Commission for Aviation Regulation

27th July 2004.

Mr Tom Haughey
Director – Market Development and Strategy
Aer Rianta
Dublin Airport
Co. Dublin.

Dear Tom

Thank you for your letter of 21 July 2004 commenting on the WHA analysis which was recently published by the Commission on its website. As requested, we have similarly published your letter and attached comments.

We note that these are initial comments and we look forward to receiving your substantive response in due course.

Yours sincerely

William Prasifka
Commissioner

3rd Floor, Alexandra House, Earlsfort Terrace, Dublin 2 Tel: +353 1 6611700 General Fax: +353 1 6611269 Travel Trade Fax: +353 1 661209
Website: www.aviationreg.ie Email: info@aviationreg.ie

Head Office: Dublin Airport, Ireland.
Telephone: 353-1-8141111, Fax: 353-1-8445386
Website Address: http: // www.aer-rianta.com

Príomhoifig, Aerfort Átha Cliath, Éire.
Teileafón: 353-1-8141111, Faics: 353-1-8445386

AerRianta

Mr. Bill Prasifka,
Commissioner,
Commission for Aviation Regulation,
3rd Floor,
Alexandra House,
Earlsfort Terrace,
Dublin 2.

21st July 2004

Dear Bill,

I am writing in relation to the capacity analyses that William Hynes and Associates (WHA) has undertaken for the Commission as part of a review of the Baseline Capacity Study produced by Aer Rianta. My comments may be viewed as an initial response, our consultants are currently working on a more detailed reply which will follow later.

There are a number of aspects of the WHA reports that give us cause for deep concern. The overall thrust of both reports, which are very short, is to cast doubt on the detailed and comprehensive Baseline Report, however, when the WHA comments are reviewed in detail, many of the comments are based either on unsubstantiated assumptions or 'beliefs' that alternative approaches are better, or are comments on relatively immaterial aspects of the methodology. Indeed we refute many of the comments made on the basis that WHA does not appear to appreciate that many facilities are currently operating below agreed target service levels at the airport. (See attached for some initial comments on certain points made in the WHA analyses).

In overall terms, Aer Rianta takes issue with each of the main points raised by WHA, in terms of the robustness of the methodology, internal consistency, and understanding of the interplay of service levels with theoretical capacity calculations. Many of the subsidiary points are immaterial to the overall analysis.

In this context, we are deeply concerned that an analysis which has so little real depth and, we would contend, merit, may be viewed by those less experienced in the design of airports, as somehow undermining the approach taken in our Masterplanning processes.

Such an outcome would have serious consequences for Aer Rianta as airport managers, but also for the Commission in terms of the credibility and robustness of the review that it has undertaken.

We would be obliged if the Commission would publish this initial response to the WHA analyses on its website as part of the section entitled "Aer Rianta's Response to Appraisal of Baseline Study".

Yours sincerely,

Tom Haughey
Director- Market Development and Strategy

Some Initial Comments on Elements of the WHA Analyses

- **October report - Page 3, paragraphs 1 & 2**
  WHA states that the 0.0002 conversion ratio used in the Baseline report is *'now agreed to be inappropriate'* - although it is unclear who has agreed this - and suggests the use of recent historical ratios instead. On page 4 it is stated that proper use of conversion ratios gives better than approximate results.

  This proposal fails to take account of the fact that the use of existing ratios can, and in this case, would, mean that existing congestion problems are perpetuated if the existing standard becomes the norm for the future. It also conflicts with later comments (page 14) that conversion ratios for the future '*may be adjusted or altered if required to represent the ratios that are forecast to apply when the terminal areas and processes are assessed to be at capacity*'.

  In passing, it is also worth noting that Aer Rianta's views on this specific issue concur more with those of another of the Commission's consultants, ASA, than with WHA. ASA correctly points out that ultimately the more critical element will be the hourly flow data used.

- There are a number of inaccuracies in the WHA analyses, such as on **page 4, paragraph 2 of the December report**, where WHA states that the current departures concourse can handle 97% of the 2002 departing passengers based on the hourly capacity figure. This however is incorrect and based on an erroneous calculation, in which the design capacity of the detuned area (2,417) is divided by the busy hour rate (2,500). The correct approach would be to calculate for the given year, the percentage of passengers processed in hours for which the throughput was less than 2417 passengers per hour.

  Furthermore, WHA mistakenly attributes the inconsistency observed between the annual and hourly calculations to the conversion ratios, rather than the inappropriate hourly calculation. This analysis cannot therefore be used to support and reinforce his views about the conversion ratio.

- **December report, page 5 paragraph 4**
  WHA states that the fall in conversion ratios at DAP highlights that *'increasing handling capacity can be achieved without any additional capital expenditure on infrastructure'*. This suggests that WHA does not appreciate that there has, in fact, been capital expenditure in recent years to provide additional capacity in some areas at the airport. It also suggests that WHA is unaware that overall service levels are now well below the target levels of Aer Rianta, and we believe, those of the Commission.

- **October report, page 6 paragraph 1**
  WHA queries the use of the 85 second average check-in desk processing time, suggesting that 120 seconds would be more appropriate. Given that the 85 second figure is the output of an airport survey, it seems strange that in a report which stresses the importance of robust methodology, WHA should advocate the substitution of a robustly observed number with a 'guesstimate'.

  Similarly, the 30 minute dwell time is *'considered excessive'* but no back-up is provided to suggest why this is inappropriate or why the alternative time proposed is more robust.

- **October report, page 10 paragraph 4**
  WHA discusses the fact that the use of the 0.0002 conversion ratio gives different results for IATA and BAA methodologies, and appears to believe that this undermines the ratio value used, and supports the use of more 'realistic' conversion ratios. However, whatever ratio was applied, these very different methodologies would result in differing annual capacities, as it is applied as a multiplier to different typical peak hourly or daily flow rate data from the two approaches. Hence the observation of differing annual capacities has absolutely no implications at all for the specific conversion ratio used.

- **December report - page 3, paragraph 4**
  WHA refers to a portion of an Ashford-Wright quotation and inaccurately portrays this as evidence that Aer Rianta believes that facility size is determined by the absolute peak hour flow. If the whole of the Ashford-Wright quotation is reviewed, it is clear that the reference points to the fact that the peak hour is preferential to annual passenger figures when carrying out capacity analysis. This is the methodology that has been applied by Aer Rianta. This paragraph of the WHA report is therefore inappropriate.

Document Lead Sheet

Client Project No:

PM Project No: **010422**

Document No: **010422-24-RP-0005**

File No: **010422.24.006**

AER RIANTA

DUBLIN AIRPORT MASTERPLAN

RESPONSE TO COMMISSION FOR AVIATION REGULATION QUERIES

ISSUE	DATE	ORIG	AUTH CHK	REVIEW	APPRVD PM	APPRVD CLIENT	DESCRIPTION
A	14/11/03						FOR INFORMATION

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1. INTRODUCTION

Aer Rianta provided the Commission for Aviation Regulation with a copy of the Dublin Airport Baseline Capacity Study (Issue E) on 24 September 2003. Following the submission, it was agreed that a workshop be held with the Commission to facilitate an in depth understanding of the methodologies used and approaches adopted in generating the study outputs. This workshop took place on 9 October 2003. In the course of that meeting, the Commission raised a number of queries. These principally related to three issues:

- Conversion ratios of hourly to annual capacities
- De-tuning (and assumptions re overspill between circulation and queuing space)
- Mezzanine contribution to capacity

In addressing these queries, Aer Rianta took the opportunity to revisit some of the theoretical and practical elements underpinning the baseline study methodology. As part of this process, the assumptions and conditions, which had been based on data from the period April 2002 to April 2003 were revisited and reviewed in the light of new information which had become available for the period from May 2003-October 2003.

The remainder of this document is structured as follows:

Section 2 addresses the conversion ratio issue and considers what the appropriate conversion ratio should be, bearing in mind that the ratio is merely a factor used to represent a relationship between hourly rates and annual capacities and that the busy hour rate is the basis of design and key capacity declarations.

Section 3 reflects on the validity of the approach to "Detuning". The word detuning was one introduced by the Masterplanning team to describe a practice that is generally used but is variously described by other planners. In this section, the rationale for using detuning is reviewed and international approaches to taking account of localised conditions examined. The company's experts undertook a review of detuned areas following the queries raised by the Commission and the outcome of this process is also presented. Finally, the Commission's query re the assumption that there is no spill over between circulating space and queuing space is addressed in detail.

Section 4 considers the impact of the Mezzanine on the CADCL [*]. It reviews the planning guidelines and practice at other airports in respect of such areas and provides an update on the dwell times in the CADCL, an issue that was also raised by the Commission.

[*] CADCL is a term coined by the Commission to describe the space previously known as the Departures Concourse Landside. CADCL is an acronym for Calculated Area Departures Concourse Landside.

Section 5 compares the ideal area required to support the 2003 Busy Hour population with the actual detuned area available in the CADCL.

Section 6 outlines the primary conclusions of this response to the Commission queries in relation to the Baseline study.

2. APPROPRIATE CONVERSION RATIO FOR CONVERTING BUSY HOUR FLOWS TO ANNUAL CAPACITY

Commission comments:

- Consultant team assumed common ratio for converting hourly departures and arrivals figures to annual capacity.
- Assumed ratio is not based on actual Dublin Airport figures.
- Assumed ratio is not specific to Dublin Airport.

