.75
Departures Airside Customs & Border Protection (CBP) - Pier B	3,071	-	13.47	4.64

Table 3.3: Analysis of Arrivals Hourly and Total Annual Handling Capacities – Dublin Airport (2003).

Terminal	Hourly Handling Capacity (pax/hr)	Total Annual Terminal Handling Capacity - Terminal (mppa)	Total Annual Pier Handling Capacity - Terminal (mppa)	Total Annual Throughput Rates – Terminal (mppa)
Arrivals				
Arrivals Through-Route - Pier A	1,875	-	12.09	7.17
Arrivals Through-Route - Pier B	1,500	-	7.24	4.64
Arrivals Through-Route - Pier C	1,500	-	6.85	3.75
Arrivals Immigration – Pier A	672	-	4.33	7.17
Arrivals Immigration – Pier B	626	-	3.02	4.64
Arrivals Immigration – Pier C	698	-	3.19	3.75
Arrivals Baggage Reclaim	2,711	18.67	-	15.77
Arrivals Customs[8]	-	-	-	15.77
Arrivals Concourse	6,700	46.14	-	15.77

[8] Arrivals Customs capacity analysis has still to be completed.

3.3 Airside Capacity Assessment

The capacity assessment of Dublin Airport's airside component has been undertaken using the **Airside Component Model**. The steps involved in this component model, and the associated outputs and findings, are as follows:

- Establish demand by selecting the departing and arriving aircraft typical hourly movement/flow rates through the various sub-systems of the airside system. The resulting typical busy (integrated) four-hourly aircraft movement rate was chosen as an average of approximately 36.75 aircraft movements per hour over the four-hour period, with a total of 593 aircraft movements over the complete day (i.e. 14/09/03), with aircraft using Runway 28. In addition, it was necessary to determine a second typical busy (integrated) four-hourly aircraft movement rate for aircraft primarily using Runway 10 for the purposes of undertaking the airside delay analysis. This period was determined as having an average of approximately 37.25 aircraft movements per hour over the four-hour period, with a total of 552 aircraft movements for the complete day (i.e. 24/08/03).
- The development and application of the **Airside Stand Capacity Model** – which involved the following (based on the analysis of the four-hour period and day of 14/09/03);
    - Calculation of Aircraft Stand Occupancy Times[9] (or aircraft stand utilisation times) of aircraft departing and arriving during the typical busy four-hour period based on aircraft code (ICAO), aircraft maximum take-off weight (MTOW), aircraft category and aircraft wing-span. This is an essential part of the Airside Stand Capacity Model, as aircraft codes are categorised based on aircraft wing-span, and based on the aircraft stand configuration there will be aircraft stand positions that cannot cater for aircraft which have a wing-span of a certain dimension. Therefore, this occurrence can have a significant impact on the capacity of the aircraft parking stand positions.
    - Determination of actual aircraft stand parking locations at Dublin Airport (i.e. central apron, north apron, etc.) and wing-span capacity of the aircraft parking stands. It is necessary to further sub-divide aircraft according to wing-span codes because limitations on wing-span handling capability apply to parking stands. The analysis set out in Table 3.4 below reports this subdivision.

[9] When calculating the stand utilisation times for aircraft that stay overnight on a stand certain occupancy time rules/restrictions have been applied in order to assess the requirements based on operational efficiencies. This has been undertaken to overcome the issue of aircraft dwelling inordinate lengths of time on stands due either to lack of aircraft stand demand or particular airline operational schedules associated with the aircraft.

- Calculation of aircraft parking stand capacity to cater for the level of aircraft demand, and associated stand occupancy times.
- Having completed this calculation, it is possible to assess whether or not the current stand provision and configuration (year 2003) at the airport is capable of handling the determined demand[10].

Table 3.4: Aircraft Stand Classification

Aircraft Stand Classification

General ICAO Stand Code	A'craft Code (ICAO)	Detailed Stand Code	Notes
A	Code A - up to but not including 15m	A1	Max Wing-Span Capacity 14.99m
B	Code B - from 15m up to but not including 24m	B1	Max Wing-Span Capacity 20.00m
B		B2	Max Wing-Span Capacity 23.80m
C	Code C - from 24m up to but not including 36m	C1	Max Wing-Span Capacity 26.40m
C		C2	Max Wing-Span Capacity 28.35m
C		C3	Max Wing-Span Capacity 28.90m
C		C4	Max Wing-Span Capacity 29.00m
C		C5	Max Wing-Span Capacity 30.20m
C		C6	Max Wing-Span Capacity 30.70m
C		C7	Max Wing-Span Capacity 34.10m
C		C8	Max Wing-Span Capacity 34.40m
D	Code D - from 36m up to but not including 52m	D1	Max Wing-Span Capacity 38.10m
D		D2	Max Wing-Span Capacity 44.84m
D		D3	Max Wing-Span Capacity 45.30m
D		D4	Max Wing-Span Capacity 47.50m
D		D5	Max Wing-Span Capacity 47.60m
E	Code E - from 52m up to but not including 65m	E1	Max Wing-Span Capacity 60.30m
E		E2	Max Wing-Span Capacity 64.94m
F	Code F - from 65m up	F1	Max Wing-Span Capacity 65.00m
F		F2	Max Wing-Span Capacity 73.30m

