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DUBLIN AIRPORT CAPACITY REVIEW



FINAL REPORT

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EXECUTIVE SUMMARY

Jacobs Consultancy UK Limited, formerly known as Leigh Fisher Associates, has been retained by the Commission for Aviation Regulation (the Commission) to undertake an independent assessment of current and future capacity at Dublin Airport. The ultimate purpose of the capacity assessment is to assist the Commission by informing further their decision on the appropriate scheduling status at the Dublin airport, in accordance with the provisions of Article 3.3 of Council Regulation (EEC) No. 95/93 as amended by Regulation (EC) No. 793/2004 of the European Parliament and of the Council.

APPROACH

The evaluation largely considers the period 2007-2010 or up to 27.4mppa. Although reference is made to subsequent years, the addition of significant additional capacity through the development of Terminal 2 (2009) and a parallel runway (circa 2012) will mitigate against any continued delays of significance. It is recommended that a capacity review is undertaken once the additional capacity from Terminal 2 and the parallel runway is operational, to re-assess the appropriate scheduling regime at the airport.

The capacity assessment has focused on three key elements of the Dublin airport system:

- passenger terminal
- apron stands
- runway/taxiway system.

Although landside access and airspace have not been assessed, it is noted that no significant landside or airspace capacity issues have been uncovered in the analysis or consultation that might influence a decision on the appropriate slot coordination regime at the airport. If there were to be a shortfall in kerbside capacity it is reasonable to expect that it could be appropriately managed to mitigate the impact. Furthermore, it is worth noting that the introduction of coordination would have a negligible effect on kerbside demand patterns and behaviour.

An extensive consultation exercise has been conducted during the assessment and summarised in Section 1 and Appendix A. Personal interviews, including with the individual representatives of the Dublin Airport Authority (DAA), Dublin Coordination Committee, Department of Transport, Irish Aviation Authority, Air Traffic Control, National Air traffic Services (NATS) and the main based carriers at the airport, were conducted. Discussions were also held with Airport Coordination Limited (ACL), who are currently responsible for schedules facilitation at Dublin airport. Issues of concern have been discussed with each party in endeavouring to understand current and future demand and capacity issues. The consultation has attempted to identify opportunities for mitigating any identified capacity issues and enhancements in operating flexibility. In addition the Airline Operators Committee was offered the opportunity to engage, directly contribute to the study and provide input and assumptions.

In determining appropriate assumptions for the analysis, a list of specific data requests was sent to the DAA and Airport Coordination Limited (ACL). Furthermore during the consultation exercise, consultees were asked for specific demand, operational and survey data that could strengthen the analysis.

Evaluation Criteria

As set out in Section 2, the traffic forecasts for the airport have been reviewed and under the 'Centreline Case', passenger traffic is forecast to rise from an estimated 20.4 million passengers per annum (mppa) in 2006 to 24.7mppa by 2010 which is an average growth rate of 4.9% per annum. It is noted that based on current trends, DAA expect demand to be significantly higher than forecast for 2006, currently estimated at 21.2mppa. Although updated forecasts are being prepared they were not available at the time of writing, although throughput in 2007 is expected to be 22.8mppa. This implies that the demand is running approximately one year ahead of the current centreline forecasts, in other words 24.7mppa is likely to achieved in 2009. Air Transport Movements (ATM's) are only forecast to rise by an average of 1.9% over the same period largely due to increasing load factors. It is also pointed out that in assessing the capacity of the airport system, the peak hour demand, rather than the annual total is the key determinant. As such the analysis has reviewed busy hour data from Summer 2006, which therefore fully reflects the higher than expected traffic in Summer 2006.

An actual summer 2006 schedule, using a day representative of 'typical' operations, was used to assess the terminal and runway analysis. The Typical Peak Hour passenger (TPHP) flow in the schedule is broadly consistent with a 30th busiest hour and provides a robust basis for assessing terminal performance against service level standards.

DAA have provided queue time service level standards which has been supplemented by IATA defined levels of service where necessary. Given that demand represents the 30th busy hour, an equivalent to level of service 'C' has been used as a capacity criteria. If the level of service drops below 'C' then a facility has been considered to either be approaching or over capacity, depending on the length of time and number of passengers affected. Future year TPHP has been assumed to grow in line with total passenger forecasts. Given that over recent years the TPHP has grown at a lower rate due to larger increases in off-peak demand, this can be considered a conservative basis for the terminal assessment.

Terminal Capacity

As set out in Section 3, Terminal capacity has been assessed through the use of a proven simulation model, ARRIVE-DEPART. A summer 2006 base case schedule has been used to calibrate the model against available survey data. Based on the 'shape' of the demand curve, maximum capacities for passenger processing facilities have been derived. The maximum capacities have then been assessed against the busy hour demand profile to quantify the potential passenger level of service for 2007-2010. Using DAA and IATA standards, an assessment has been made as to whether a facility is under, approaching or over capacity.

The results show that, despite likely localised congestion at security and immigration in Summer 2007, the check-in and security capacity enhancements proposed in 2007 and 2008 by DAA would appear to provide

sufficient capacity for the terminal to handle the predicted peak passenger demand through to 2010, but that congestion at security will require careful management in order to operate effectively in 2007 and 2008. It is noted that although immigration is very sensitive to short peaks in demand, the proposed centralisation of immigration in 2008 will improve processing efficiency and provide sufficient capacity through to 2010. Solutions to capacity constraint at immigration and security have been proposed.

Whilst there are circulation issues on the departures concourse, peak hour circulation can be improved through pro-active management of passenger flow to and from check-in, changes in airline check-in policy and a potential re-allocation of check-in desks within the concourse areas.

It is therefore concluded that despite likely localised issues in Summer 2007, based on the forecasts for passenger demand and the developments proposed by DAA, the passenger terminal system should be able to operate at an acceptable level of service through to the opening of Terminal 2.

STAND AVAILABILITY

It is evident from the existing apron layout and stand allocation, as shown in Section 4, that Dublin airport is currently approaching stand capacity during the overnight period. However, there would appear to be only sufficient stands to accommodate current predicted wishlist[1] demand in summer 2007. However, during Summer 2007 contingency stands are likely to be required to accommodate scheduled aircraft at peak, and therefore stand allocation will require careful management at peak times. Due to works associated with the construction of Terminal 2, the number of stands available in winter 2007 will not meet peak demand requirements. Although additional remote stands are proposed in 2008-2010 to meet demand, there appears to be no contingency provided and the resultant increase in bussing will reduce the operational efficiency of airport operations. In addition to the difficulties likely to be caused by the construction of Terminal 2, there is also a risk that remedial pavement works may be required.

Taken together it is concluded that current stand availability will be significantly compromised from Winter 2007. In conjunction with the increased reliance on bussing and the potential for operational constraints with the construction of Terminal 2, additional demand beyond Summer 2007 will increase aircraft delay and exacerbate congestion in the cul-de-sacs.

RUNWAY CAPACITY

NATS have assessed and confirmed the ability of runway 10/28 to handle the summer 2007 demand with average delays of less than the 10 minute criterion assumed from summer 2007. As shown in Section 5, a VisSim model of the runway and feeder taxiways has been constructed to investigate the capacity of the runway under a range of parameters, rather than just test current conditions. A base case model has been developed and calibrated against the HERMES model used by NATS.

[1] In managing airline schedule requests, the appointed facilitator ACL, looks to voluntarily agree a schedule, defined as the wishlist, that provides a more balanced distribution of daily departures and arrivals within the capacity thresholds of the airport.

The modelling has confirmed the peak movement capacity of the runway as declared by NATS for summer 2007 and shown that additional peak movements lead to an exponential increase, not just in average but peak and 90 percentile delays. The key reason for the delay is the assymetrical nature of the peak hour demand which constrains the effective capacity of the runway in this period.

An additional 2 movements per hour could allow the runway to handle a small increment in peak demand over the Summer 2007 peak hour wishlist. The VisSim modelling has shown that such small increases in peak capacity, *may* be achievable either through :

- ATC adopting reduced 1Nm landing clearances; or
- Additional airfield infrastructure, such as previous DAA proposals for a bypass taxiway, an expanded holding point and an additional RET.

We understand that DAA is currently assessing the business case for the apron enhancements, but it is clear that no improvements are likely by Summer 2007 and therefore will not provide any short-term solution to the peak period capacity constraint.

Whilst the development of Terminal 2 mitigates any potential future terminal capacity shortfall, the additional stands provided cannot be optimally used until the parallel runway is completed. It is therefore recommended that the development programmes for Terminal 2 and the parallel runway are reviewed and closely coordinated to ensure that additional stand and runway capacity is delivered as soon as possible.

Conclusion

Due to the asymmetry of arrivals and departures in the peak morning schedule and reduced stand availability, additional peak services beyond those in the Summer 2007 wishlist will increase apron delays and average runway delays above the currently agreed 10 minute delay criterion. It is therefore recommended that Dublin Airport be designated as coordinated from the Winter 2007 season due to insufficient airport runway and apron capacity during peak times.

As shown in Section 6, evidence on prior activity patterns from recent seasons suggests that outturn peak demand would be greater than assumed in the current Summer 2007 wishlist. It is therefore recommended that schedules coordination at Dublin Airport also be strongly considered for the Summer 2007 season, as the airport will be at the capacity of its airfield infrastructure and there appears to be no operational contingency provided. Coordinated status for Summer 2007 would help to ensure that capacity constraints are effectively managed and fair access to available slots is provided.

Based on the analysis conducted, runway and stand constraints mean that the airport will not be able to cater for additional peak services until the proposed parallel runway has been completed and additional stands provided, although this is not to say that additional demand cannot be accommodated outside the peak hours. It is therefore recommended, that the appropriate scheduling status of the airport is reviewed again once the planned additional stand and runway capacity are operational.

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1 INTRODUCTION

Jacobs Consultancy UK Limited, formerly known as Leigh Fisher Associates, was retained by the Commission for Aviation Regulation (the Commission) to undertake an independent assessment of current and future capacity at Dublin Airport. The ultimate purpose of the capacity assessment is to assist the Commission by informing further their decision on the appropriate scheduling status at the Dublin airport, in accordance with the provisions of Article 3.3 of Council Regulation (EEC) No. 95/93 as amended by Regulation (EC) No. 793/2004 of the European Parliament and of the Council.

1.1 BACKGROUND

This report arises as a result of representations over recent years that capacity at Dublin is no longer sufficient for airlines' planned operations against a backdrop of strong traffic growth over recent years. The Commission for Aviation Regulation commissioned a capacity study in 2004, and determined that it was appropriate to designate Dublin Airport as coordinated for the summer season of 2006. However, following legal challenge, the airport reverted to schedules facilitated status in July, 2006. The Commission has decided that in order to help determine the most appropriate future coordination status of the airport, it is necessary to carry out a further capacity analysis study.

1.2 APPROACH

The following three key elements of the airport system have been assessed:

- Passenger Terminal
- Aircraft Stands
- Runway and taxiways

Although landside access and airspace have not been assessed, it is noted that no significant landside or airspace capacity issues have been uncovered in the analysis or consultation that might influence a decision on the appropriate slot coordination regime at the airport. If there were to be a shortfall in kerbside capacity it is reasonable to expect that it could be appropriately managed to mitigate the impact. Furthermore, it is worth noting that the introduction of schedules coordination would have a negligible effect on kerbside demand patterns and behaviour.

The assessment has been undertaken based on the Terms of Reference set out in Appendix C. In conducting the assessment, Jacobs Consultancy has undertaken an extensive consultation exercise with stakeholders at the airport, to ensure that analysis is inclusive and reflects, where feasible, the range of views, issues and concerns.

A summary of our approach is set out the sections below.

1.2.1 Consultation

An extensive consultation exercise has been conducted.

We have actively sought to engage airport stakeholders and both personal and telephone interviews have been conducted. Issues of concern have been discussed with each party in endeavouring to understand current and future demand and capacity issues. The consultation has attempted to identify opportunities for mitigating any identified capacity issues and enhancements in operating flexibility.

Personal meetings and telephone interviews were held with representatives from:

- Dublin Airport Authority
- Ryanair
- Aer Lingus
- Aer Arran
- CityJet
- bmi
- US Airways
- Servisair
- Aviance
- Signature
- FBO
- Air Contractors
- ACL
- Irish Aviation Authority
- Air Traffic Control (ATC)
- Department of Transport
- NATS
- DAA consultants for T2 development and T1 capacity

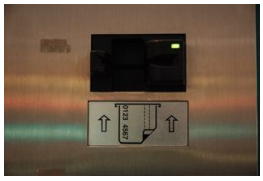
Although a formal meeting the Dublin Coordination Committee was not arranged, meetings with most of the individual representatives on the Committee were conducted. In addition the Airline Operators Committee meeting on 11th October, 2006 was attended and the members of that group were additionally contacted twice by email. Discussions were also held with Airport Coordination Limited (ACL), who are currently responsible for schedules facilitation at Dublin airport. In all instances the representatives were offered the opportunity to engage, directly contribute to the study and provide input and assumptions. Further details are set out in Appendix A.

A tour of the existing landside and airside facilities was conducted with DAA. Furthermore, a walk around the landside terminal area was undertaken with Ryanair, to help assess potential options for improvement.

In order to improve both the robustness and credibility of the assessment, and provide consultees with confidence in the conclusions, key assumptions have been circulated to relevant parties for comment and feedback. Therefore, for example, the assumptions proposed for the analysis of check-in were circulated to the main airline carriers through the AOC, whilst the Dublin Airport Authority has had the opportunity to review the other airport operational assumptions.

This report sets out the key assumptions used in the analysis and through distribution amongst the stakeholder group provides opportunity for further review and comment.

1.2.2 Assumptions



In determining appropriate assumptions for the analysis, a list of specific data requests was sent to the DAA and ACL. In addition during the consultation exercise, consultees were asked for specific demand, operational and survey data that could strengthen the analysis. Where information was forthcoming from consultees it has been reflected where possible in the analysis.

The time period initially considered for evaluation is 2007-2012 on the basis that the opening of Terminal 2 in 2009 and the proposed parallel runway in 2012 will resolve any identified terminal capacity issues. It is suggested that a further capacity study will be required by 2012 given the significant terminal, stand and capacity enhancements that will have been introduced by then. Although this report recognises that there are some airport stakeholders who do not believe that Terminal 2 provides an effective solution to Dublin's capacity requirements, the purpose of this report is not to speculate on the relative merits of the proposed scheme.

The terminal and stand capacity has focused on the period 2007-2010 or up to 24.7mppa, on the basis that on current trends the demand forecasts for 2010 may be realised by 2009 or the same time as Terminal 2 is completed. The analysis has considered the peak movement capacity of the runway and then assessed this against forecast movements in 2007 and beyond.

Details of the specific assumptions used in the terminal and runway modelling are set out in Appendix B.

1.2.3 Analytical Methodology

Terminal capacity has been assessed through the use of a proven simulation model, ARRIVE-DEPART. The model has been used effectively on many capacity studies worldwide, including London Heathrow, Washington Dulles, Birmingham, Bristol and Marseilles airports. A summer 2006 base case schedule has been used to calibrate the model against available survey data. Based on the 'shape' of the demand curve, capacities for passenger processing facilities have been assessed against the demand profile to quantify the potential passenger level of service for 2007-2010. Using DAA and IATA standards, an assessment has been made as to whether a facility is under, approaching or over capacity.

The analysis of stand availability examines the stand capacity at key planning horizons until 2010, with the opening of T2 due in 2009. Changes to fleet size, aircraft mix and proposed new routes have been

identified where possible through discussions with airlines. Where appropriate, additional changes including the impact of Open Skies have been identified and added to the future demand for aircraft stands. A comparison between supply and demand of stands has been conducted to evaluate the future availability of stands.

To help investigate the capacity of the runway under a range of parameters, a review of the analysis undertaken by National Air Traffic Services (NATS) has been conducted. In addition, a simulation model was constructed using VisSim software to develop an operational model. The purpose of the model is not to replicate the NATS work, but rather to allow further consideration of throughput under a range of parameters.

1.3 Report Structure

Section 2 sets the demand context for the study. Section 3 reviews the analysis of terminal capacity, Section 4 stand availability and Section 5 runway capacity. Section 6 considers other issues relevant to the coordination status at Dublin, whilst Section 7 provides conclusions. Appendices A, B, C and D contain further details on the consultation undertaken, assumptions made and the terms of reference.

2 DEMAND CONTEXT

2.1 FORECASTS

DAA provided centreline airport demand forecasts for the period 2006 – 2010, which are set out in Table 1 below, showing a compound annual growth rate (CAGR) of 4.9% for passengers and 1.9% for air transport movements. However, it is noted that based on current trends, DAA expect demand to be significantly higher than forecast in 2006, currently estimated at 21.2mppa. Although updated forecasts are being prepared they were not available at the time of writing, although 2007 is expected to be 22.8mppa. This implies that demand is running ahead of the forecasts by about one year and that 24.7mppa may be achieved by 2009. In this context, it is worth noting that in assessing the capacity of the airport, the key is to assess at what peak demand level capacity is considered breached, and then relate that back to a timeline. In this way, we can ensure that the assessment is based on capacity limits, rather than notional dates which are subject to change if demand does not match expectations. It is also pointed out that in assessing the capacity of the airport system, the peak hour demand, rather than the annual total is the key determinant. As such the analysis has reviewed busy hour data from Summer 2006, which therefore fully reflects the higher than expected traffic in Summer 2006.

Table 1 - Dublin Airport Forecast Growth

Year	2005	2006	2007	2008	2009	2010	CAGR
Pax ('000)	18, 450	20,411	21,653	22,563	23,613	24,717	
Growth	*7.7%*	*10.6%*	*6.1%*	*4.2%*	*4.7%*	*4.7%*	*4.9%*
ATM	173.0	179.1	183.3	186.8	189.9	193.4	
Growth	*3.1%*	*6.1%*	*4.2%*	*3.5%*	*3.1%*	*3.5%*	*1.9%*

Source: Dublin Airport Passenger & Aircraft Movement Demand Forecast Report, updated August 2006

2.2 PEAK TERMINAL DEMAND

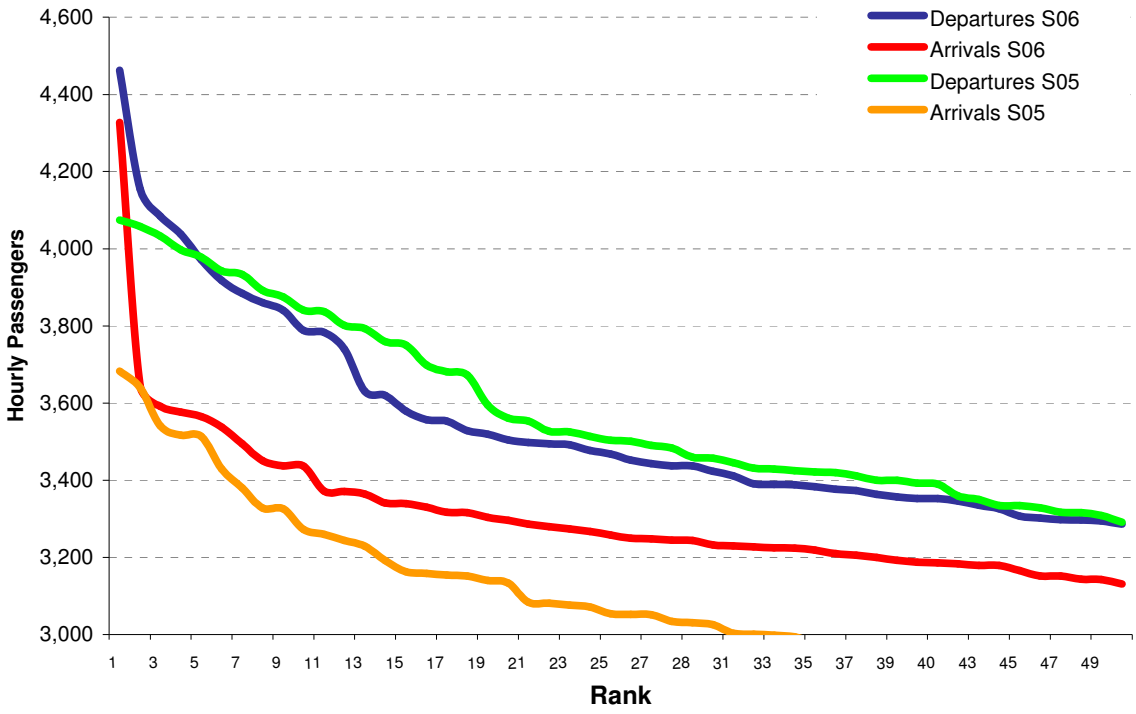
In airport capacity analysis, it is important to ensure facilities meet demand to required standards, whilst accepting that lower levels of service will be experienced in the peak periods. Typically airport facilities are designed for the 30th busy hour of the year. In other words facilities are designed to accommodate the 30th busy hour demand to a certain level of service, but recognising that there will be other times when the levels of service is lower.

The capacity of the airport terminal is related to the Typical Peak Hour Passenger flow (TPHP). This relates closely with the 30th Busy Hour of the airport in a year. Information was provided by DAA outlining the passenger flows for each hour of Summer 2006. This was used to determine the 30th Busy Hour on

arrivals and departures and can be seen plotted in Figure 1. As can be seen from the graph, the absolute busiest hour has a passenger throughput much above the 30th busy hour. However, catering for the maximum peak would result in a high degree of redundancy throughout the airport as this is a rare event and not typical. The 30th hour is an industry standard used in determining an appropriate design point for a specific level of service. In the context of this study, the 30th hour can be considered a reasonable point for determining the upper capacity of the airport.

Analysis of Summer 2006 shows that although the peak demand is 4,463 on departures and 4,328 on arrivals, the 30th busy hour design point is 3,423 on departures and 3,233 on arrivals. In assessing terminal capacity at the airport, the 30th busy hour has been used as reflecting a typical busy day at which reasonable levels of service should be expected to be maintained. If the broadly accepted levels of service are significantly breached under the 30th busy hour, then it would be reasonable to conclude that the airport is operating over its effective capacity.

Figure 1- Top 50 Passenger Busy Hour Rates Summer 2005 and Summer 2006



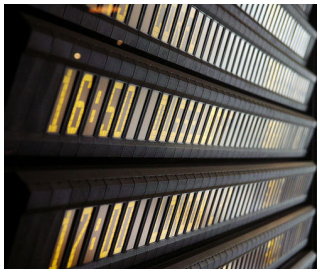
It is worth noting that the departures peak is significantly above the 30th busy hour for longer than the arrivals peak, in that the second busiest hour of the year on arrivals is 3,645.

Compared to summer 2005, it is interesting to note that the 30th busy hour was actually higher in summer 2005 than in summer 2006. This may in part reflect the effect of the schedule coordination in place during the period. On arrivals the shape of the demand profile is consistent with summer 2006 and the 30th busiest hour was 7 % higher.

The three key constraints identified in the setting of the Summer 2007 capacity limits are concourse circulation, departures security and immigration, which are therefore a key focus for further evaluation.

2.3 Busy Hour Forecasts

Relating the annual number of passengers to the busy hour gives an indication of the traffic characteristics at Dublin. In general as annual traffic increases the ratio of busy hour to annual passengers decreases because as traffic increases it tends to spread the peaks within and between seasons. This has certainly been the case over recent years at Dublin and in 2006, annual number of passengers to 30th busy hour was 5,962 on departures and 6,313 on arrivals. This compares to factors of between 5,000 and 6,000 on previous capacity studies at Dublin and indicates that the airport has a smoother annual and daily passenger flow than in the recent past.



It is also useful to compare the recent growth in overall traffic with growth in the 30th busy hour. Despite a traffic increase estimated at 10% in 2006, the summer busy hour growth was 7% on arrivals, whilst on departures the 30th busy hour was actually lower in summer 2006 than in summer 2005. Whilst the impact of schedule coordination may have affected the 2006 demand, this does show that much of the future growth is increasingly being accommodated in off-peak periods.

Whilst not material in the context of slot coordination, the analysis does lend weight to the fact that peak capacity at Dublin airport may be approaching its original design limits and therefore additional demand is increasingly being accommodated in off peak periods.

Based on the overall demand growth, it is reasonable to expect that the busy hour demand will grow by a *maximum* factor of 4.9% annually which would give a 30th busy hour of 4148 on departures and 3918 on arrivals by 2010. This assumes that the busy hour will grow in proportion with the overall demand, whereas in practice, as has been seen in recent years, additional demand would affect the peak periods less proportionately. However, given the expected higher demand than forecast for 2006 this is considered a prudent assumption. Furthermore maintaining the 'shape' of the 2006 summer schedule provides a robust basis on which to simulate the ability of the terminal to handle increased peak passenger demand.

Table 2 - Forecast 30th Busy hour rates 2006-2010

BHR	2006	2007	2008	2009	2010
Departures	3423	3632	3784	3962	4148
Arrivals	3233	3430	3574	3742	3918
MPPA	20.4	21.7	22.6	23.6	24.7

It is worth re-iterating the purpose of this report is to assess to what extent the capacity of the airport system has been reached, as such the focus is on determining whether there is scope for additional services rather than an assessment of the likely demand itself.

2.4 SUMMER 2007

In assessing the capacity of the runway and future stand availability, the early departures wave at Dublin is significant in that it leads to significant numbers aircraft parked overnight, and hence stand demand. Furthermore it means that the peak departures wave in the early morning is the key in determining runway capacity.

ACL have initially identified excess departures demand for Summer 2007. Initial requests have shown a demand for 45 departures for the 0500 hour, a total of 49 movements in the hour. This is 19 movements higher than the declared Summer 2006 capacity.

ACL have subsequently prepared a Summer 2007 wishlist for 7 additional home based aircraft, with 5 additional departures in the 0500 hour and 2 additional in 0600 hour bring the total to 40 movements. Over the day the peak movement demand is 45 in the 0800 hour and 47 in the 1600 hour. 44 movements is a common demand from 1000-1300. The Summer 2007 wishlist has been used in the runway analysis, and in particular to help determine the number of additional peak movements that could be accommodated.

In attempting to quantify peak hour terminal demand for summer 2007, we have used the summer 2006 schedule as a baseline profile. We have then applied growth factors to the 2006 demand profile to allow an assessment of the impact of forecast growth on the terminal facilities. In this way the existing 'shape' of the schedule is maintained in assessing the level at which growth in the peak periods is achievable. The resulting busy hour demand can then be related back to an annual estimation.

In assessing the capacity of the runway system and stand availability, the Summer 2006 schedule has been used with reference to the 2007 wishlist schedule prepared by ACL.

3 TERMINAL CAPACITY

3.1 APPROACH

The analysis of the passenger terminal has been carried out in a number of steps. For each facility in the process, data was collected to enable characteristics such as queue length and process time to be calculated. Using this together with an actual summer 2006 schedule it is then possible to model the passenger flow through the airport.

The modelling of passengers flows through the airport was carried out using ARRIVE-DEPART software developed by Jacobs Consultancy. ARRIVE-DEPART has been utilised and validated on many airport projects including London Heathrow (Terminals 1, 3, 4 and 5), Birmingham International, Bristol, Washington Dulles and New Athens International. The software takes input from arrival and departures schedules to model the flow of passengers from entering the terminal to boarding the aircraft and from leaving the aircraft to the arrivals concourse.

The theoretical capacity of any facility in an airport terminal is the maximum process rate of one unit multiplied by the number of units in the facility. For example the theoretical capacity of a bank of check-in desks is the maximum processing speed of one of the desks multiplied by the number of desks. However in reality passenger flows at an airport do not allow this to happen. Even airports that have relatively flat passenger flow profiles still experience peak periods and consequently need to be able to provide for them. As a result the nature of the schedule will not allow all of the facilities to be utilised during all periods. The use of ARRIVE-DEPART allows the capacity assessment to consider the variation in passenger flows and has been used to map the profiles of the passengers to each facility.