It is proposed by the Commission that a conversion ratio in the range .000164 to 0.000170 is the appropriate ratio to use to convert Busy Hour Rates in Departures areas to Annual Declared Capacities and a conversion ratio in the range .000144 to 0.000149 is the appropriate ratio to use to convert Busy Hour Rates in Arrivals areas to Annual Declared Capacities.

2.1 Preferred Unit for Evaluation of Capacity

The PM team were tasked with analysing the historic performance of the existing terminal and piers in terms of capacity, functionality and service level capability with reference to Level of Service B as defined by IATA.

After analysing the terminal and piers using IATA and BAA guidelines, the team deemed that the BAA Group Planning guidelines were the preferred basis on which to carry out this analysis. In the introduction to their guidelines, BAA states that their guidelines can be used:

- *As a check on the assessment of the capacity of existing facilities and the identification of constraints on the use of those facilities*

BAA also states that *in airports where passenger throughput levels are high enough for the effects of individual flights to become largely absorbed in overall volume/flow characteristics* (such as Dublin), *hourly passenger flows are the appropriate basis for planning*. Reference BAA Planning Guidelines, Calculations, Introduction – March 1997.

The BAA defines Busy Hour Flow as that hourly rate above which 5% of annual traffic in a given terminal or airport is handled at or below a declared level of service.

The use of some form of an hourly rate or daily rate for evaluating capacity potential is common practice, rather than using a derived figure. The following list outlines the approaches used by a number of agencies:

Table 1 – Commonly Used Ratios

Agency	Measure
ICAO	30th hour
BAA, UK	5% Busy Hour 30th value
Arbeitsgemeinschaft Deutscher Verkehrsflughaefen, Germany	30th Busy Hour
Ministère de Transports, France	30th and 40th Busy Hours
Zurich Airport, Switzerland	10th Day, 30th Hour

The PM team used the BAA definition of the Busy Hour Rate which is regarded as providing a lower Level of Service (B/C) than that specified as the preferred methodology for all capacity evaluation of individual spaces and processors in the Baseline report.

2.2 Declaration of Capacity

Ashford & Wright state that *although knowledge of annual passenger movements is important for the estimation of potential revenues, the demand that is manifested in the peak hour determines facility size*. Reference "Airport Engineering", Chapter 8.9, Space Requirement for Individual Facilities.

One of the main reasons that terminal and pier capacity is often declared in general airport parlance in terms of annual passenger traffic figures is that this is a useful tool in analysing historic revenues and estimating potential revenues.

Declared annual capacity that has been derived on the basis of the application of a conversion factor from hourly capacities can at best be deemed "approximate" or "indicative". It has not been derived on a first principle basis and is always subject to an interpretation and judgement on the appropriateness of the conversion ratio.

Conversely, declared hourly capacity that has been converted from annual figures has the same problems.

However, capacity declared on the basis of Busy Hour Rates defines real capacity for individual processors and identifies the shortfall or excess in terms of the actual measured Busy Hour Flow.

By reference to the Baseline Report, if we consider the CADCL:

The detuned circulation area was identified at 2,495 sq m in 2002. (Queries raised with regard to the detuning process are dealt with later in this report).

This circulation area can support an equivalent Busy Hour population of 2,417 passengers per hour as calculated using the BAA formula with the assumptions* used in the Baseline in regard to mezzanine and dwell time.

The actual Busy Hour flow was measured at 2,500 passengers per hour in 2002.

Therefore, one can state that the population in the area was congested during the Busy Hours.

Secondly, if there was overspill from other processors, this overspill would add to the congestion in the CADCL. In other words, it would reduce the equivalent Busy Hour Flow capacity of the CADCL in proportion to the additional number of overspill passengers.

Thirdly, by inserting the measured Busy Hour Flow into the BAA formula and adding the recommended allowance for seating, one can reverse calculate the ideal required area that would be necessary to support 2002's Busy Hour Rate and identify the area shortfall (without regard to overspill from other processors) as follows:

Actual Busy Hour Rate = 2,500 passengers per hour in 2002

Required area to support BHR of 2,500 pax/hr = 2,713 sq m

Area Shortfall = 2,713 - 2,495 = 218 sq m or the area was undersized by 8.74%.

In summary, the BHR approach (based on the assumptions in the Baseline report) shows:

- that the population in the CADCL experienced congestion during the Busy Hours
- that the area was undersized by at least 8.74% in 2002
- that the capacity potential would be further eroded were overspill from adjoining areas to be included
- that the capacity potential would be further eroded were an appropriate (BAA Standard) space for seating passengers to be included

* Whilst there are some seats dispersed across the CADCL, the Baseline assumption set does not include a space allowance for designated seating (10% as per BAA standard) as this was an analysis of existing conditions and the seats in question are moveable.

2.3 Appropriate Conversion Ratio to be used

The conversion ratios proposed by the Commission reflect the actual conversion ratios for years 2001 and 2000 respectively.

The following table and Figure 1 show the actual conversion ratios for years 1991 to 2002 for Departures. In 1991, the value was 0.00021. In 2002, the value was 0.000166. The graph shows a decreasing trend with a +/-5% deviation.

Table 2 – History of Conversion Ratios

Year	Total Annual Passengers MPPA	Busy Hour Rate Departures Pax Per Hour	Conversion Ratio
1991	5,278,534	1,107	0.000210
1992	5,808,024	1,189	0.000205
1993	5,938,126	1,367	0.000230
1994	6,980,983	1,454	0.000208
1995	8,024,894	1,610	0.000201
1996	9,091,296,	1,767	0.000194
1997	10,333,202	1,849	0.000179
1998	11,641,100	2,045	0.000176
1999	12,802,031	2,232	0.000174
2000	13,843,528	2,353	0.000170
2001	14,333,555	2,346	0.000164
2002	15,084,667	2,500	0.000166

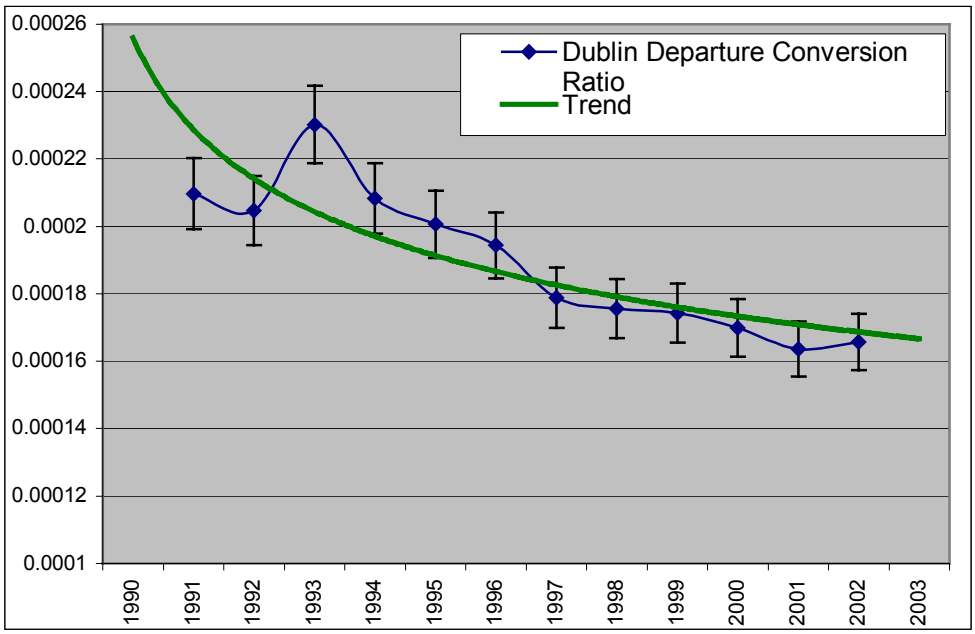

Figure 1 - Conversion Ratios 1990 - 2002

It is worth noting that there are anomalies in the early and final years of this trend, the latter most likely a reflection of the unusual traffic profile associated with 2001 in the aftermath of the September 11th terrorist attacks. Anomalies of this nature, step changes and other effects underpin the risks associated with using conversion ratios per se in historic analyses and future long term planning of facilities.

As traffic in an airport increases, it becomes increasingly congested if no extra capacity becomes available. As peak hours become more congested and capacity limits are reached, no further traffic can be handled during these periods. This will encourage traffic to move into hours that were previously off-peak. As this pattern continues, traffic becomes more evenly distributed, and the share of the traffic in the top hours will decline. Thus the ratio of traffic at the 5% busy hour level (or the 30th busy hour) to the annual total traffic declines.

The development of such ratios follows a hyperbolic curve over time. (See Figure 2). With increasing congestion, the ratio will get closer and closer to some limiting value on this curve. This graph can be represented as a function of two main elements. A “demand” component reflects the willingness or ability of carriers to move to off-peak times and a “supply” element is influenced by local airport configuration issues (eg, night-time curfew, runway congestion etc). If capacity usage is optimised, the graph tends towards lower values. In some cases, if there are constraints to efficient utilisation or inadequate market development, an airport may never reach the ratio levels achieved at larger more developed airports.