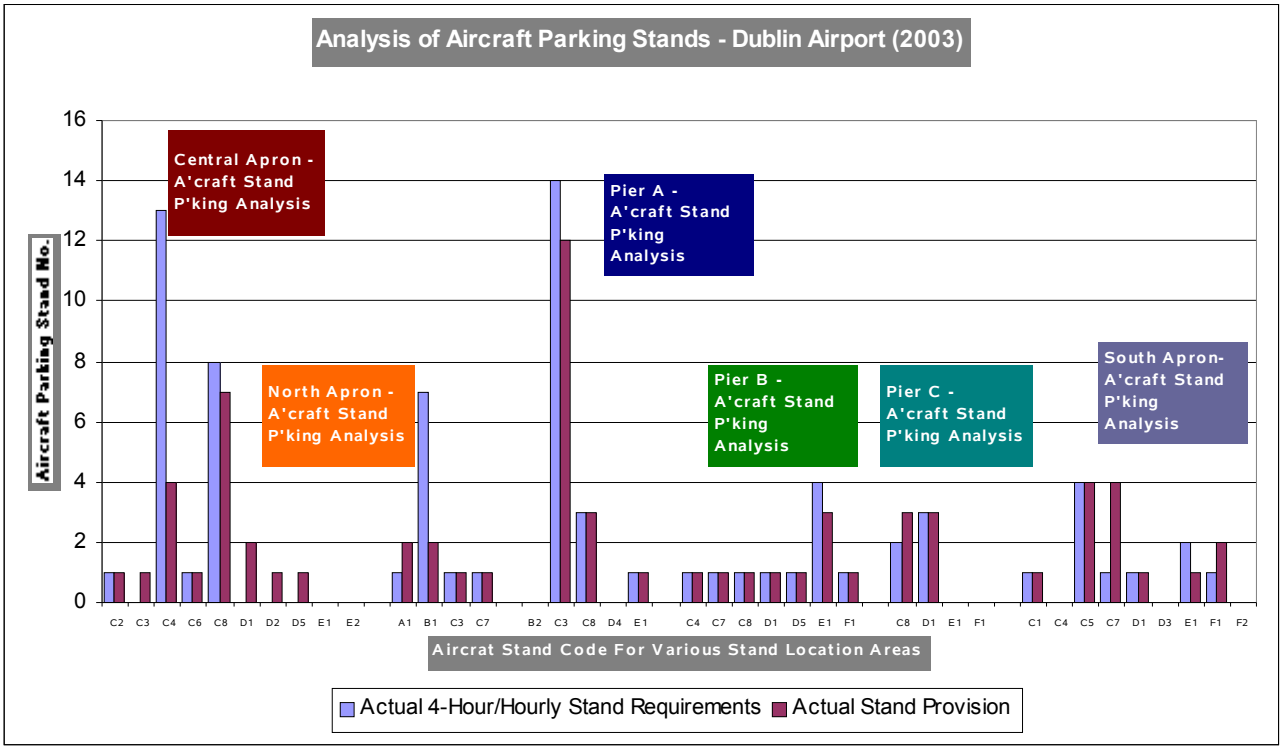
- Based on this analysis, the current stand provision and configuration was sufficient to handle 2003 demand at Pier C and South Apron, with a very limited level of spare capacity. However, at the Central Apron, North Apron, Pier A and Pier B, there is a measured capacity deficit, with almost all stands

[10] Aircraft movements that occurred outside the typical busy four-hour period but that were parked on stands during this four-hour period have been excluded from the assessment, as have the actual parking stands occupied by these aircraft, when comparing demand with supply. The rationale for excluding these aircraft is that the assessment is concerned with the ability to accommodate aircraft movement demand that occurred during the typical busy four-hour period. In addition, the actual parking stands occupied by these aircraft have been excluded from the assessment. Generally, these aircraft were parked on non-contact stands, with approximately half being parked in the light aircraft parking locations.

operating at capacity. Five stand types had insufficient capacity. Chart 3.1 below illustrates these findings.

- Therefore, in summary, based on the aircraft parking stand demand analysis, there appears to be an overall stand capacity deficit, with a particular need for additional aircraft contact stands. It is assumed that higher levels of demand have accentuated the need for additional aircraft parking stands in 2004.

Chart 3.1: Analysis of Aircraft Parking Stands - Dublin Airport (2003)



- The development and application of the **Airside Runway Capacity Model** to determine the current handling capacity of Dublin Airport's Runway 10/28. The model used is based on the original *'Blumstein Runway Landing Capacity Model'* (1959) and the various extensions that have been made to the *'Blumstein Model'* over time[11]. It applies the 2004/05 operational procedures implemented at the Dublin Airport air traffic control centre by the Irish Aviation Authority (IAA). In determining the handling capacity of Runway 10/28 the following capacity definition is applied: (known as *'Ultimate Capacity'*, *'Saturation Capacity'* or *'Throughput Rate'*) - "*the maximum number of aircraft operations that an airfield can accommodate during a specified interval of time when there is a continuous demand for service, i.e., there are always aircraft ready to take off or land*" (FAA - as quoted by Horonjeff and McKelvey, 1994, pp. 300). This means that aircraft delay is excluded from the capacity assessment. In calculating the capacity of Runway 10/28 it is assumed that an aircraft is positioned within the Final Approach to the runway for landing, which is a realistic assumption based on discussions with the Irish Aviation Authority (IAA) (December, 2004). Therefore, in carrying out these calculations, the mean position of a trailing aircraft is assumed to be the minimum separation between the leading and trailing aircraft. The calculations and end result(s) give the runway's maximum '*throughput rate*' or '*throughput capacity*' over an hourly period.
- The steps involved in the development and application of the Airside Runway Capacity Model are as follows (based on the analysis of the four-hour period and day of 14/09/03):
    - Classification of the various aircraft into categories[12]. In addition, it is necessary to further classify departure aircraft into 4 groupings based on runway take-off speeds, as set out by the IAA.
    - Measurement of the average runway occupancy time for arrivals and departures.
    - Development of the Arrivals Model to determine the capacity of the runway to service only arrivals (A-A). (The outputs from this model are applicable to both Runway 10 and Runway 28 as the separation rules are common to both.)