For each facility modelled, a graph has been produced which shows the passengers flows through the facility in the peak period under consideration. The rate at which passengers arrive at the facility is reflected by the gradient of the curve. Plotting the process rates onto the graph allows the actual processing rate to be compared to the demand. If the gradient of the schedule-derived curve becomes steeper than the actual processing rate, then this indicates that a queue would develop. Two parallel lines have been plotted next to the actual processing rate. These coincide with a maximum queue which would be allowed to develop in terms of a time standard and space available. If the processing rate line is placed at the point on the schedule curve where the maximum processing rate is exceeded, then it is only when a queue has developed past the queue standard lines that the capacity is reached. The capacity is therefore a function of both the processing rate and the queue that is deemed as being acceptable.

3.2 PASSENGER DEMAND

In order to create a model that can be calibrated against current terminal operations, a schedule of actual aircraft movements was provided by ACL for the week 4th to 10th Sept 2006. Analysis of the schedule indicates that the Friday is the busiest day of the week. Therefore, Friday 8th September 2006 has been used for an analysis of a typical busy day schedule at Dublin Airport. Table 3 below illustrates the data that was used to determine the busy day.

Table 3 - Determination of Busy Day

	MO 4th	TU 5th	WE 6th	TH 7th	FR 8th	SA 9th	SU 10th
Arrival movements	293	274	282	313	328	303	301
Departure movements	294	284	278	297	330	301	305
Total movements	587	558	560	610	658	604	606
Arrival seats	43452	40180	41404	43155	48485	48551	48704
Departure seats	42457	40776	41109	44487	49890	47752	48209
Total seats	85909	80956	82513	87642	98375	96303	96913

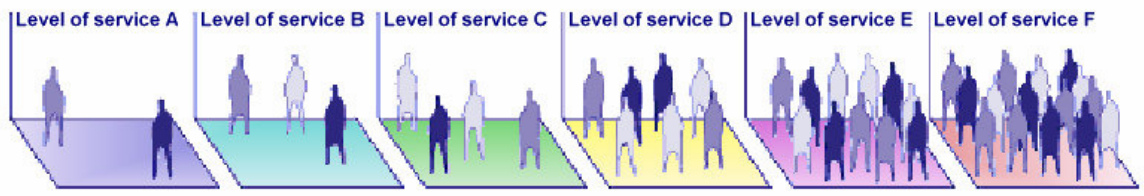
Note: Seat numbers have not been adjusted for load factors.

3.3 LEVEL OF SERVICE CRITERIA

There are many interplaying factors that influence the relationship between available space, time and level of service. Level of service can primarily be expressed as a function of space available or a function of time, although additional criteria such as comfort, convenience and distance can reasonably be included. In reviewing the capacity of the terminal at Dublin, we have focused on quantifying the level of service based on time and space criteria.

It is useful to consider the framework for Level of Service that has been developed by IATA:

A	Excellent level of service; condition of free flow; no delays; excellent level of comfort
B	High level of service; condition of stable flow; very few delays; high level of comfort
C	Good level of service; condition of stable flow; acceptable delays; good level of comfort
D	Adequate level of service; condition of unstable flow; acceptable delays for short periods; adequate level of comfort
E	Inadequate level of service; condition of unstable flow; unacceptable delays; inadequate level of comfort
F	Unacceptable level of service; condition of cross-flows, system breakdown and unacceptable delays; unacceptable level of comfort



In assessing the capacity of the Dublin airport system, the IATA levels of service will be referenced unless specific queue or space time standards have been provided by the DAA. Whilst a static analysis can specifically quantify the processing capacity of the system, a dynamic analysis assesses the ability of a facility or process to accommodate the pattern of traffic flows. Capacity is ultimately a measure of system capability and, given that the airport system can operate at varying degrees of congestion and delay, therefore needs to be related to the level of service provided.

Since the appraisal has used a typical demand schedule, broadly equivalent to the 30th busy hour, it is important to recognise that at peak periods facilities will experience higher demand. Therefore, consistent with industry practice, level of service of 'C' has been used as a broad benchmark of capacity. In other words if the level of service in the 30th busy hour drops below 'C' then the facility can be considered as close to capacity. A terminal properly planned to provide a good level of service at its design flow rate would be expected to cope with a 20% overload and still provide an adequate level of service. Therefore, in general it has been assumed that if more then 20% of passengers in the peak period experience level of service 'D', then the facility can be considered to be over capacity.

If any passengers experience level of service E or worse, then it is reasonable to conclude that the facility is over capacity given that the demand profile used in the assessment does not represent the absolute peak in the year.

For each of the facilities in the terminal system, we have therefore quantified the performance in the peak period as follows:

Below capacity	*Level of Service C or better experienced by all passengers in the peak period*
At capacity	*Up to 20% of passengers in the peak period experience Level of Service D*
Over capacity	*More than 20% of passengers in the peak period experience level of Service D or worse*

Table 4 summarises the level of service assumptions used in the capacity assessment.

Table 4 – Level of Service Assumptions

Area	A	B	C	D	E	F
	m^2 per pax	m^2 per pax	m^2 per pax	m^2 per pax	m^2 per pax	m^2 per pax
Pre check-in concourse	>2.5	2.5	2.3	<2.3		
Post check-in concourse	>2.3	2.3	1.8	<1.8		
Security	1.7	1.4	1.2	1.1	0.9	<0.9
Immigration	1.4	1.2	1.0	0.8	0.6	<0.6
Arrivals Concourse			1.7			

Note: Circulation space is assessed on whether LOS C is exceeded or not

This method has provided the basis for assessing capacity at key passenger processing points. The assessment of capacity at check-in was based on the total desks provided, the percentage of check-in queue space utilised at any one time and the space per person provided in the circulation space. This is discussed later in this report. Due to the fluidity of allocation in gate and reclaim areas, a review of and reference to previous empirical capacity studies undertaken by Arup has been conducted. Where this method has been used, the demand into the facility has been generated in ARRIVE-DEPART and has been assessed against the proposed empirical capacity.

3.4 Current and Proposed Infrastructure

In assessing the future capacity of the terminal system, a number of proposed infrastructure and capacity enhancements have been included, as set out in Table 5 below.

Table 5 - Proposed Infrastructure Enhancements

PROPOSED ENHANCEMENTS	YEAR
Check-in area 14, 24 desks	Early 2007
Additional security channels, total 14 Area A and 10 Area B	2008/9
Centralised immigration, 12 channels	2008

3.5 Arrive-Depart Calibration Against 2006 Operations

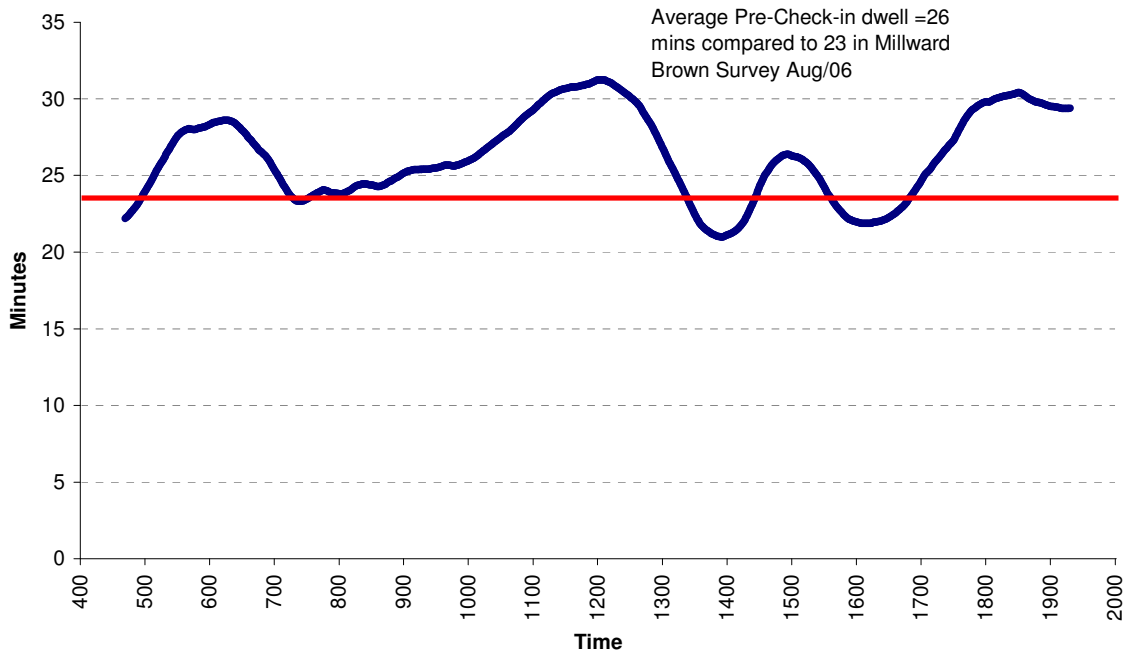
In order to assess the impact of different demand and operational scenarios, it is important that the ARRIVE-DEPART model is representative of current performance. The ARRIVE-DEPART terminal model was calibrated against available survey data, largely from Summer 2006, and also referenced against anecdotal evidence learned in the consultation exercise. A detailed calibration check was undertaken to ensure that the model was delivering a realistic account of existing terminal operations. The computer model uses a reference schedule provided by ACL for Friday 8th September 2006. It is recognised that the model will represent a typical day of operation but that any number of factors may affect the terminal on any given day. Where it is

considered that the model of Dublin Airport is particularly sensitive to events likely to occur at Dublin, sensitivity tests have been conducted. The results from the model calibration are set out in the following section, focusing on the areas where the model will be used to assess capacity.

3.5.1 Departures Concourse Dwell

It is noted that Dublin Airport is characterised by a particularly early passenger turn-up profile. This results in a significant proportion of passengers dwelling at the airport before the check-in desks are opened for the passengers to check-in. Survey data reported by Millward Brown in August 2006, on behalf of DAA, indicated that the average pre-check-in dwell period at the airport was 23 minutes. Figure 2 illustrates the average pre-check-in dwell calculated by ARRIVE-DEPART compared well at 26 minutes. It was concluded that ARRIVE-DEPART is correctly calculating the turn-up of passengers and friends and family prior to check-in opening.

Figure 2- Calibration of Average Pre-Check-in Dwell



3.5.2 Check-In

Data was collected from airlines and DAA to model the check-in process. This information included process times per passenger, desk opening and closing times, queue standards and desk allocation. This information was used to generate check-in queues and desk opening profiles in ARRIVE-DEPART.

Figure 3 describes the check-in desk opening profile at Dublin throughout the day. The graph illustrates the number of desks opened, based on demand, as calculated by ARRIVE-DEPART. This is then compared to the

actual desk allocation as supplied by DAA for a typical busy Friday during Summer 2006. It is evident from this graph that there appears to be in the order of 20% additional desk capacity between that generated as pure desk demand and the number of desks actually available during the peak (140 desks). However, this does not take into account the location of desks or for how long a desk may be closed. For example, one airline may need 4 desks for a period of 3 hours but for the first half hour may only need to man 2 of the 4 desks. It would be inappropriate to assume that the 2 closed desks could be allocated to a different airline for the half hour period when they are not in use.

The graph therefore also shows a separate line describing the number of desks required taking into account "unusable" desks. This clearly shows that at peak, all of the 140 desks available are allocated and therefore the check-in hall is close to capacity during the peak, as experienced today.

Data provided by DAA showed that as an example, several of the US carriers located in aisles 11 to 13 have requested additional desks in order to process passengers more efficiently. These requests have been turned down during Summer 2006 due to lack of available desks.

Figure 3- Traditional and Bag Drop Desks Required (08/09/06) -Modelled and Actual

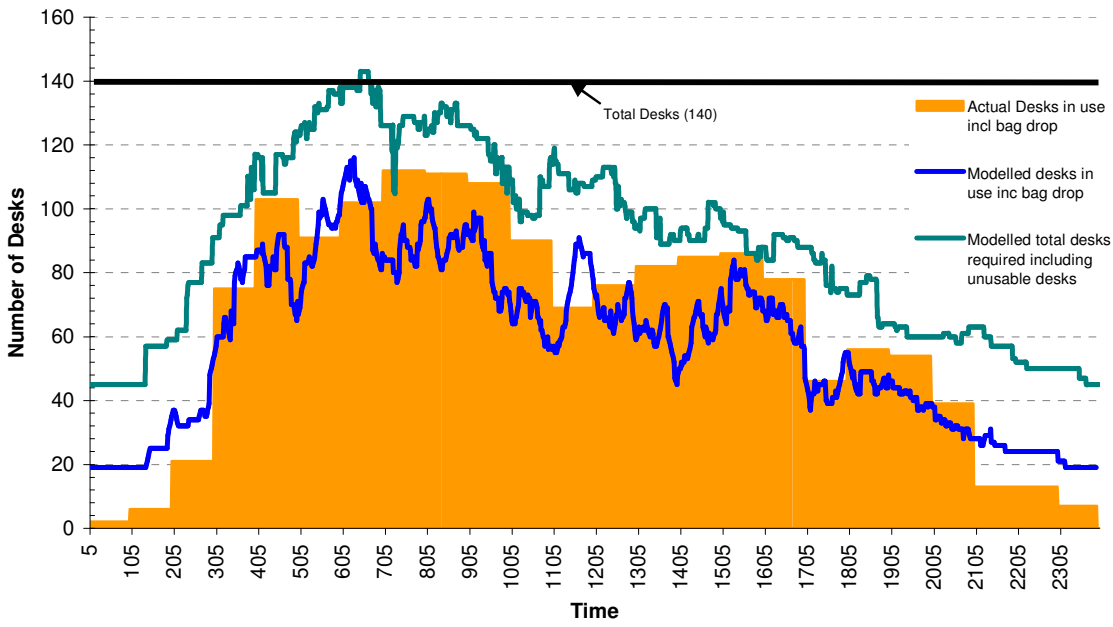
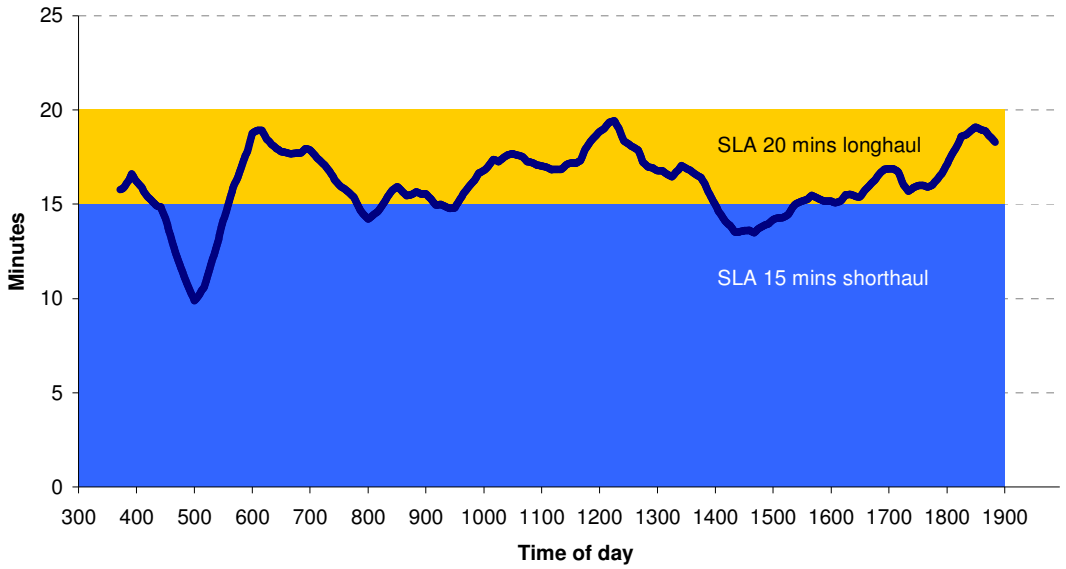


Figure 4 illustrates modelled average queue time in comparison to service level agreements (SLAs) based on time in queue at check-in. SLAs were quoted as 15 minutes for shorthaul destinations and 20 minutes for longhaul destinations by DAA. An average queue time of 16.7 minutes was computed by ARRIVE-DEPART which highlights the dominance of shorthaul traffic at Dublin Airport and compares well to the surveyed information.

Figure 4 - Average Check-in Queue Length (Rolling hour) Summer 2006



It is concluded that the model results compare well with available survey data, both in terms of the number of desks forecasts to be required and the queue lengths.

3.5.3 Security

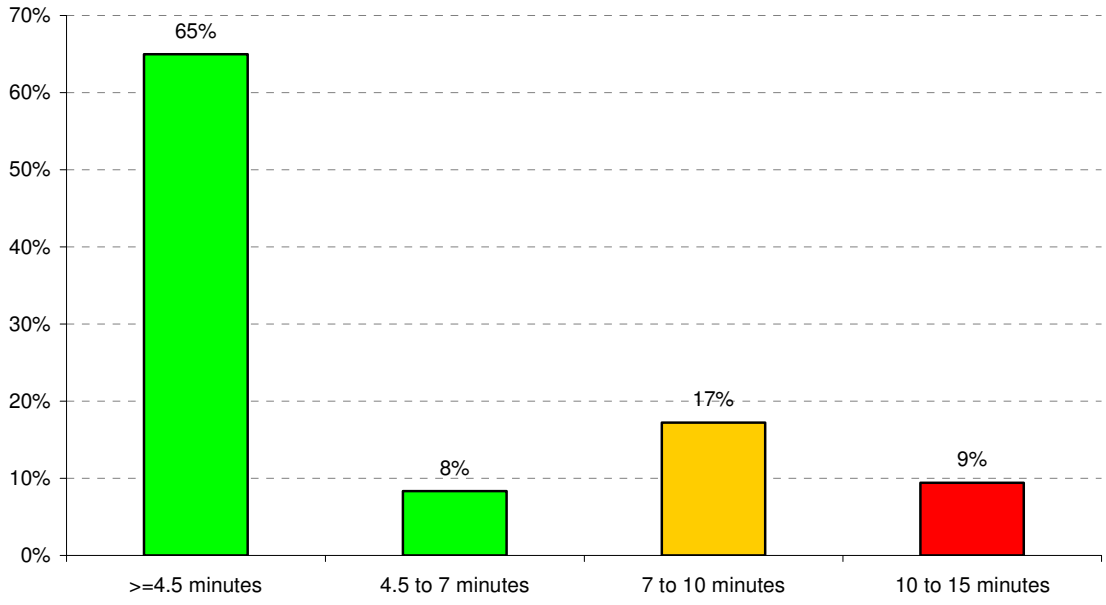
Security has been analysed assuming that all passengers from Aer Lingus and from aisles 1 and 2 are directed to Security B, and that all other passengers are directed to Security A. This general pattern of behaviour is apparently typical of current daily operations in the terminal. Given that the flow of passengers from aisles 1 and 2 is relatively small and that the flow from Aer Lingus is less "peaky" (due to the large proportion (65%) of self service check-in and ability to check-in at any desk), the hourly flow to Security B reaches a maximum of approximately 1320 pax/hour. The flow of passengers to Security A is characterised by larger pulses of passengers and an hourly flow of 2235 passengers. Only a very small percentage (<10%) of passengers using Security A are assumed to have used self service or web based check-in. In addition, the desk opening policies of the airlines using Security A are such that passengers must often wait for check-in to open, resulting in more pronounced waves of passengers using Security A.

It is noted that the total area dedicated for queuing passengers at Security B is 449m^2 whereas that for Security A is only 147m^2 in summer 2006 (rising to 249m^2 in winter 2006). Assuming that each passenger in the queue takes 16.2 seconds to be processed at security, from survey data, the total population in the queue would equate to:

Queue = No. machines x (queue length in minutes/process time per pax) = 9x(7/0.27273)=231 passengers

Therefore, using this methodology and assuming $1m^2$ per person, in order to stay within the queuing space at Security A the maximum queue time would have to equate to approximately 4.5minutes. The SLA for security is stated as 7 minutes. Figure 5 illustrates the proportion of time during the peak three hours that modelled queues exceed the queue area boundary (4.5 minutes), the SLA 7 minutes, and those queuing beyond 10 minutes. At no point did queues exceed 15 minutes.

Figure 5 - Proportion of 3 hour busy period where queues exceed service level agreements – Security A Summer 2006



It is clear from the analysis that during the peak three hours, queues at Security A will remain within the designated queue area for 66% of the peak 3 hour period. However, for the remaining 34% of time the queue will spill over into the concourse and adjacent check-in area, even when the 7 minute SLA is achieved. This is concurrent with anecdotal evidence of queues from Security A impacting on check-in aisles 11 to 13 during peak periods.

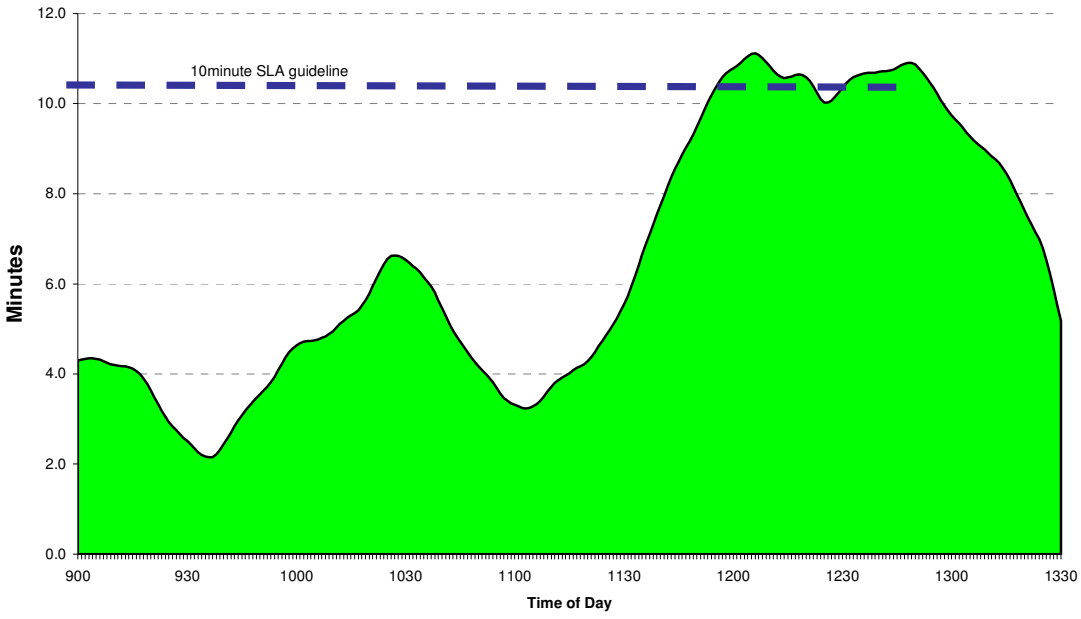
Queues at Security B are comfortably contained within the designated queue area and processed within the 7 minute SLA. It is recognised that passengers will not always choose to use the security areas as designated in the ARRIVE-DEPART model. However, for the purpose of this study, the model provides good representation of current operations at Dublin Airport during peak periods.

3.5.4 Immigration

Calibration of processes on arrival is more complicated as there is no definitive guidance on which stands will commonly be used by different aircraft, and passenger processing will be very sensitive to the actual time on stand of each aircraft. In order to obtain a realistic allocation of aircraft to stands, stand gantt charts were provided for a typical busy Friday in Summer 2006. Flight numbers from the schedule were identified in the gantt chart and aircraft were allocated to the corresponding pier. Arriving aircraft are scheduled to arrive in a 5 minute period. It is therefore possible to have multiple aircraft arriving at the same time in the schedule. In reality it is unlikely that aircraft will arrive on stand at exactly the same moment. Therefore, schedule times were adjusted by up to 3 minutes in a random manner in order to spread out false peaks generated by the schedule. For the purpose of calibration, Pier A has been analysed as it is the busiest immigration channel and has the most sustained flow of passengers throughout the day.

There are no set SLAs for immigration at Dublin Airport. However, DAA did indicate that queue lengths should not exceed 10 minutes whenever possible. DAA also gave anecdotal evidence of passengers queuing back along the corridor from immigration towards Pier A during peak times. Queues generated in ARRIVE-DEPART for Pier A immigration, which are shown in Figure 6 below, indicate that during the peak two hour period in the morning (longhaul peak), queues are between 10 and 11 minutes long for approximately one hour (12:00 to 13:00). This concurs with the anecdotal evidence from DAA. It is recognised that due to the sensitivity of this area, queues may exceed the 10 minute recommended maximum queue length for short periods of a few minutes. This will be dependent on actual time on stand of individual aircraft and how fast passengers walk to immigration on a given day.

Figure 6 – Rolling Hour Pier and Immigration Queues



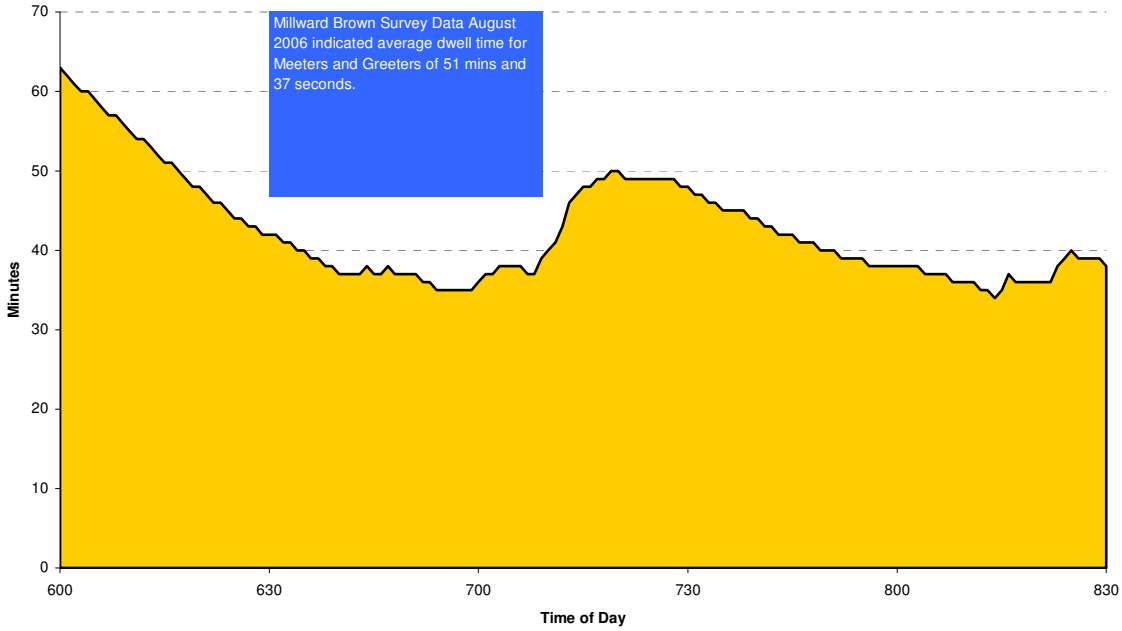
3.5.5 Baggage Reclaim

The situation in baggage reclaim is closely related to the performance of immigration and thus any calibration is reliant on the flow from immigration Analysis of the model suggests that currently up to 8 belts are generally utilised at any one time which concurs with current belt provision. During the consultation, no comments were received that indicated that there were insufficient belts to cope with current demand.

3.5.6 Arrivals Hall

In the same way that passengers typically turn up early for departing flights, it is typical at Dublin to find meeters and greeters arriving up to one hour prior to a flight arriving. Survey data reported by Millward Brown in August 2006 on behalf of DAA, indicated that the average dwell time for friends and family was 51 minutes 37 seconds. Figure 7 below, generated by ARRIVE-DEPART, shows average wait times during peak periods of up to 50 minutes which compares favourably with the survey data.

Figure 7 - Meeters and Greeters Average Dwell Time in Arrivals Hall (Morning Peak)



An average number is dependent on how big the population is that it is derived from. For example, if you only have 2 people of which one waits 1 minute and the other waits an hour, the average would be 30 minutes but this would not be a fair representation of current activity. The early part of this graph (prior to about 6:30) is therefore weighted by the fact that fewer people have turned up and the ones that have turned up are the ones at the beginning of the arrivals profile who have to wait the longest, therefore the average wait time appears to be high. The total population increases around 7:00 to 7:30 and therefore this is a much better representation of average wait time for the meet and greet population.