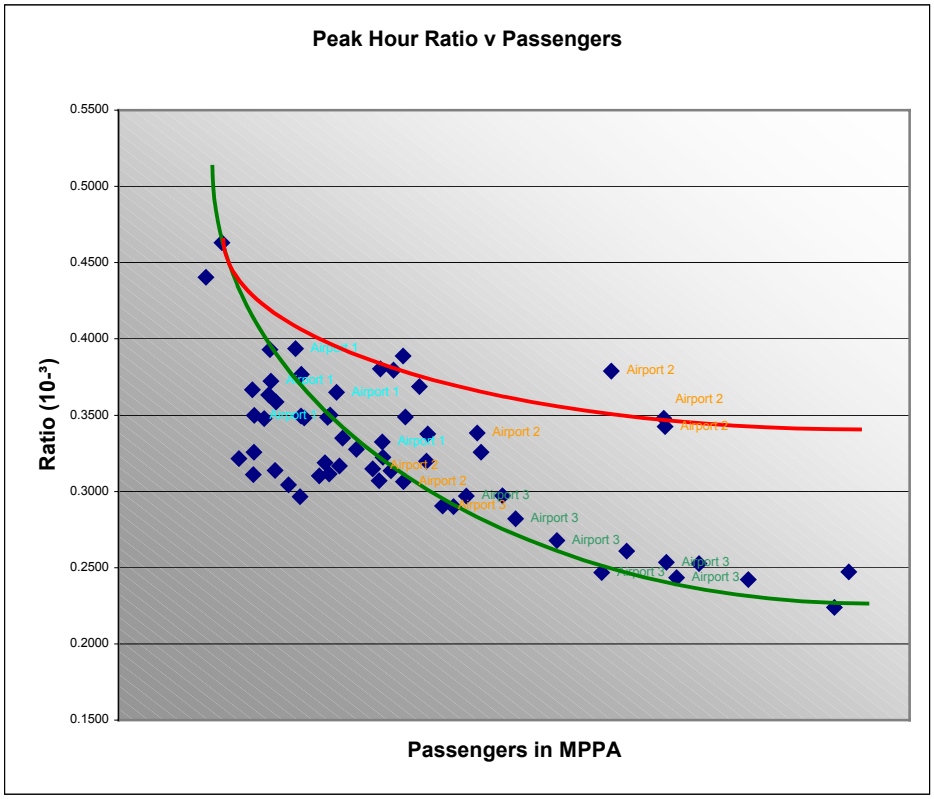

Figure 2 - Peak Hour Ratio vs Annual Passengers for Various Airports

(Actual data from various airports, names withheld due confidentiality)

Moving from an efficient but congested situation to an un-congested situation (i.e. when new system capacity comes on-line) will mean that traffic growth is unconstrained for a period. Additional traffic will be expected to concentrate during the most "attractive" hours from a market perspective i.e. the peak hours. Thus the ratio increases again for a time, until increasing congestion begins to encourage traffic back into off-peak periods. This is clearly illustrated by the progression of Airport 2 in Figure 2 as additional capacity comes on stream. Other similar trends obtain for other airports adding capacity. Thus the relatively low value of peak to annual ratios is a characteristic of congested airports and implies that there is already extensive capacity utilisation in the off-peak.

This can be further illustrated by considering how as traffic volumes increase, service levels degrade and congestion occurs.

It is possible to record and calculate the Levels of Service. If we consider the whole of the Departures floor including the Check-In areas we know that in 2002, the overall Level of Service was sub-standard. This is confirmed in Section 5 in discussions relating to areas required to support differing BHRs. Some specific examples of sub-standards are as follows:

- The circulation space between the Check-In queues was 2.0M instead of the BAA standard of 5.0M. *"Access routes are required behind check-in queues. These should be at least 5 metres deep where queues back on …..*

  (source: BAA Planning Guidelines, Section 4.2 Queuing Area)

- The Level of Service within the Queues was equivalent to IATA LOS "D"

- There are extensive criss-cross flows of departing passengers as depicted in Figure 6-17 in the Baseline report.

- The BAA service standard states that there should be at least enough seats in the departures concourse for a minimum of 10% of the total occupancy. Very recent advice from the BAA would suggest that a minimum level of seating required is in fact 10% of the Busy Hour flow which of course is significantly greater than the total occupancy requirement.

  "*Seats (should be) provided for 10 percent of people on the concourse where people do not have to wait, ie passengers can move airside at any time….. The number of seats required may be calculated from the total occupancy, since seats are required for 10 percent (or 50 percent) of people present".*

  (source: BAA Planning Guidelines, Section 2 Service Standards)

  "*BAA allows 1.5 to 1.6 seats for every passenger who wants seating to allow for people putting their bags on seats etc. 10% of the Busy Hour flows is the minimum allocation of seats for a given area"*

  (source: BAA Planning Department 2003, Contact available on request)

- In reference to the time period associated with the specific range of conversion ratios suggested by the Commission, there is clear evidence that levels of service were considerably worse during that period than obtained in 2002. This is evidenced by the following references to unacceptable levels of service in the duty airport managers' reports.

  - *Additional temporary check-in facilities had to be provided in the multi-storey carpark atrium.*
  - *Check-in queues extended through the emergency doors out onto the footpath.*
  - *Escorts were restricted from entry into the terminal and only passengers were allowed enter the terminal.*
  - *Airport police assisted in forming corridors to facilitate passenger circulation.*
  - *Announcements requesting passengers to proceed to piers were discontinued due to congestion in piers.*
  - *Passengers were unable to find start of check-in queues due to levels of congestion.*

- *Trolley staff were unable to remove trolleys from check-in areas due to levels of congestion.*

On this basis, we feel it is inappropriate to rely on a conversion ratio that reflects these conditions. The use of the range of conversion ratios proposed by the Commission would perpetuate the sub-standard Levels of Service that pertained in those years.

There is normally little practical difference between arriving and departing ratios when Levels of Service are acceptable overall. This can be seen by comparing the historical trends of arriving and departing ratios especially during the periods when Levels of Service were known to be acceptable at Dublin Airport. Thus the same conversion ratio was used for both.

3. DETUNING

Commission comments:

- Nature of exercise renders application of industry wide metrics meaningless
- CAR unable to locate authority for such an exercise in academic (BAA handbook, Fruin) or industry sources (internet search)
- Industry standards do not assume ALL space is fully maximised. Rather, bottlenecks and congestion taken into account in lower LOS

3.1 Industry Wide Metrics and the Concept of Unusable Space

The focus of most approaches to capacity analysis for airport terminal design assumes that new facilities are being provided and the calculation methodologies tend to be structured to facilitate and support this design process. Even with the design of new facilities it is acknowledged that space planning must take into account the unusable spaces generated both by the design process, local conditions and operational constraints. While every effort is made to reduce these spaces, most methodologies suggest various ways to take these into account. It therefore in no way negates the value of these various industry metrics to adopt certain assumptions to take unusable space into account.

When attempting to analyse existing facilities, with the built in constraints, both physical and operational, which have developed over the lifetime of the facility, it is reasonable to consider how these constraints are to be dealt with and state the assumptions clearly.

Aer Rianta's briefing requirement to the consultant team in this regard, in relation to existing facilities, stated the following requirement:

"*Assessment of the characteristics, capacity and operational efficiency/constraints of the existing terminal facility (14 Bays) and piers and preparation of a strategic, cost effective plan to correct shortcomings and prepare the facility for the expansion envisaged in line with the business needs of the company*."

In an effort to avoid overstating existing perceived problems, some of which could possibly be addressed by management intervention, the team decided not to incorporate the inefficient use of space caused by:

- building geometry
- queuing overspill
- cross flows
- edge effects
- resource management.

The concentration would be on identifying spaces within the terminal, which could reasonably be removed by virtue of being unusable and being quantifiable (rather than being based on subjective qualitative judgement). In addition, they tried to account for unusable space by the removal of certain areas where people are likely to gather and congest for various reasons. This approach is consistent with the concept of useable or effective space as employed in architectural planning terms and standard methods of measurement favoured by surveyors.

The team coined the phrase “de-tuning” to account for the removal of these dead, or unusable spaces to arrive at effective space, which is required by all capacity calculation methodologies and dynamic simulation programmes.

3.2 Citations in Support of Detuning

The use of a term that was coined by the team to describe a process that is variously described by other planning experts may have inadvertently caused a measure of confusion. The following selection of citations from leading experts will help to establish that the process is one generally adopted by transport planners.

Odoni and deNeufville

Odoni and deNeufville state that a problem with standards [in use] is “*that they assume that the space provided for an activity will be useful, no matter how or where it is provided. Implicit in the formula is the idea that the occupants of a space somehow disperse to make use of an entire area. People are not gasses, however, and unfortunately no such physical law exists for them. The fact is that people tend to congregate in specific places either because of a focus of attention, such as an information booth or an open check-in counter; or because they perceive such points in the terminal to be convenient (i.e. the mouth of the baggage chute or the check-in counters immediately in front of the entrance of the of the terminal). Thus, it easily and quite predictably happens that a terminal with enough space by the LOS criteria, in fact has a number of significant problem areas, which make the building feel, and thus be, inadequate*.”