[11] Generally, these extensions have been made by Airborne Instruments Laboratory/FAA (1963) (determination runway capacity through *'steady state queuing theory'*), Harris/MITRE/FAA (1974) (models for the assessment of the 'ultimate capacity' of a runway), FAA (1976, 1981, 2001) (techniques for determining runway capacity and delay), and Gilbo (1993) ('runway capacity envelope'), and particularly by the undertaking of this runway capacity assessment.

[12] Aircraft classification is based on Light Aircraft (LT); Medium Turbo-Propellers (MTP); Medium Jets (MJ); Heavy Jets (HJ)) based on the Aircraft Maximum Take-Off Weight (MTOW) - Categories, i.e. Light Aircraft (LT) (either Propellers or Jets) - up to and including 7,000kgs; Medium Turbo-Propellers (MTP) - 7,001kgs up to and including 48,000kgs; Medium Jets (MJ) - from 7,001kgs up to and including 136,000kgs; Heavy Jets (HJ) - from 136,001kgs upwards. In addition, classify Departure Aircraft into 4 Groupings based on runway take-off speeds.

- Development of the Departures Model to determine the capacity of the runway to service only departures (D-D). (The outputs from this model are applicable to both Runway 10 and Runway 28.)
- Development of the Mixed Operations Model to determine the capacity of the runway system to service mixed operations based on an arrivals-departures-arrivals (A-D-A) sequence. It is necessary to undertake separate analysis for both Runway 10 and Runway 28, as there are different arrivals Runway Occupancy Times and also different departure Line-Up Times for aircraft using each of the two runway directions.
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- Assessment of the capacity of the runway based on the sequencing of aircraft under various scenarios, namely, during the selected typical busy four-hour period, during the entirety of the selected day 14/09/03, and for each hour of the selected day. Table 3.5 and Chart 3.2 illustrate the capacity calculations for Runway 10/28 at Dublin Airport. These give various hourly capacity assessments. The most applicable measure of the runway's maximum '*throughput rate*' is that based on mixed operations because it most closely reflects the actual sequencing for the flight schedule of 14/09/03. This shows that Runway 10/28 can handle a maximum of 45 aircraft movements per hour, with a minimum handling capacity of 33 aircraft movements per hour.
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- In general these output measures are similar to the NATS results (Dublin Airport Runway Capacity Study - Assessment of Runway Capacity for Summer 2004 - Final Report, NATS, 2003), based on its methodology. In that

study, NATS concluded that Runway 10/28 can handle a total maximum of 44 aircraft movements per hour, with a minimum handling capacity of 32 aircraft movements per hour. However, the NATS capacity assessment includes an allowance for aircraft delay.

- The Dublin Airport Runway Capacity Group (DA-RCG) has developed a strategy to maximise the capacity of Runway 10/28, resulting in a 5 movement increase during peak hours and, therefore, a total maximum aircraft movements per hour of 49/50, and to increase the hourly sustainable capacity to approximately 44 movements per hour.
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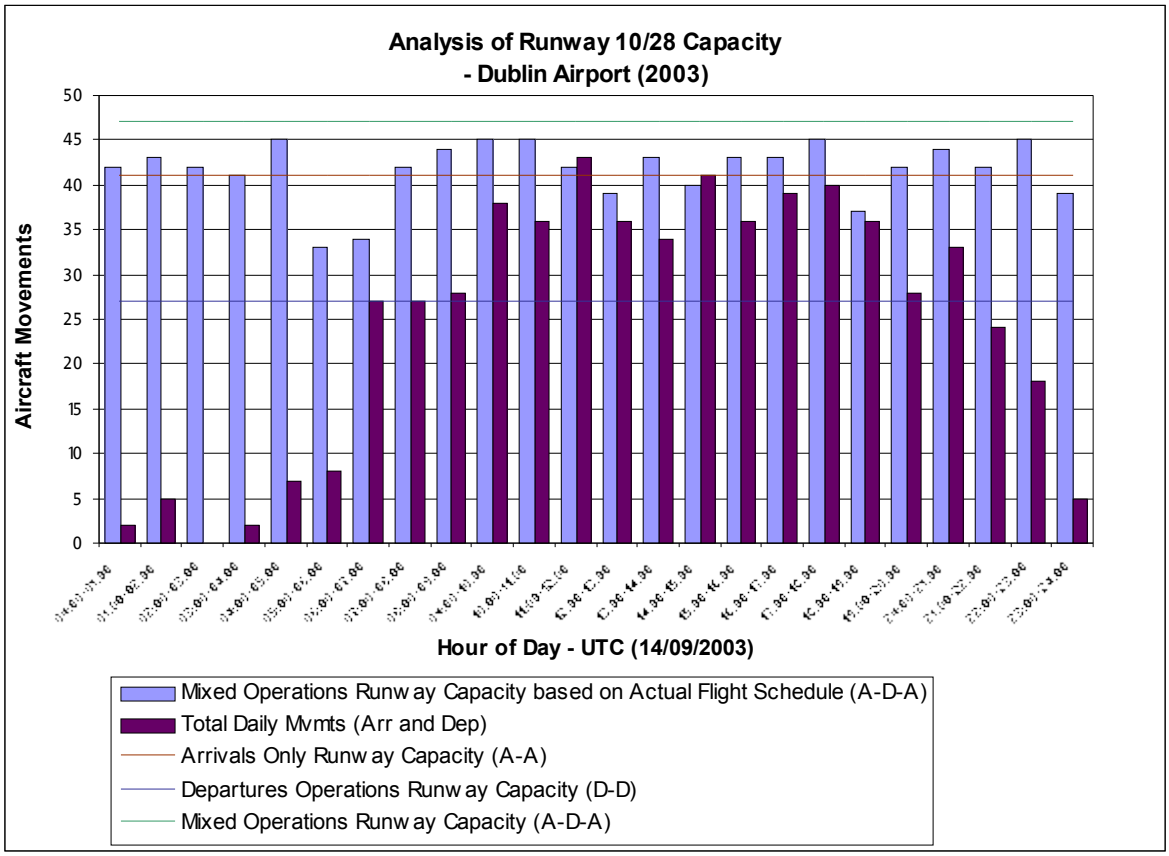
- Therefore, based on the maximum mixed operations runway capacity of 45 aircraft movements per hour (as determined under this current study) and the DA-RCG's expected runway capacity increase, and analysing the DAA's latest forecast aircraft movements (Dublin Airport Passenger & Aircraft Movements Demand Forecast Report – March 2005), an initial assessment indicates that the hourly capacity of Runway 10/28 will be reached by approximately 2013/14, at which time a second parallel runway will be required.