It is therefore concluded that the model is correctly generating the appropriate dwell times for meeters and greeters within the arrivals hall during the peak period.

3.5.7 Conclusion

In conclusion, based on the survey data available, the model provides a good representation of a typical busy Friday during summer 2006, although schedule perturbations and other events will alter the performance of facilities within the terminal. The calibration of the ARRIVE-DEPART model indicates that the model can be used with a good degree of confidence in order to assess current and future capacity of Dublin Airport terminal.

3.6 Departures Terminal Capacity Assessment

In order to assess capacity, peak demand schedules representing demand up to 24.7mppa have been tested with the model. Although the DAA centreline forecasts suggest this demand is reached in 2010, it is recognised that based on current trends, it may be reached sooner.

The following sections summarise the existing situation, based on the calibrated 2006 model, and then assess the future capacity of each system element, including where appropriate or required potential short-term solutions to provide additional capacity.

3.6.1 Check-in

Since demands after check-in are a function of the flow though check-in, the check-in and departures concourse area is therefore the key determining process on departures. There are two aspects to consider:

- Number of desks
- Queueing and Interaction of check-in queueing with concourse circulation

(a) Current Situation

It is clear from the consultation and analysis of 2006 that the current check-in hall is close to available check-in desk capacity. The current terminal copes with an inflow rate to the check-in concourse of 3370 pax/hour. Predicted demand for 2010 is 24.72mppa which based on a linear relationship at the peak, would equate to 4081 passengers in the busy hour or an increase of 711 in the busy hour between 2006 and 2010.

Assuming that there are only minimal gains in desk throughput capacity by reallocating check-in desks, the additional capacity will need to be provided by check-in facilities in Area 14, if check-in is to accommodate forecast demand beyond 2006. Due to the early turn-up profile of passengers using the airport care must be taken to provide enough circulation space as well as check-in capacity.

(b) Check-in capacity thresholds

An empirical analysis of the departure concourse would assume that each check-in bank will operate as effectively as possible and that the circulation space will be equally used by all passengers, friends and family. However, in reality each aisle will operate in a different way throughout the day depending on schedule of departing flights, the type of passenger checking in (self service or traditional check-in), the desk opening policy of the airline, and the mix of airlines using the aisle. Therefore, for the purpose of this study, check-in has been split into the five areas shown in Table 6 below.

Table 6 – Modelled Check-in Areas

Zone	Aisles/Airline
Area 1	Aisles 1 and 2
Area 2	Aer Lingus
Area 3	Ryanair
Area 4	Aisles 9 and 10
Area 5	Aisles 11, 12 and 13

Each of these areas has been assessed independently. It is assumed that the each queuing passenger and accompanying baggage occupies on average 1.7m^2 (IATA LOS C for high percentage of passengers with trolleys) and that queues will be managed for each area as currently done by the 'pink shirts'. Each area is assessed throughout the day to determine whether the queuing area is being fully utilised. This is expressed as a percentage of available space for each area being used at any one time. The calibration of the model indicated that the correct number of desks are being allocated throughout the day by the model. Therefore any queues generated that overspill outside the queue area must be a function of either insufficient queue space or passengers turning up prior to check-in opening and thus generating large queues. The following categorisation has been used to assess queue space available for each area:

Check-In Queue space	
Area operating at less than 50% of capacity	
Area operating between 50% and 90% of capacity	
Area operating at greater than 90% of capacity or at 100% for more than 0.5 hours	

Where the queues back into the concourse circulation areas, the population has been added to that of friends and family and passengers waiting to check in. It is noted that dense check-in queues are not an indication of poor performance, however where queues overspill into circulation areas the passenger density is relevant.

The total pre-check-in population has been adjusted to reflect the survey evidence that 37% of passengers and friends and family dwell elsewhere in the terminal. This includes the mezzanine area and the arrivals concourse. People dwelling pre check-in are assumed to occupy 2.3m^2 per person which is concurrent with IATA ADRM Level of Service C standards for passengers that have not yet checked-in their baggage.

(c) Assessment of Additional Check-in Capacity from Area 14

It is assumed that any additional check-in capacity beyond 2006 will be supplied by Area 14. Area 14 provides an additional 295m^2 of check-in queue space of 9m depth. 514m^2 of additional circulation space is also provided. IATA LOS C indicates that each queuing passenger should have 1.7m^2 of queue space. This equates to queuing population of 174 passengers.

The capacity of Area 14 will depend on what type of check-in operation is operated in the area. Four different scenarios have been examined to determine whether an additional busy hour demand of 674 passengers, the additional busy hour demand at 27.4mppa, can be accomodated. The following four scenarios have been assessed:

- Scenario 1 - Manual Check-in assuming a check-in operation similar to Ryanair where 2 desks are allocated per flight.
- Scenario 2 – 35% Web Check-in and Automated Check-in system – suggested configuration for relocating Ryanair to Area 14.
- Scenario 3 - An airline with a significant self-service/bag drop check-in operation and where passengers for any flight can check in at any desk allocated to the airline. This is similar to the current Aer Lingus check-in operation.
- Scenario 4 - A mix of smaller airlines that each operate a selection of services including premium check-in and self service/bag drop. This could be equated to airlines such as British Airways or Air France.

(i) Scenario 1 - Manual Check-in

Assuming that a flight can successfully be checked in by two desks, an additional 12 flights could theoretically be checked in this manner. This would equate to an additional in flow or busy hour rate of 1161 passengers in addition to the main concourse. However, Dublin Airport is characterised by approximately 30% of passengers on shorthaul flights arriving 2.5 hours before departure. Given that desks do not open until 2 hours before departure, there is likely to be a significant increase in concourse population that cannot check in. This could be in the order of an additional 800 people in the concourse area. Given that at peak times the main concourse is already at capacity, and that the concourse area of Area 14 is limited, there would likely be an unacceptable overall population in the circulation areas under this scenario.

It should be noted that Ryanair currently require 26 desks at peak in order to serve 13 departures and have a significant impact on the total number of people in the circulation space of the check-in concourse. Given only 24 desks are available and Ryanair have requested an additional 10 desks, it does not therefore appear to be possible to locate the entire Ryanair operation in Area 14 unless there is a change in the check-in operation away from manual check-in or a split operation is assumed.

(ii) Scenario 2 - 35% Web Check-in and Automated Check-in system

This scenario assumes the same schedule as proposed in Scenario 1, but with 35% of passengers by-passing check-in and moving directly to security. The remaining passengers can check in at any of the 24 available desks. Discussions with Ryanair indicated that they would be willing to investigate earlier desk opening times of up to 3 hours prior to departure. Early desk opening has been assumed in this scenario. All passengers dwelling pre and post check-in are assumed to be accommodated in Area 14. The total inflow of people to the departures concourse equates to a busy hour rate of 1207. This is slightly higher than in scenario 1 due to the fact that passengers turning up having checked in on-line are assumed to turn up closer to the time of departure. The total concourse population for Area 14 would be 151 people resulting in no overspill into the main departures concourse. This appears to be an effective way of using the facilities provided in Area 14.

This scenario has assumed that all 24 desks will be manned. However, by manning 18 of the 24 desks the total number of passengers queuing would reach 181 at peak (exceeding 174 passengers for 15 minutes during the day). The additional 6 desks could provide additional capacity for future Ryanair growth. It is therefore, concluded that if Ryanair were able to automate their processes and open desks an hour earlier than present, relocating Ryanair to Area 14 could provide additional capacity beyond 2010.

(iii) Scenario 3 - Single bank for check-in for all flights including 65% self service up take

Check-in Area 14 would be able to cope with an additional 13 flights in this configuration resulting in an increase in the busy hour rate of 1020 people. Assuming 14 bag drops and 8 check-in desks could be manned throughout the peak as well as 15 additional self service kiosks passengers could be processed without queues overflowing to the main concourse area.

(iv) Scenario 4 - Individual Airlines with Premium and Self Service Products

A typical desk allocation of 5 desks per airline (3 traditional check-in, 1 bag drop and 1 Premium desk) is likely to operate no more than 2 additional flights in the peak. Assuming that desks could be configured to accommodate 5 such airlines the total increase to the busy hour inflow rate could increase in the order of 10 flights or 695 passengers in the busy hour and will have very limited impact on the main concourse area.

It is noted that the American carriers are unlikely to fit in this area as their desk demand currently exceeds provision in Area 14. There could be some gain in allocating charter flights to Area 14 however, charter peaks are not concurrent with the main scheduled peak and therefore the overall gain at peak times is likely to be less effective if Area 14 is dedicated to charter airlines.

It is therefore concluded that under each scenario, as shown in Table 7, Area 14 is capable of providing sufficient capacity enhancements to meet demand until 2010 and possibly beyond. The decision as to which

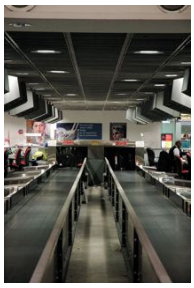
airlines occupy the space however will depend on the impact on the concourse areas and other operational considerations.

Table 7 - Impact of Area 14 on Concourse Population under various Scenarios

Scenario	BHR	Impact on Concourse Population
Current Busy Hour Rate	3370	Currently exceeds LOS C at peak
Required capacity to meet 24.7mppa	4081	
BHR + Scenario 1	**4531**	Negative impact at peak
BHR + Scenario 2	**4577**	Short lived manageable impact at peak in Area 14 only
BHR + Scenario 3	**4390**	Short lived manageable impact at peak in Area 14 only
BHR + Scenario 4	4065	No impact

(d) Impact of 35% Web Check-in for Ryanair on Check-in Capacity

It is understood that Ryanair predict a significant rise in Web Check-in to 35% by Summer 2007. These passengers check in on-line and must travel with hand baggage only and thus do not require a dedicated bag drop facility. Although this will cause a reduction in the number of people checking in at the airport, it is unlikely that Ryanair will be able to open any fewer desks as passengers will continue to turn up over the same period as they do currently and one desk is unlikely to be able to cope with the demand generated by the remaining 65% of passengers. As Ryanair currently operate a manual check-in process any reduction in the number of passengers checking in will not equate to a reduction in the number of desks required as one desk cannot be used to check-in more than one flight. It is recognised that although the increase in web check-in is unlikely to have any effect on the number of desks required by Ryanair, there will be reductions in queue length and circulation issues in the area surrounding Ryanair check-in are likely to be eased.



It is anticipated that passengers using web check-in are likely to turn up later at the airport given the anticipation that they do not need to queue at check-in. It is possible that this may have an impact at security if a significant percentage of passengers turn up very close to the time of departure. However, without a better understanding of passenger behaviour at Dublin airport, it is not possible to determine whether this will have a detrimental impact at security. It is suggested that the turn up profile of these passengers in monitored as web check-in becomes increasingly popular.

In order to significantly increase the capacity of check-in desks through the introduction of web check-in Ryanair would need to move to an automated check-in system. This would allow any passenger to check in at any desk and therefore reduce the total number of desks required or alternatively, reduce the queue length if all desks are manned throughout the peak. This option has already been discussed in Scenario 2 as a possible way to accommodate Ryanair in Area 14.

3.6.2 Departures Concourse

The post check-in population has also been adjusted to reflect passengers, friends and family who choose to dwell elsewhere in the terminal. People dwelling post check-in are assumed to have 1.8m^2 per person which is concurrent with IATA ADRM Level of Service C standards for passengers that have checked-in their baggage.

The post-check-in dwell area has further been adjusted to reflect that security queues at Security A often overspill into the main concourse during peak times. It is assumed that each passenger that overspills from the main security queue requires 1.2m^2. Although security queues are commonly calculated using 1.0m^2 per person, this slightly higher figure has been used to account for passengers queuing in an area that is not controlled by barriers or other queuing methods. This overspill population is calculated for each minute of the day and is used to adjust the available space for post-check-in circulation.

(a) Current Operations

The departures concourse is considered by DAA to be an area that is close to capacity during peak times, and can be subject to crowding on regular occasions throughout the peak summer season. As already described in this report, the schedule used for analysis is typical for the 30th busy hour during the Summer 2006 season and therefore is unlikely to generate the level of crowding anecdotally witnessed on the busiest days of Summer 2006.

During Summer 2006 passengers were advised by the media to allow extra time to check-in for departing flights. This caused passengers to turn up earlier than usual, prior to check-in desks opening and thus resulted in an increase in the departures concourse population. Similarly, security scares throughout the summer also added to the number of people allowing additional time to check-in. It would not appear reasonable given current levels of security to assume that this behaviour will change in coming years.

It is also recognised that any delay to flights has a very significant impact on the concourse population. This is especially true close to aisles 7 and 8 where the circulation space is narrowed by the presence of the ticket desks located adjacent to the terminal entrance. This is a busy area due to the number of flights operated by Ryanair being checked in at a limited number of desks. The flight information display screens are also located in this area resulting in people congregating in the area. During severe delays it is not uncommon for some flights to be cancelled and for passengers to be directed to the ticket desks to rebook tickets. This causes particular congestion around the ticket desks due to the large number of flights operated by Ryanair.

Using the colour coding system described in Appendix D and summarised earlier, the diagrams on the following pages provide a series of illustrative snapshots throughout the morning peak describing the nature of population density within the check-in hall and departures concourse for Summer 2006. The illustrations give an indication of which area of the departures concourse is working hardest throughout the morning.

below capacity	at capacity	over capacity

0300-0500hrs

The first diagram indicates that at 0300 the first passengers start to arrive for check-in for Ryanair's early morning departures. The diagram suggests that the Ryanair area is already filled with passengers waiting to check-in. In reality it is more likely that these passengers will arrive closer to the time of departure given the early morning departure time resulting in a smaller population than modelled. Similarly, passengers are unlikely to wait in the Ryanair check-in area but will use the available circulation space and mezzanine level.

By 0400, each of the check-in areas begins to fill with passengers arriving for early morning departures. As passenger volume increases the pre-check-in area fills up and the resulting area per person is reduced.

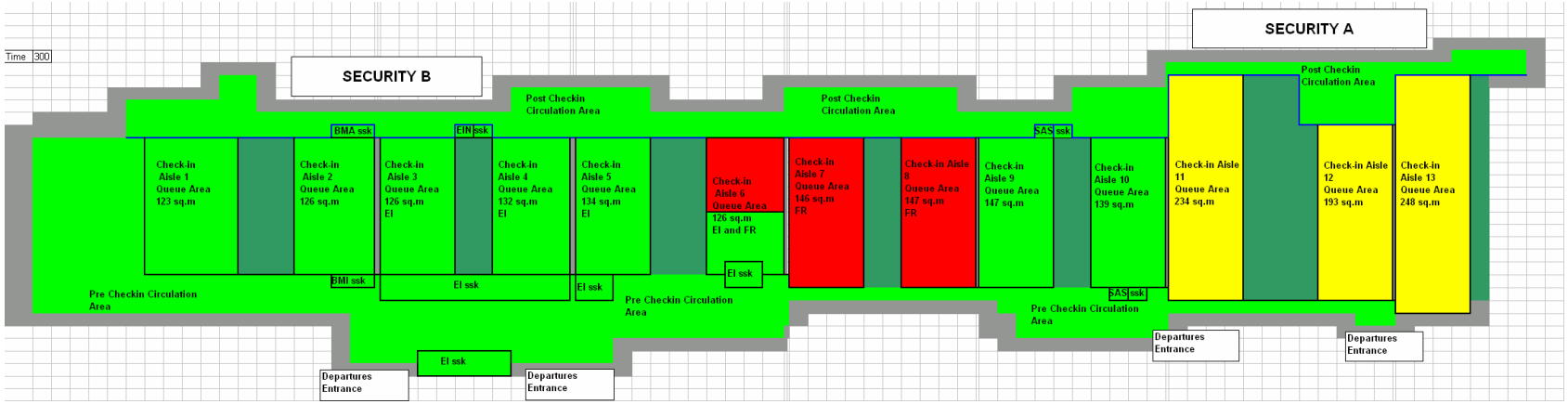
0500-0700hrs

0500 appears to be the busiest time of the morning. At this time, all of the check-in areas are functioning with queues filling at least 90% of the available queuing area. Aisles 1 and 2 are the sole exception. The pre-check-in dwell area fills up due to an increase in the number of passengers arriving for flights at around 0700 to 0800. This population is increased by overspill from busy check-in areas.

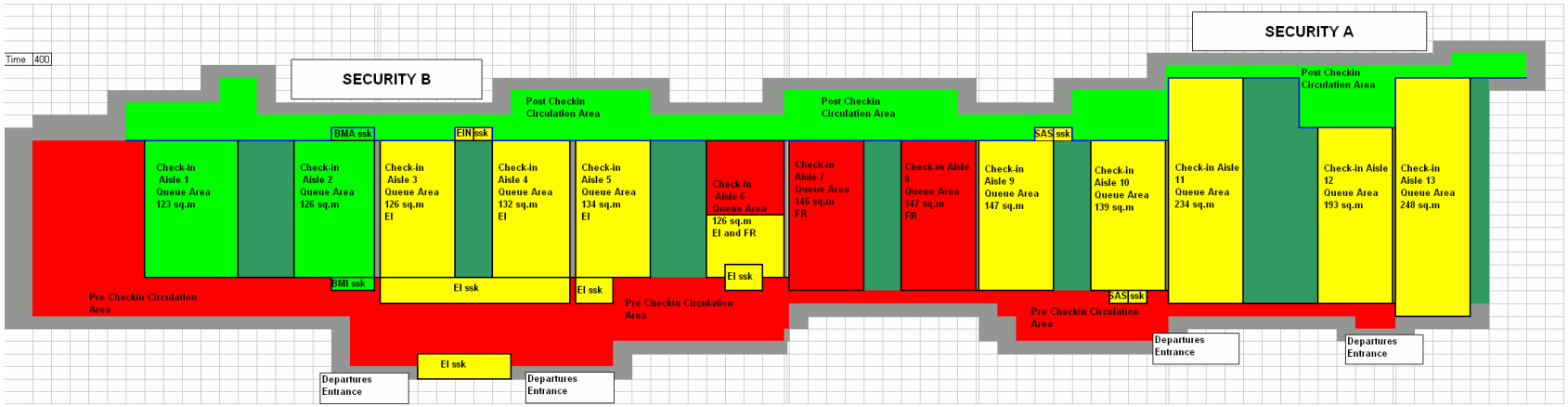
By 0600 the Aer Lingus check-in area appears to be under less pressure and the pre-check-in circulation area less congested. This trend continues through hours 0700 and 0800 with check-in becoming less busy. The Ryanair check-in area remains busy throughout the peak period. This is partly due to the number of flights Ryanair operates, and partly due to the desk opening policy operated that results in queues building prior to desks opening.

It is concluded that although the departures concourse does become crowded during the peak period, the concourse population can be reasonably managed within the overall space available. It is however, recognised that the concourse will be congested at certain times and may become critical on the busiest days of the summer period. However there are a number of potential improvements which would help to improve passenger circulation and reduce crowding along the main front area.

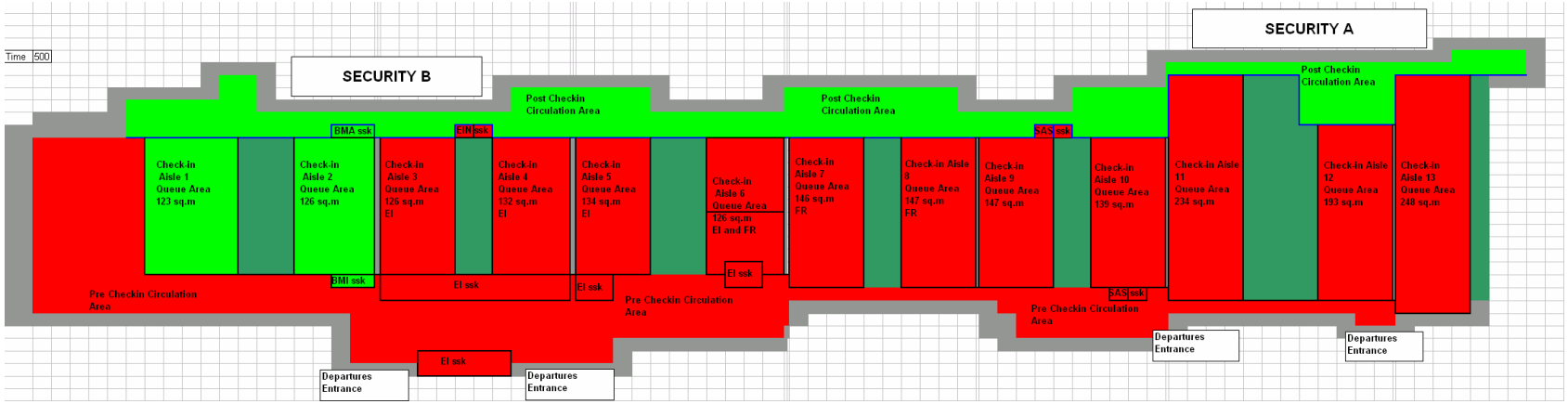
0300 Departures Concourse (Summer 06)



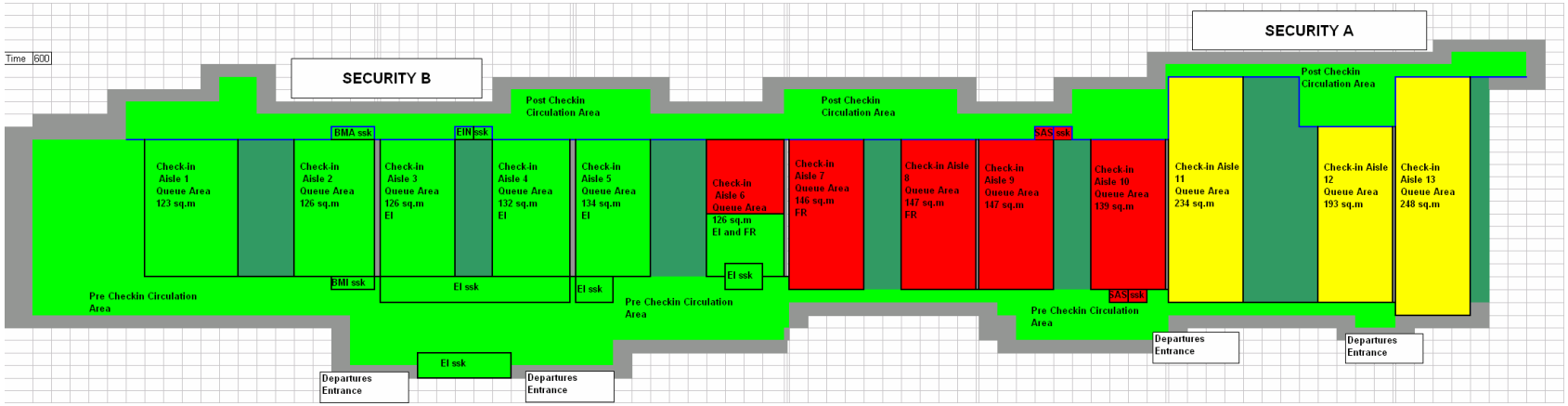
0400 Departures Concourse (Summer 06)



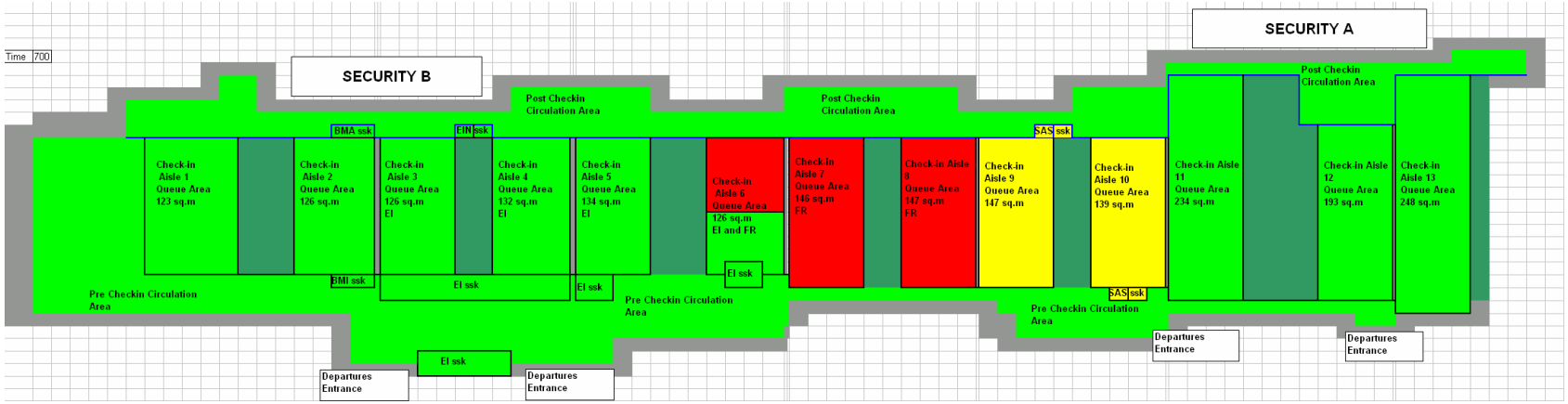
0500 Departures Concourse (Summer 06)



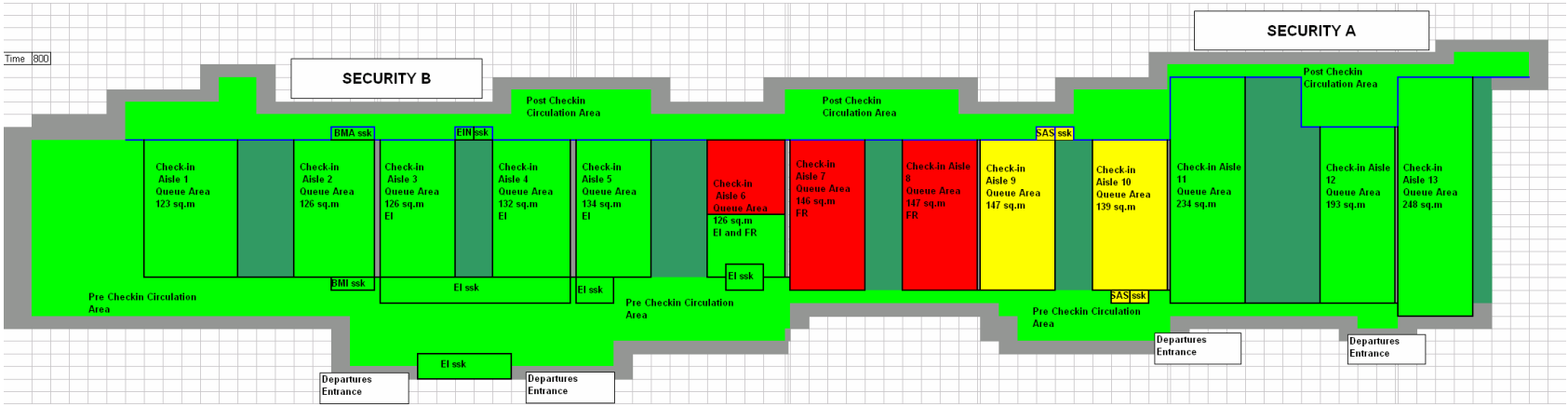
0600 Departures Concourse (Summer 06)



0700 Departures Concourse (Summer 06)



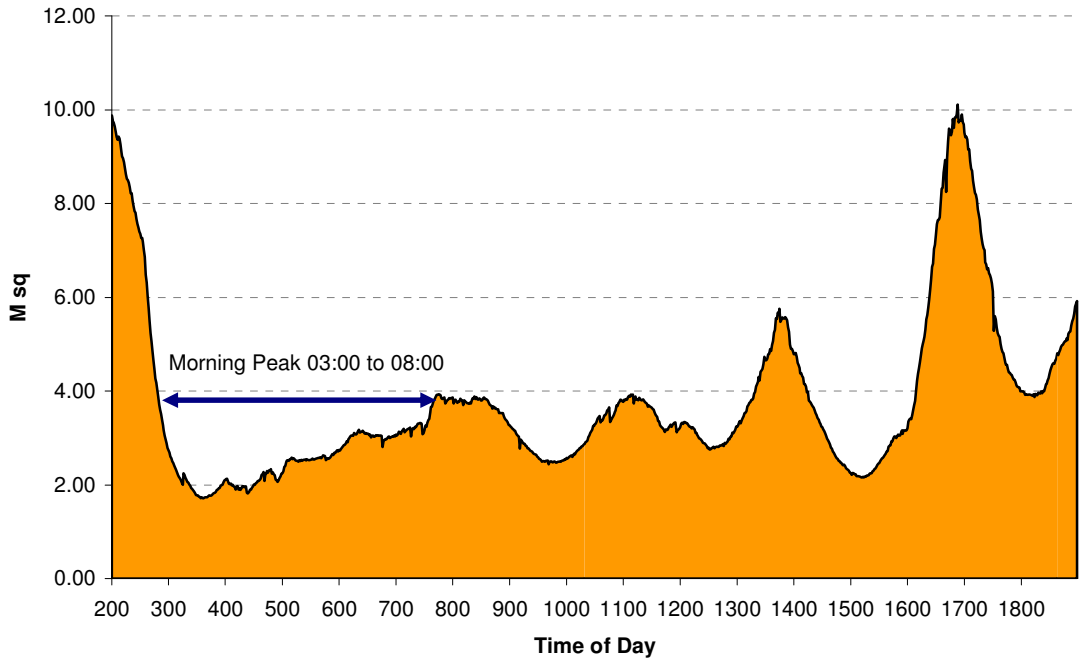
0800 Departures Concourse (Summer 06)



(b) Future Capacity Assessment

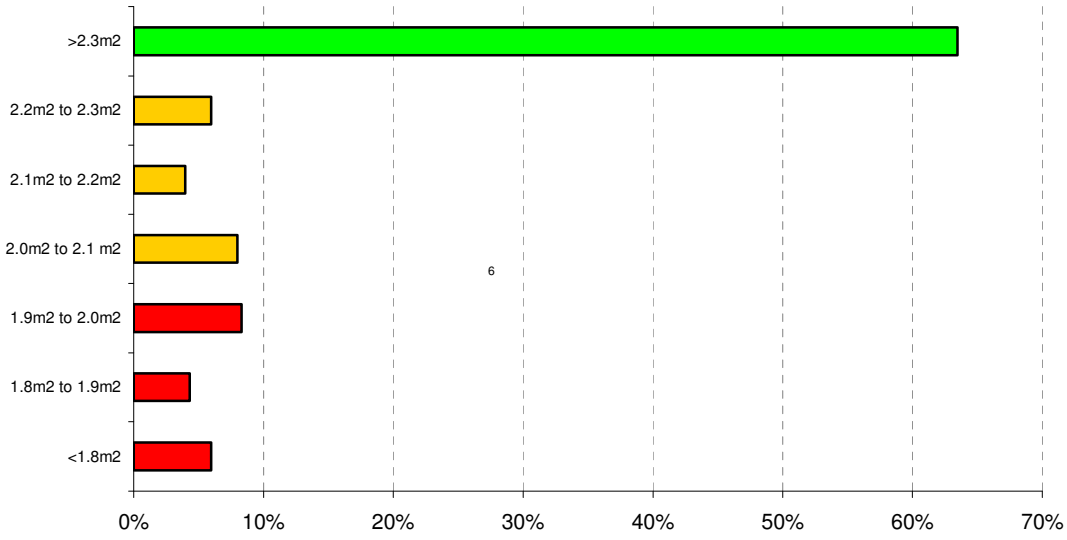
Figure 8 illustrates the Summer 2006 peak period during the morning where pre-check-in circulation space is reduced to below 3m^2 per person. This peak is identified as 03:00 to 08:00. For the purpose of further analysis this period is analysed in more detail.

