For Public Release

German Airspace Project

7 October 2005

Remit

The remit of our assignment with the Canton of Zurich follows on from our advisory assignment and fairness opinion in relation to the proposed purchase of Swiss International Air Lines ("Swiss") by Lufthansa and relates specifically to the implications of various restrictions on the use of airspace at Zurich airport. Specifically we have been requested to focus on the costs and other implications for Unique Zurich Airport and Swiss associated with the restrictions arising from the introduction of the Durchführungsverordnung ("DVO") by Germany beginning in October 2001.

The NewSmith Capital ("NSC") Approach and Caveats

3rd-Party Discussions

NSC has carried out its remit via a series of meetings with related parties. These include:

Unique (Flughafen Zurich AG) – "Unique"

Skyguide Swiss Air Navigation Services Limited – "Skyguide"

Slot Coordination Switzerland – "Slot Coordinators"

Swiss International Air Lines – "Swiss"

Federal Office for Civil Aviation – "FOCA"

Information Access

A considerable range of both **public** and non-public information has been reviewed and this includes:

- A paper examining the implications of the Restrictions of the State Contract and the DVO compiled by Unique Zurich Airport in December 2003
- A paper on ATFM Delays at Zurich airport compiled by Skyguide in April 2005 (and partially updated in August 2005)
- Association of European Airlines punctuality statistics (2004 and 2005)
- Eurocontrol Annual Report 2004 on Delays to Air Transport in Europe
- Performance Review Commission (Eurocontrol) report of April 2005 on Air Traffic Management in Europe during 2004, including Air Transport Delays
- Slot Coordination Switzerland comparisons of arrival and departure flows (2000-2005)
- Swiss International Air Lines presentation on German Airspace Issues of July 2005
- Unique Zurich Airport presentation on the Zeus information system and the monitoring of delays
- Intraplan Consult GmbH draft report on Long-Term Air Traffic Demand in Switzerland, dated July 2005
- A report by EMPA, the Swiss Material Sciences and Technology Research Institute, of July 2005 on DVO-related noise costs at Zurich airport

Much of this information has been supplemented by conversations with a series of representatives from the respective organisations (all such information, to the extent it is non-public, being the "Information"). **NSC has (a) used and relied primarily on the Information and on information available from generally recognized public sources in writing this report without having independently verified the same, (b) does not assume responsibility for the accuracy or completeness of the Information and such other information and (c) has not made an appraisal of any assets.**

Background

In response to growing pressure from the Southern German communities near the Swiss border, the German Government requested in 1998 a renegotiation with Switzerland of the administrative agreement of 1984 on air approaches to Zurich airport. The talks were aimed at concluding a bilateral airspace agreement regulating the use of German airspace by flights to and from Zurich.

In early 2000, the German Government served notice to terminate the existing administrative agreement at the end of May 2001 after aircraft noise became an election issue in Southern Germany, and in April 2001 the parameters of a new, more restrictive, bilateral airspace agreement had been determined.

However, this 'revised' Staatsvertrag ("State Contract") was rejected by the National Council, the Council of States and the German Parliament and has never been ratified. Consequently, Germany issued an ordinance (the DVO) which became effective in several phases from October 2001 to April 2005, thereby initiating the setting of limits in relation to the use of airspace over the Southern States of Germany. Clearly any reduction in airspace availability will result in a theoretical reduction in the capacity of an airport, but because the implementation of this restriction (which came in five stages) coincided with a series of other events, including reduced traffic volumes, the impact has become more difficult to isolate.

The Dynamics of the Situation

In simple terms, Zurich airport had a certain theoretical level of runway capacity in the year 2000 (prior to the German Government serving notice of any changes), the use of which was tempered by a range of operational constraints (geography, air space availability, weather, etc.). In the subsequent years any developments that further restricted the use of runway capacity have been at least partially masked by the combination of a decline in traffic volumes and compensatory procedural initiatives. That any such restrictive measures may not have manifested themselves in the form of traffic diverting to other airports due to counter measures, however, is academic since the fact remains that some capacity has been lost (whether it would have been used now or at some stage in the future) and this can only be interpreted as detrimental to the airport and its users.