Table 3.5: Analysis of Runway Capacity 10/28 – Dublin Airport (2003)

Analysis of the Capacity of Runway 10/28
Dublin Airport (2003)

Date	Hour of Day (UTC)	A-A Mvmts	D-D Mvmts	A-D-A Mvmts	Total Mvmts	Arrivals Operations Runway Capacity (A-A)	Departures Operations Runway Capacity (D-D)	Mixed Operations Runway Capacity (A-D-A)	Mixed Operations Runway Capacity based on Actual Flight Schedule (A-A, D-D, A-D-A)	Mixed Operations Runway Capacity based on Typical Busy 4-Hour Mvmts (A-D-A)	Mixed Operations Runway Capacity based on Overall Day Mvmts (A-D-A)
14/09/2003	00:00-01:00	1	0	1	2	41	27	47	42	41	42
14/09/2003	01:00-02:00	2	0	3	5	41	27	47	43	41	42
14/09/2003	02:00-03:00	0	0	0	0	41	27	47	42	41	42
14/09/2003	03:00-04:00	2	0	0	2	41	27	47	41	41	42
14/09/2003	04:00-05:00	3	0	4	7	41	27	47	45	41	42
14/09/2003	05:00-06:00	2	5	1	8	41	27	47	33	41	42
14/09/2003	06:00-07:00	0	18	9	27	41	27	47	34	41	42
14/09/2003	07:00-08:00	6	5	16	27	41	27	47	42	41	42
14/09/2003	08:00-09:00	6	2	20	28	41	27	47	44	41	42
14/09/2003	09:00-10:00	6	2	30	38	41	27	47	45	41	42
14/09/2003	10:00-11:00	3	2	31	36	41	27	47	45	41	42
14/09/2003	11:00-12:00	1	10	32	43	41	27	47	42	41	42
14/09/2003	12:00-13:00	5	13	18	36	41	27	47	39	41	42
14/09/2003	13:00-14:00	14	3	17	34	41	27	47	43	41	42
14/09/2003	14:00-15:00	5	13	23	41	41	27	47	40	41	42
14/09/2003	15:00-16:00	6	6	24	36	41	27	47	43	41	42
14/09/2003	16:00-17:00	8	5	26	39	41	27	47	43	41	42
14/09/2003	17:00-18:00	3	3	34	40	41	27	47	45	41	42
14/09/2003	18:00-19:00	1	17	18	36	41	27	47	37	41	42
14/09/2003	19:00-20:00	13	3	12	28	41	27	47	42	41	42
14/09/2003	20:00-21:00	10	2	21	33	41	27	47	44	41	42
14/09/2003	21:00-22:00	5	5	14	24	41	27	47	42	41	42
14/09/2003	22:00-23:00	6	0	12	18	41	27	47	45	41	42
14/09/2003	23:00-24:00	0	2	3	5	41	27	47	39	41	42

Chart 3.2: Overall Analysis of Runway Capacity 10/28 – Dublin Airport (2003)