Figure 8 - Summer 2006, Pre-Check-in Circulation Space per Person



During the peak period the space per person in the pre-check-in circulation area drops below 2.3m^2 for 36% of the time. Under the parameters set out in this report, the circulation space should be declared at capacity if the space requirements are not met for more than 20% of the peak period. Figure 9 illustrates the space provision person as a percentage of the peak period.

Figure 9 - Pre-Check-in Concourse Population, space per person as proportion of peak 5 hour period



It is clear that if an average per person space parameter of 2.0m^2 could be deemed acceptable during the peak period, the capacity limit would be achieved for 82% of the peak period. It should be noted that the

post check-in space requirement of 1.8m^2 per person is exceeded throughout the day, with a minimum space provision of 3.2 m^2 per person. This adequacy of space provision is shown on the coloured area analysis plans illustrated on the next pages.

(c) Potential Improvements to Check-in and the Departures Concourse

Although it has already been shown that Area 14 will provide sufficient check-in capacity until the opening of T2 there may be improvements to the layout of the check-in hall that could improve overall circulation and passenger management.

It is noted that Aisles 1 and 2 do not share the same peak period as Ryanair and aisles 9 and 10. For this reason it may be prudent to investigate moving carriers located in aisles 1 and 2 to Area 14 thus vacating desks in the main concourse. If Aer Lingus were to move from aisles 5 and 6 to aisles 1 and 2 this would provide additional space for Ryanair to expand in to at peak times. It is understood that Aer Lingus would be able to operate the hold baggage system (HBS) allocated to aisles 1 and 2 and that Ryanair could continue to share the HBS currently operated by Aer Lingus as well as the system they currently utilise.

Similarly, some gain could be made by applying the above scenario but with Ryanair and Aer Lingus in opposed positions. This would provide additional queue area adjacent to aisle 1 that could be utilised for queues forming for Ryanair. However, it is noted that such a move reallocating both Aer Lingus and Ryanair would cause significant disruption and may not be achievable in the short-term.

It is suggested that the introduction of a 'one-way' flow through check-in would help to improve passenger distribution. Essentially this would reduce the immediate flow along the main corridor at the front of the concourse and force passengers to use the area at the rear of the concourse which is less densely populated. This would provide benefits whether passengers were heading straight to security after check-in or heading to the mezzanine level.

Airline signage has been introduced at the terminal entrance to encourage better distribution of entry between the two entry doors. However, since the signs are not visible to cars and taxis dropping off, the benefits are largely muted. It is recommended that signage be more clearly visible to arriving passengers and vehicles.

The main departures notice board would seem to encourage passengers to dwell closer to the centre of he concourse area. This central area is the area under most pressure at peak since it serves for Ryanair check-in overspill and main circulation. Consideration could be given for encouraging greater use of the small display screens at either end of the terminal to help improve passenger distribution and reduce blockages created by passengers stopping to read the departures board.

If Ryanair were to move to Area 14 it may be prudent to relocate airlines operating smaller aircraft to aisles 7 and 8 (currently operated by Ryanair). This could improve circulation in the central area of the departures concourse and ease flow through the concourse to security and to the escalators leading to the

Mezzanine level. Removal of the aisles could increase circulation space but would reduce the flexibility of allocating check-in desks at peak times.

The location of the airline ticket desks in the centre of the concourse uneccessarily restricts passenger space in the area most heavily used by passengers. It is suggested that these are removed and relocated to the underused area by Aisle 1, where the Bank of Ireland used to be. This would open up the central area and significantly improve passenger circulation and reduce congestion.

(d) Conclusion

Taken as a whole, it is concluded that with the additional capacity provided by Area 14 and greater passenger redistribution through active management the overall concourse area can deliver an appropriate level of service until the opening of Terminal 2 in 2009.

3.6.3 Security

The inflow to security is directly related to the flow of passengers from check-in. The amount of time a passenger decides to dwell prior to joining the security queue after having checked in will be dependent on the amount of time that the passenger has before the flight departs and how long the queue is. Therefore, when the queue length exceeds the SLA of 7 minutes for security, it is not unreasonable to assume that the length of time that a passenger may wait in a queue will be dependent on a number of factors. The model cannot account for passenger behaviour in terms of whether the passenger decides to wait until the queue subsides or whether to join the queue. Queue times over 7 minutes are therefore provided as an indication of what may happen on a typical day. The results of this analysis refer to an average delay on a typical busy day, in reality it is possible that short lived peaks of a few minutes could occur depending on passenger behaviour on any given day.

In 2007 the number of available security units at Security B is reduced by one unit which has a knock-on effect on the queues in this area. Queues could exceed 7 minutes for 1.5 hours during the busy three hour period. Conversely, additional security facilities at Security A in 2007 reduce the queues in the area and all passengers meet the 7 minute queue standard.

During 2008 Security B queues are greater exceeding 15 minutes for approximately 1 hour of the day. Security A appears to have additional capacity and therefore queues could be managed by directing passengers to the smallest queue.

The addition of 4 extra units at Security B in 2009 provides sufficient capacity to cope with demand with all passengers processed within 7 minutes. A summary of results is illustrated in Table 8.

Assuming current security process times, security overall would appear to provide sufficient processing capacity. However in order to realise this capacity until 2009, active management and direction of passengers to both queuing areas will be needed.

Table 8 - Security Queue length as proportion of peak period

Year	Security Facility	Units	Area (m^2)	mppa	Queue length as % of Peak 3 hours			
					Less than 7 minutes	7-10 minutes	10-15 minutes	Greater than 15 minutes
2006	A	9	146	20,411	74	17	9	0
2007	A	12	268	21,653	100	0	0	0
2008	A	14	268	22,563	100	0	0	0
2009	A	14	268	23,613	100	0	0	0
2010	A	14	268	24,717	100	0	0	0

Year	Security Facility	Units	Area (m^2)	mppa	Queue length as % of Peak 3 hours			
					Less than 7 minutes	7-10 minutes	10-15 minutes	Greater than 15 minutes
2006	B	7	449	20,411	100	0	0	0
2007	B	6	449	21,653	48	14	37	0
2008	B	6	449	22,563	36	11	23	31
2009	B	10	449	23,613	100	0	0	0
2010	B	10	449	24,717	100	0	0	0

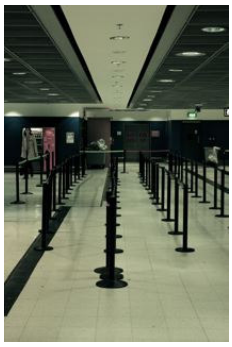
(a) New Security Protocol

New European-wide security protocols were introduced on November 6, 2006. Sensitivity tests indicating a 26% rise in average process time were applied in the Summer 2007 capacity declaration report to assess the impact of new security protocols. The analysis was based on data collected when the new protocols were first introduced in the UK in Summer 2006. However, the analysis overstates the impact of the new measures and process times can be expected to normalise once passengers and staff become accustomed to the new procedures. For this reason, Jacobs Consultancy have tested a 20% increase in process time (to 19 seconds per person) to illustrate the possible impact. At the time of writing no survey data is available on the potentially higher process times, although a 20% increase in considered a worst case scenario. The assessment has been made to understand the impact in Summer 2007 as although some new facilities have been introduced the full security upgrade programme has not been completed. The impacts of the new protocol are likely to be most greatly felt at this point.

The higher process time has a limited effect on queues at Security A due to the introduction of additional security facilities in the area. The SLA of 7 minutes is exceeded for 15% of the 3 hour peak period (equivalent to half an hour). However, due to the reduction in security units from 7 to 6 at Security B nearly all passengers at Security B are likely to experience queues in excess of 7 minutes. Queues are likely to exceed 15 minutes for approximately 80% of the peak 3 hour period. If the 7^{th} security unit can be retained, the queues are likely to be reduced so that the maximum queue length at Security B would be 15 minutes. Security B could expect to have queue times of 10 to 15 minutes for approximately 1.5 hours during the peak period. However, by effectively managing the queues so that passengers are

directed to either Security A or B depending on which is busier, queues could be maintained at or below 7 minutes for 70% of the peak period with queues exceeding 10 minutes for approximately 35 minutes during the peak (maximum queue wait of 15 minutes). If the 7th unit at Security B could be retained and passengers balanced between Security A and B, queues would exceed 7 minutes for approximately 35 minutes with queues reaching a maximum of 10 minutes.

Assuming that the 20% higher process is experienced beyond 2007 and that additional security facilities are provided in line with the current development programme, security should be able to cope with forecast demand until 2010 as long as queues are closely managed. This would include queue combing to bring forward late passengers, and redirecting passengers to the Security Area that has the least queues. This is illustrated in Table 9 below. However, over time it is reasonable to expect that process times will not be as long as assumed, although this cannot be confirmed until survey data on process times are collected after the new protocol has been operational for a period.



The results indicate that security is very sensitive to any change in process time and manning of available security facilities. This analysis illustrates that although the terminal is likely to be able to cope on typical days, large queues are likely to result on peak days during the summer 2007 period. It is suggested that the area by the old Bank of Ireland in aisle one which is under-used could be used as an overspill area for Security B queues. Passengers could be actively directed to Security B to use the extra queueing space. This is considered a temporary measure until additional capacity is provided and any short term increase in process times has stabilised.

A potential scheme has been suggested which would create a centralised security under the mezzanine escalators. Although the disruption may be fairly minimal, more detailed evaluation of the constructability would be required. Essentially this scheme would formalise the 'active queue management' proposed with an infrastructure solution, as such it is likely to provide the additional capacity, however queuing back in to the central aisles is likely. Removal of desks in aisles 7 and 8 would be possible but would compromise the airport's check-in capacity for expansion.

Table 9 - New Security Protocol: Security Queue Length as proportion of peak period

					Queue length as % of Peak 3 hours			
Year	Security Facility	Units	Area (m^2)	mppa	Less than 7 minutes	7-10 minutes	10-15 minutes	Greater than 15 minutes
2007	Security A	12	268	21,653	74	16	10	0
2007	Security B	6	449	21,653	1	7	11	82
2007	Security B	7	449	21,653	41	12	47	0
2007	ALL	18	717	21,653	70	10	20	0
2007	ALL	19	717	21,653	80	20	0	0
2008	ALL	20	717	22,563	84	16	0	0
2009	ALL	24	717	23,613	100	0	0	0
2010	ALL	24	717	24,717	100	0	0	0

In conclusion, in order to maintain a similar flow of passengers to that experienced during Summer 2006, a total of 19 units in conjunction with carefully monitored queue management are likely to be required throughout the peak during Summer 2007. Furthermore if the additional security capacity can be brought forward, or the area reconfigured to provide a centralised system, this will reduce the extent of active management required. Taken as whole, even with the worst case security process times, there would appear to be sufficient security queueing space and processing capacity. It s expected that process times will stabilise over time, and that security should not be considered a capacity constraint, although maximum use of the available capacity can be made either through active queue management or a reconfiguration of the desks into a centralised arrangement.

3.6.4 Airside Lounge and Gates

As part of this study the Arup Capacity Report (May 2006) was reviewed. The method used for assessing capacity of the hold areas in the report is consistent with any capacity study that may be undertaken by Jacobs Consultancy. It is noted that the seat availability is less than the IATA recommended 80%.

During the course of this study there has been no evidence that individual gate lounges are currently unable to cope with the size of aircraft commonly using the stands they are serving. It is assumed that passengers will not be called forward to a gate unless the previous aircraft has departed, therefore the capacity of individual holding lounges has not been assessed as part of this study. However, where a group of stands is served by a single holding lounge this has been assessed.

The capacity of the hold rooms is not anticipated to be a significant problem whilst Pier C is still in use and Pier E has not been constructed. However, when Pier C is demolished in order to construct Pier E and Terminal 2, there will be a loss of 3 wide bodied gate rooms (1565 m^2). During this period, the number of remote movements will increase as early release Pier E stands come on line and remote stands on the western side of the cross wind runway are used. There is likely to be an increase in the number of remote movements and therefore requirement for bussing gates. Although small aircraft may be accommodated during "gate rests" on functioning piers, any large aircraft displaced during the construction work are more likely to be difficult to find sufficient hold rooms for. Examination of stand gantt charts for a typical busy Friday in Summer 06 indicates that between 06:00 and 09:00 there are several opportunities to use gate rests to allow bussing to remote aircraft departures. However, between 09:00 and 12:00 there may only be room to accommodate 1 of the 9 departures displaced from Pier C on Pier B. There may be opportunities to use the new Pier D stands for bussed departures depending on the frequency of use of these stands for shorthaul and domestic departures.

Although gates may become increasingly under pressure during the construction of T2 and the demolition of Pier C, passenger dwell time at the gate can be managed through appropriate call forward times to meet demand. There is unlikely to be any additional delay to aircraft departures based on gate capacity. There are likely to be some issues in the number of bussing gates available for use of remote stands during the construction of T2. This is very closely related to contact stand availability which is referred to in section 4 of this report. It is recommended that bussing operations are centralised either through DAA or a single operator. This would maximise the efficiency of increased bussing operations airside.

3.7 ARRIVALS CAPACITY ASSESSMENT

For the purpose of modelling arrivals, two distinct peaks have been analysed. A morning peak encompassing the arrival of longhaul aircraft, and a shorthaul peak in the afternoon. The shorthaul peak generates the greatest number of inflowing passengers but due to the nature of the passenger profile (greater percentage EU passengers), has less impact on facilities such as immigration and therefore baggage reclaim.

3.7.1 Immigration

It has been assumed that the following desks are open for each pier, shown in Table 10:

Table 10 - Immigration Desks

Pier	Desks (manned)
A	4
B	6
C	3
Centralised Immigration A/D	12

It has been assumed that each desk can process both EU and Non-EU passengers and that passengers are not segregated. It has also been assumed that Domestic passengers continue to be routed through immigration with no bypass facility.

The following EU and Non-EU split has been assumed, shown in Table 11:

Table 11 – Passenger Split by Flight Type

Flight Type	EU%	Non EU%
Domestic	100	0
Ryanair	94	94
Other Shorthaul	80	20
Longhaul	50	50

The following process times have been assumed, shown in Table 12:

Table 12 - Immigration Process Times

Pier	EU (secs)	Non EU (secs)
A	4	39
B	4	43
C	4	49
Centralised Immigration	4	43

For the purpose of this study queuing standards have been applied in terms of time in queue rather than space per person. DAA have indicated that in the absence of a service level agreement they aim to achieve a maximum queue of 10 minutes for any passenger. The IATA ADRM assumptions for maximum queue time are shown in Table 13:

Table 13 - Immigration Queuing Standards

Area	Short to acceptable	Acceptable to long
Passport Control	0-7 mins	7-15 mins

For the purpose of this report, queue time has therefore been assessed as shown in Table 14:

Table 14 – Adopted Immigration Queuing Time Assumptions

Area	Good	Acceptable	Review
Passport Control	0-5 mins	5-10 mins	10+ mins

The theoretical capacity of both Piers B and C indicates that both piers could accommodate a large increase in throughput. However, the real throughput of the pier will depend on the likely mix and spacing of aircraft using the pier.

(a) Current Operations

The hourly capacity of Pier C was computed to be 868 passengers in the Arup report (May 2006). The model indicates that in a rolling hour Pier C immigration is processing 572 passengers. Pier C can currently accommodate 6 narrow bodied aircraft or 3 wide bodied aircraft. In reality it is unlikely that Pier C will have to cope with more than the equivalent of 4 short haul arrivals in a 20 minute period due to operational constraints in unloading more than four aircraft in 20 minutes. This is concurrent with the operation today. This type of arrival pattern results in a queue of approximately 220 people with a maximum dwell time of 15 minutes for most passengers, with occasional peaks of up to 30 minutes. This analysis is based on 3 of the 6 available desks being manned as per current practice. If short peaks were to occur on Pier C additional desks are available if staff could be assigned to operate the desks. Although there are short peaks when queues exceed 10 minutes, it is not anticipated that Pier C immigration is a constraint to growth at Dublin Airport.

The model shows that Pier B currently processes passengers with a maximum wait time of 13 minutes and a maximum queue of approximately 160 passengers. The Arup report indicates that the theoretical capacity of Pier B immigration should be 973 passengers. The model computes that under a Summer 2006 schedule the pier is processing 946 passengers an hour and is therefore operating close to capacity. However, operational constraints in terms of getting aircraft on and off stand suggest that it is unlikely that more than one longhaul and two shorthaul aircraft would be able to unload in five minutes, as is the case today. Therefore, it is suggested that the capacity of the immigration facility at Pier B is unlikely to

be a constraint to growth at Dublin airport. If short peaks were to occur there are two additional desks that are currently not manned. Manning these additional desks would ensure that predictable short lived peaks could be managed.

Immigration at Pier A has been reported as being over crowded at peak times with passengers forced to queue back along the corridor towards Pier A. Since Summer 2006 immigration has been improved by adding an additional desk (total 4 desks). The modelling shows that this has reduced the overall queuing time to less than 10 minutes for most arriving passengers with short lived peaks reaching 15 minutes. At peaks where passengers have to wait 15 minutes or more the total population can reach approximately 366 passengers which is concurrent with anecdotal evidence of queues in the area. However, throughout most of the day the total population is less than 250 people. Assuming the space per passenger should be $1m^2$ per person, the queues should regularly be maintained within the given $236m^2$ of queuing space provided. The dwell time expressed as a rolling hour for Immigration on Pier A equates to 10 to 11 minutes during the peak 2 hour period.

The Arup report indicates that the theoretical capacity of the pier is 1323 passengers an hour. The model indicates that 1946 passengers can be processed in an hour if the queue is allowed to build to 15 minutes delay for short periods of the day and the queue is governed by a queue threshold defined by time rather than space (i.e. passengers are allowed to queue along the corridor towards Pier A during peak times).

It is noted however, that if process times increase or one of the four passport controls is not manned,

queues quickly increase beyond the tolerable limits for queuing space or dwell time. As a sensitivity check the model has been run by increasing the process time for EU and Non-EU passengers by one second. Results indicate that by increasing process times by only one second, queues are likely to regularly exceed 15 minutes, with queues occasionally reaching half an hour. Analysis indicates that over a six hour period between 07:00 and 13:00 the total population would exceed 300 passengers for approximately 1.7 hours and could on occasion reach 595 passengers. Given that the area is so close to exceeding capacity, additional measures for providing additional immigration facilities should be investigated.

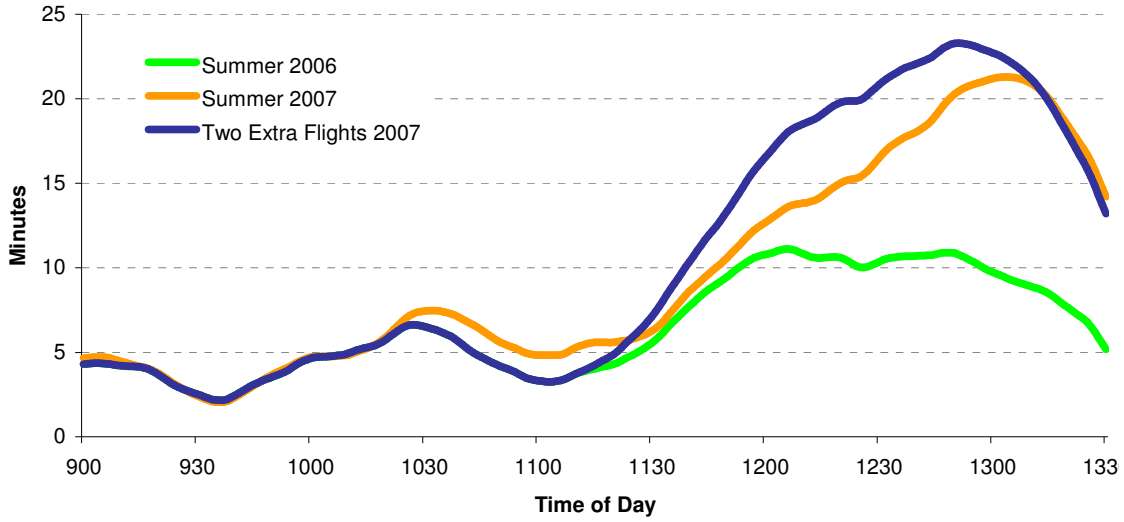
(b) Future Capacity

In Summer 2007 the typical peak hour population is assumed to increase in the order of 6% in line with predicted growth. This growth has been applied evenly to the schedule and results in an increase in queue time to approximately 20 minutes during the peak 2 hours at Pier A. This growth could similarly be expressed as two additional shorthaul flights arriving in the peak. The impact of the "even" growth compared to that of adding two shorthaul flights of 170 passengers during the peak hour is illustrated in Figure 10.

It is evident from this graph that capacity of Pier A will be exceeded during Summer 2007. One additional immigration desk would provide sufficient capacity to meet the 10 minute queue time if manned throughout the peak two hour period. The summer 2007 wish list includes short scheduled peaks of

arrivals on Pier A that could result in 4 simultaneous arrivals within a 5 minute period and up to 8 arrivals in a scheduled 15 minutes. It is recognised that that these aircraft are unlikely to unload passengers at the same moment in time, however, even with randomisation of these flights allowing delay of up to 10 minutes, the resulting population at Immigration on Pier A is likely to generate queues of up to 20 minutes in duration.

Figure 10 – Centralised Immigration, Rolling Hour Pier A& Immigration Queues

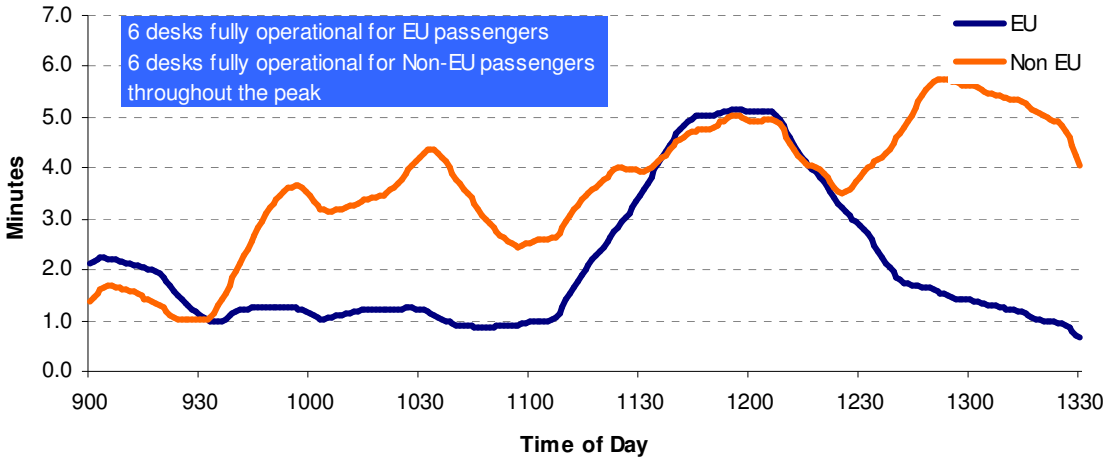


A single extra desk would relieve the queues. However, the greatest benefit would be gained by providing a dedicated route for Domestic and CTA flights. Assuming that these passengers pass directly through immigration (1.8 seconds process time), queues could be kept at below 2 minutes for domestic/CTA passengers, and less than 10 minutes for remaining passengers arriving from the EU. It would be essential that these passengers are provided with a dedicated route that is not restricted by passengers queuing for EU and Non-EU immigration. Alternatively, flights arriving in quick succession should be allocated to either Pier B or C in order to alleviate queues on Pier A.

It is suggested that in Pier A, one of the departures corridors could be rededicated as an additional immigration channel. It is understood that the a two-way flow used to in place, but it is now just a departures flow. Relocating the Perspex divider wall would create a temporary additional immigration channel.

It is understood that a new facility in the old terminal building is proposed for 2008. This would provide 12 immigration desks. Analysis of this facility indicates that in 2008 it could handle the entire arrivals population if manned throughout the day. This area could operate with 6 EU dedicated desks and 6 Non-EU dedicated desks. However, the greatest capacity will be achieved if all passengers can use any desk throughout the peak. This additional capacity would be sufficient to serve the airport until the new T2 facility is open. Figure 11 illustrates predicted queue lengths for the new facility assuming all passengers use a centralised immigration point.