(source: Passenger Terminal Design Paper, copyright 1992 Pergamon Press),

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Discusses de-tuning in terms of “*effective design width which is the total width less obstacles (e.g., telephones, wastebaskets, benches, protruding displays, video displays, passenger queue areas extending into corridors, etc*.” (source FAA Advisory Circular : 150/5360)

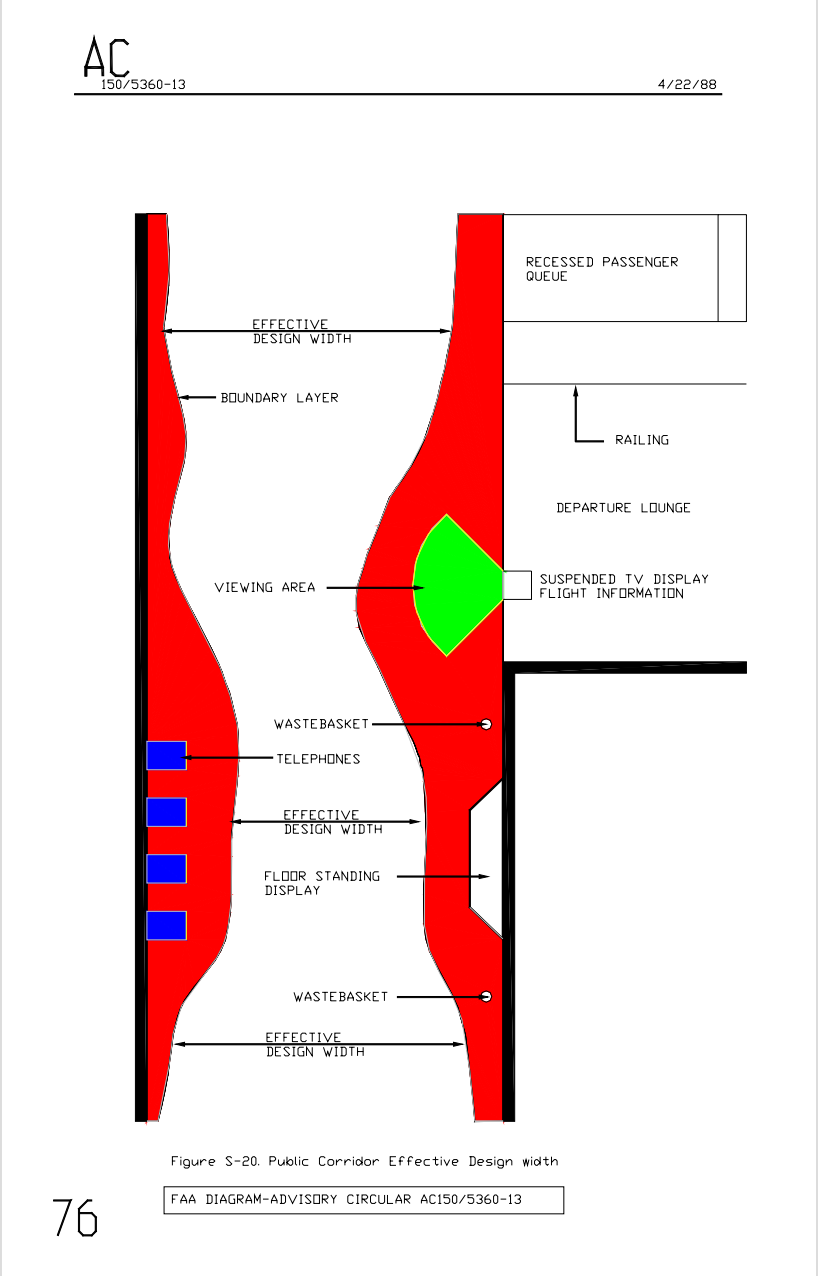


Figure 3 - Effective "Detuned" Areas

IATA

IATA says in its Airport Development Reference Manual; "*As the 'perfect' design for a passenger airport…has not been designed, it will be necessary to adapt the guidelines of this manual to local conditions." "Not all formulae will be applicable to all airports. The formulae do not take account of the level of service criteria and they assume constant throughput rates - a situation rarely observed in practice. Care must be taken to ensure all local factors are included".*

(source: IATA Airport Development Reference Manual, 8th Edition April 1995)

BAA

"Planning Guideline Calculations can be used……. as a check on the assessment of the capacity of existing facilities and the identification of constraints on the use of those facilities. This (third) use must be approached with caution as spurious results can be obtained if the characteristics of the particular facility being assessed are not properly taken into account".

"*The capacity of the landside concourse area is dependent upon layout. The calculation assumes people are evenly distributed across areas but in practice some areas may become very congested whilst others are under-utilised*."

(source: BAA Group Planning Guidelines)

AIA at ATHENS INTERNATIONAL AIRPORT

"*Estimate circulation space as it affects the terminal capacity by defining "grey" areas, such as: along walls, corners of walls, around large objects (such as columns, machines, unique systems) and other areas thought to be rational for exclusion. The total space occupied from the areas is then deducted from the processing element, and the net value is used in their calculations*."

(source: Landside Planning Department, Höchtief Athens International Airport – contact available upon request)

FRAPORT at FRANKFURT INTERNATIONAL AIRPORT

"*After geometrical assessment of processing and circulation areas, any areas which would not be used by passengers for processing or circulation are taken out (e.g. "dead" corners), thereby reducing the original determined areas*."

(source: Head of Traffic and Retail Capacity Management, Fraport AG – contact available upon request)

Dr. Richard de Neufville, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Discusses de-tuning in terms of "concentration phenomenon" – meaning that "*the capacity of large facilities cannot be found simply by applying standards to whole areas and that people do not spread out evenly but rather cluster, thereby creating bottlenecks. It is these bottlenecks that should define capacity*."

(source: MIT Airport Systems Planning & Design course notes, "Defining Capacity of Airport Buildings")

J. FRUIN

"…*personal space preferences are of interest to the designer because inter-person spacing of pedestrians affects the practical and comfortable environmental capacity of such facilities as lobbies*…"

(source: Pedestrian Planning and Design. 2nd. Ed.)

3.3 Industry Standard Assumptions

The Commission has stated that industry standards do not assume that all space is fully maximised. However it is clear from the above citations that planning experts only factor in effective space, ie the space available when unusable areas have been removed. Non-useable space cannot be used by definition, regardless of which industry standard is used.

The particular BAA industry metric of 2.15 m^2 as used in the calculation of capacity for the CADCL includes necessary allowance to ensure passengers can move and circulate in the Busy Hour. The only other "allowance" the metric includes is an allowance for miscellaneous moveable small items such as waste bins, planters, tables and occasional displays etc. None of these moveable items were included in the areas identified for removal to arrive at the effective circulation area post detuning.

It is worth noting that the BAA metric of 2.15 m^2 is just at the mid point between the IATA metric of 2.3 m^2 (LOS B) and 1.9 m^2 (LOS C).

The Commission also suggests that bottlenecks and congestion may be taken into account in lower Level of Service. Appraising capacity on the basis of the BAA methodology already presumes that 5% of passengers were exposed to Levels of Service below B/C.

To appraise capacity on the basis of a lower level of service than B/C would mean that even more passengers would be exposed to increased congestion and unacceptable comfort conditions. It is the team's opinion that an appraisal of capacity at these levels is inappropriate.

3.4 Review of Detuning Exercise

As part of the baseline analysis in 2002 the gross circulation areas in the Departures and Arrivals Concourses, the Airside Departures Concourse and Baggage Reclaim Hall were measured. By examination and observation and consultation with Airport Management, areas were identified for removal to arrive at the effective area to be used in the capacity assessment. The results are tabulated as follows:

Table 3 - Effective Circulation Areas Post Detuning Baseline

2002 Conditions	Circulation Areas Pre detuning (m^2)	Effective Circulation Areas Post detuning (m^2)
CADCL	3657	2495
Departures Concourse Airside	6901	5688
Baggage Reclaim Hall	3510	2645
Arrivals Concourse Landside	2964	2788

These areas were re-measured in October 2003 subsequent to the Commission's query in relation to "detuning".

The detuned areas referred to are shown in the following drawings followed by selected photographs to illustrate some of the dead or unusable spaces identified in detail in the drawings. All photographs are catalogued in Appendix A. Photographs not included in this report are available on request. (All photographs were not included to minimise file size).

Key to Drawings:

Pink Cross Hatched Areas denote unusable areas that have been extracted to arrive at the effective circulation area post detuning.