The 'State Contract'

The review of the State Contract starting in 2000/01 focused primarily upon aircraft noise levels over Southern Germany and proposed a reduction in capacity along the following lines:

1) Phase 1. No approach to Zurich from the north between 10.00pm and 6.00am as of 19 October 2001
2) Phase 2. No approach to Zurich from the north between 8.00pm and 9.00am at weekends (which includes Southern German holidays) as of 27 October 2002
3) Phase 3. A shift in holding patterns into Swiss airspace and a **volume ceiling of 100,000 Air Transport Movements (ATMs)** per annum over German airspace **(but no restriction between 6.00am and 7.00am on weekdays)** from 20 February 2005

The proposed transition time until full implementation of the critical Phase 3 was close to 3 1/2 years. On the other hand, the Contract gave the option for both parties to re-negotiate. With the implementation of the DVO by Germany, however, the State Contract was superseded.

The DVO

What is the DVO?

The German ordinance that is known as the DVO was also introduced in stages and involved a series of measures similar to the proposed State Contract but in some respects more restrictive:

1) Restriction 1 - October 2001: No approach to Zurich from the north between 10.00pm and 6.00am
2) Restriction 2 - October 2002: No approach to Zurich from the north **between 8.00pm and 9.00am at weekends** (including Southern German holidays)
3) Restriction 3 - April 2003: No approach to Zurich from the north **between 9.00pm and 7.00am on weekdays**
4) Restriction 4 - October 2003: **Curtailment of exceptions** to Zurich approach from the north during restricted times
5) Restriction 5 - April 2005: Shift of the holding zones over German territory into Swiss airspace

The Operational Consequences

Whilst the DVO did not include a numeric limitation on the number of landings from the north, generally its consequences **relative to the State Contract** were more onerous. They relate to a reduced flexibility for arrivals and shorter connection times during part of the critical early morning time on weekdays, but have their strongest impact on weekends and during Southern German holidays when extended DVO time restrictions apply:

- The drop in punctuality to below 50% in the morning on weekends due to the extended DVO restrictions until 9am, which has a knock-on effect during the entire day and is exacerbated by a significant runway capacity shortfall compared to “declared” arrival slots (“slot overbooking”) during certain times of the early morning.
- The loss of slots (starting as early as October 2001) due in particular to the reduced arrival capacity between 6.00am and 7.00am on weekdays (switch from Northern to Eastern approach). The loss of early morning capacity was significant as it is a peak time for in-bound long-haul flights with a high proportion of connecting traffic.
- The decline in punctuality is particularly challenging for Zurich airport as a hub operation as hubs only function when transfer times can be guaranteed. Missed connections and/or lost baggage will prompt transfer passengers to consider alternative routes. As passengers migrate, so long-haul volumes decline, routes become unprofitable and disappear and the hub will die.
- The further loss of flexibility in using early morning arrival capacity due to the accelerated introduction of the Southern approach in October 2003 to accommodate Restriction 4 of the DVO. Again, this further limits slot availability at the peak time for inbound long-haul flights.
- The loss of simultaneous usage of the two longer (North/South) runways when approaching from the South as the runways converge.

In order to better understand the implications of such measures on the capacity of Zurich airport, it is necessary to look more closely at the factors that determine an airport’s usage and where any restrictions might manifest themselves.

Determinants of Airport Usage

An airport’s current capacity will determine the amount of traffic (passengers and/or cargo) it is able to handle. But the decision by an airline to use a particular facility to offer services from will typically be determined with reference to permutations of several criteria:

Location Clearly the location of an airport is fundamental to its attractiveness to potential users. Such issues as the size of its catchment area for origination and destination passengers and the scale and scope of the infrastructure that serves it are vital to the willingness of airlines and passengers to use it.

Network carriers will typically look to operate services on routes with a proven level of demand, whereas low-cost airlines will also incorporate a view on the likely level of demand that can be stimulated through a low-fares policy.

Charges The level of traffic charges (i.e. what it costs an airline to use a particular facility) is also a factor that will influence the decision-making process of airlines, depending upon the type of service they operate. For airlines carrying long-haul premium passengers airport charges will be less of a factor than for short-haul low-cost carriers where fare structures are substantially lower.

Facilities A further criteria will typically be the level of facilities provided by the airport. This will range from the specification of the runway (and therefore the type of aircraft it can handle) to the quality and scale of facilities for the processing and handling of passengers.

Capacity Clearly the availability of sufficient capacity to accommodate an airline's services will be a fundamental factor, but here there are some subtleties to acknowledge:

- It is not just the aggregate daily capacity that matters but the 'spread' of capacity, i.e. what is available at differing times of the day and the ability to accommodate the patterns of demand that an airline will generate. The type of traffic using the airport will influence both the time of day that capacity is required and the type of aircraft operating the services.
- Furthermore, airlines will look to the **future** growth potential of the airport and its ability to handle increasing volumes. If an airline is to commit to a particular route, it wants to be able to see that the growth in traffic can be accommodated within a reasonable time horizon.