Figure 11 - New Immigration Facility – Rolling Hour Immigration Queues 2008



This study assumes that the additional immigration facilities provided in 2008 are manned throughout peak times. This is essential in order to maintain acceptable queue lengths. Immigration queues at Pier A are likely to exceed current capacity in Summer 2007. Either provision must be made to hold passengers in queues for up to approximately 20 minutes or additional immigration positions must be provided and manned. This may be in the form of a temporary structure adjacent to the existing immigration channel. The forecast queues at immigration are well in excess of typical standards, and it is noted that service times may be improved if the schedule was managed to ensure that additional arrival flights are not added to the peak. However, given that there is no formal SLA and that additional capacity is due to come online in 2008, temporary measures and facilities may help to reduce the queue times.

3.7.2 Reclaim Hall

Baggage reclaim is very closely linked to upstream processes for arrivals passengers, in particular immigration. The processing rate at immigration will determine the flow of passengers to the reclaim hall. Therefore, at a busy international airport with centralised immigration and a stable schedule, it is possible to calculate a realistic flow rate in to the reclaim hall. However, at Dublin immigration is not centralised. There are three discreet flows of passengers entering baggage reclaim. Although there is some pattern in the allocation of aircraft to different piers, the allocation can change on a day to day basis. Furthermore, the immigration provision is different for each pier. It has already been noted in the previous section that processing at immigration is extremely volatile at Dublin airport with the potential for significant queue to build rapidly. For these reasons it is not practical to construct a typical passenger flow into the reclaim hall and hence determine an average dwell time that is truly indicative of typical operations.

(a) Capacity Assessment

Therefore for the purpose of determining the capacity of the reclaim hall an empirical approach provides a more reliable measure. The Arup report (May 2006) assessing capacity for Summer 2007 used a standard approach in determining capacity in the reclaim hall. Jacobs Consultancy have reviewed the assumptions used in this analysis and concluded that the capacity calculations provide a robust account of capacity at reclaim given the available data and in the absence of a stand allocated future demand schedule. The

findings of the Arup report have been used for comparison against the peak hour flow generated by the ARRIVE-DEPART model.

The Arup Report calculated that the total capacity of the baggage hall was 3930 passengers per hour based on belt length and utilisation. This took into account the current operational constraints restricting utilisation of each belt. The ARRIVE-DEPART model computes that the typical summer 2006 peak hour population for baggage reclaim in the longhaul peak is currently 2583 people. This would indicate that the baggage reclaim hall is operating at 66% of its actual capacity and that the hall has capacity for approximately 28mppa. Similarly in the afternoon shorthaul peak, baggage reclaim is operating at 76% of capacity. It is also noted in the Arup report that capacity could be increased as utilisation of belts 6 to 10 is increased.

It is reasonable to conclude that baggage reclaim is not capacity constrained in the assessment period and can accommodate demand up to 2010 as shown in Table 15 and Table 16.

Table 15 – Baggage Reclaim Capacity, Morning Longhaul Peak

Morning Longhaul Peak

Year	2006	2007	2008	2009	2010
mppa	20411	21653	22563	23613	24717
tphp	2583	2740	2855	2988	3128
Capacity	3,930	3,930	3,930	3,930	3,930

Table 16 – Baggage Reclaim capacity, Afternoon Shorthaul Peak

Year	2006	2007	2008	2009	2010
mppa	20411	21653	22563	23613	24717
tphp	2993	3175	3309	3463	3624
Capacity	3,930	3,930	3,930	3,930	3,930

(b) Sensitivity Tests

Given the close relationship between immigration and reclaim a number of sensitivity tests have been conducted. If passengers are processed faster through immigration then, they will experience a longer dwell in the reclaim hall although the demands for baggage belt space will be reduced. Conversely if passengers are processed slower through immigration, then there is the potential for bags to arrive ahead of passengers increasing the demands on the baggage system, but reducing passenger dwell times in the reclaim hall.

Sensitivity tests on the model indicate that in 2006 the knock-on effect of one additional second in average processing time at immigration could reduce the total peak hour population by approximately 150

passengers. Similarly by assuming that only 3 desks are manned at Pier A immigration the total population could reduce by a further 150 passengers.

Consequently, as these passengers take longer to reach baggage reclaim due to queues at immigration the number of baggage belts required will increase as bags are not claimed so quickly. Currently 8 belts should be able to cope with peak demand if each flight is allocated to a different belt. With an increase of one second for all passengers at immigration and only 3 desks manned on Pier A, all 10 belts would be occupied with some flights doubled up on belts. The belts can take up to 3-4 flights, so a doubling up of belts is not perceived to be a problem.

The sensitivity tests support the overall conclusion that the capacity of the arrivals baggage system and reclaim hall is sufficient to accommodate predicted future growth to 2010.

3.7.3 Customs

As described for baggage reclaim, an empirical approach to defining capacity has been used for customs. Jacobs Consultancy are in agreement with the methodology used in the Arup report (May 2006) for assessing capacity. The equivalent hourly throughput is assessed to be 7059 passengers per hour and is therefore not considered to be a constraint.

3.7.4 Arrivals Concourse

The arrivals hall has been assessed both on the number of passengers dwelling in the area and the number of friends and family waiting for passengers. As with passengers turning up early for departure, it is also common for friends and family to turn up, up to one hour prior to an aircraft landing at Dublin Airport. This results in a significant population of people dwelling in the arrivals concourse for a significant amount of time. (For a full version of the turn-up profile used for friends and family please see the assumptions appendix).

Information supplied by DAA indicated that there is likely to be one friend or family member meeting every 2.56 arriving passengers. This is approximately double that stated in the Arup Capacity Report (May 2006) which used a ratio of one friend or family member for every 5 arriving passengers. The Arup report also states an effective area of 1083m^2 for the arrivals concourse in 2006, with other areas used for general circulation, information point, car rental and other service. This area is to increase to 1191m^2 in 2007. This appears to be an appropriate area given the layout of the arrivals concourse.

The total population of the arrivals hall is calculated in ARRIVE-DEPART to be 853 people. Assuming a space per person allocation of 1.7m^2 (concurrent with IATA Level of Service C for arrivals concourse), it would initially appear that there is insufficient space provided for the population of the arrivals concourse. However, it is recognised that the area designated for the arrivals concourse is only part of the overall floor area in the arrivals area and that during the peak, people use other areas. Passengers dwelling for

longer than 20 minutes are also likely to use other parts of the terminal. For example, they may use the Mezzanine level for food and beverages, shops and the area outside of the terminal if they wish to smoke.

The DAA survey data for "passenger to friend" ratio has been used for the purpose of this analysis. However, on visiting Dublin airport, this ratio appears to be high and it may be more appropriate to use the ratio of 1 person per 5 passengers assumed in the Arup report. This ratio results in a total population in the arrivals hall is of approximately 60% of that calculated with the higher ratio.

However assuming that the higher ratio of 1 person per 2.56 passengers is correct, then at peak 695 of the 853 people in the arrivals hall modelled by ARRIVE-DEPART are passengers. Observations of the arrivals hall indicate that these people typically walk through the arrivals hall directly to one of the exit doors on to the kerb side. The time which these passengers are assumed to be inside the arrivals concourse is 41 seconds (data supplied by DAA). This time typically represents the time it takes for passengers to walk to exit the arrivals concourse.

If it is assumed that 1 passenger out of every 2.56 passengers (39%) stops to wait for friends and family, this equates 271 passengers that wait in the arrivals hall and do not head straight for the exit during peak times. The arrivals concourse area is being increased to 1191m^2 for summer 2007. Assuming that 100m^2 of the arrivals concourse is effectively used as corridor space for passengers heading towards the exit doors, this leaves a remaining 1091m^2 for dwelling passengers, meeters and greeters. Therefore the total space per person equates to:

Total effective area / (Total Meet/Greet Population +39% of passengers)
=1091 / (170 +271)
=2.47m^2 /person

The IATA recommended space per person in the arrivals concourse is 1.7m^2. The recommended space per person is therefore met. Assuming linear growth at peak to meet the predicted 2010 forecasts, the space per person is unlikely to fall below 2m^2/person. Given that the ratio of meeter/greeter is thought to be generous, and that most of this population are likely to wait in other areas of the airport, the arrivals concourse is not believed to be a constraint to capacity prior to 2010.

3.8 Conclusion

A summary of the conclusions from the terminal modelling analysis is shown in Table 17. The table uses a colour coding system to indicate whether facilities are under capacity (green), approaching capacity (amber) or over capacity (red). The assessment has been based on determining the level of service experienced at peak times times. It is important to remember that whilst level of service can be quantified, it inevitably has a subjective component in that different stakeholders have different service level expectations for their customers. With regards to circulation areas, the key is to ensure that in addition to passenger comfort, queues and congestion do not get to the point where operational activities are compromised.

It is clear that the capacity enhancements proposed by DAA to check-in, security and immigration are sufficient to provide processing capacity to meet demand up to 24.7mppa. Where feasible, it is recommended that DAA bring forward plans for additional security channels as soon as possible, but in the meantime active queue management to even out the flow between Security A and Security B should maintain suitable service levels. Similarly at immigration, the Summer 2007 queue times predicted on Pier A would be significantly reduced if an additional desk and Domestic bypass facility could be temporarily introduced until the centralised system is operational. It is suggested that there is scope to provide the additional channel rather than let passenger experience unsatisfactory queue times.

A number of localised passenger flow issues on the departures and arrivals concourse will require close supervision and active management, but specific initiatives have been identified and are recommended for further investigation which will reduce the level of localised congestion.

Taken as a whole, on balance it is concluded that the terminal can be managed to provide sufficient capacity for up to 24.7mppa which should be sufficient to handle demand until T2 opens in 2009. It is noted that the effect of schedules coordination is likely to be less significant in the terminal due the distilling effect of the processes passengers pass through.

Table 17 – Summary of Results

Below capacity	At capacity	Over capacity

Year	2006	2007	2008	2009	2010
Passenger Throughput (Millions per year)	20,411	21,653	22,563	23,613	24,717
Departures					
Pre Check-in Concourse *1					
Check-in					
Post Check-in Concourse					
Security A					
Security B					
Arrivals					
Immigration A *2					
Immigration B					
Immigration C *3					
Centralised Immigration					
Baggage Reclaim					
Arrivals Concourse					

Facility Decommissioned or not yet Operational	

Comments
*1 The opening of area 14 eases congestion and accommodates predicted future increase in throughput to 2010
*2 Immigration A is at capacity during 2007 however with the arrival of a new immigration area in 2008 it may be acceptable to continue to operate with some modification.
*3 Immigration C appears to reach capacity in 2007. However, availability of stands suggest that short peaks when capacity is reached, can be appropriately managed.

Classification of parameters and limits used for defining whether a facility has reached capacity is described in Appendix D Criteria for assessing capacity of airport terminal processes.

4 STAND AVAILABILITY

The analysis in this section aims to determine the current and future capacity of the apron stands at Dublin Airport. Discussions with both the DAA and airlines operating at Dublin have indicated that the aprons appear to currently be approaching capacity over night.

The analysis examines the stand capacity at key planning horizons until 2010, with the opening of T2 due in 2009. Future schedules have not been developed as part of this study. Changes to fleet size, aircraft mix and proposed new routes have been identified where possible through discussions with airlines. Where appropriate, additional changes including the impact of Open Skies have been identified and added to the future demand for aircraft stands.

A comparison between supply and demand of stands is discussed and key issues that are likely to influence stand availability and the functionality of the aprons are identified.

4.1 CURRENT AND PROPOSED INFRASTRUCTURE

The current apron layout makes significant use of multi-choice configurations of stands whereby different configurations of aircraft parking can be used at different times of day to best accommodate the mix of aircraft on the ground. For example Multi Apron Ramp System (Mars) stands where two smaller aircraft can be arranged to fit on one larger stand. This is typical of an airport that has a significant shorthaul overnight peak such as Dublin.

In order to create additional capacity for both narrow bodied and wide bodied aircraft, Dublin Airport is undertaking a phased development plan to provide additional stands. This plan is projected to be complete in 2010.

The plans involve developing new narrow bodied contact stands around the new Pier D. This is likely to be primarily occupied by Ryanair but will provide four wide bodied stands for larger aircraft in a Marsed configuration.

In addition a new apron is to be built on the western side of the airport on the west side of the cross wind runway. These will consist of remote stands and will therefore be used for long stay towed aircraft and both passenger and cargo aircraft where appropriate. It is anticipated that during the phased development around the terminal, these stands will be required for overspill from the existing aprons.

A new double sided pier is proposed as part of the Terminal 2 development. In order to construct T2 and the new Pier E, the existing Pier C is proposed to be demolished. During the development period, it may be possible to park shorthaul aircraft on runway 11/29. This area would be for remote parking for towed aircraft only.

4.2 CAPACITY ASSESSMENT

4.3 METHODOLOGY

The following approach has been used to assess apron capacity at Dublin Airport:

- Determine the number of existing stands, as documented in the AIP, to provide existing supply
- Adjust the number of stands for each quarter to reflect stand development programme
- Assess stand demand at key peak periods throughout the day using existing gantt charts taken from a busy day during Summer 2006
- Compare stand demand and supply for peak periods during Summer 2006
- Document and explain any differences between supply and demand in Summer 2006
- Describe any shortfall or excess capacity in stand provision for each development phase
- Comment on possible factors that may influence future demand for stands and how this may affect capacity
- Comment on possible ways in which capacity may be increased or shortfall mitigated

4.3.1 Existing Stand Supply

The total number of stands provided at Dublin Airport has been calculated based upon the Dublin Airport AIP dated 08 June 2006. This information is assumed to be current for 2006 Q3.

Given the complex nature of the aprons at Dublin Airport it is difficult to give a concise account of overall stand capacity due to the extensive use of Marsing at Dublin Airport. Approximately 65% of currently declared stands for commercial aircraft are reliant on another stand being vacant in order to be used. Therefore, the stand supply has been generated in two ways. The first assumes that shorthaul aircraft will get preference to stands, and therefore configurations that increase the number of available narrow bodied stands will be counted over those that favour wide bodied stands. The second stand supply figures have been calculated with the bias in favour of wide bodied stands. It is understood that there are a wide variety of stand sizes at Dublin Airport. For simplicity these have been categorised into narrow bodied (smaller than B767), and wide bodied (larger than and including B767). Current stand supply is described in Table 18 below.

Table 18 – Current Stand Supply

	Supply		
Peak	narrow	wide	total
narrow bias	67	3	70
wide bias	32	18	50

For the purpose of this analysis the "100" stands, Maintenance areas and the existing aprons to the west of the cross wind runway have not been included in the stand supply for commercial aircraft. The cargo stands to the south of the main apron have been included.

4.3.2 Future Stand Supply

Examination of key stages in the development plan enables us to develop an understanding of how many stands will be lost and gained over time.

Table 19 below was provided by Dublin Airport Authority and summarises the net change to stand supply over the next four years. For the purpose of comparison this information was compiled based upon the number of narrow bodied stands provided during any phase of development.

Table 19 - Net Change to Stand Supply

Narrow Bodied Aircraft	2007				2008				2009				2010			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Remote South Apron Regrading				-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
Gate 15			-1	-1	-1	-1										
North Side D	-2	-2	-2													
South Side D				-2	-1											
Apron 6 A/B				6	6	13	13	13	15	15	15	15	15	15	15	15
Pier E							6	6	11	11	11	11	19	19	19	19
Pier C and Gate 48									-7	-7	-7	-7	-7	-7	-7	-7
Total	**-2**	**-2**	**-3**	**-8**	**-7**	**1**	**8**	**8**	**8**	**8**	**8**	**8**	**16**	**16**	**16**	**16**

In order to be able to understand the possible implications of wide bodied stand demand during the longhaul peak, the data provided has been analysed in conjunction with phased development drawings provided by Dublin Airport Authority. These drawings illustrate the supply of wide bodied aircraft over time. The phasing drawings are based upon an annual time resolution therefore some interpolation has been required in determining when stands may come on line.

Table 20 below illustrates stand supply over time. As for the 2006 Q3 figures, supply has been calculated based on two interpretations, one assuming a bias to providing stands for narrow bodied aircraft, and one assuming a bias to providing stands for wide bodied aircraft.

Table 20 - Stand Supply Over Time

	Narrow Bodied Bias			Wide Bodied Bias		
	narrow	wide	total	narrow	wide	total
2006 Q3	67	3	70	32	18	50
2007 Q3	64	3	67	29	18	47
2007 Q4	59	3	62	24	17	41
2008 Q2	66	3	69	26	19	45
2008 Q4	72	3	75	28	21	49
2009 Q1	72	3	75	28	24	52
2010 Q1	76	3	79	26	27	53
Net Change from 2006 Q3	***9***	***0***	***9***	***-6***	***9***	***3***

It is noted that the drawings and future stand supply figures are part of an on going study being undertaken by the airport and we have been advised are subject to change.

4.4 CURRENT STAND DEMAND

Dublin Airport Authority has provided a week of actual stand allocations for the dates 24th to 30th July 2006. This data has been used to analyse a typical peak period and understand how aircraft are allocated on a day to day basis.

ACL have provided a schedule of movements that actually occurred for a typical busy week. The week that was supplied reflected movements between 4th and 10th Sept 2006. The analysis of data from ACL indicates that Friday is typically the busiest day of the week. Although different weeks were supplied for the stand allocation and the schedule, it does not seem unreasonable to assume that Friday is the typical busy day of the week throughout the summer season. Therefore, Friday 28th July 2006 was selected as a basis for understanding typical current stand allocation.

For the purpose of this analysis it has been assumed that all domestic and shorthaul aircraft are narrow bodied and all longhaul aircraft are wide bodied. It s noted that on occasion there are deviations from this rule, but where this is the case it has been clearly identified.

Analysis of the narrow bodied peak and the wide bodied peak has been conducted to determine the demand for stands at different times of day. Typically the narrow bodied peak occurs over night and is made up primarily of base carriers Ryanair and Aer Lingus. The wide bodied peak occurs between approximately 09:00 and 10:00 when longhaul aircraft from America and the Middle East are typically on the ground. This peak currently occurs predominantly after the first wave of morning departures, however late departures of shorthaul aircraft coupled with early arrivals of longhaul aircraft do overlap in some cases. This overlapping of aircraft types is likely to get worse as the airport gets busier and will result in a less efficient use of Marsed type configurations.

It is noted that there are in the order of 20 to 25 of private aircraft on stand which are typically located on the "100" stands or on the opposite side of the airfield. These are not counted as part of the commercial aircraft stand demand or supply.

Cargo aircraft are typically located on the cargo apron and overspill on to the remote stands opposite Pier C. These aircraft are included in both stand supply and demand.

4.5 CAPACITY ANALYSIS

4.5.1 Q3 2006

The supply and demand for stands in Q3 2006 are described in Table 21. In order to compare options an adjusted stand demand/additional capacity figure has been computed. This assumes that one wide bodied stand equates to two narrow bodied stands. Therefore, where there is a shortfall in either narrow or wide bodied stands, alternative configurations can be provided to negate the shortfall. For example, if there is a shortfall of one wide bodied stand, and an over provision of two narrow bodied stands, the narrow bodied stands would be reconfigured to allow the wide bodied aircraft to be accommodated. In

this case the wide bodied shortfall would be reduced by one and the narrow bodied surplus would be reduced by two.

Table 21 - Stand Supply and Demand

	Supply			Surplus Supply			Adjusted Surplus		
	narrow	wide	total	narrow	wide	Surplus	narrow	wide	Surplus
Narrow Bodied Peak	67	3	70	9	1	10	9	1	10
Wide Bodied Peak	32	18	50	-2	10	8	0	9	9

In order to measure the capacity of the apron a series of factors have been taken into account:

- Number of existing stands (narrow bodied and wide bodied)
- Stand configuration (Marsed configuration and other layouts that may govern the allocation of aircraft)
- The mix of aircraft size using the stands throughout the day
- The mix of aircraft type (scheduled, charter, cargo, private, maintenance) using the stands throughout the day
- Whether aircraft can be towed to remote stands during peak periods

Given that the peak for shorthaul aircraft has been identified to be overnight, it is appropriate to compare demand during this period with the "narrow bias" supply. Similarly, the longhaul peak occurs between approximately 09:00 and 10:00, so for this period the "wide bias" supply is more appropriate to compare with demand. For any moment in the day the stand supply will vary dependent on the choice of stand allocation by the stand allocation team and dependent on the aircraft mix on the day.

It is evident from the figures for 2006 Q3, that the apron is approaching capacity. It s noted that although overnight there appear to be typically seven (to nine) narrow bodied stands vacant and one longhaul stand vacant overnight, the vacant stands provide necessary operational contingencies. For example, the seven narrow bodied stands are primarily remote stands that provide contingency for aircraft that are on the ground for short periods over night (e.g. Eastern European destinations – 4 aircraft, charter flights – 2 aircraft), those that are not in the schedule, aircraft that have technical issues, and stands outages due to maintenance. The one longhaul stand needs to remain vacant to receive the first longhaul arrivals in the morning.

4.5.2 Future Capacity of Apron

The following two tables illustrate the estimated shortfall or excess supply of stands over the next few years. From discussions with the airport and where possible the airlines, it has been concluded that the growth in 2007 may include; 3 Ryanair based shorthaul aircraft, 2 Aer Lingus based shorthaul aircraft, 2 Aer Lingus longhaul aircraft, 3 shorthaul arrivals during the wide bodied peak. This growth has been assumed when calculating future surplus or shortfall in stand supply.

No information relating to growth in the schedule was provided for the period post summer 2007. However, it is unrealistic to assume that there will be no further growth. A range of growth rates from

2% to 6% growth have been applied to the predicted demand for 2007 in order to assess the possible stand demand between 2007 and 2010.

It should be noted that longhaul routes may be served by smaller aircraft such as 757s and 767s. It is recognised that it may be possible on occasion to identify solutions to accommodate these aircraft. However, it is likely that aircraft of this size serving longhaul destinations will be replaced over time with larger aircraft. For the purpose of this study, all longhaul growth is assumed to be achieved through wide bodied aircraft.

Table 22 describes the surplus supply of stands for both the narrow and wide bodied peaks at key development phases between 2006 and 2010 exclusive of growth beyond 2007. For the purpose of comparison, the adjusted surplus figures have been provided (as described earlier in this section).

Table 22 – Predicted Stand Surplus 2006-2010

Shorthaul/Narrow Bodied Peak (5-6am)

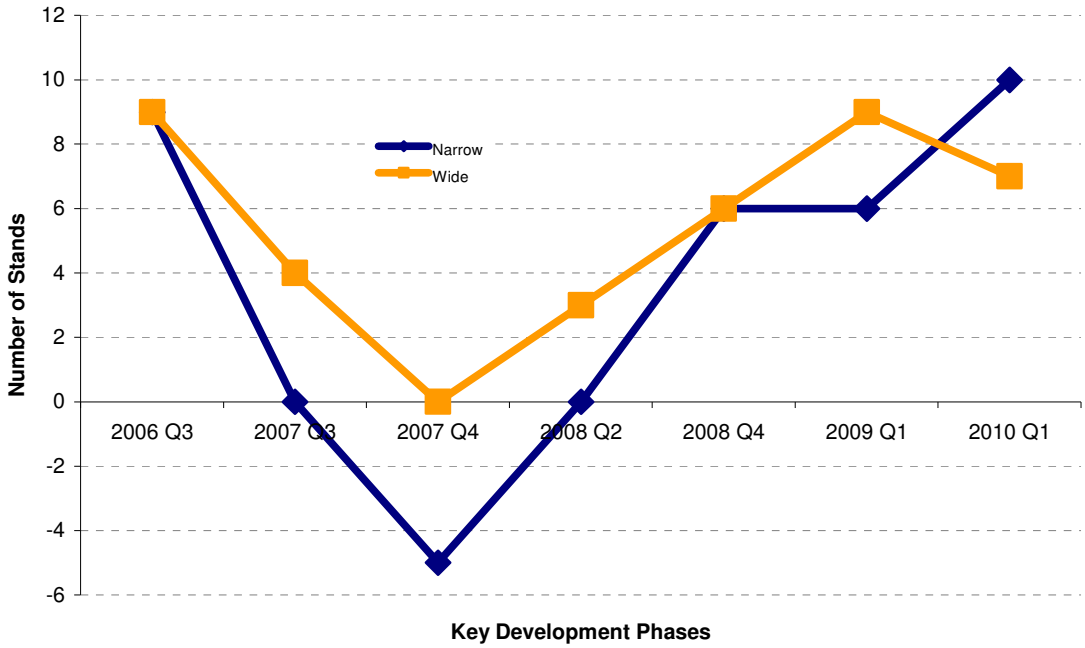
	Supply			Surplus Supply			Adjusted Surplus		
	narrow	wide	total	narrow	wide	Surplus	narrow	wide	Surplus
2006 Q3	67	3	70	9	1	10	9	1	10
2007 Q3	64	3	67	0	-1	-1	0	-1	-1
2007 Q4	59	3	62	-5	-1	-6	-5	-1	-6
2008 Q2	66	3	69	2	-1	1	0	0	0
2008 Q4	72	3	75	8	-1	7	6	0	6
2009 Q1	72	3	75	8	-1	7	6	0	6
2010 Q1	76	3	79	12	-1	11	10	0	10
Net Change from 2006 Q3	***9***	***0***	***9***	***3***	***-2***	***1***	***1***	***-1***	***0***

Longhaul/Wide Bodied (9-10am)

	Supply			Surplus Supply			Adjusted Surplus		
	narrow	wide	total	narrow	wide	Surplus	narrow	wide	Surplus
2006 Q3	32	18	50	-2	10	8	0	9	9
2007 Q3	29	18	47	-8	8	0	0	4	4
2007 Q4	24	17	41	-13	7	-6	1	0	1
2008 Q2	26	19	45	-11	9	-2	1	3	4
2008 Q4	28	21	49	-9	11	2	1	6	7
2009 Q1	28	24	52	-9	14	5	1	9	10
2010 Q1	26	27	53	-11	17	6	1	7	8
Net Change from 2006 Q3	***-6***	***9***	***3***	***-9***	***-1***	***-10***	***1***	***-2***	***-1***

Figure 12 illustrates the surplus of stands based on known demand to Summer 2007. The absolute number of stands required throughout the day will depend upon the mix of aircraft on the ground at any one time. The blue line refers to a scenario where the stand demand is dominated by narrow bodied aircraft. This is typical of the early morning peak at Dublin. The orange line relates to a scenario where the stand demand is dominated by wide bodied aircraft. This is more typical of stand demand mid morning. At any one point in time the actual stand demand may lie some where between these two curves depending on the mix of aircraft on the ground.

Figure 12 - Surplus Stand Supply

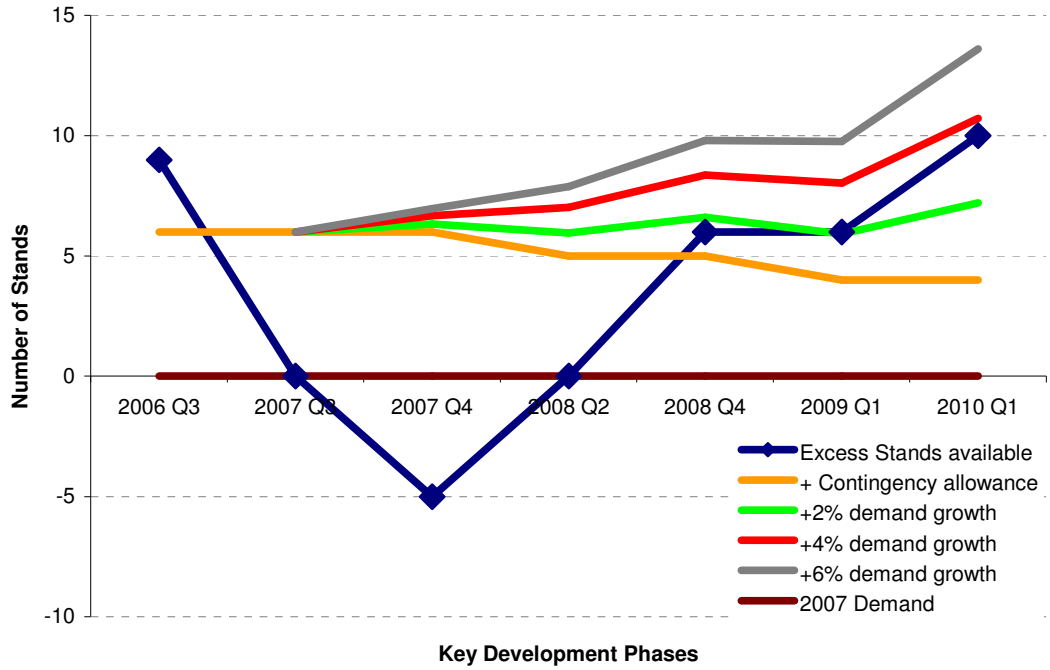


It is recognised that a certain amount of contingency is required in order to take into account of aircraft on the ground for a limited period over night and for stands that are temporarily out of use. A typical requirement would be in the order of 10% of typical stand demand. For narrow bodied aircraft in 2007 this equates to 6 stands and for wide bodied aircraft 1 additional stand would be required. Analysis of the gantt charts provided for Summer 2006 indicates that three of the contingency stands are required for early arrival of longhaul flights or short stay overnight aircraft that do not appear in the peak stand demand.