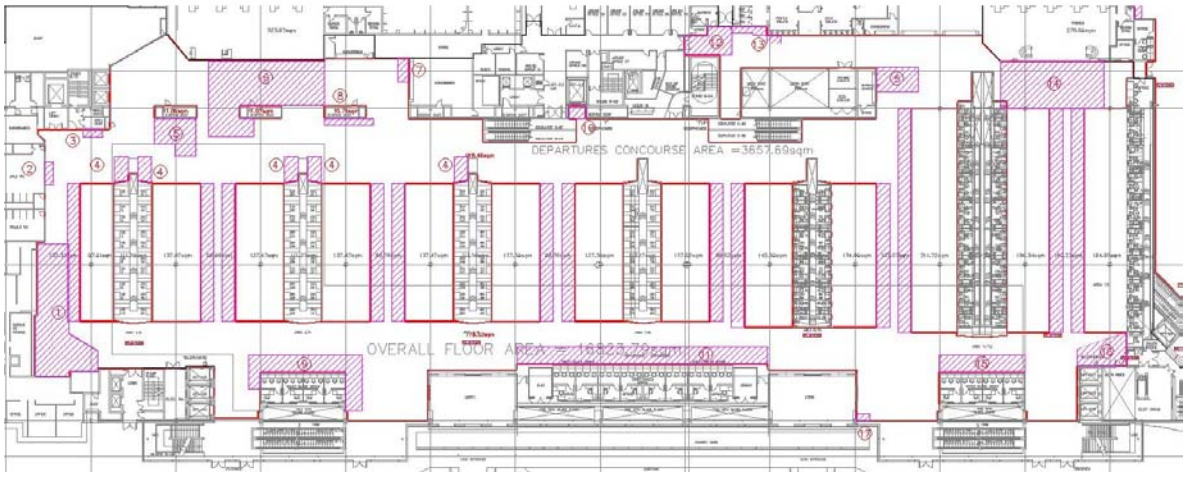


Figure 4 - CADCL Resurvey of unusable areas October 2003

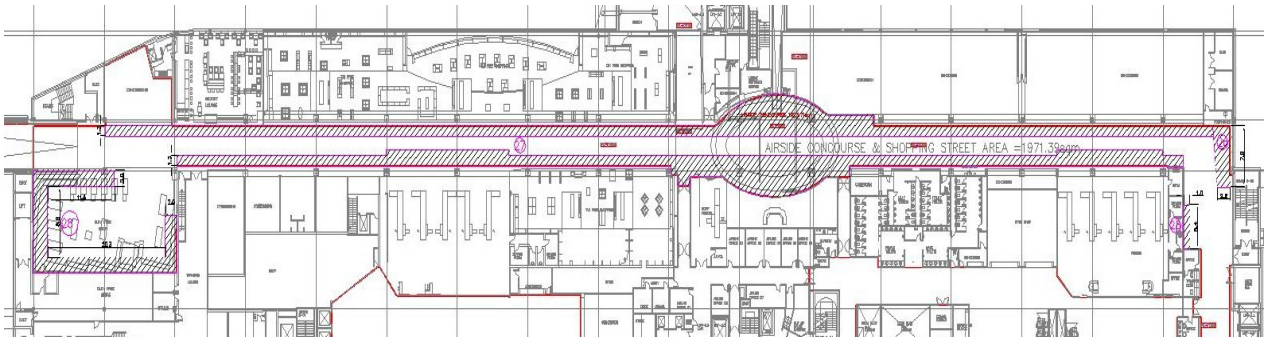


Figure 5 – Departures Concourse Airside Resurvey of unusable areas October 2003

Note: The piers were not resurveyed as part of the October 2003 exercise.

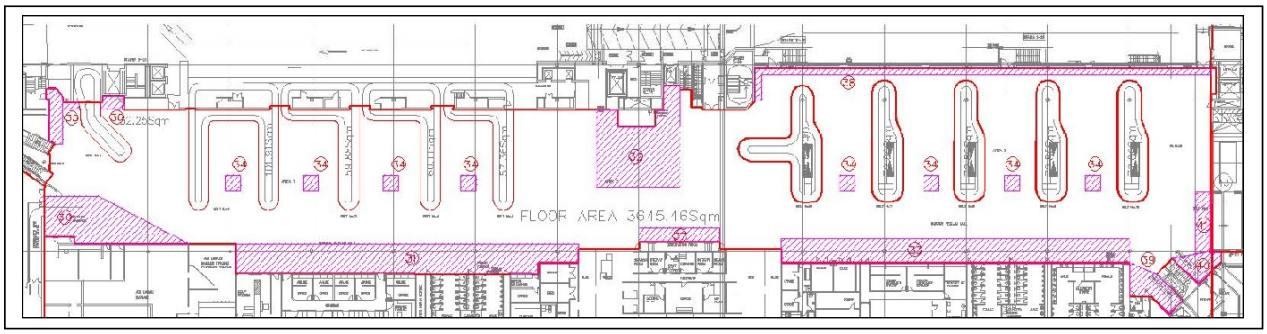


Figure 6 - Baggage Reclaim Hall resurvey of unusable areas October 2003

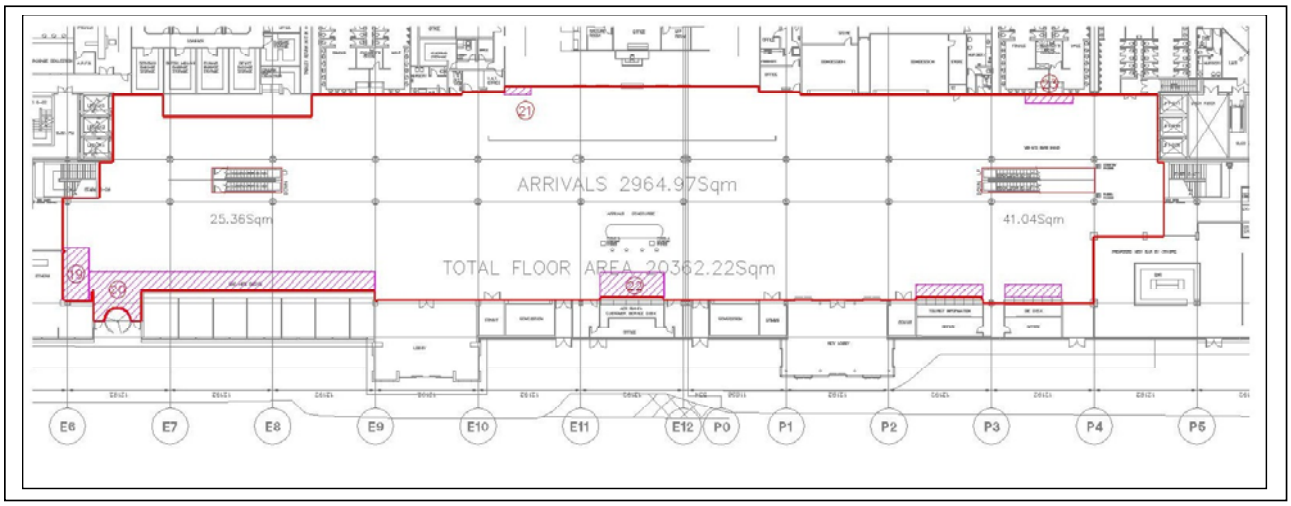
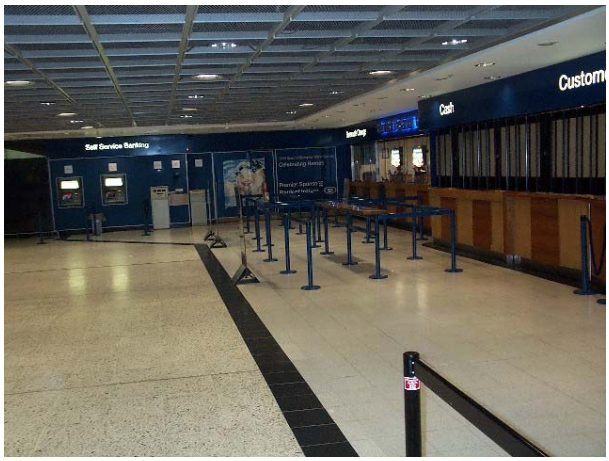


Figure 7 - Arrivals Concourse Landside resurvey of unusable areas October 2003



1A BOI Queuing Area

14 Security Queue Area – 6 bay Extension

9 Queue Area for Aer Lingus Ticket Desk

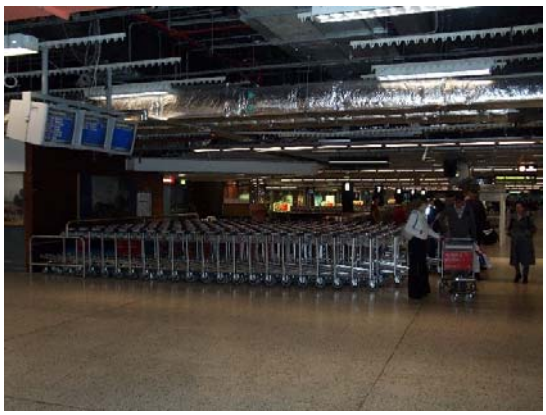
Selection of Photos of Unusable Areas in CADCL

18B Strip both sides along “street” due to shops

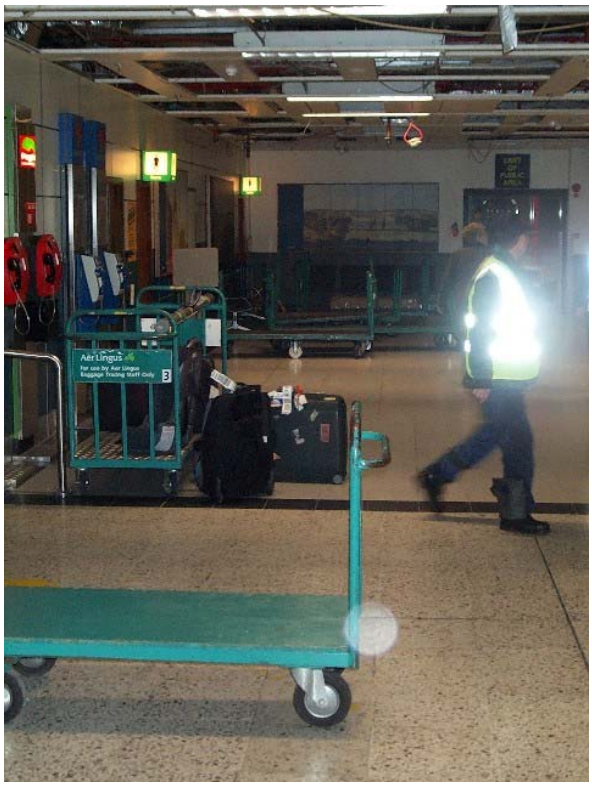
18A Strip both sides along “street” due to shops