- The

- development and application of the **Airside Delay and Capacity Model** for the determination of current airside delay for Dublin Airport. Two typical busy (integrated) four-hour periods for aircraft movements for the year 2003 were analysed. These periods relate to the separate use of Runway 10 and 28 for arrivals and departures. To allow for the assessment of airside delay, the level of delay agreed by the DA-RCG is used. The steps involved in the development and application of the Airside Delay and Capacity Model are as follows (based on the analysis of the four-hour periods and days of 14/09/03 and 24/08/03):
    - Determination of average undelayed taxiing times between runway and aircraft parking stands (and vice versa) for stands located in each of the Central Apron, North Apron, Pier A, Pier B, Pier C and South Apron. These times are taken from or based on Dublin Airport Runway Capacity Study - Assessment of Runway Capacity for Summer 2004 - Final Report (NATS, 2003).
    - Measurement of actual times from stand location to runway (10 and 28) for departures and from runway to blocks on for arrivals. These calculations use the daily flight schedule to establish the stand push-back and runway wheels-up times for departing aircraft, and the runway touch-down and stand blocks on times for arriving aircraft throughout the entire two days selected (i.e. 14/09/03 and 24/08/03).
    - The calculation for both Runway 10 and 28 of the average airside delay for arrivals and departures. Table 3.6 and Charts' 3.3 and 3.4 below illustrate the analysis of the daily airside delay for Runway 10 and 28 for arrivals and departures, and the corresponding average delay (i.e. the resulting delay based on the analysis of both arrivals and departures combined). The sample analysed indicates that the departures delay on both Runway 10 and 28 exceed the agreed acceptable airside delay of 8 minutes.
    - This analysis indicates an airside infrastructure capacity deficit for departing aircraft. There is a need for additional taxiway and aircraft holding infrastructure to accommodate the build-up and queuing of departure aircraft.
    - For arrivals, the levels of delay experienced are low, with the sample indicating that the agreed acceptable airside delay of 8 minutes is never exceeded. This would imply that arriving aircraft are readily accommodated on the taxiways and on approaching parking stands.

Table 3.6: Analysis of Aircraft Airside Delay Associated with Runway 10/28 – Dublin Airport (2003)

Analysis of Aircraft Airside Delay Associated with Runway 10/28
Based on Selected Flight Schedules - Dublin Airport (2003)

	Runway 10								Runway 28							
Hour of Day - UTC	Date	Arrival Mvmts	Depart-ure Mvmts	Total Mvmts	Arrival Mvmts Delay	Depart-ure Mvmts Delay	Av. Arr & Dep Mvmts Delay	Accept-able Level of Delay	Date	Arrival Mvmts	Depart-ure Mvmts	Total Mvmts	Arrival Mvmts Delay	Depart-ure Mvmts Delay	Av. Arr & Dep Mvmts Delay	Accept-able Level of Delay
00:00-01:00	24/08/2003	0	0	0	00:00	00:00	00:00	08:00	14/09/2003	1	1	2	00:00	00:00	00:00	08:00
01:00-02:00	24/08/2003	0	0	0	00:00	00:00	00:00	08:00	14/09/2003	4	1	5	00:20	01:52	01:06	08:00
02:00-03:00	24/08/2003	0	0	0	00:00	00:00	00:00	08:00	14/09/2003	0	0	0	00:00	00:00	00:00	08:00
03:00-04:00	24/08/2003	0	0	0	00:00	00:00	00:00	08:00	14/09/2003	2	0	2	00:00	00:00	00:00	08:00
04:00-05:00	24/08/2003	2	0	2	00:00	00:00	00:00	08:00	14/09/2003	5	2	7	00:23	02:13	01:18	08:00
05:00-06:00	24/08/2003	1	6	7	00:00	00:51	00:25	08:00	14/09/2003	2	6	8	00:48	01:36	01:12	08:00
06:00-07:00	24/08/2003	4	20	24	00:58	02:07	01:32	08:00	14/09/2003	5	22	27	00:00	04:06	02:03	08:00
07:00-08:00	24/08/2003	13	13	26	00:09	03:15	01:42	08:00	14/09/2003	14	13	27	01:01	02:59	02:00	08:00
08:00-09:00	24/08/2003	17	7	24	00:13	03:50	02:01	08:00	14/09/2003	16	12	28	01:16	03:12	02:14	08:00
09:00-10:00	24/08/2003	11	11	22	00:17	22:00	11:09	08:00	14/09/2003	21	17	38	01:54	02:59	02:27	08:00
10:00-11:00	24/08/2003	18	18	36	01:00	20:20	10:40	08:00	14/09/2003	18	18	36	03:10	06:11	04:41	08:00
11:00-12:00	24/08/2003	17	22	39	00:08	12:37	06:23	08:00	14/09/2003	17	26	43	00:07	11:24	05:45	08:00
12:00-13:00	24/08/2003	17	24	41	00:13	17:13	08:43	08:00	14/09/2003	14	22	36	00:38	01:56	01:17	08:00
13:00-14:00	24/08/2003	14	18	32	00:06	09:49	04:57	08:00	14/09/2003	23	11	34	01:05	03:04	02:05	08:00
14:00-15:00	24/08/2003	21	18	39	00:04	02:33	01:19	08:00	14/09/2003	16	25	41	00:11	03:12	01:41	08:00
15:00-16:00	24/08/2003	18	23	41	00:38	03:44	02:11	08:00	14/09/2003	18	18	36	00:48	02:42	01:45	08:00
16:00-17:00	24/08/2003	19	16	35	00:00	00:51	00:25	08:00	14/09/2003	21	18	39	00:25	04:34	02:30	08:00
17:00-18:00	24/08/2003	22	20	42	00:16	09:06	04:41	08:00	14/09/2003	20	20	40	00:52	10:39	05:45	08:00
18:00-19:00	24/08/2003	14	21	35	00:01	02:47	01:24	08:00	14/09/2003	10	26	36	00:00	06:43	03:22	08:00
19:00-20:00	24/08/2003	18	12	30	00:43	03:15	01:59	08:00	14/09/2003	19	9	28	00:27	01:58	01:13	08:00
20:00-21:00	24/08/2003	17	15	32	00:02	08:54	04:28	08:00	14/09/2003	21	12	33	00:24	03:30	01:57	08:00
21:00-22:00	24/08/2003	14	3	17	00:53	00:18	00:36	08:00	14/09/2003	12	12	24	00:10	01:26	00:48	08:00
22:00-23:00	24/08/2003	13	8	21	00:32	03:14	01:53	08:00	14/09/2003	12	6	18	00:00	03:20	01:40	08:00
23:00-24:00	24/08/2003	3	4	7	00:00	03:49	01:55	08:00	14/09/2003	1	4	5	00:00	01:56	00:58	08:00