Given that airports of similar size typically have two to three contingency stands it is not unreasonable to assume that over time, as demand for stands increases, the number of contingency stands at peak may fall slightly to provide stands for actual stand demand. For the purpose of this study it is assumed that the stand contingency may fall to 4 stands in the future for narrow bodied aircraft. It would be unwise to reduce the stand contingency for wide bodied aircraft to less than 1.

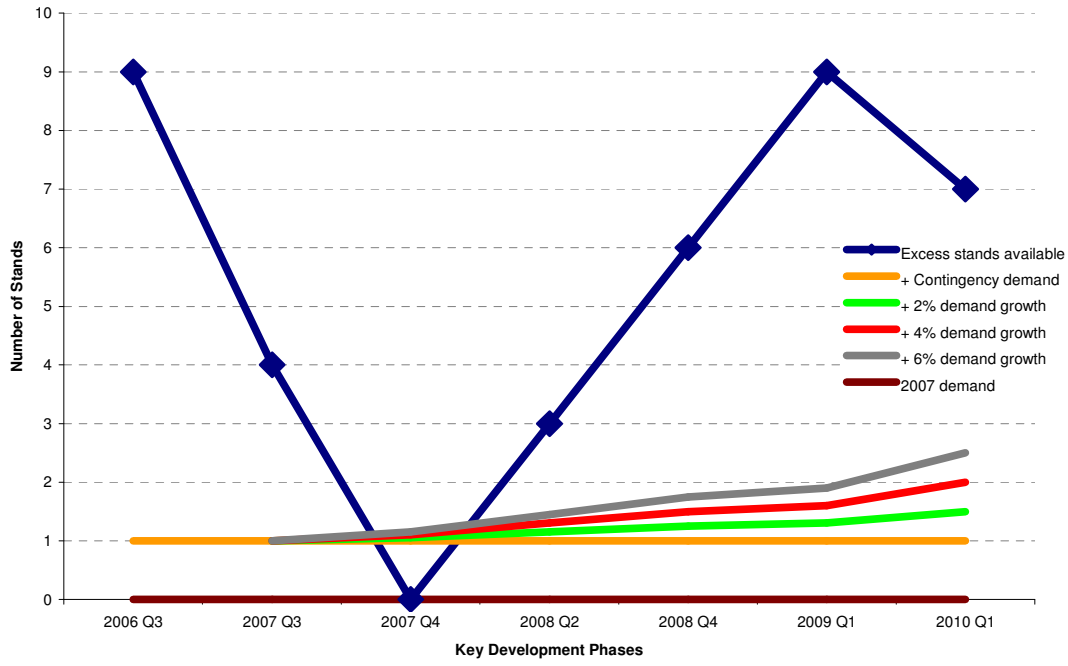
Figure 13 and Figure 14 compares the number of excess stands (relative to Summer 2006) available to accommodate growth beyond the Summer 2007 wishlist and compares this to the projected increases in demand. The assessment includes a requirement for contingency and also takea into account possible increases in demand post 2007. Three different demand growth scenarios have been analysed. These indicate different rates of growth (2%, 4% and 6% per annum). The gap between the 'demand curve' and the ,'excess supply' illustrates any shortfall or surplus in stand supply.

Figure 13 - Narrow Bodied Stand Surplus



It is concluded that there is shortfall for all growth scenarios until 2008 Q4 when 2% pa growth is likely to be accommodated. A 4% pa growth is likely to be accommodated by 2010 Q1 but a 6% pa growth would require more development than is currently identified.

Figure 14 - Wide Bodied Stand Surplus



It is concluded that there is only a small shortfall in 2007 Q4 of one stand. This conclusion is not significantly affected by growth scenarios although does indicate that additional demand will be difficult to accommodate.

Specific issues affecting each period of development are discussed further in the following sections.

4.5.3 Apron Capacity 2007-2010

The number of stands available at any time dictates how much additional capacity is available in the future. This is then compared with the estimated scheduled growth in aircraft movements at peak times.

At each stage specific care is be given to understand the impact of introducing both short and longhaul routes to the schedule. For example, care is be taken to understand the size and length of both the narrow and wide bodied peaks, and whether they are likely to overlap in the future, thus reducing the effectiveness of Marsed configurations.

The analysis examines the impact of the opening of T2 and the possible impacts of Open Skies in increasing the demand for wide bodied stands.

Consideration has been given to the location of cargo and private aircraft stands and how these can be most efficiently used with minimal impact on scheduled and charter aircraft.

(a) 2007 Q3/Q4

In 2007 Q3, work on Pier D and Gate 15 reduces the contingency of narrow bodied stands to four. It is not clear from the phasing information available at the time of writing this report, whether the number of stands taken out at any stage will be limited to two during the development of Pier D. Given that the pavement to the south of Pier D is relatively old, it is possible that the number of stands taken out during the development of the pier may exceed two at a time if pavement rehabilitation works are also carried out.

It is understood having talked to both DAA and airlines operating from the airport that there are likely to be an increase in the number of aircraft using the airport during 2007. Although Ryanair have stated that they can accommodate their entire operation from 14 stands at Pier D, it has been indicated that they may seek to have up to 19 overnight based aircraft. In addition Aer Lingus would look to have at least two more narrow bodied aircraft at the airport overnight, and have also expressed interest in bringing in two A330 aircraft early in the morning. In addition to this, other regional airports have indicated that they are looking to accommodate up to four narrow bodied aircraft overnight, positioned for arrival in Dublin during the morning peak (09:00 to 10:00). In discussion with DAA, it was suggested that there could be an up turn in the number of aircraft from Eastern Europe operating from the airport overnight. Each of these factors will add to the increasing problem of apron capacity at Dublin Airport.

(b) 2008 Q2

At present many of the aircraft serving longhaul routes are 757s and 767s and therefore sit on narrow bodied stands. In the future longhaul airlines are likely to increase aircraft sizes as well as introduce new routes and additional rotations on popular routes. As an indication of the possible impact of such a change in the aircraft mix it could be assumed that there is likely to be some increase from narrow to wide bodied aircraft during the peak in Q2 2008.

If Open Skies comes into operation in the near future there is likely to be an increase in the number of wide bodied aircraft serving Trans-Atlantic routes using Dublin Airport. This has been reflected in the 2008 Q2 demand but could impact the airport earlier or later depending on legislation.

Current indications suggest that up to 3 additional wide bodied aircraft could be accommodated during the peak if no contingency were provided. This is unlikely to be sufficient to cope with both increases in fleet size, aircraft size and Open Skies and would require additional Marsing of stands that are not currently configured for wide bodied aircraft. It is unclear if there are appropriate locations on the existing apron where there is sufficient depth to accommodate wide bodied stands that have not already been provided.

Pier B has a very limited hold area for US bound passengers that have cleared US Customs and Border Protection (CBP). The holding lounge is capable of accommodating approximately 2 US wide bodied (747-400) departures. Currently, US bound flights stopping in Shannon (and clearing US CBP in Shannon) are allocated to stands on Pier C. During the development of T2, Pier C will be lost. It is therefore assumed that passengers will either be bussed to Pier E or will use the wide bodied stands on Pier D, thus displacing shorthaul aircraft assumed to be located on Pier D.

(c) 2009

During 2009 it appears that the overnight demand could be met by marsing wide bodied stands. The extent of marsing that can be achieved will be dependent on the aircraft that are to be accommodated as different wide bodied aircraft are different sizes. An increase in wide bodied stands does provide sufficient stands during the wide bodied peak and provides contingency in the order of 13 narrow bodied stands or 1 narrow and 6 wide bodied stands.

Between 2007 Q4 and 2010 Q1, the new additional stands planned for Area 6 and Pier E are all remote stands. The pier served stands provided by Pier C are lost. Therefore, prior to Pier E being fully opened, between 40% and 50% of stands are likely to be remote. It is unclear at this point whether sufficient bussing gates will be provided in order to serve this number of remote operations.

It is understood that the stands in Area 6 are likely to be used for towed aircraft and cargo aircraft. Pier D is predominantly occupied by Ryanair. There are four wide bodied stands located on the north side of Pier D once the stands have been reconfigured. Given that Ryanair operate a consistently busy schedule throughout the day there is unlikely to be significant opportunity for using these wide bodied stands if Ryanair continue to operate from this area.

(d) 2010

By the end of 2010 it is assumed that all of the apron development has been completed and that Pier E is functioning as part of Terminal 2. By this stage there is sufficient capacity for wide bodied aircraft during the longhaul peak with capacity for approximately 7 additional wide bodied aircraft. These would likely be accounted for with growth in longhaul scheduled aircraft, increase in aircraft size and Open Skies. Over night, the narrow bodied peak is accommodated however with excess capacity in the order of 10 narrow bodied aircraft. This will however be filled by an increase in based aircraft, aircraft requiring stands for short periods overnight (e.g. Eastern European carriers), and additional contingency. There is no additional capacity for wide bodied aircraft overnight unless Marsed stands can be provided. This could provide a problem if longhaul aircraft start to arrive earlier in order to attain additional slots, or aircraft have technical problems that require an aircraft to stay overnight.

It is assumed that all GA and small business jets will be encouraged to use apron and hangars available on the western side of the cross wind runway. Alternatively, the "100" stands could be used. The "100" stands are not counted in the overall capacity of the airport for commercial aircraft.

4.6 Opportunities for Increasing capacity

There are also likely to be an increase in remote movements during terminal construction will result in an increase in bussed movements. It is recommended that bussing operations are centralised either through DAA or a single operator to maximise the efficiency of increased bussing operations airside and minimise bussing gate requirements and vehicular movements on the aprons.

It has been suggested that once Pier C has been lost, a new Pier replicating Pier D to the South of Pier C could be created, thus keeping existing stands and adding new ones. Such a development would likely require the demolition and relocation of the following facilities:

- Cargo
- Animal centre
- Catering
- Vehicle wash building

Whilst there may be scope to relocate some of these facilities, more significantly the potential development would appear to be severely restricted by the approach surfaces which would likely prevent access to the far side of the pier and would restrict the length of the pier. Whilst such a development cannot be entirely ruled out without a detailed engineering appraisal, it would seem to be unlikely to provide a short-term solution to the forthcoming stand availability constraints.

4.7 CONCLUSIONS

It is evident from the existing apron layout and stand allocation, that Dublin Airport is currently approaching stand capacity during the overnight period. This is made up primarily of shorthaul based aircraft operated by Aer Lingus and Ryanair. In addition some stands must be kept vacant for late night operations from Eastern Europe and for early arrivals in the morning.

It is likely that during winter 2007 season, the demand for stands at Dublin Airport will exceed the supply of stands. It should be noted that the demand is derived purely from scheduled aircraft on the ground during the peak and does not include any contingency. The shortfall is primarily due to the fact that stands have been taken out to allow future development but no new stands have been provided. This is coupled with anticipated growth of the base carriers.

It is noted that an airport wide gating study conducted for DAA also concluded that there would be a shortfall in stand availability between 2007 and 2010.

In the period between 2007 Q4 and 2010 Q1 all the additional stands that are provided are remote stands. Although this provides additional capacity over time, the number of bussing gates required is likely to be high. It is understood that the passenger throughput is likely to be greatest through the contact stands, however, there it is not unreasonable to assume that bussing will become a constraint during the development of T2.

Although US bound aircraft that clear US immigration in Dublin, currently operate from Pier B, it is understood that they will operate from Pier E in the future and that a dedicated CBP facility will be integral to the design of the pier. However, in the interim period (2007 to 2010), additional US flights are likely to be accommodated on remote stands. Pier B will be available, however, is unlikely to be able to cope with growth in either movement numbers or aircraft size. Similarly, when Pier C is knocked down, wide bodied aircraft will be allocated to remote stands or will displace shorthaul aircraft on Pier D. It is understood that there will not be a CBP facility on Pier D.

From 2008 onwards stand supply meets 2007 demand based on limited growth. However, there is no contingency provided. There is also concern that additional stands may be lost over and above those already programmed due to the potential need for pavement rehabilitation works, but which are not currently reflected in DAA plans.

In conclusion, there are likely to be problems in providing sufficient capacity during the development of Dublin Airport from Winter 2007. The capacity constraint is caused by the proposals to withdraw stands during the development of additional stand capacity, growth in aircraft movements and potentially unforeseen stand closures due to pavement rehabilitation works. There are also likely to be an increase in remote movements during this period which will result in an increase in bussed movements. It is recommended that bussing operations are centralised either through DAA or a single operator to maximise the efficiency of increased bussing operations airside and minimise bussing gate requirements and vehicular movements on the aprons.

However due to works associated with the construction of Terminal 2, the number of stands available in winter 2008 will not meet peak demand requirements. Although additional remote stands are proposed in 2008-2010 to meet demand, there appears to be no contingency provided and the resultant increase in bussing will reduce the operational efficiency of airport operations. In addition to the difficulties likely to be caused by the construction of Terminal 2, there is also a risk that remedial pavement works may be required.

The lack of contingency in stand availability from Summer 2007,means that any additional demand beyond that identified in the Summer 2007 wishlist prepared by ACL is unlikely to be able to be accommodated and will further compromise the service levels provided. In conjunction with the increased reliance on bussing and the potential for operational constraints with the construction of Terminal 2, additional demand for based aircraft and peak movements beyond that identified in the Summer 2007 wishlist will increase aircraft delay and exacerbate congestion in the cul-de-sacs.

5 RUNWAY AND TAXIWAY CAPACITY

5.1 CURRENT AND PROPOSED INFRASTRUCTURE

There are three current operational runways at Dublin:

- Runway 10/28
- Runway 16/34
- Runway 11/29

The main arrivals and departures runway at Dublin is 10/28 which includes a single Rapid Exit Taxiway (RET) and parallel taxiway. Runway 16/34 is essentially a runway used if cross-wind conditions restrict operations on 10/28 although it is occasionally used at the discretion of ATC or during periods of planned maintenance on 10/28. Runway 11/29 is effectively used on a tactical basis by ATC for small jets and turboprops to help minimise departures queues on 10/28.

DAA have produced proposals for a parallel taxiway, additional RET and expanded holding point. However we understand that despite the operational improvements the proposals would provide, the business case is currently under review.

It is noted that proposals for parallel runway are in development, although this is unlikely to be completed before 2012 and is not explicitly integrated into the Terminal 2 programme.

5.2 REVIEW OF NATS RUNWAY ASSESSMENT

National Air Traffic Services (NATS) undertakes an annual assessment of proposed runway 10/28 operations capacity at Dublin to establish the declared runway capacity for each season. The most recent assessment was conducted for the Summer 2007 season[2], based on the wishlist provided by ACL, although at the time of writing only the summary conclusions from this assessment were available. The NATS study is reported to the Dublin Airport Coordination Committee and is based on the NATS benchmarked approach to runway capacity assessment using the HERMES model.

Significantly, the analysis assumed an average delay criterion of 10 minutes (defined as average delay for a given 30 minute period) based on a recommendation by the Dublin Airport Coordination Committee. An 8 minute average delay criteria had previously been used. The increase in average delay resulted in NATS being able to accommodate the summer 2007 ACL wishlist with a peak declared capacity of 47 movements in the hour; maximum hourly arrivals capacity was set at 27 movements, with 31 peak movements for departures.

It is noted that although no specific validation appears to have been conducted against Summer 2006, we understand that model was validated against observed data collected over a two week period in July 2005.

[2] NATS Dublin Airport Summer 2007 Wishlist

The standard times to move through the system are checked and used as part of the validation process. Secondary checks are carried out for the busy hour as well as over the full day. It is reasonable to conclude that the model provides a good representation of runway movements at Dublin for appraisal purposes.

It is noted that although the NATS report shows that the 10 minute average delay criterion is not breached for any significant period, since this is an average 30 minute delay some aircraft will experience significantly higher delays. This means that additional movements may exponentially increase overall delays in the peak period and that reference to the 90 percentile and maximum aircraft delay is also important in drawing firm conclusions.

The NATS reports are intended to predict the delay resulting from a given wishlist of demand. If the delay is acceptable to the Dublin Airport Coordination Committee, then the demand profile is published as the capacity profile for that year.

This is made apparent by, inter alia, the NATS-declared capacities for 2005, 2006 and 2007. By inspection there is now more capacity declared in the hours at 1200 and 1300 UTC, and less capacity at 0700, 1800 and 1900 hrs UTC. However, there has been no substantive change in the operation or the infrastructure to cause such an increase and reduction in capacity.

Worst case delays are not caused by the highest movement rates on the runway, but by asymmetric usage, i.e. more arrivals than departures or vice versa. Looking at the NATS brief presentation on the work for summer 2007, the highest capacity declared is 47 movements per hour for the hour commencing 1600 UTC. However, the greatest delays are for the hour commencing 0600 UTC at only 40 movements per hour biased towards departures at 30% arrivals 70% departures, and at 2100 and 2200 UTC for 36 to 32 movements per hour biased towards arrivals at 67% arrivals 33% departures.

5.3 VISSIM ANALYSIS

To help investigate the capacity of the runway under a range of parameters, and not just perform a test of current conditions, a simulation model was constructed by Jacobs Consultancy. This uses VisSim software to develop an operational model and works by assigning behavioural routines to objects in a 3-D environment. The model can simulate not only the rules of the airport approach and departure procedures, but also the physical accelerations and decelerations of the aircraft and their choice of available runway exits. A similar modelling technique has previously been successfully used by Jacobs Consultancy at London City Airport and at Marseilles Airport to assess capacity.

It is important to note that the VisSim model has not been set up to replicate the NATS work. This VisSim model runs on a different basis and the purpose of its application is to investigate other issues that have not been directly addressed to date by the NATS work. However, as with any model it is important to establish a base case that reflects current operating conditions and we have been able to obtain a calibration of the VisSim model against the HERMES model used by NATS under similar conditions.

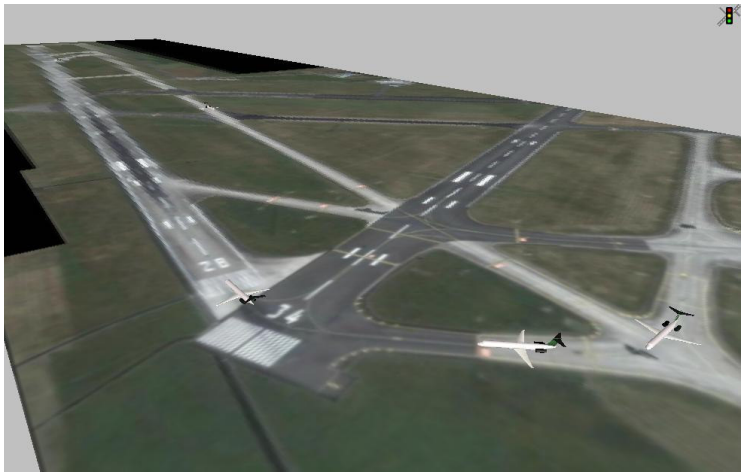
5.3.1 Model Calibration

With a 155 second ADA time interval as measured by NATS, and as generated by the VisSim model at 156 seconds, there is an obvious arithmetic capacity figure of 2 * 3600 / 155 = 46.4 movements per hour for a 50:50 arrivals departures mix. The fact that there will be some natural variation in the times at which arrivals and departures each present themselves to use the runway means that some delay is generated. The NATS HERMES model synthesises this delay by selecting statistically from a distribution of measured times for elements of the operation whereas the VisSim model simulates the actual operation of the aircraft.

The NATS work for 2007 shows a period of quite balanced usage at 44 to 43 movements per hour for 5 hours from 1000 to 1400. The NATS generated delays during this period are 4 to 5 minutes average for both arrivals and departures. The VisSim model for a balanced usage indicates an average delay of about 7 minutes. Given that the NATS validation work, reported in Fig 5.2 of the NATS Summer 2006 report, indicates that the HERMES model may understate the delay by over 2 minutes, this shows a good validation of the VisSim model.

5.4 Capacity Assessment

Having calibrated the Vissim model against 2006 operations, it was therefore possible to consider what use could be made of the model to support the capacity study. Firstly the potential effect of an increased number of "Heavy" transport aircraft, such as may occur under an open skies policy, was assessed. At double the proportion of "Heavies" there is no significant change in the delay curve. On considering the result, it seems that the increase in average wake vortex separation, which would imply a commensurate reduction in arrivals movement capacity, is compensated by the increased window of opportunity for a departure to be launched between the arrivals.



The VisSim model results support the general results from NATS. During a 40:60 asymmetric departures peak the average delay reaches 10 minutes at 39 movements per hour according to the VisSim model as shown in the figures below. The NATS work is declaring a capacity of 40 at what is approximately a 30:70 asymmetric departures peak usage. At balanced usage NATS has a maximum declared capacity of 47 movements per hour but that is not sustained. A NATS declared capacity of 44 movements per hour is sustained for 4 consecutive hours. The VisSim model shows that the average delay at 44 movements per hour is about 6 minutes increasing to 7.5 at 47 movements per hour. The VisSim model also reports the 90%ile delays and it can be seen from Figure 15, Figure 16, Figure 17 and Figure 18 that these are rising quite steeply as the demand goes from 40 to 50 movements per hour. As a judgement on the 90%ile delays that could be tolerated by

short sector airline operations we would agree with the NATS view that the current capacity for balanced usage should be limited to about 44 for consecutive hours, but could rise to 47 on occasional hours. The analysis of the arrivals peak in the evening is affected by the fact that the VisSim model has not been set up to model airspace delay within the TMA. This becomes significant when more than 23 arrivals are scheduled per hour. In view of the agreement between the two models we can accept the NATS findings that a declared capacity of up to 39 movements per hour at a 67:33 asymmetric arrivals peak generates average delays of over 8 minutes but under 10 minutes and should be considered a capacity limit.

A summary of the results are shown in Table 23 below giving the delays for various scenarios, whilst the delay curves are included in the following pages.

Table 23 – Runway Delays under Various Scenarios

	60% Deps:40% Arrs		50% Deps:50% Arrs		40% Deps:60% Arrs		Increased Heavy %age	
Movts ph	Avg	90%ile	Avg	90%ile	Avg	90%ile	Avg	90%ile
20	4	10	1	2	2	4	3	7
30	7	16	2	8	3	12	4	13
40	11	23	6	18	5	21	6	18
50	14	36	9	27	8	37	9	23

Thus, without changes to operations or infrastructure, it is concluded that the capacity of the runway is largely as declared by NATS for summer 2007. Some of the reductions in declared capacity, for example during the early afternoon, are essential to allow for system recovery from periods when the typical capacity has not been able to be delivered.

5.4.1 Sensitivity Tests

There have been a number of sensitivity tests conducted to investigate the impact on delay of additional early morning peak hour departures. NATS have carried out sensitivity tests on the 2007 wishlist with one and with two additional departures in the hour commencing 0500. The results in Table 24 show that the average delay increases by 3 minutes and by 5.5 minutes respectively.

More severe tests were carried out using the VisSim model. The 2007 currently proposed Summer 2007 schedule shows a flurry of departures 0445 to 0459 and these were used to provide an appropriate warm start to the VisSim modelling of the departures peak. Sensitivity tests were carried out with results as summarised below.

Accepting the NATS value of 8.5 minutes average delay for the 2007 wishlist basecase, then all these tests give results over the agreed criterion of 10 minutes average delay and are examples of where demand would have exceeded capacity. Furthermore, the 90 percentile delay reported by the VisSim model increases from 32 minutes to 45 minutes over the VisSim sensitivity tests, supporting the view that the additional demand tested takes the demand well beyond the capacity of the runway to handle such an asymmetric arrivals-departures mix.

Table 24 - Results of Runway Delay Sensitivity Testing

Case	Additional Departures 0500/0600/0700 hrs	Test movements in hrs mins	Increase in average runway delay
2007 Wishlist		Arr 9/11/16	N/A
	0/0/0	Dep 31/29/25	
NATS Test 1	1/0/0	Dep 32/29/25	+ 3
NATS Test 2	2/0/0	Dep 33/29/25	+ 5.5
VisSim Test 1	1/2/1	Dep 32/30/23	+ 7
VisSim Test 2	2/3/1	Dep 33/31/23	+ 11
VisSim Test 3	3/5/2	Dep 34/33/24	+ 12

5.5 Opportunities for Increasing Capacity

Having established the Vissim model, it has been possible to better assess the extent to which further capacity increases are possible. The analysis reveals that further capacity increases would be modest.

The comparison provided by NATS for the ADA time compared with Gatwick shows that 16 seconds in 155, say a 10% improvement is the difference with what may be recognised as best practice and achievement in the industry. Thus, as a theoretical maximum some additional 4 movements per hour is an upper limit to what could be achieved. In reality, the wider range of aircraft types and speed ranges using Dublin means that it is unlikely that all of this improvement in ADA time could be consistently achieved. It is therefore reasonable to suggest that half of this improvement, 5% or 2 additional movements per hour, could be achieved. This would relate pro-rata to an annual traffic volume of about 23 mppa which the latest projections by DAA indicate will be reached by 2008.

This achievement in increased capacity can only come from one or both of two measures.

One is that ATC release departures closer to the inbound arrival. ATC have stated that they generally seek to give landing clearance at 2Nm, but can go down as low as 1Nm but "this is tricky". The VisSim model indicates that at 2Nm there is enough time to get a departure onto the runway and clear after a previous arrival, provided that it does not have to wait on the runway for either a dep-dep clearance or for the preceding arrival to clear the runway. Sometimes, and usually frequently at 40+movements per hour, the departing aircraft is held on the runway in the model and the next arriving aircraft gets as close as 1.25 to 1.3 Nm. This is a measure of how far the ATC are being pushed into being "tricky" and there are a few more seconds available here down to 1Nm. Capacity improvements would come from ATC developing an ability to operate more normally at this landing clearance.

The second measure to increase capacity would be to provide additional infrastructure, for example (1) an additional runway exit to reduce runway occupancy time and (2) a straight taxiway link to the 28 threshold to improve departing pilot's visual acquisition of a preceding arrival coming over the threshold, thus cutting a few seconds off the time to then move onto the runway, assuming that clearance to enter after arriving has been given.

However, it is unlikely that either or both could deliver more than a 5% improvement, or 2 movements per hour, across the board that has been discussed above.

It would be a business driven decision both by the DAA and the airlines (who would ultimately have to fund the investment through higher aeronautical charges) as to whether the modest increase in capacity is worth the significant investment.

During the study, comparison of the performance at Dublin with other single runway airports was often cited, in particular London Gatwick. Whilst the declared peak hour capacity at Gatwick at 51 movements is higher than the 47 proposed at Dublin (both using a 10 minute average delay) , there are a number of other factors to consider. In particular, the general apron and taxiway infrastructure taxiway system at Gatwick is much more extensive than at Dublin. There are more holding points, Rapid Exit Taxiways (RET) and aircraft stands. Aside from differences in traffic mix, the physical infrastructure at Dublin is not comparable to that at Gatwick and it is therefore not reasonable to expect Dublin to deliver comparable runway throughout without a significant expansion and redesign of the apron and taxiway system.