Efficiency Whilst the above criteria may be met, a further issue that will influence both passengers' and airlines' desire to use a particular airport, and which is linked to capacity, is reliability or more specifically punctuality arising from the efficiency with which the airport operates. Here it is important to **distinguish between delays and punctuality.**

Delays: Where delays can be anticipated airlines will, to a point, accept them and schedule accordingly. Thus scheduled journey times on some of the more congested and developed routes have increased in recent years and interconnecting routes have been adjusted. However, there comes a point where the passenger will not accept the length of journey time and where the commercial impact of airlines building-in assumed delays becomes materially uneconomic. To the extent that capacity becomes saturated, delays will occur and the attractiveness of the service to the passenger will diminish.

Punctuality: To the extent that delays can be anticipated and accommodated punctuality can be maintained. However, once punctuality starts to decline, passenger perception diminishes and operational problems emerge. Thus in looking at the implications of capacity problems punctuality is the key factor.

Definitions of Airport Capacity

The 'capacity' of an airport is a function of several factors ranging from geography and the scale of infrastructure to events that influence the very short-term operations and the use of such infrastructure. Breaking the components of capacity down, they split broadly into 4 groups:

- Terminal Capacity – the volume of passenger traffic that can be handled at any given time within the terminals (immigration, security, lounges, etc.)
- Ramp Capacity – the number of aircraft that can be handled and serviced at any given time at the terminals (gate availability, ground handling capacity, etc.)
- Runway Capacity – The number of take-offs and landings or ATMs that the runway(s) can accommodate within a given timeframe given the physical attributes
- Airspace Capacity – the number of ATMs that can be accommodated at a given time given physical and regulatory constraints

Clearly all four of these capacity components are linked and should ideally increase at a commensurate rate to accommodate any future increases in demand. The development of Terminal and Ramp capacity is a function of many factors including availability of land and long-term planning. However, in circumstances where Terminal and Ramp capacity are readily available, it is Runway capacity that is the key determinant of an airport's ability to accommodate demand growth. Whilst there are numerous examples of individual runways around the world to set capacity precedents, what the theoretical capacity of a specific facility might be will ultimately be determined by geographic, regulatory and political factors relating to airspace usage.

Moreover, runways will differ in terms of both their specification (length, lighting category, etc.) and their direction and proximity to other runways. Runway capacity is also complicated further by shorter-term operating circumstances (such as weather conditions) that can cause theoretical capacity to diminish. The usage of runways and of airspace is obviously closely interdependent and the capacity that they represent can be measured in take-off and landing slots. The various definitions of this are explained below:

'Theoretical' Capacity

The number of take-off and landing slots that can be achieved on a given runway assuming ideal weather conditions and all aircraft are spaced and sequenced correctly.

'Declared' Capacity

Declared or Coordinated capacity is the number of take-off and landing slots that the airport and the slot coordinators allocate to the airlines for every summer and winter season. It is designed to be the level of capacity at which Air Traffic Control (ATC) will not produce any delays and assumes ideal operating conditions for only 80% of the time.

'Actual' Capacity

Actual capacity (or the 'Acceptance' rate in case of arrivals) is the capacity resulting from airline slot requests shortly before aircraft arrivals and departures. It is subject to shorter-term operational adjustments during the day and could, for example, be reduced to reflect adverse weather conditions such as thunderstorms.

The Effect of Peaks & Troughs

The danger of looking at capacity on an annual or even a daily basis is that it masks the impact of seasonality and the fluctuations that take place in the demand levels during the course of a day. All scheduled services (whether short-haul or long-haul) reflect a certain daily pattern. Short-haul services will typically involve several daily frequencies and for hub operators requiring maximum connection opportunities this will typically reflect in a 'wave' pattern. Long-haul services will typically involve fewer frequencies but the nature of preferred departure and arrival times and connection requirements is such that services become very concentrated at certain times of day.

Thus whilst an airport's actual capacity on an annual or even daily basis may appear to be sufficient to accommodate aggregate demand, it may be insufficient at certain times of the year or at certain times of day. When looking at any form of capacity constraint it is therefore essential to consider the implications on an as short-term basis as possible. Furthermore, it should be noted that the impact of high concentrations of traffic at specific times of the day can substantially affect all aspects of airport capacity, not just runways. The arrival of several long-haul aircraft in quick succession will put pressure on both the physical assets of an airport (sky trains, baggage handling, etc.) as well as manpower (immigration, customs, etc.) with negative economic consequences for all related parties.