18C Strip both sides along “street” due to shops

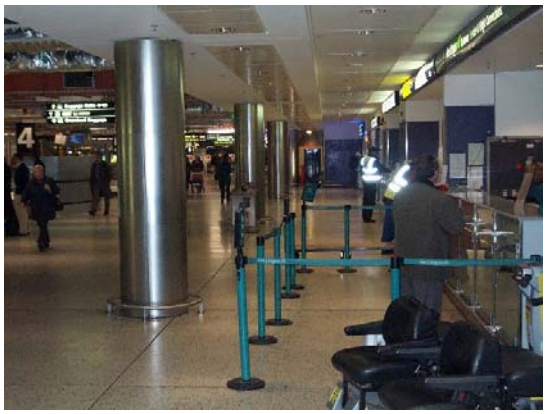
Selection of Photos of Unusable Areas in Departures Concourse Airside



25 Large Trolley Storage Area



23 Storage Area for Baggage Handling Equipment (8 Bay)



24 Support Desks (8 Bay)

Selection of Photos of Unusable Areas in Baggage Reclaim Hall

21 Queue Area for Info Desk

20 Revolving Doors & queue area along car hire desks

19 Entrance to Bar

Selection of Photos of Unusable Areas in Arrivals Concourse Landside

Despite an exhaustive re-examination of the unusable areas, it can be seen from Table 4 that the Effective Circulation Areas Post Detuning in October 2003 are less than or have remained unchanged from the time of the Baseline Report thereby validating the approach adopted in the Baseline Report.

Table 4 – Comparison – Baseline Detuned vs October 2003 Detuned Area

Effective Circulation Areas Post Detuning m^2	Baseline Surveyed Areas m^2	October 2003 Surveyed Areas m^2	Difference m^2
CADCL	2495	2357	- 138
Departures Concourse Airside	5688	5621	- 67
Baggage Reclaim Hall	2645	2645	0
Arrivals Concourse Landside	2788	2788	0

3.5 Overspill into Queuing Space

Commission Comments

Detuning Exercise assumes no spill over between circulating space and queuing space.

We know queuing space is available

- Baseline assumes proportion of check-in desks open at peak times is 67%
- No physical separation
- CUTE allows for operational flexibility

3.5.1 Availability of Queuing Space

The Level of Service for the Check-In Queuing space was determined to be inadequate in the Baseline Report and equivalent to Level of Service “D” as defined by IATA.

Appendix B details a re-appraisal of the Check-In Queuing space using the BAA methodology at a Level of Service equivalent to a mid-range between “B” and “C”.

The calculation shows that even with 67% of desks occupied, the profile of arriving passengers during the Busy Hour in 2002 causes very significant overspill into the CADCL. Under Baseline conditions, the detuned area available for circulating passengers during the busy hour would be eroded by 583sqm from 2495sqm to 1,912 sq m, which is equivalent to a 23% erosion of circulation space. This would translate into a proportionate reduction in the Busy Hour population that the reduced space could support at an acceptable Level of Service.

At 2003 conditions, the detuned CADCL space would be eroded by 656sqm from 2357sqm to 1701 sq m or 28%, again of course with a proportionate reduction in the Busy Hour population that the reduced area could support.

The following drawing shows the dramatic effect this overspill would have on the already detuned spaces. It highlights an equivalent area to the overspill effect in green.

Key to Drawing:

Green Cross Hatched Area	Denotes the equivalent areas within the CADCL that would be required to handle the overspill from the congested check-in queues.
Pink Cross Hatched Area	Denotes unusable areas that have been extracted to arrive at the effective circulation area post detuning.

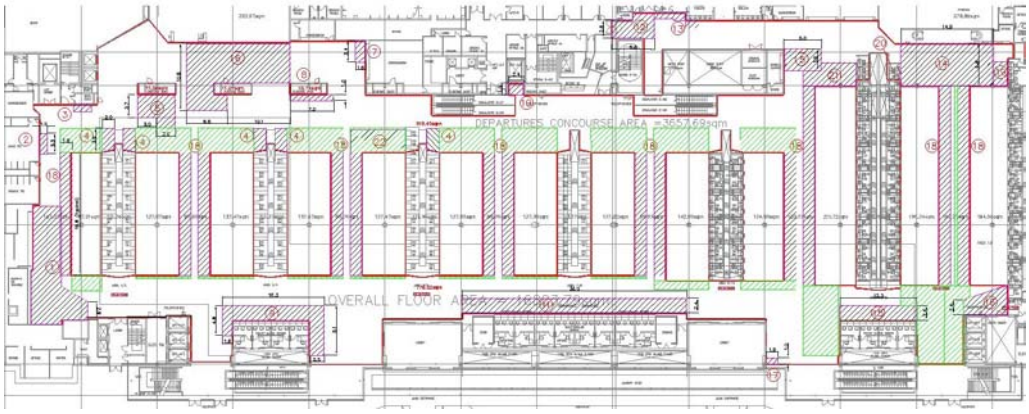


Figure 8 - Equivalent Overspill Areas from Check-In Queues

3.5.2 Operational Flexibility

There are a number of operational constraints preventing a more flexible use of the queuing space associated with empty check-in desks. These are listed as follows:

a) Limited queuing space in Area 1, due to its close proximity to the Bank of Ireland / Bureau de Change corral area and associated ATMs and the location of the toilets. Queuing space is reduced between Monday and Friday and by the bureau at weekends.

b) The presence of a snake queuing system in line with user demand, involving the setting out of barriers which are in use during the day, even when not all the desks are manned. These barriers cannot be easily removed and replaced during breaks in the operation. These systems cover the following areas:

- Area 2 from desks 210 – 203 (in use from 05:00 - 20:00, but not all desks are open).
- Area 10 from desks 1010 – 1007 (in use from 05:00 - 20:00, but not all desks are open).

c) The baggage sortation process is split between two baggage halls,

- An automated sortation system with 56 chutes serving check-in areas 9-13 with a total of 66 check-in desks.
- A manual sortation area serving check-in areas 1-8 with 76 desks feeding 3 carousels.

i. Areas 1,2,3 and 4 (36 desks) feed carousel 1.

ii. Areas 5,6 (20 desks) feed onto carousel 2.

iii. Areas 7,8 (20 desks) onto carousel 3.

d) Working requirements for the use of baggage make-up carousels:

- Aer Lingus generally use areas 1 - 6, which feed carousels 1 and 2. During the busy peak time Aer Lingus say that they cannot facilitate all their baggage operation on one carousel only and require the use of both carousel 1 and some of carousel 2. This is due to their current work practices incorporating containerised and non-containerised baggage.
- Ryanair utilise all of Carousel 3.

e) Additional handling agent staff requirements to operate between two halls:

- During the summer it became quite apparent that at peak periods during the weekend, areas 9-13 became congested while desks in areas in 1 – 8, feeding carousels 1 – 3 that use manual sortation, remained available.
- Handlers were approached to move part of their operations to these facilities. Sky Handling were unable to do so as staffing levels did not permit operations from two sites.
- Aviance eventually agreed to move some of its charter flights at peak weekend times and Aer Lingus flights were moved from area 6 to area 5 to facilitate this move. Aviance shared carousel 2 with Aer Lingus during this time. This move required considerable negotiation with the handlers but relieved some of the pressure on check-in areas 9-13.
- Although additional space was available in areas 1-8, some handling agents refused to move and split their baggage operation between 2 halls.

3.6 Summary - Calculation of Effective Space by Detuning

- The calculation of effective space by “de-tuning” existing areas was carried out and documented to ensure transparency of the methodology employed
- The selection of areas for “de-tuning” was carried out by observation of constricted, restricted, impeded or otherwise inaccessible dead space to arrive at a net effective area
- Even though professional designers would argue otherwise, this determination of effective area does not take into account:
  - building geometry
  - queuing overspill
  - cross flow inefficiencies
  - edge effects on circulating persons
  - resource management issues

  (had these additional factors been taken into account, in particular the queuing overspill from the adjacent check-in area, the available space would be significantly less as would be its capacity to support a busy hour population)
- In the application of the various calculations it is assumed that input parameters are given in terms of effective space and therefore require “detuned” areas to be used in the formulae, not gross areas.
- As indicated in the various citations, this is an appropriate approach to calculating allowances for physical constraints in a transparent manner and does not negate the value of industry wide metrics or calculation methodologies
- Revisiting the process has resulted in a slight increase in “detuned” areas in the Departures Concourses, Landside and Airside ie, a small decrease in the Effective Circulation Areas Post Detuning. The relative stability of the values over time confirms the validity of the process.

4. IMPACT OF MEZZANINE ON CAPACITY OF CADCL

Commission comments:

- Mezzanine should be taken into account either
  - Reduce CADCL dwell times or
  - Include some portion of mezzanine in CADCL

4.1 Commercial Areas

The drivers of capacity in the BAA formula which were applied in calculating capacity are

- the area of the CADCL,
- the population of passengers and escorts in the CADCL
- the time spent (dwelt) by the population in the CADCL

The area of the CADCL has been dealt with in Section 3 "Detuning ".

In regard to the number of passengers and escorts, the BAA methodology assumes that 10% of the population is absent from the CADCL and has gone to commercial areas where commercial includes both retail and catering outlets. In the case of Dublin Airport, the Mezzanine floor comprises the catering component.