It is noted that ATC do not envisage any constraints in airspace at Dublin.

5.6 TAXIWAYS

The apron area is served by a dual taxiway system to piers A, B and C currently. Development plans provided by DAA show that construction of a parallel taxiway to taxiway 5 to the west of Pier D will start in 2007 and be operational as far south as taxiway H1 in 2008. This arrangement allows controllers to direct aircraft on a variety of routes to reach either the stands or the runways.

The stands are arranged around four piers and the maximum number of stands on any cul-de-sac is ten which should be operationally acceptable even with the short turn round time that may be planned by a number of the operators

Delays that are currently experienced are mostly operational in terms of push back delays, poor push back performance by some operators and tugging to take out of service aircraft off operational stands. The cul-de-sac arrangement of many stands at Dublin also contributes to some of the current delays.

The predominant operational direction is 28 and there are again a variety of options to reach the 28 threshold via taxiways F3 to F1 and Taxiways A, B1, E1 and E2 as well as runway 16/34.

It can therefore be concluded that the taxiway system at Dublin airport is not considered to be a significant capacity constraint.

Figure 15 - VisSim Modelled Delay Curve – 60% Departures, 40% Arrivals, 23% Light, 70% Medium, 7% Heavy

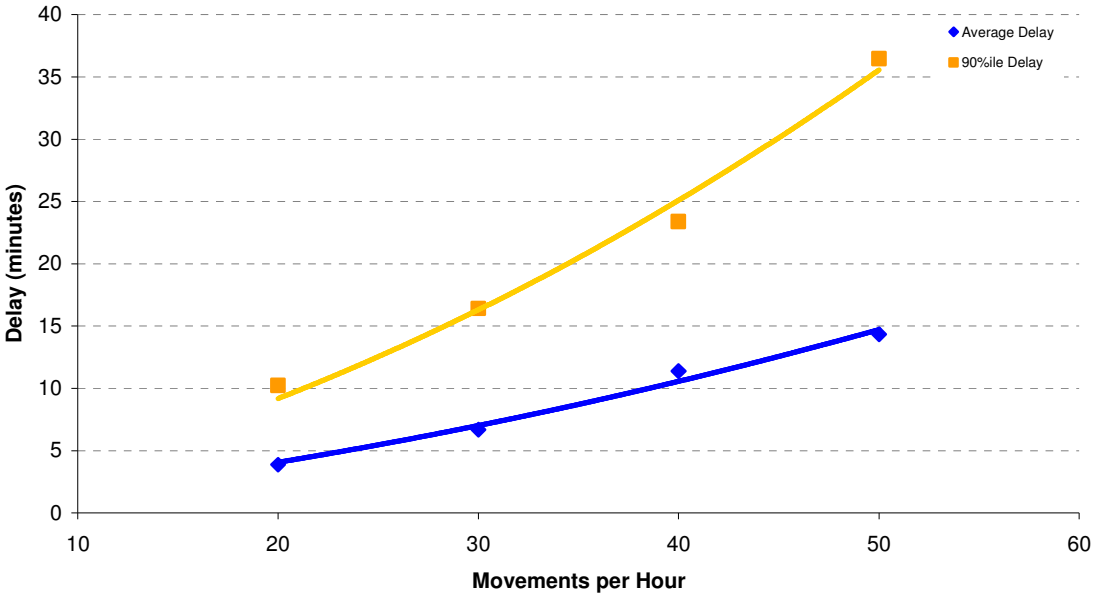


Figure 16 – VisSim Modelled Delay Curve – 50% Departures, 50% Arrivals, 23% Light, 70% Medium, 7% Heavy

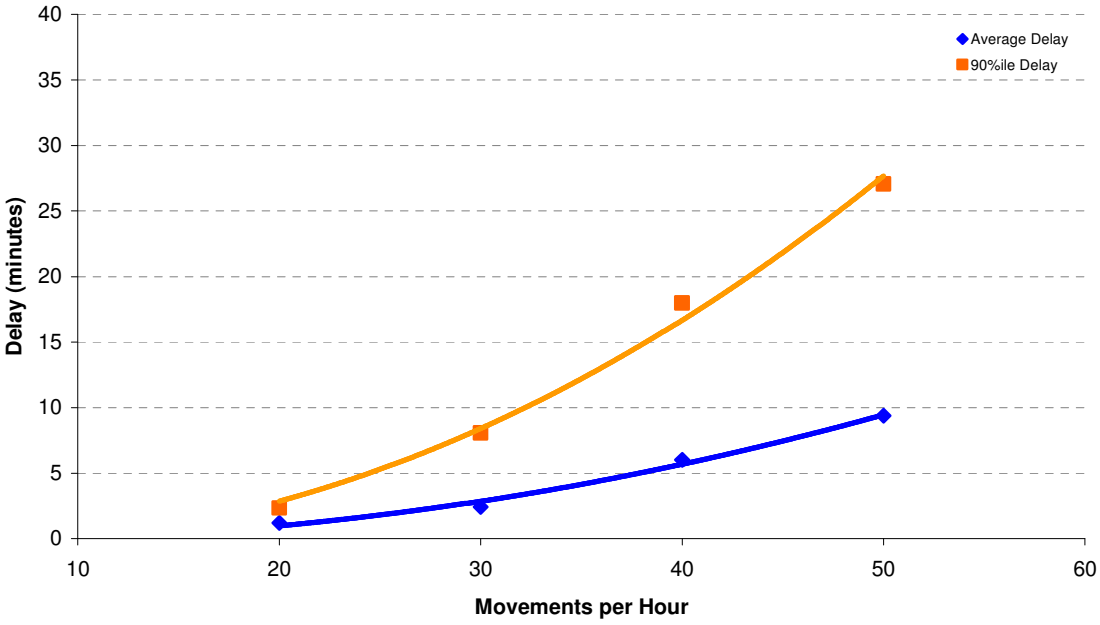


Figure 17- VisSim Modelled Delay Curve – 40% Departures, 60% Arrivals, 23% Light, 70% Medium, 7% Heavy

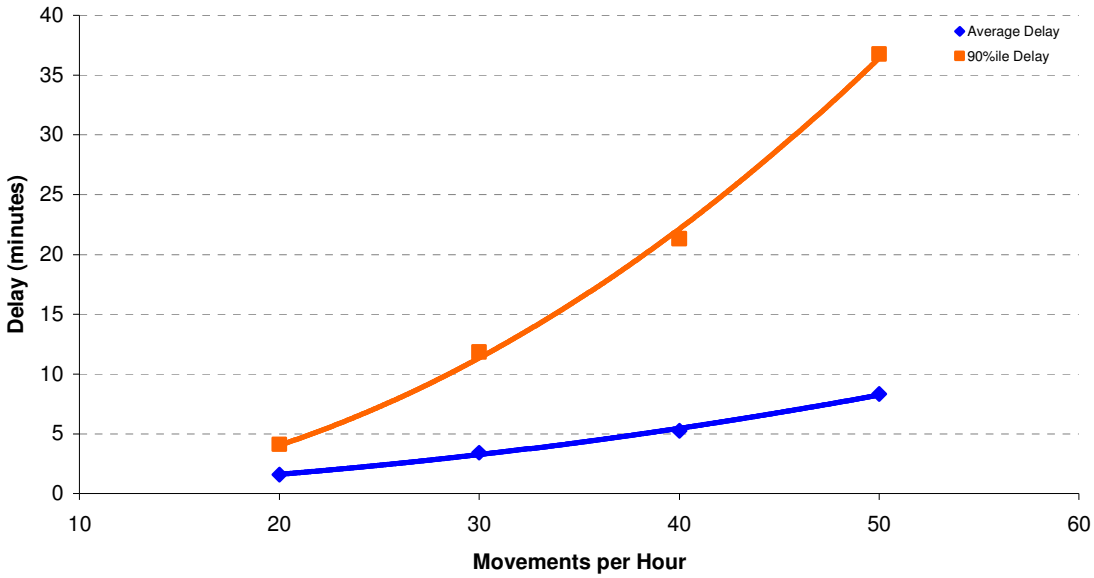
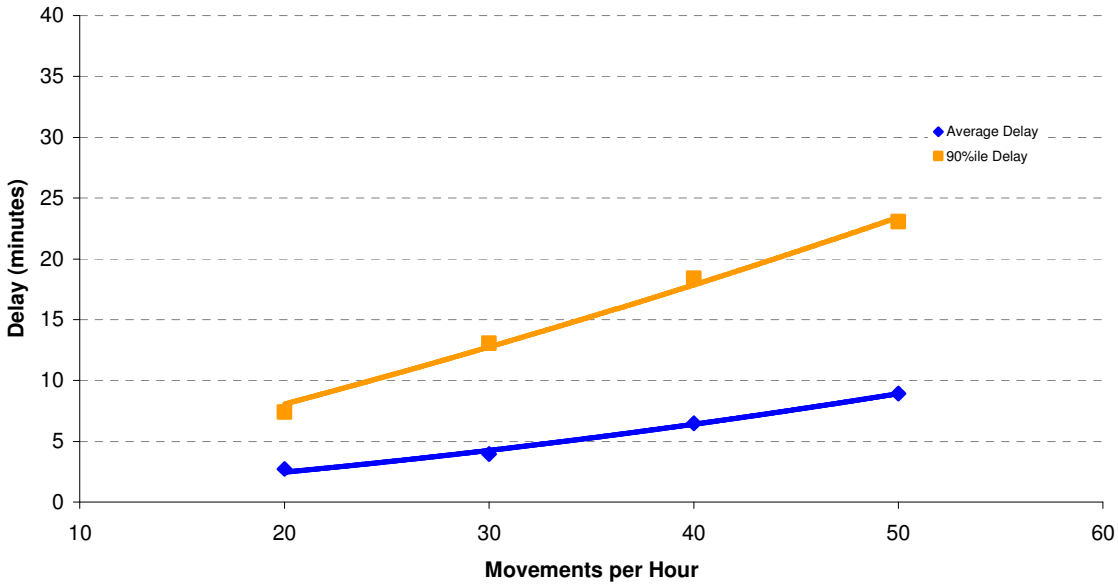


Figure 18 - VisSim Modelled Delay Curve – 50% Departures, 50% Arrivals, 20% Light, 68% Medium, 14% Heavy



5.7 CONCLUSIONS

In conclusion, it is clear from the NATS work, and our own additional modelling, that whilst the runway can meet the 10 minute average delay criterion with the Summer 2007 wishlist, additional demand leads to an exponential increase in capacity related runway delays. A key driving factor is the asymmetrical nature of the peak demand between arrivals and departures. This means that optimal runway utilisation cannot be delivered. Whilst proposals for additional bypass taxiway, RETs and holding areas may slightly increase the peak runway capacity, the infrastructure could not be delivered by Summer 2007. As such we conclude that the any demand in excess of the Summer 2007 wishlist will lead to a significant increase in runway related capacity delays and the short term peak capacity of the runway can reasonably be considered to be equivalent to the peak demand in the Summer 2007 wishlist.

6 COORDINATION STATUS

6.1 LEGAL FRAMEWORK AND EUROPEAN CONTEXT

The relevant EU legislation is Council Regulation (EEC) no. 95/93 of 18 January 1993, as amended by Regulation (EC) No. 793/2004 of the European Parliament and of the Council relating to the allocation of take-off and landing slots at airports within the EU. This regulation makes provision for the competent authority of each Member State (the Commission for Aviation Regulation in Ireland) to designate an airport as "schedules facilitated", i.e. one where a neutral body is appointed to facilitate airline operations on a voluntary basis, or as "coordinated", i.e. one where airlines must use take-off and landing slots allocated by the neutral airport coordinator. Article 3.3 of the regulation states that an airport shall be designated as coordinated when the analysis from a capacity study, using commonly recognised methods, does not indicate the possibility of resolving insufficient capacity for actual or planned airline operations within a short time period.

In consequence, the Commission needs to determine whether, in fact, Dublin Airport suffers from capacity constraints that cannot be alleviated within the short term. This is a complex and multi faceted issue, since the capacity of the airport is determined not only by the physical infrastructure, principally runways, aircraft stands and terminal capacity, but also by the type and mixture of operations by airlines, the relative peakiness of airline operations (both by time of day and time of year), and the flexibility that airlines are willing to offer in adjusting their operations in terms of, for example, use of contact stands, exact take-off and landing times, etc. Changes to operating procedures by the airport itself may also impact on capacity (e.g. manning of security posts, allocation of baggage belts to incoming flights, etc.).

The Commission deliberated on this same issue in 2001, taking representations from Aer Rianta, Aer Lingus, Ryanair and others, and having regard to a capacity study of the airport by consultants. As in 2004, there was disagreement between the airport operator and the airlines as to whether fully coordinated status was appropriate, with the airport and ground handling agencies largely in favour of the change but the airlines opposed. This reflects the fact that schedules coordination status could potentially ease certain bottlenecks and congestion that cause problems (and imply additional investment) at the airport. Conversely, airlines generally prefer to maintain coordinated status, under which their schedules are not formally constrained by an outside body, in this case the airport coordinator. On many routes the destination airport may itself be slot constrained, and given the airline's need to maintain aircraft utilisation, a reluctance to accept schedules coordination is understandable.

The 2001 and 2004 consultants' report indicated that, with certain caveats, runway, stand and terminal capacity was sufficient. Furthermore, the 2004 study indicated that while capacity was in principle sufficient, airlines would need to accept a lower standard of service as regards contact stands (or allow some airlines superior service to others in this regard), in order to avoid unacceptable levels of congestion that would trigger the need to designate the airport as coordinated. Furthermore the willingness of airlines to engage with the coordinating authority and the prospect of additional transatlantic traffic were highlighted as potential risks that may trigger the need for schedules coordination.

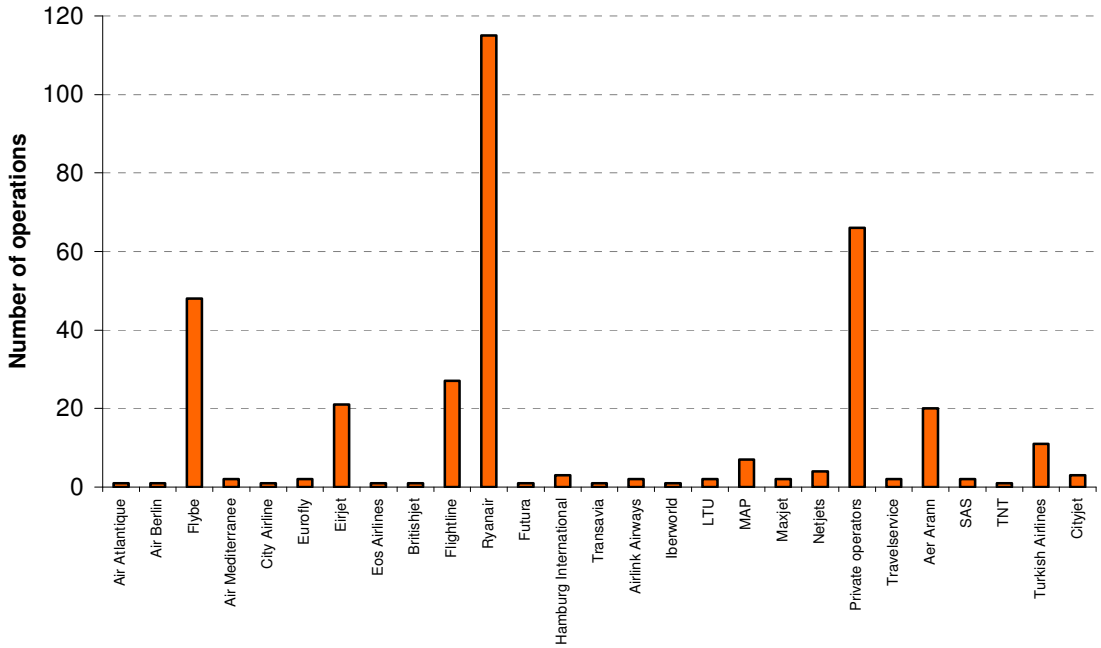
On the basis of these representations and the analysis, the Commission decided in 2001, and again in 2004, that grounds did not then exist to designate Dublin Airport as coordinated. However, by 2005, the Commission felt that the situation had changed sufficiently that schedules coordination was justified for the summer season in 2006. However, following legal challenge, the airport reverted to schedules facilitated status in July, 2006.

6.2 Analysis of Schedules Facilitation at Dublin

In managing airline schedule requests, the appointed coordinator, ACL, looks to voluntarily agree a schedule, defined as the wishlist, that provides a more balanced distribution of daily departures and arrivals within the capacity thresholds of the airport. Essentially this involves encouraging airlines to reschedule departures and arrivals to shoulder, off-peak periods to reduce the level of delays. Since the schedules facilitated system is voluntary, airlines can refuse any requests to reschedule. Requests are usually submitted ahead of the season to coincide with the IATA slot coordination process.

It is reasonable to expect that there may be some initial overbidding for slots, which would explain the initial airline demand for 45 departures in the 0500 hour, which is 19 movements higher than the declared Summer 2006 capacity. It is therefore more significant to assess the robustness of ACL wishlist demand which represents the demand which can be accommodated within the capacity declarations of the airport. It is also useful to consider the prior activity patterns in previous years as a guide to whether the voluntary schedules facilitation process can be effective in constraining demand to a capacity threshold. Figure 19 summarises the number of proposed adjustments that were not accepted in the summer 2006 season, a total of 348 movements of which 33% were by Ryanair.

Figure 19 – Schedule adjustments not accepted in Summer 2006



Compared to preceding seasons, the summer 2006 refusals were low reflecting the initial coordinated status of the airport during summer 2006. Although the airport reverted back to schedules facilitated

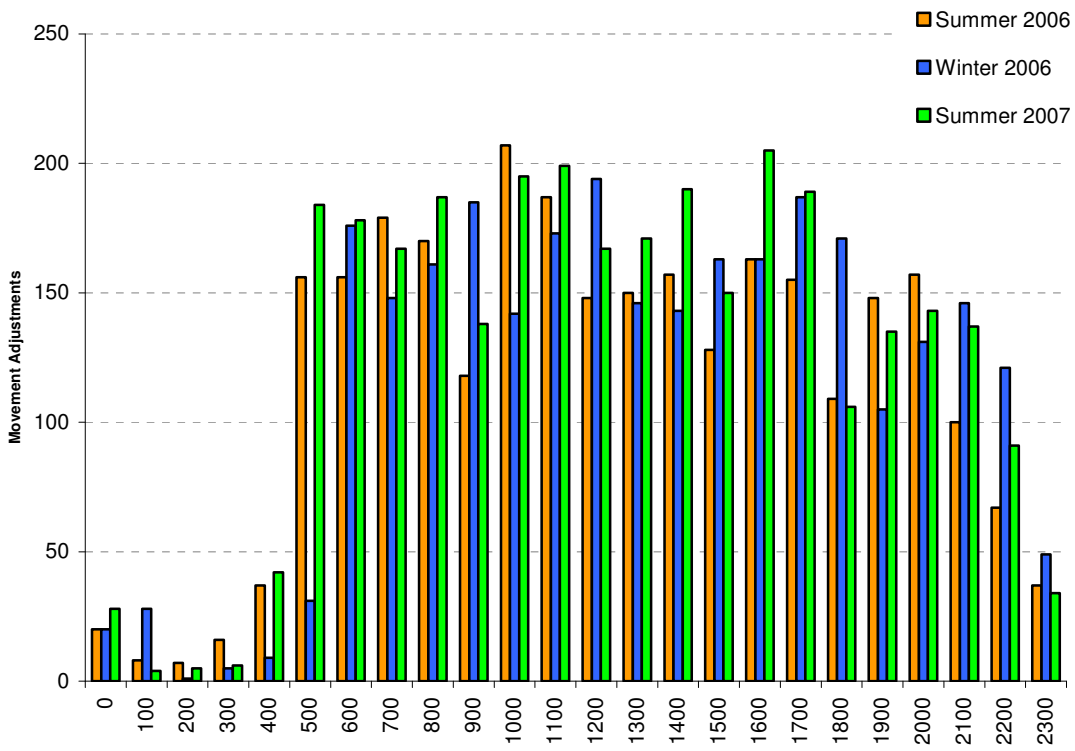
status in July 2006, there was only limited scope for airlines to adjust flight times mid-season and hence the number of actual schedule movements compared to the original wishlist is relatively low.

In summer 2005, a total of 7,495 adjustments were not accepted by airlines compared to, with 3,890 schedule adjustments which were accepted. Adjustments that were not accepted therefore represented 6.9% of the total movements. As would be expected the highest number was by the base carriers, 51% were by Ryanair and 24% by Aer Lingus.

Compared to analysis in a previous study for Summer 2003 and Summer 2004, the number of adjustments required and the number of adjustments that were not accepted increased significantly in Summer 2005, the last directly comparable season. Although seemingly a small percentage overall, the impact can be significant in the peak periods and effectively translates into higher demand than initially planned for in the ACL wishlist.

It is apparent that the number of requested 'wishlist' adjustments for Summer 2007 is higher than Winter 2006, which in itself was higher than Summer 2006 as shown in Figure 20. This suggests that despite increased capacity declaration limits, it is increasingly difficult to effectively schedule additional peak movements.

Figure 20 – Wishlist adjustments at end of IATA conference



Source: ACL

Given that the peak runway demand has been shown to be at capacity in the Summer 2007 wishlist, the potential for any additional demand beyond this is therefore significant. If the experience from previous years is considered a reasonable guide, then it would appear likely that a combination of proposed

adjustments which are not acceptable to the airlines and additional services, will mean that Summer 2007 outturn will be higher than the Summer 2007 wishlist.

Considered another way, if the current schedules facilitation process is not successful in voluntarily constraining peak period demand to that set out in the Summer 2007 wishlist, then runway delays will increase beyond current criterion. In that case, an effective means to constrain peak demand will be required maintain effective airport operations, and provide sufficient scope to recover quickly from unforeseen events.

6.3 STAKEHOLDER VIEWS

The extensive consultation undertaken with airport stakeholders revealed a number of common capacity concerns, often focused on the lack of contact stands especially during the forthcoming construction of Terminal 2. Although it was recognised that the passenger terminal is close to capacity, the majority of those interviewed believed that it was not a defining constraint and that the DAA proposals for additional check-in, security and centralised immigration would probably resolve many of the recent congestion issues until Terminal 2 is operational.

There was no common consensus on the future coordination status of the airport. Most of the airlines interviewed expressed the view that, despite reservations, they would potentially support a change in status if the capacity assessment supported the case. The main rationale was that the continued demand for peak hour slots set against an environment where the supply of contact stands and peak runway slots will be increasingly constrained, meant that independent coordination of the schedule would safeguard continued fairness in the future allocation of slots.

However, one airline in particular, suggested that the proposed development of Terminal 2 was not necessary given the additional capacity that could be provided from an enhanced Terminal 1. The aim of this report is to assess airport capacity with proposed airport developments, rather than to consider the relative merits or otherwise of the current airport development plan. However, specific recommendations for short-term enhancements to capacity have been set out in this report.

7 CONCLUSIONS AND RECOMMENDATIONS

This report has considered the ability of the current and proposed airport infrastructure to accommodate the projected increases in demand over the period 2007-2012. Beyond 2009 the proposed introduction of Terminal 2 will negate any issues concerned with terminal capacity and increase stand capacity, whilst the proposed development of the parallel runway in 2012 will provide additional runway capacity.

In assessing whether the airport should be designated as coordinated, the capacity of the terminal, stands, taxiway and runway have been reviewed. However, in determining whether the coordination status at the airport should be changed, there are two key issues to consider:

- Does demand exceed capacity such that significant delays cannot be avoided at the airport
- Can solutions be developed to effectively resolve identified problems in the short term

In summary, the following has been concluded from the analysis:

Terminal

- With the infrastructure enhancements proposed in 2007 and 2008 by DAA, there would appear on balance to be sufficient system capacity for the terminal to handle up to 24.7mppa at a reasonable level of service.
- There are likely to be capacity issues that justify active management and temporary facilities on the concourses, at security and Pier A immigration during Summer 2007.
- Whilst there are circulation issues on the departures concourse, peak hour congestion could be mitigated through active management, changes in airline check-in policy and a potential re-allocation of check-in desks within the concourse areas.

Stands

- The airport appears to only have sufficient stand capacity to handle the Summer 2007 wishlist
- It appears that by the winter 2007 season, the demand for stands at Dublin Airport will exceed the supply of stands.
- With the proposed stand re-allocations associated with the development of Terminal 2, the lack of availability of contact stands will be a significant constraint on demand in 2008 and beyond.
- The reliance on remote stands and bussing, and the disruption caused by the construction (and potential pavement works) are likely to lead to unacceptable levels of delay and congestion.

Runway

- The capacity of the runway is largely as declared by NATS for summer 2007 and sufficient to accommodate the summer 2007 schedule wishlist.
- Significant investment in additional taxiway infrastructure and improvements in ATC procedures may potentially yield a small increase in current declared peak capacity. However, the

economic case for such investment has not been sanctioned by the DAA or the airlines at the time of writing and seems unlikely to be deliverable in the short term.

- Given the asymmetry of arrivals and departures in the morning peak, additional peak demand beyond that set out in the Summer 2007 wishlist will significantly increase runway-based delays.

Due to the asymmetry of arrivals and departures in the peak morning schedule and reduced stand availability, additional peak services beyond those in the Summer 2007 wishlist will increase apron delays and average runway delays above the currently agreed 10 minute delay criterion. It is therefore recommended that Dublin Airport be designated as coordinated from the Winter 2007 season due to insufficient airport runway and apron capacity during peak times.

As shown in Section 6, evidence on prior activity patterns from recent seasons suggests that outturn peak demand would be greater than assumed in the current Summer 2007 wishlist. It is therefore recommended that schedules coordination at Dublin Airport also be strongly considered for the Summer 2007 season, as the airport will be at the capacity of its airfield infrastructure and there appears to be no operational contingency provided. Coordinated status for Summer 2007 would help to ensure that capacity constraints are effectively managed and fair access to available slots is provided.

Based on the analysis conducted, runway and stand constraints mean that the airport will not be able to cater for additional peak services until the proposed parallel runway has been completed and additional stands provided, although this is not to say that additional demand cannot be accommodated outside the peak hours. It is therefore recommended, that the appropriate scheduling status of the airport is reviewed again once the planned additional stand and runway capacity are operational.

JACOBS CONSULTANCY
Airport Management Consulting

APPENDIX A - CONSULTATION

MEMORANDUM SENT TO PERSONAL INTERVIEWEES AND AIRLINE OPERATORS COMMITTEE

To: Whom it may concern
From: Andy Carlisle
Date: 4th October, 2006
Subject: **Dublin Airport Capacity Review**

Jacobs Consultancy-Airport Management Consulting (formerly known as Leigh Fisher Associates), has been retained by the Commission for Aviation Regulation to undertake a capacity assessment of Dublin Airport. The purpose of the engagement is to review the coordination status at the airport through analysis of current and future capacity as defined in Article no. 95/93.

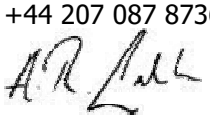
As part of the assignment, we are keen to engage with airport users and stakeholders to ensure that the analysis is inclusive and reflects, where feasible, the range of views, issues and concerns. Over the next few days, Andy Carlisle and Graham Strudwick will be conducting a series of personal interviews in Dublin to understand and appreciate the perspectives of both airport users and stakeholders. In order to facilitate as inclusive an approach as possible, additional telephone interviews will also be conducted.

In particular we are keen to understand the following:

- Summary of current Dublin operations
- Summary of future passenger/ATM forecasts and infrastructure requirements
- Current operational problems and experience at Dublin as it relates to capacity
- Which areas of the airport currently or potentially provide the greatest capacity constraint
- The number of requested slots which are denied and the resulting operational impact
- The extent of delays attributable to capacity constraints (terminal, gate and airfield)
- The potential impact on operations with the proposed development of Terminal 2
- Comments on the current co-operative slot coordination arrangements
- Comments on performance during the Summer '06 season when full slot coordination was largely in operation
- Any available reports or data that could strengthen the capacity analysis
- Suggestions on ways to mitigate any identified capacity issues
- Overall views on the coordination status at Dublin

Although comments made will largely be reported in aggregate, the notes taken by Jacobs Consultancy will provide a documented record of the conversations.