Chart 3.3: Analysis of Aircraft Airside Delay - Runway 10 - Dublin Airport (2003)

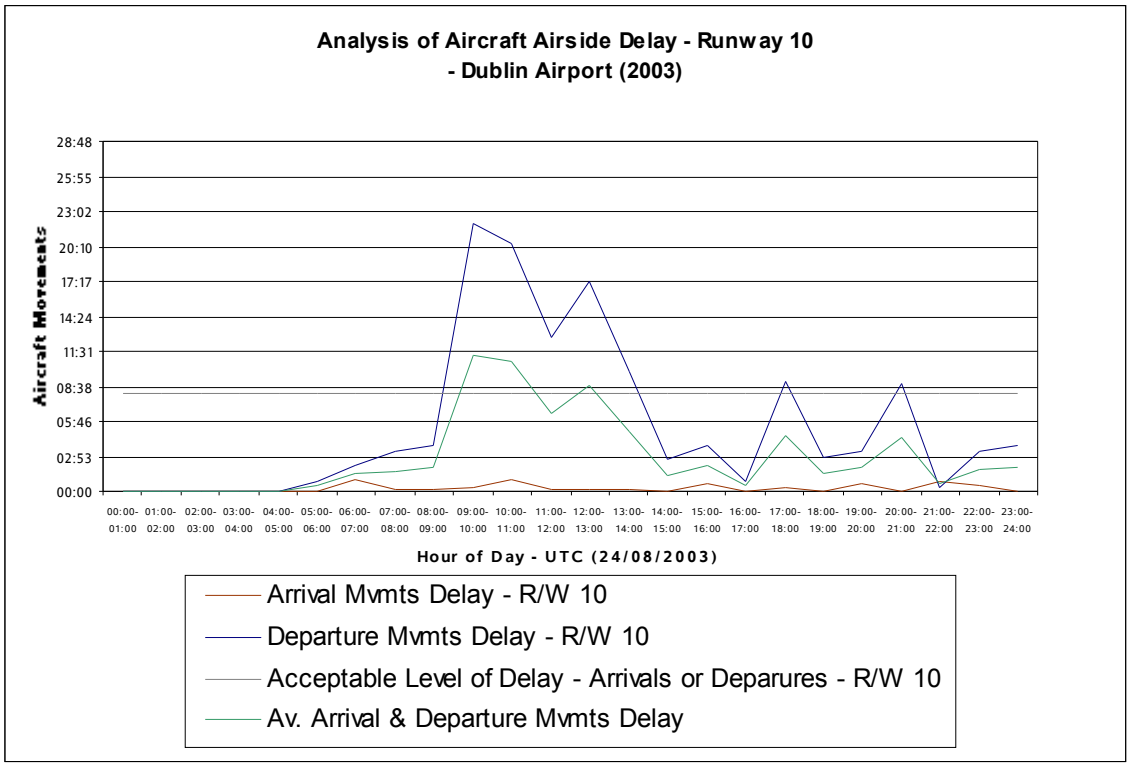
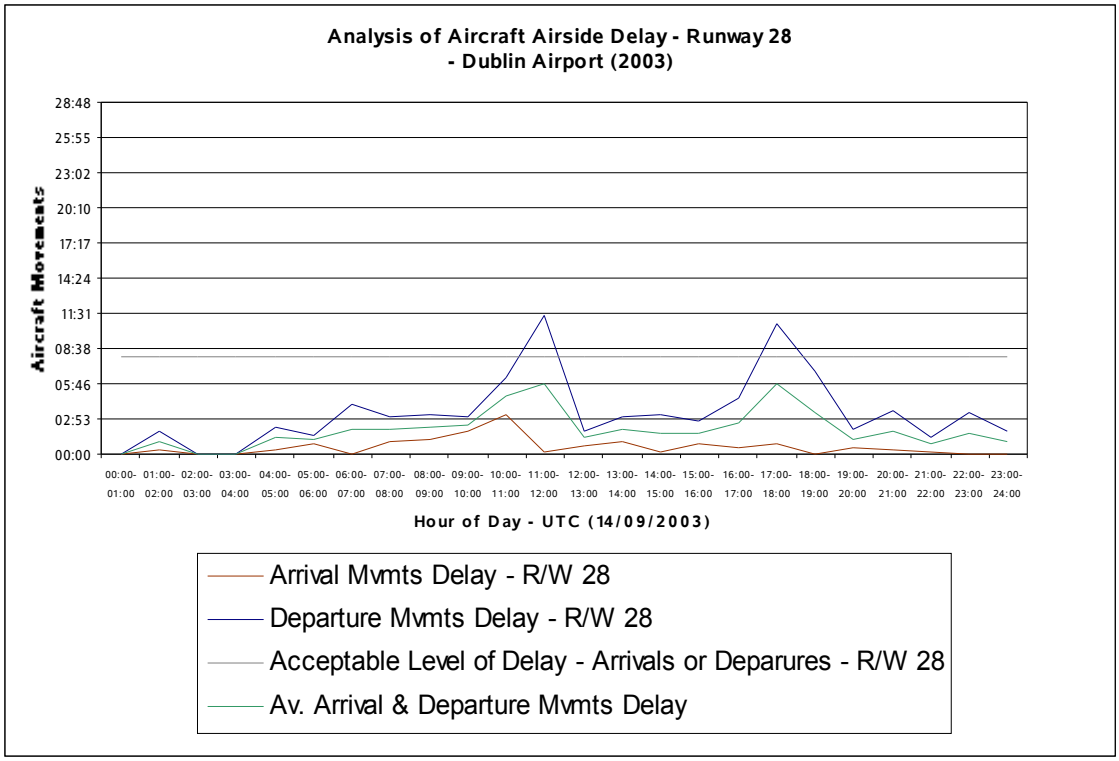