The BAA methodology states that although commercial areas absorb an amount of the population, the processing capacity of the CADCL is constrained by the non-commercial areas. This approach is shared by AIA and Fraport and the following citations underpin this.

BAA

"*Although commercial areas absorb a proportion of passengers and escorts present on the concourse they should not be the capacity constraint. The capacity is constrained by the non-commercial areas".*

(source: BAA Group Planning Guidelines)

Athens International Airport

"AIA disregard their mezzanine as a provider of additional passenger capacity on the departures lounge landside. Passengers, escorts and visitors make a discreet choice to go to the mezzanine and since it does not provide any processing capacity on the departures lounge for passenger capacity issues it therefore should only be considered as a revenue making space."

(source: Landside Planning Department, Höchtief Athens International Airport – contact available upon request).

Fraport at Frankfurt International Airport

"*It is confirmed that mezzanines or areas/paths leading to commercial are not part of the circulation area, as those areas are too much dependent on commercial activity*."

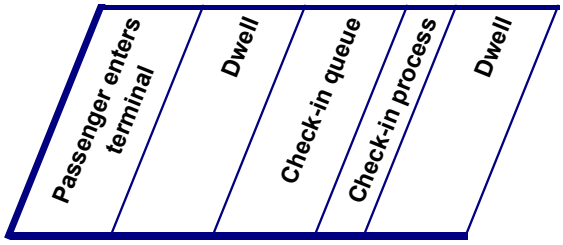
(source: Head of Traffic and Retail Capacity Management, Fraport AG – contact available upon request).

Therefore, the approach adopted by the team in assessing the effective capacity of the CADCL is consistent with approaches elsewhere in that the mezzanine as a commercial area is not included as passenger circulation area. It is taken into account through the allowance being made for a percentage of the population being apportioned to the commercial areas.

4.2 Dwell Time

A dwell time of 30 minutes for passengers and 20 minutes for escorts was used in the application of the BAA formula for calculating the capacity of the CADCL. This was based on survey data from 2002.

The dwell time data can now be updated to reflect the outcome of TNS mrbi's survey of August 2003 (Appendix C). The dwell time is now 36.11 minutes as detailed in Figure 9.



mrbi Arrival at kerb to Security (mins)	47.18			
mrbi Arrival at kerb to Check-in (mins)	26.24		-	
mrbi Check-in to Security (mins)	-		20.94	
Estimated time per process (mins)	16.57	9.67	1.4	19.54

Total dwell time pre/post Check-in (mins)	36.11

Figure 9 - Timeline Reflecting August 2003 Conditions

The following question was asked by the Commission:

- Baseline assumes 30min/20 min dwell time in CADCL for passengers and escorts (MRBI survey).
- What are they doing?
  - Not in mezzanine
  - Not in queuing
  - Not shopping (assumptions that only 10% of pax in commercial areas)
  - Not entertaining escorts (assumption 0.1% ratio)

It is not correct to assume that passengers are not on the mezzanine. Given the approach that was taken, the 10% assumption in the BAA formula does in fact assume that these passengers go to both retail and catering (mezzanine). In the absence of survey data, the 10% assumption was used.

In addition there are many other activities that passengers might also be doing during their dwell time as follows:

- Wayfinding
- Reading FIDS
- Using Toilets
- Collecting/Returning Trolleys
- Going to outside areas (smoking)
- Appraising/Filling out Immigration/Customs Forms
- Purchasing or collecting tickets
- Waiting for check-in desk to open

5. REVIEW OF REQUIRED AREA CALCULATION 2003

In the Baseline Report an equivalent busy hour rate (BHR) was derived on the basis of the effective available circulation area post detuning. This area was compared with the area that the actual busy hour population of 2002 would require. The shortfall between the required area and the detuned area was identified. This is summarised in Table 5 below which was calculated as follows.

5.1 Baseline Report

Step 1 – Notional Capacity

The notional capacity was calculated by applying the BAA formula to the total area of the Departures Concourse Landside presuming that all the area was available, (ie, it was not detuned) and using the following assumption set.

- Dwell time per pax – 30 minutes
- Dwell time per escort – 20 minutes
- Percentage of pax in commercial areas – 10%
- Ratio of escorts to pax – 0.1
- Peaking factor – 1.1
- Proportion of pax transferring airside – 0
- Space per pax – 2.15 m^2 BAA standard; IATA B/C

Note: The Baseline assumption set as used in Steps 1 and 2 does not include a space allowance for seating (10% as per BAA standard) as this was an analysis of existing conditions and there are only a small number of seats dispersed around the CADCL and these are removed/relocated on occasion.

In determining the derived required area in Step 3, an additional space allowance was made for seating in accordance with BAA standard – 1 m^2 per pax for 10% of static capacity. (Refer citation page 11).

Step 2 – Effective Capacity

The effective capacity was calculated by applying the BAA formula to the effective circulation area of the Departures Concourse Landside after the non-useable areas had been extracted (post detuning) and using the same assumption set as above.

Step 3 – Derived Required Area

The ideal area that would be required to support the actual Busy Hour Rate population of 2002 was calculated by reverse application of the BAA formula. However a space allowance for seating 10% of the total occupancy was assumed in addition to the above assumption set to ensure the calculation of the ideal area complied with the BAA methodology. (Refer citation page 11).

Step 4 – Short Fall Between Detuned and Derived Required Areas

The effective circulation area post detuning was subtracted from the derived required area to identify the short fall between the two areas shown in Table 5.

Table 5 – Shortfall between detuned and required area Baseline

CADCL	Notional Capacity		Effective Capacity		Derived Required Area		Shortfall between detuned and required areas	
Assumptions	Non-detuned Circulation Area (m^2)	Derived Equivalent BHR (pax/hr)	Detuned Circulation Area (m^2)	Derived Equivalent BHR (pax/hr)	Actual BHR (pax/hr)	Derived Equivalent Circulation Area (m^2)	Circulation Areas (m^2)	Percentage Shortfall
Baseline Conditions	3657	3544	2495	2417	2500	2713	- 218	- 8.74%

5.2 Calculation of Ideal Required Area 2003

The ideal required area to support the 2003 Busy Hour rate was calculated as a form of sensitivity analysis to compare the approach taken in the Baseline with the output when October 2003 conditions were applied to the BAA methodology.

2003 Assumption Set

- Dwell time per pax – 36.11 minutes
- Dwell time per escort – 20 minutes
- Percentage of pax in commercial areas – 33.95%*
- Ratio of escorts to pax – 0.1
- Peaking factor – 1.1
- Proportion of pax transferring airside – 0
- Space per pax – 2.15 m^2 BAA standard; IATA B/C

Note: The 2003 assumption set as used in Steps 1 and 2 does not include a space allowance for seating (10% as per BAA standard) as this was an analysis of existing conditions and there are only a small number of seats dispersed around the CADCL and these are removed/relocated on occasion.

In determining the derived required area in Step 3, an additional space allowance was made for seating in accordance with BAA standard – 1 m^2 per pax for 10% of static capacity. (Refer citation page 11).

* As it was not possible to be definitive about the assumption regarding the percentage visitations to the mezzanine, a very limited survey using the mezzanine as a proxy for all commercial areas was undertaken recently. The results of this survey require further validation.

To ensure consistency so that all assumptions in the calculation would reflect October 2003 conditions, the resurveyed detuned areas were also incorporated. (Reference Table 4 and Schedule of Detuned Areas and Photos – Appendix A).

The same procedure as outlined in Steps 1 thru 4 above was then followed to develop Table 6 below.

Table 6 - Shortfall between detuned and required area October 2003

CADCL	**Notional Capacity**		**Effective Capacity**		**Derived Required Area**		**Shortfall between detuned and required areas**	
Assumptions	Non-detuned Circulation Area (m^2)	Derived Equivalent BHR (pax/hr)	Detuned Circulation Area (m^2)	Derived Equivalent BHR (pax/hr)	Actual BHR (pax/hr)	Derived Equivalent Circulation Area (m^2)	Circulation Areas (m^2)	Percentage Shortfall
October 2003 Conditions	3657	4058	2357	2615	2600	2509	- 152	-6.44

5.3 Summary

Using the Baseline assumptions, the CADCL was 8.74% undersized relative to the area required to support the actual BHR for 2002.

Applying October 2003 survey conditions, the CADCL is 6.44% undersized relative to the area required to support the estimated BHR for 2003.

This would lead us to conclude that the assumptions used in the Baseline Report based on the available data at that time were reasonable.

6. CONCLUSIONS

6.1 Conversion Ratio

The sizing and service level capabilities of facilities is best analysed and declared in terms of hourly flows. The use of derived Annual Capacities in declaring or appraising the capacity of facilities is risky and not sound practice. However, if annual capacities are to be used as broad brush indicators, they should be converted from actual hourly figures on the basis of a conversion ratio that is based on satisfactory historic performance of the facility in question. The appraisal of satisfactory performance needs to integrate Level of Service Capability with throughput capacity.

6.2 Detuning Process.

There are many citations that support the approach to detuning in the literature and body of planning material albeit that the term “detuning” is not in general use. A resurvey of conditions and areas in October 2003 shows that the approach taken to detuning in the Baseline was very conservative.

In particular, in regard to the potential to supplement the CADCL with excess space from the Check-In queuing areas, the opposite is the case. The Check-In queuing areas are already congested and operating at a low Level of Service. It is not practicable to use the “available” space at the non-occupied desks. Further space within the CADCL is required to raise the unsatisfactory Levels of Service in the queuing areas.