We would like to thank you in advance for agreeing to assist us in this assignment, and look forward to meeting with you. If you have any questions, please do not hesitate to call me on +44 207 087 8736 or +44 7747 007 165.



Andy Carlisle
Director, European Airport Practice
Jacobs Consultancy—Airport Management Consulting

16 Connaught Place
London W2 2ES
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EMAILS SENT TO AIRLINE OPERATORS COMMITTEE MEMBERS

Carlisle, Andy

From: Carlisle, Andy
Sent: 06 October 2006 17:31
To: 'eoscott@airfrance.fr'; 'Joan.M.Carrick@delta.com'; 'rcopeland@shp.ie'; 'angela.1.cook@britishairways.com'; 'czechairlines@clubi.ie'; 'david.simpson@monarch-airlines.com'; 'nigel.ames@firstchoice.co.uk'; 'dubkk@iberia.es'; 'karen.mcloughlin@dlh.de'; 'marjorie.briggs@flybmi.com'; 'matt.danaher@sas.dk'; 'ryan.mckeag@gulfairco.com'; 'robert.airaut@aa.com'; 'pat.reade@coair.com'; 'info@atrs-ireland.com'; 'lonergant@iata.org'; 'italbaciliberto@yahoo.co.uk'
Cc: 'Therese_Jager@usairways.com'
Subject: Dublin Airport Capacity Study

I have passed your address by Therese Jager in her capacity as Chair of the Airline Operators Committee.

You may be aware that Jacobs Consultancy-Airport Management Consulting (formerly known as Leigh Fisher Associates), has been retained by the Commission for Aviation Regulation to undertake a capacity assessment of Dublin Airport. The purpose of the engagement is to review the coordination status at the airport through analysis of current and future capacity as defined in Article no. 95/93.

As part of the assignment, we are keen to engage with airport users to ensure that the analysis is inclusive and reflects, where feasible, the full range of views, issues and concerns. Over the the period 10th to 13th October, we are conducting a series of personal interviews in Dublin and in order to facilitate as inclusive an approach as possible, subsequent telephone interviews will also be conducted.

We would welcome your input to the study and if you or a relevant colleague are able to spare the time to help, I would be grateful if you could contact me by email on andy.carlisle@jacobs-consultancy.com or by phone on +44 7747 007 165 to schedule a mutually convenient time to talk.

I attach a brief memo that summarises the aims of the study and provides an outline of the issues we are keen to understand.

We hope to attend part of the AOC meeting on Tuesday 10th October where we would be happy to discuss the study further or answer any questions you may have.

I look forward to hearing from you

Regards

Andy Carlisle

Effective October 1, 2006, Leigh Fisher Associates has been renamed Jacobs Consultancy– Airport Management Consulting.
To learn more, visit our website at www. jacobs-consultancy.com

Andy Carlisle
Director, European Airport Practice

JACOBS
CONSULTANCY ***Airport Management Consulting***

16/11/2006

EMAILS SENT TO AIRLINE OPERATORS COMMITTEE MEMBERS

Carlisle, Andy

From: Carlisle, Andy
Sent: 19 October 2006 20:04
To: 'eoscott@airfrance.fr'; 'Joan.M.Carrick@delta.com'; 'rcopeland@shp.ie'; 'angela.1.cook@britishairways.com'; 'czechairlines@clubi.ie'; 'david.simpson@monarch-airlines.com'; 'nigel.ames@firstchoice.co.uk'; 'dubkk@iberia.es'; 'karen.mcloughlin@dlh.de'; 'marjorie.briggs@flybmi.com'; 'matt.danaher@sas.dk'; 'ryan.mckeag@gulfairco.com'; 'robert.airaut@aa.com'; 'pat.reade@coair.com'; 'info@atrs-ireland.com'; 'lonergant@iata.org'; 'italbaciliberto@yahoo.co.uk'; 'sharongreenhalgh@servisair.com'; 'HOReilly@aircontractors.com'; 'anne.bradley@aerlingus.ie'; 'brendan.mccarthy@aerlingus.ie'; 'darran.allen@aviance-uk.com'; 'declan.ryan@cityjet.com'; 'john.hilliard@cityjet.com'; 'philip.clarke@cityjet.com'; 'elizabeth.roche@aerarann.com'; 'aidan.power@aerlingus.ie'; 'doolana@ryanair.com'
Cc: 'Therese_Jager@usairways.com'
Subject: RE: Dublin Airport Capacity Study

Further to my email below i would like to thank you for granting me the time to briefly speak at the AOC meeting on October 11th, 2006.
I would just like to re-iterate our committment to consult with you all as fully as possible on the airport capacity study.

For your information, to date we have directly spoken with representatives from US Airways, bmi, Aer Lingus, Ryanair, CityJet, Air Arran, Air Contractors and FBO. If you would like to contribute to the study or have any operating data that might support the capacity analysis, please contact me on the numbers below.

Equally if there are other members of your respective organisations who you feel we should speak with, please let me know or ask them to contact me.

If we do not hear from you, we will assume that you are content for the capacity review to continue.

Many Thanks

Andy

Effective October 1, 2006, Leigh Fisher Associates has been renamed Jacobs Consultancy. To learn more, visit our website at www.jacobs-consultancy.com

Andy Carlisle
Director, European Airport Practice

Jacobs Consultancy

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-----Original Message-----
From: Carlisle, Andy
Sent: 06 October 2006 17:31
To: 'eoscott@airfrance.fr'; 'Joan.M.Carrick@delta.com'; 'rcopeland@shp.ie';

16/11/2006

EMAIL SENT TO AIRLINES (THROUGH DAA) TO CONFIRM CHECK-IN ASSUMPTIONS

From: Catriona.Francis@jacobs.com [mailto:Catriona.Francis@jacobs.com]

Sent: 26 October 2006 09:05

Cc: Francis, Catriona

Subject: Airline Check-in Assumptions

Dear Sir/Madam,

Jacobs are currently developing a capacity model of Dublin Airport in order to assess the current and future capacity of the airport. As part of this process we are putting together a computer model of the terminal and will be looking to validate the model against existing facilities. In order to use the best possible information available to us we would appreciate it if you would spend a couple of minutes reviewing the input assumptions we currently have for your airline (assumptions attached)?

In particular we need to understand your process times per passenger (actual rather than aspiration), how you operate your desks/self service/bag drop, and when you open and close your desks relative to STD. We are also interested in any information you may have that indicates when your passengers turn up at the airport. For example, do you experience big queues when you first open check-in because your passengers turn up early.

As with any study we are operating to a tight deadline and we would very much appreciate it if you could respond by Tuesday next week (31st October). Although Kevin Conheady has been kind enough to send out this e-mail on my behalf, I have copied myself in so that you can respond to me directly.

In the absence of any data received from you we will assume that the data provided in the document attached is sufficiently accurate for us to proceed in building the computer model.

Your help in making sure that our input data correct is greatly appreciated,

Regards,

Catriona Francis

<<Terminal Capacity Input Assumptions - Other Shorthaul or Charter.doc>>

Jacobs
Catriona Francis
Airport Planner
Tel: 0118 963 5224
E-mail: catriona.francis@jacobs.com

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APPENDIX B - MODELLING ASSUMPTIONS

ARRIVE-DEPART

Ref.	Description	Base Assumption	Source	Comments
Passenger mix on aircraft				
	Flight schedule & transfer destination matrix	8th September 2006	Dublin Airport received 05/10/2006	
	Phase 1 transfer assumptions	3.90%	Dublin Airport received 05/10/2006	
	Aircraft Class Configurations	See Table 1	Jacobs Assumption made on 16/10/06	
	Load Factors	Middle East 70.5% Charters 88.6% Shorthaul 78.4% Ryanair 90% Transatlantic 69.9% Domestic 63.1%	Dublin Airport received 05/10/2006	
	Passenger mix on DOM flights Passenger mix on EU flights Passenger mix on NEU flights	100% DOM 80% EU, 20% NEU 50% EU, 50% NEU	Dublin Airport received 05/10/2006 - uses 2006 figures for purposes of validation	
Modal split and terminal access information				
	Vehicle load factors	Car - 2.16 pax / vehicle Taxi - 1.94 pax / vehicle Bus - 8pax / vehicle	Dublin Airport Authority 07/11/06	
	Mode of transport to the airport for all flight types	See Table 5	Dublin Airport received 05/10/2006	
Passenger baggage				
	Pax with hand/hold bags at check-in	No hand/hold segregation at check-in modelled		
	Bags per passenger	DOM = 1.0, SH = 1.0, LH = 1.0	DAA data 2006 WK 1-34	
Stand, airbridge and off-pier activity				
	Embarkation rates on pier via airbridge Disembarkation rates from aircraft, on pier by airbridge Disembarkation from aircraft	10 pax/min 27 pax/min CIP passengers and bags unload first	From Jacobs Heathrow Terminal 5 Study and assumes all stands are contact	
Passenger circulation and people movers				
	Passenger journey speed	1 m/s	Jacobs Assumption	
Check-in, concourse and landside retail				
	Reporting patterns at check-in	Table 2	Jacobs generated profile from LHR T1 study 2006	
	Dwell Time with Friends at Bank	Part of departure concourse dwell below	Jacobs Assumption made on 16/10/06	
	Meeters and Greeters per passenger -	0.08 per Passenger	Dublin airport received 05/10/06	
	Check-in queue standards	Table 3	Dublin airport received 05/10/06	
	Check-in transaction times	Table3	Dublin airport received 05/10/06 updated where possible with airline specific assumptions (still to be confirmed for EI and FR)	
	Check-in deskopen and close-out times	Table 9	DAA Assumption	
	Check-in opening times (SSK's)	300minutes before Departure	Jacobs Assumption made on 16/10/06	To Simulate that SSKs are always open
	Check in desks	Table 4	Dublin airport received 05/10/06 (verified by airlines where possible)	
	Passengers that do not dwell in departure concourse prior to security	37%	Millward Brown Survey Aug 2006	
	Friends and Family dwell time	17 minutes	Jacobs Assumption	
	Departures concourse dwells - pre check-in Departures concourse dwells - post check-in / retail	pre-check-in dwell caclulated by the model and calibrated againsy survey data. 10.65 mins post check-in assumed	Discussions with DAA based on Millward Brown Survey 2006	
	US ICTS Process time	1.5 mins	DAA - e-mail 26/10/06	
Departing passenger processes				
	Departures security X-Ray process time	16.2 seconds	Weighted average process time based on survey data provided by Dublin Airport Oct 2006	
	Departures security X-Ray process time(security protocol introduced)	19 seconds	Jacobs (based on 20% increase)	
	Departures security X-Ray queue standard	No longer than 7 minutes, 95% of the time	Dublin airport received 05/10/06	
	Security X-rays	16 in 2006 18 in 2007 20 in 2008 24 in 2009	Total number for 2006 supplied by DAA	
Departure lounge use and boarding				
	CIP Lounge	All CIP assumed to use normal lounge	Jacobs Assumption (worst case)	
	Call forward times from lounges	All Passengers called forward from lounge 62.3 minutes before departure time	Millward Brown Survey Aug 2006	
	CBP Document Check - desks	2	Observation by Jacobs during visit (Oct 2006)	
	CBP Document Check - process time	15 secs	Estimated by Jacobs	
	CBP Immigration desks	8 desks (5 staffed)	Ove Arup Report May 2006	
	CBP Immigration - process time	1 min	Ove Arup Report May 2006	
	CBP Immigration - Queue Standard	40 pax	Jacobs Assumption (based on 195m2 area Ove Arup 2006 report, and Q standard at normal immigration)	
Arrivals immigration				
	Arrivals immigration process times	See Table 6	Based on Ove Arup report 24/05/06	
	Arrivals immigration queue standards	EU passport holders = 10 mins	DAA recommendation	
		NEU passport holders / Traveller = 10 mins	DAA recommendation	
	Immigration desks	See Table 7	Based on Ove Arup report 24/05/06	
Reclaim				
	First bag on belt	10 mins	Typical time from Millward Brown Surveys Summer 2006	
	Reclaim belts	See table 8	Ove Arup Report May 2006	
	Bags per metre	1.5	Jacobs	
	Baggage delivery rate	15 bags/min load & unload, 80 bags per "baggage train"	Jacobs Assumption	
	Baggage hall pax orientation time	5 minutes	Jacobs Assumption	
	Baggage belts	10	Based on Ove Arup report 24/05/06	
Customs				
	Passenger throughput modelled			
Arrivals concourse				
	Arriving pax meeters per pax	0.39	DAA Assumption	
	Meeters arrival profile	See table 10	Millward Brown Surveys Summer 2006	
	Arriving pax dwell on concourse with meeters	51.62 mins for meeters/greeters	DAA Assumption	
	Effective Arrivals Hall Area	1191 sq.m	DAA Assumption	
Transfer passenger processes				
	Transfer passengers are assumed to go through immigration and then to enter security area A. At security, transfers mix with departing passengers. From this point on transfers follow the same route as normal departing passengers.		Jacobs - Discussions with DAA	

Table 1 - Phase 1 aircraft configurations

Service Type	Cabin Configuration		
	Premium	Economy	Total
Domestic	0.00%	100.00%	100.00%
Short Haul	0.00%	100.00%	100.00%
Long Haul	0.00%	100.00%	100.00%

Exceptions			
Airline	Premium	Economy	Total
AF,LH,BD,BA,SK,AY,AC, IB, AZ, CO,AA,US,DL	20.00%	80.00%	100.00%

Source: Jacobs Assumption made on 16/10/06

Table 2 - Cumulative percentage reporting patterns at check-in

Airline DUB	330	315	300	285	270	255	240	225	210	195	180	165
FLAG/OTHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	10.0
EI/FR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	10.0
US	0.0	1.0	1.0	1.0	2.0	4.0	8.0	12.0	20.0	31.0	43.0	58.0
CHARTER	0.0	1.0	3.0	8.0	14.0	23.0	32.0	41.0	52.0	64.0	72.0	80.0
SS EU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	3.0
SS NON EU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	9.0	13.0	22.0
DOMESTIC	0.0	8.0	9.0	9.0	9.0	10.0	10.0	11.0	11.0	13.0	16.0	24.0

Airline DUB	150	135	120	105	90	75	60	45	30	15	0	15
FLAG/OTHER	19.0	31.0	48.0	65.0	80.0	93.0	98.0	100.0	100.0	100.0	100.0	100.0
EI/FR	19.0	31.0	48.0	65.0	80.0	93.0	98.0	100.0	100.0	100.0	100.0	100.0
US	71.0	83.0	91.0	96.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
CHARTER	89.0	92.0	99.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
SS EU	4.0	7.0	19.0	27.0	40.0	58.0	79.0	95.0	100.0	100.0	100.0	100.0
SS NON EU	35.0	59.0	76.0	83.0	93.0	94.0	100.0	100.0	100.0	100.0	100.0	100.0
DOMESTIC	30.0	44.0	53.0	63.0	74.0	83.0	96.0	99.0	100.0	100.0	100.0	100.0

Source: Millward Brown 2006 Survey of check-in times adjusted to take into account check-in queues

Table 3 - Check-in standards and process times

Description	Queue Standards	Process Time
All Standard Check-in (except transatlantic)	15	124s
Standard Check-in transatlantic	20	124s
All self service Check-in	15	73s
Bag Drop	15	66s

Source: Dublin airport received 05/10/06
Where possible, data has been verified by airlines

Table 4 - Check-in desks

Area	Number of desks
1	9
2	9
3	9
4	9
5	9
6	10
7	10
8	10
9	10
10	10
11	15
12	15
13	16

Source: Dublin airport received 05/10/06

Table 5 - Mode of transport to the airport

Transport	%
Car	46%
Taxi	27%
Bus/Coach/Train	27%

Source: Dublin airport received 05/10/06 (adjusted to take into account % transfers)

Table 6 - Arrivals immigration process times

Area	Processing Rates (sec)		Utilization (%)	
	EU	Non-EU	EU	Non-EU
Pier A (Existing)	3	39	80	20
Pier B	4	43	50	50
Pier C	4	49	80	20

Source: Dublin airport received 05/10/06 Figures used to verify 2006 data

Table 7 - Immigration desks

Area	Position	Staff
Pier A(Winter 2006)	4	4
Pier B	8	6
Pier C	6	3
Centralised (2008)	12	12

Source: Dublin airport received 05/10/06 Figures used to verify 2006 data

Table 8 - Baggage Claim Devices

Device	Length (m)
1	20
2	66
3	38
4	38
5	49
6	54
7	41
8	41
9	41
10	41

Source: Ove Arup Report May 2006

Table 9 - Check-in by Airline

Airline	Process Time (minutes:seconds)	Time before departure check-in closes (minutes)	Time before departure check-in opens (minutes)
BJ	01:20	45	210
BUC	02:04	45	150
ECA	02:04	45	150
EIR	01:20	45	150
FCA	01:20	45	150
FLT	02:04	45	150
FUA	01:20	45	210
JKK	02:04	45	150
MON	01:20	45	150
MPJ	02:04	45	150
MYT	01:20	45	150
OU	02:04	45	150
QS	02:04	45	150
TSC	02:04	45	210
EI NON US	01:20	45	150
EI NON US SS	01:13	45	300
EI US	02:04	45	210
EI US SS	01:13	45	300
FR	01:20	40	120
FR WEB	00:00	45	600
AF EC	02:04	45	120
AF PR	02:04	45	120
AF SS EC	01:13	45	300
LH EC	02:04	45	150
LH PR	02:04	45	150
BD EC	02:04	45	150
BD PR	02:04	45	150
BD SS EC	01:13	45	300
BA EC	02:04	45	150
BA PR	02:04	45	150
BA SS EC	01:13	45	300
SK EC	02:04	45	180
SK PR	02:04	45	180
SK SS EC	01:13	45	300
AY EC	02:04	45	150
AYPR	02:04	45	150
AC EC	02:04	45	210
AC PR	02:04	45	210
IB EC	02:04	45	150
IB PR	02:04	45	150
AZ EC	02:04	45	120
AZ PR	02:04	45	120
BE	01:20	45	150
BT	01:20	45	150
C0	01:20	45	210
GF	02:04	45	210
HHI	02:04	45	150
HLX	02:04	45	150
HYR	02:04	45	150
LG	01:20	45	150
LO	01:20	45	150
LX	02:04	45	120
MA	01:20	45	150
NJE	02:04	45	150
OK	01:20	45	150
RE	02:04	45	150
TK	02:04	45	150
TP	02:04	45	150
WOW	02:04	45	150
CO EC	02:04	45	210
CO PR	02:04	45	210
AA EC	02:04	45	210
AA PR	02:04	45	210
US EC	02:04	45	210
US PR	02:04	45	210
DL EC	02:04	45	210
DL PR	02:04	45	210

Source: DAA and discussions with airlines and handlers

Table 10 - Arrivals Meet/Greet Turn-up Profile

Time compared to arrival	-1.00	-0.45	-0.30	-0.15	Arrival	0.15	0.30	0.45	1.00
Cumulative %	9%	14%	25%	44%	63%	78%	90%	96%	100%

Source: Millward Brown Survey

VISSIM Runway Capacity Model

Take Off and Landing				
	TakeOff Velocity Cat B Aircraft	225 kph	Jacobs	
	TakeOff Velocity Cat C Aircraft	275 kph	Jacobs	
	TakeOff Velocity Cat E Aircraft	280 kph	Jacobs	
	TakeOff Acceleration Cat B Aircraft	1.6 m/s^{-2}	Jacobs	
	TakeOff Acceleration Cat C Aircraft	1.96 m/s^{-2}	Jacobs	
	TakeOff Acceleration Cat E Aircraft	2.19 m/s^{-2}	Jacobs	
	Landing Velocity Cat B Aircraft	175 kph	Jacobs	
	Landing Velocity Cat C Aircraft	215 kph	Jacobs	
	Landing Velocity Cat E Aircraft	280 kph	Jacobs	
	Landing Deceleration Cat B Aircraft	1.25 m/s^{-2}	Jacobs	
	Landing Deceleration Cat C Aircraft	1.7 m/s^{-2}	Calculation of required deceleration to achieve speed for first taxiiway exit as indicated in NATS report	
	Landing Deceleration Cat E Aircraft	1.6 m/s^{-2}	Calculation of required deceleration to achieve speed for first taxiiway exit as indicated in NATS report	
	Delay time after touchdown before deceleration	2 s	Jacobs	
	Minimum Runway Speed	75 kph	Jacobs Assumption	
	Minimum Time that aircraft must vacate runway before touchdown	2 mins	Jacobs	
Departure Separation				
	Cat B following Cat B	100 s	Jacobs	
	Cat B following Cat C	120 s	Jacobs	
	Cat B following Cat E	175 s	Jacobs	
	Cat C following Cat B	80 s	Jacobs	
	Cat C following Cat C	100 s	Jacobs	
	Cat C following Cat E	150 s	Jacobs	
	Cat E following Cat B	80 s	Jacobs	
	Cat E following Cat C	80 s	Jacobs	
	Cat E following Cat E	100 s	Jacobs	
Arrival Separation				
	Cat B following Cat B	5.6 km	ICAO Air Traffic Services Planning Manual	Time separations between arriving aircraft are the greater of wake turbulence separation requirements and time required allowing for differing landing speeds and time between previous arrival vacating runway and touchdown.
	Cat B following Cat C	9.3 km	ICAO Air Traffic Services Planning Manual	
	Cat B following Cat E	11.1 km	ICAO Air Traffic Services Planning Manual	
	Cat C following Cat B	5.6 km	ICAO Air Traffic Services Planning Manual	
	Cat C following Cat C	5.6 km	ICAO Air Traffic Services Planning Manual	
	Cat C following Cat E	9.3 km	ICAO Air Traffic Services Planning Manual	
	Cat E following Cat B	5.6 km	ICAO Air Traffic Services Planning Manual	
	Cat E following Cat C	5.6 km	ICAO Air Traffic Services Planning Manual	
	Cat E following Cat E	7.4 km	ICAO Air Traffic Services Planning Manual	
	Approach Speed	160 kts until 4 nm from touchdown, then landing speed	Dublin ATC	
Taxiing				
	Runway Exit Point Cat B	E6 - 55.6 %	Figure A1 Runway 28 Exit Point Usage for Summer 2005, Dublin Airport Runway Capacity Study for Summer 2006, NATS	
	Runway Exit Point Cat B	E5 - 44.4 %		
	Runway Exit Point Cat C	E7 - 3.30%		
	Runway Exit Point Cat C	E6 - 83.7 %		
	Runway Exit Point Cat C	E5 - 13.0 %		
	Runway Exit Point Cat E	E7 - 10.0 %		
	Runway Exit Point Cat E	E6 - 90.0 %		
	Taxiway Speed on Straight Sections	25 kph	Data obtained from London City Airport Modelling Report	
	Taxiway Speed on Curved Sections	20 kph	Data obtained from London City Airport Modelling Report	
	Priority of aircraft at Taxiway intersections	First to arrive at hold has priority	Jacobs Assumption	

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APPENDIX C - TERMS OF REFERENCE

The Terms of Reference for this assignment were set out in the notice published by the Commission for Aviation Regulation on August 1, 2006.

1. To conduct a full capacity analysis of Dublin Airport, Ireland, in accordance with established principles and commonly recognised methods, and in a manner consistent with the requirements of Regulation 95/93, as amended.

2. To review the current scheduling status of Dublin Airport and to make recommendations as to its continued and future appropriateness

3. To determine, in full consultation with all relevant interested parties, if there is any shortfall in capacity at Dublin Airport having regard to current/forecast traffic(taking into account any environmental constraints which may exist) and existing/planned infrastructure.

4. To consider and report on the possibilities of overcoming any assessed deficiencies in capacity through new of modified infrastructure, operational or any other change, and the timeframe envisaged to resolve any such deficiency in capacity, if found.

To prepare and submit a report, together with an executive synopsis in non-technical language, which shall make an explicit recommendation at to whether Dublin Airport shall be designated schedules facilitated or coordinated and in either case from what date and for what period.

APPENDIX D - CRITERIA FOR ASSESSING CAPACITY OF AIRPORT TERMINAL PROCESSES

Check-in Area

The capacity of a check-in area is deemed to be met if the passenger population in that area exceeds the space provided for queuing for more than 20% during peak period. Space per queuing passenger is deemed to be 1.7m2 (IATA LOS C).

	Space per pax does not fall below 1.7m^2 at any time in 3 hour peak
	Space Per pax falls below 1.7m^2 but for less than 20% of the time
	Space Per pax falls below 1.7m^2 for more than 20% of the time

Circulation Areas

In order to assess the space available per person prior to check-in, the total circulation space has been calculated as set out in the table below.

Calculation of Circulation Areas

Pre Check-in Concourse Circulation Space	Area (m^2)
Total Circulation Area Provided (From drawing supplied and calculated by Arup)	2778
Subtract Post Check-in Circulation Space	907
Subtract area between check-in queue area and check-in bank, and area between adjacent check-in aisles as unusable dwell area	546
Subtract redundant area to the left of security area B	7
Subtract redundant area towards security above check-in bank 13	15
Resulting Pre-Check-in circulation space	**1303**

Pre-Check-in

Capacity of the pre check-in circulation area is deemed to be met if the space per passenger in the peak period falls bellow 2.3m2 (IATA LOS C for passengers with carts pre check-in) for more than 20% if the time during the peak. The peak period has been defined as a 5 hour period in the morning.

	Space per pax does not fall below 2.3m^2
	Space Per pax falls below 2.3m^2 for more than 20% of the time during the peak 3 hour
	Space Per pax falls below 2.3m^2 for more than 20% of the time during the peak 3 hours

Post-Check-in

Capacity of the post check-in circulation area is deemed to be met if the space per passenger in the peak period falls bellow 1.8m2 (IATA LOS C for passengers with few carts post check-in) for more than 20% of the 5 hour morning peak period.

	Space per pax does not fall below 2.3m^2
	Space Per pax falls below 1.8m^2 for more than 20% of the time during the peak 3 hour
	Space Per pax falls below 1.8m^2 for more than 20% of the time during the peak 3 hours

Security Area

Given that the SLA of 7 minutes cannot be met within the given space provided it is assumed that overspill in to the concourse can be tolerated as long as the queues do not affect check-in processes. Capacity of security is therefore deemed to be met if the queue exceeds SLA of 7 minutes for more than 20% of the peak 3 hour period.

	All passengers in peak experience less than 7 minutes queue
	7 minute queue is exceeded for less than 20% of peak period
	7 minute queue is exceeded for more than 20% of peak period

Immigration areas

Capacity of Immigration is deemed to be met if 20% or more passenger in the 2 hour peak period experience queue lengths of longer than 10 minutes (DAA service level).

	All passengers in peak experience queue lengths of less than 10 minutes
	Some passengers in the peak but less than 20% experience queue length of more then 10 minutes
	More than 20% of passenger in peak experience a queue length of more than 10 minutes

It should be noted that where the passengers are waiting for more than 10 minutes, further discussion has been provided within the report to assess the severity of the additional delay in order to cope with short term capacity issues.

Baggage Reclaim

Empirical analysis has been used to assess the capacity of the baggage reclaim hall. Comparison has then been made to the typical busy hour rate generated in the model

	Empirical BHR is exceeded
	Empirical BHR is exceeded for less than 15 minutes (based on IATA level of service maximum waiting time guidelines)
	Empirical BHR is exceeded for more than 15 minutes (based on IATA level of service maximum waiting time guidelines)

Arrivals Hall

Capacity in the arrivals hall is based on a defined area for meters/greeters and arrivals passengers of 1191m2. IATA recommended space per person in meeter/greeter halls is 1.7m2.

	Space per pax does not fall below 1.7m^2 at any time in 3 hour peak
	Space Per pax falls below 1.7m^2 but for less than 20% of the time
	Space Per pax falls below 1.7m^2 for more than 20% of the time