Chart 3.4: Analysis of Aircraft Airside Delay - Runway 28 - Dublin Airport (2003)



3.4 Landside Capacity Assessment

Set out below are the principal steps involved in the development of the **Landside Component Model**, together with the outputs and findings:

- Identify the elements of an airport's landside system to be analysed. These elements include landside kerb departures and arrivals, short- and long-term car parking, and coach parking. Road links, interchanges, junctions, etc, are excluded from this capacity assessment.
- Establish demand by choosing the typical busy departing and arriving passenger hourly movement/flow rates at Dublin Airport for the year 2003. The departing and arriving Busy Hour Rates are used to assess the landside kerb and coach parking requirements. In addition, a typical busy hour scheduled bus/coach service for departing and arriving passengers was chosen.
- Determine typical busy days for short-term and long-term car parking and the associated car parking typical busy hour throughput rates. This analysis is based on 2004 data. These throughput rates are used to assess the car parking requirements.
- Table 3.7 illustrates the determined passenger BHRs and the car parking typical busy hour throughput rates.

Table 3.7: Passenger Busy Hour Rates (2003) and Car Parking Typical Busy Hour Throughput Rates (2004) - Dublin Airport.

	Departures BHRs (2003)	Arrivals BHRs (2003)	Typical Busy Hour Throughput Rates (2004)
Terminal	2,491	2,290	-
Short-Term Car Parking	-	-	675
Long-Term Car Parking	-	-	140

- Compute the capacity assessment mathematical calculations applicable to the elements of an airport's landside system.
- Assess whether the current landside elements are capable of handling the current (2003/2004) levels of demand, thus indicating capacity shortfalls or surpluses. The various outputs of the landside capacity assessment, and the associated current supply figures, are set out in Table 3.8 below.

Table 3.8: Analysis of Landside Capacity Demand and Supply – Dublin Airport (2003/04)

	Capacity Demand	Capacity Supply
Departures Landside Kerb Length (Private Car and Taxi)	137m	264m
Arrivals Landside Kerb Length (Taxi Pick-Up only)	27m	60m
Short-Term Car Parking	2,248 Spaces	3,800 Spaces
Long-Term Car Parking	15,957 Spaces	14,600 Spaces
Coach Parking	14 Spaces	30 Spaces

- Based on these outputs, and with reference to Table 3.7, the following are the key findings:
    - The Departures Kerb length requirements are 88m for Private Car Set-Down and 49m for Taxi Set-Down. The available Kerb length provision is 137m for Private Car Set-Down and 127m for Taxi Set-Down. Therefore, there is sufficient space provision to handle the percentage Departures BHR demand.
    - The Arrivals Kerb required for Taxi Pick-Up (only) is 27m. Arrivals Kerb length provided for Taxi Pick-Up (only) is 60m. In addition, 108m are currently provided for Taxi Queuing. Therefore, there is an adequate space provision for taxi facilities on the current Arrivals Landside Kerb.

  - A number of the dedicated bus/coach stops provided on the Arrivals Landside Kerb have inadequate capacity to cater for the service demand. 134m of Arrivals Landside Kerb is provided to handle the current bus/coach services, with a further 86m provided for additional set-down/pick-up areas, i.e. Coach Set-Down, Hotel/Car Hire/Car Park Shuttle Busses.
  - With regard to car parking, the short-term has spare capacity of approximately 1,550 spaces. This finding may be an over-estimate due to the assumed average dwell time of 180 minutes (DAA, 2005), which is low (note: subsequently, DAA has provided three additional times of 242 minutes minimum, 383 minutes maximum and 310 median (April, 2005). If the median time of 310 minutes is applied the space demand (i.e. 3,872) is slightly higher than the space provision). In addition, the long-term car park has a capacity deficit of approximately 1,360 spaces.
  - Coach parking provision is more than sufficient, with more than double the required spaces being provided.

- Based on the above findings, the Departures Landside Kerb, certain parts of the Arrivals Landside Kerb, Short-Term Car Parking and Coach Parking elements of the Dublin Airport's landside component have varying levels of spare capacity. However, parts of the Arrivals Landside Kerb and the Long-Term Car Parking provisions have inadequate capacity. It is noted that DAA does not permit private cars to use the Arrivals Road due to a possible capacity deficit.

Section Four

4 Next Steps Involved

Set out above are the initial findings of the current handling capacity of Dublin Airport (2003/04). Overall, the three components of the airport, and their numerous associated elements, appear to display varying degrees of capacity adequacy or inadequacy.