6.3 Mezzanine Floor

The BAA methodology apportions a certain percentage of passengers out of non-commercial areas into commercial areas, both retail and catering (mezzanine).

BAA determine that capacity is constrained by the remaining population potential in the non-commercial areas. They calculate the capacity of the non-commercial areas on the basis of the time spent by that proportion of the population in those areas.

The Baseline report assumed a certain dwell time based on limited survey data. There are a variety of possible passenger activities that made this dwell time seem reasonable. More recent dwell time survey data for August 2003 underpinned this assumption.

Further recent survey data (albeit limited) resulted in only a small variation to the short fall in ideal area requirements to support the Busy Hour population thus validating the approach to mezzanine visitations taken in the Baseline.

APPENDIX A

SCHEDULE OF DETUNED AREAS AND PHOTOS

SCHEDULE OF DETUNED AREAS AND PHOTOS

	PHOTO	AREA	DESCRIPTION	SQ.M.
DEPARTURES CONCOURSE LANDSIDE	1	1	Bank of Ireland queuing area	
	1A		Different photo of BOI queuing area	106.4
	2	2	Vending machine	4
	3	3	Vending machine	3.08
	4	4	Areas for storage adjacent to check-in islands	7.33 (X5)
	5	5	Trolley storage	32.4
	6	6	Security queue area	130.8
	7	7	Security search table in concourse	5.4
	8	8	Vending machine	7.8
	9	9	Queue area for Aer Lingus ticket desk	56.8
	10	10	Lift lobby for trolleys	4.5
	11	11	Queue area for ticket desks	86.5
	12	12	Staff entrance to airside	23.7
	13	13	Vending machine	5.2
	14	14	Security queue area (6-bay extension)	101.3
	15	15	Queue area for ticket desks	29.5
	16	16	Staff entrance to airside	33.6
	-	17	Vending machine	1.9
	-	18	Check-in queue areas	561.9
	-	19	Check-in queue areas (hand-bag only desks)	9
		20	Check-in queue areas (hand-bag only desks)	undefined as it overlaps with security queue
	-	21	Check-in queue areas (hand-bag only desks)	27.8
	-	22	Check-in queue areas (hand-bag only desks)	32
		23	Number not used	
		24	Number not used	
DEPARTURES CONCOURSE AIRSIDE	28	25	Vending machine at entrance to pier A	8.4
	17	26	Sky shop (added since original baseline)	19.6
	18	27	Strip both sides along "street" due to shops	-
	18A		More photos of Strip along "street"	-
	18B		More photos of Strip along "street"	-
	18C		More photos of Strip along "street"	sub total street 639
	-	28	Area around perimeter of bar	106
	-	29	Piers A, B & C	507.4
ARRIVALS CONCOURSE LANDSIDE	19	30	Entrance to bar	20
	20	31	Revolving doors and queue area along car hire desks	99
	-	32	Vending machine	3.1
	21	33	Queue area for info desk	23
	22	34	Vending machine	6
	29	35	Queue area for tourist info	13.5
	30	36	Queue area for bus info	11.5
BAGGAGE RECLAIM HALL	23	37	Storage area for baggage handling equipment (8-bay)	100
	24	38	Queue area and storage area for baggage support desks (8-bay)	213
	25	39	Large trolley storage area	138
	26	40	Queue area and storage area for baggage support desks	182
	27	41	Additional area for trolley storage between reclaim belts	40 (total)
	31	42	Area unused adjacent to escalators	20
	31	43	Area unused adjacent to reclaim belt	6.6
	32	44	Area in front of observation room	24
	33	45	Area unused behind reclaim belts in 6-bay	72
	34	46	Area unused adjacent to escalators	29.6
	34	47	Area unused adjacent to escalators	20
	35	48	Area unused adjacent to lobby from airside	21

APPENDIX B

CHECK-IN QUEUE OVERSPILL

Dublin Airport

CHECK-IN QUEUE SPACE REQUIREMENT FOR PASSENGERS AT LEVEL OF SERVICE "B/C" FOR 2002 AND 2003

This calculation, based on earlier calculations on Check-In queue area capacity at Dublin Airport, is intended to derive the required queuing space overspill for Busy Hour Passengers (BHR) at Dublin Airport at the IATA Level of Service (LOS) "B/C". LOS "B/C" equates to BAA standard. It compares the baseline conditions with current conditions where the queue lengths have been extended further into the circulation space of the CADCL.

Assumptions from the Baseline Report and updated traffic figures:

- BHR 2002: 2500 pax
- BHR 2003: 2600 pax
- 50% of pax arrive within first 20 minutes = 1250 pax in 2002 / 1300 pax in 2003
- 106 desks open during Busy Hour 2002 (67% of 158 desks)
- 100 desks open during Busy Hour 2003 (64.7% of 142 standard desks + 8 handbag-only desks)
- 85 second average check-in time
- Level of Service "B/C" = 1.5sqm/ pax in check-in queue ("B" =1.6, "C" = 1.4sqm)
- Average queue depth available = 6.5m (2002) / 6.9m (2003, measured)
- Queue depth per pax = 0.8m (as per BAA, resulting from 1.5sqm. /pax)

1. Area overspill for LoS "B/C" in 2002:

1250 pax 106 desks	= 11.792 pax/desk queuing in busy 20 mins.
6.5m queuing depth 0.8m/pax	= 8.125 pax capacity in queue
11.792 pax – 8.125 pax	= 3.667 pax outside queuing space
3.667 pax **x** 1.5sqm/pax	= 5.50 sqm occupied by queuing pax outside queuing area
5.50 sqm. **x** 106 desks	= **583 sqm. overspill in 2002**

2. Area overspill for LoS "B/C" in 2003:

1300 pax 100 desks	= 13.0 pax/desk in busy 20 mins
6.9m queuing depth 0.8m/pax	= 8.625 pax capacity in queue
13.0 pax – 8.625 pax	= 4.375 pax outside queuing space
4.375 pax **x** 1.5sqm/pax	= 6.5625 sqm occupied by queuing pax outside queuing area
6.5625 sqm. **x** 100 desks	= **656 sqm. overspill in 2003**

APPENDIX C

MRBI SURVEY RESULTS AUGUST 2003

Dwell Time Survey Information

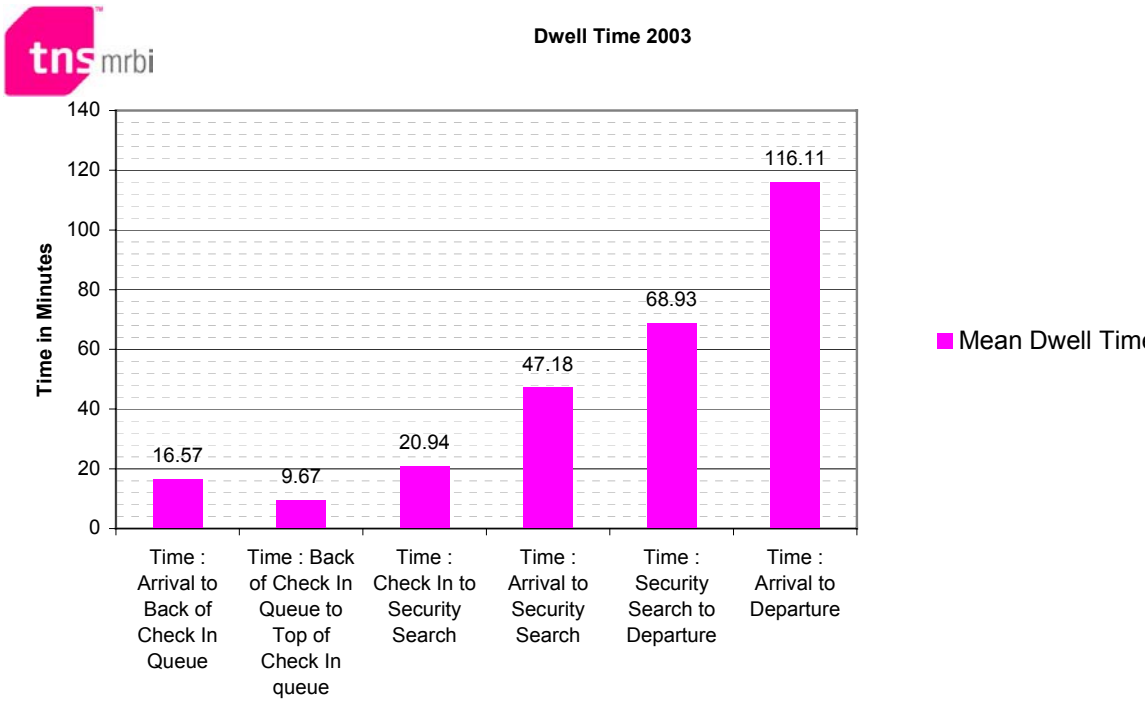
TNS mrbi carry out an extensive market research programme at Dublin Airport throughout the year, covering a number of areas, one of which is an annual 'dwell time' study conducted within the terminal building.

The survey requires the distribution of survey cards to passengers and records the time they reach each of the following points within the terminal building:

- Arrival in the terminal building
- Join the back of the check-in queue
- Front of the check-in queue
- Security search coral
- Departure gate

The survey framework has been defined to cover flights within 7 summer season route groups, covering 9,253 departing passengers.

The results from 2003 show the following average times for passengers between each area surveyed:



Data: 25th – 31st August 2003