Due to operational/infrastructure changes recently occurring at the airport, there will be a need for some further detailed analysis to determine up-to-date capacity assessment. This will also afford the opportunity to update the capacity assessment using 2004 data and to examine additional data sets so as to provide an increased level of analysis.

In addition, a detailed examination of the forecast demand for passenger and aircraft movements will be undertaken to provide a more robust determination of when capacity-related infrastructure development will be required.

5. Bibliography

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National Air Traffic Services (NATS) (2003), *"Dublin Airport Runway Capacity Study - Assessment of Runway Capacity for Summer 2004 - Final Report"*.

Parsons Brinckerhoff (2002), *"Dublin Airport Transport Study"*.

Project Management International (PM), Skidmore Owings Merrill (SOM) and TPS Consult (TPS) (2003), *"Dublin Airport Baseline Report"*.

6. Appendix

Set out below is a summary of the overall capacity findings of the various Dublin Airport capacity studies undertaken by external consultants between 2002 and 2004.

Summary of Findings Regarding Dublin Airport Transport Study (Parsons Brinckerhoff, 2002):

Kerbside System

"The existing Dublin Airport terminal kerb condition is very unsatisfactory for pedestrians and vehicles during peak-periods. There is not enough kerb width, length or roadway vehicle capacity. To compensate for this deficiency, the Airport restricts private vehicles and taxi drop-offs to the departure level and all other movements to the arrivals level. In 2001 kerb length was 20-50 percent less than major guidelines say is needed. The arrivals kerb has a more series deficiency than the departure kerb."

Parking System

"The long-term parking system at Dublin Airport is not sufficient in the peak demand periods when all the car parking spaces fill up completely. The peak demand period run from about Easter through October. The Airport has immediate need for more long-term car parking spaces now and will require even more spaces for future predicted passenger levels.

The location of the short-term parking, although convenient, causes a lot of congestion on the Airport terminal arrivals and departures roads due to the number of pedestrian crossings. Traffic queues at the MSCP entry point can back onto the West Link Road. Access to parking at the Old CTB adds to congestion on the departures level road."

Pedestrian System

"… the single largest pedestrian issue is the road crossing at the arrivals road. People walking from the MSCP to the terminal building and vice versa, cross at grade on the arrivals road.

Whilst the primary concern is the safety of the pedestrian, the delay to vehicles should not be ignored. In some instances, it takes more time for a vehicle to pass through the crossing than the time it takes to stop to pick up/drop off passengers and is directly related to traffic backups from the arrivals road onto access roads."

Airport Employees

"Airport employment is a significant transport issue in terms of the volume of employees, their mode of travel to work and the amount of parking area they require."

Commercial Vehicles

"During … peak periods as many as 250 taxis an hour are needed to service the passengers on the arrival level, but the remote hold area can accommodate only 140 vehicles at a time. This creates a major call forward problem…."

"… arrivals road … kerb space is very limited … and bus operators have a problem with bus queues and passenger loading areas."

Car-Hire

"Current Dublin Airport car-hire facilities are small, antiquated and inconvenient for a major airport and need to be upgraded according to industry stakeholders."

Summary of Findings Regarding Dublin Airport Runway Capacity Study (NATS, 2003 and WHA, 2005).

Time (UTC)	Max. Total Movements (NATS, 2003)	Max. Total Movements (WHA, 2005)
00:00	32	42
01:00	32	43
02:00	32	42
03:00	32	41
04:00	32	45
05:00	32	33
06:00	36	34
07:00	44	42
08:00	37	44
09:00	36	45
10:00	42	45
11:00	41	42
12:00	38	39
13:00	38	43
14:00	42	40
15:00	35	43
16:00	44	43
17:00	41	45
18:00	37	37
19:00	37	42
20:00	37	44
21:00	35	42
22:00	32	45
23:00	32	39

Table 1: Summary of Findings Regarding Dublin Airport Runway Capacity Study (NATS, 2003 and WHA, 2005).

Summary of Findings Regarding Dublin Airport Terminal Capacity Studies (Project Management International/ Skidmore Owings Merrill and TPS Consult, 2003) (Alan Stratford & Associates, 2004).

		Dublin Airport Baseline Report (PM/SOM /TPS)	**Dublin Airport Capacity Study (ASA)**	**Assessment Handling Capacity of Dublin Airport (WHA)**
Area/Process		**BAA Method: Total Annual Passenger Capacity – mppa (LoS B)**	**BAA Method: Total Annual Passenger Capacity – mppa (LoS B)**	**BAA Method: Total Annual Passenger Capacity – mppa (LoS B)**
Departures Concourse (landside)		12.09	20.1-22.0	20.58
Check-In – Desk Processing		21.18	24.8-27.2	27.65
Security	Position A	8.97	9.4-10.3	18.39
	Position B	13.46	14.1-15.5	
Departures Concourse (airside)		16.00	19.2-21.0	21.28
Departures Gate Lounges		-	18.9-20.9	39.74
Passport Control Positions – All Piers		28.15	31.0-33.8	21.08
Baggage Reclaim Hall		18.85	20.5-22.4	18.67
Arrivals Customs		15.00	21.1-23.0	-
Arrivals Concourse (landside)		25.30	19.4-21.1	46.14

Table 2: Summary of Findings Regarding Dublin Airport Terminal Capacity Studies (PM/SOM/TPS, 2003) (ASA, 2004) (WHA, 2005).