Zurich Airport Capacity

Unique has commissioned a study by third-party consultants Intraplan on projected future traffic levels that is due to be published later this year. Ahead of the publication of this study we would summarise the capacity position at Zurich airport as follows:

Terminal & Ramp Capacity

Following a CHF 2bn capital investment programme in the form of the 5th Expansion phase, substantial Terminal and Ramp capacity is available. In theory there is scope to handle some 35m passengers per annum, but recent operational changes to security arrangements (increased security for carriers and new EU arrangements for transfer passengers) combined with the closure of Dock B have reduced the Terminal capacity to nearer 20m passengers per annum. However, if Dock B were to re-open the capacity would increase to about 25m passengers per annum.

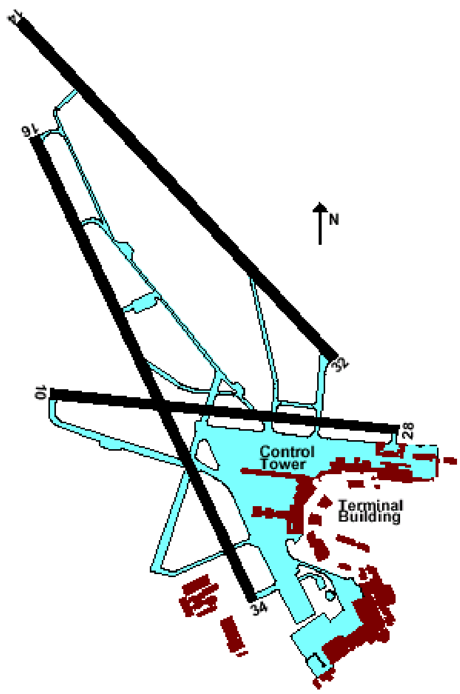
Runway Capacity

Although Zurich has three runways they vary in specification (length, taxiways, instrument landing systems, etc.) and therefore the capacity they offer:

Runway 14/32 runs from north to south, is 3,300 metres in length and has CAT III landing aids on runway 14 and a localizer on runway 32

Runway 16/34 also runs from north to south, is 3,700 metres in length and has CAT III landing aids on runway 16 and CAT I landing aids on runway 34

Runway 28/10 runs from east to west, is 2,500 meters in length and has CAT I landing aids under construction on runway 28 and no landing aids on runway 10



Prior to the introduction of the DVO the pattern of runway usage involved landings mainly from the north (on runway 14 at a rate of up to 38 per hour and on runway 16 before 7am and after 9pm), with take-offs mainly towards the south and west (on runway 16 and runway 28, respectively, and on runway 34 towards the north before 7am and after 9pm). However, the airspace usage restrictions that resulted directly and solely from the various components of the DVO have imposed changes on the pattern of runway usage and reduced the hourly arrival and departure rates at various times of the day: Between 6 and 7am on weekdays (6 to 9am on weekends) and after 9pm on weekdays (after 8pm on weekends), arrivals now take place mainly from the south in the morning (on runway 34) and from the east in the evening (runway 28), while take-offs are towards the north on the two available runways. The table below is from a study conducted by Unique Zurich Airport in December 2003 and shows a comparison of daily runway capacity pre and post the DVO.

Whilst weekends represent only 2 of the 7 days of the week the effects of the DVO are much stronger: Restrictions on weekends (and Southern German holidays) last an additional two hours until 9am in the morning and start earlier from 8pm onwards in the evening.

Runway Capacity (comparison of “normal concepts”)

Pistensystem-Kapazität (Vergleich der "Normal-Konzepte")

Lokalzeit		Kapazität pro Stunde		Differenz	Bemerkung
von	bis	bis Sept 01	ab 30.10.03		
Landungen					
05:30	06:04	10	0	**-10**	früheste Landung. Gemäss Weisung BAZL (23.06.03) 06^{00}LT für Ost und Süd. Gemäss Entscheid Unique Okt 03 06^{00}LT für Nord und 06^{04}LT für Süd
06:04	06:59	20	20	**0**	Umstellung von Konzept "Nacht Nord" auf Konzept "Süd"; *)
07:00	08:59	38	20	**-18**	Wochenende und baden-würtembergtische Feiertage; Umstellung von Konzept "Nord" auf Konzept "Süd"
20:00	20:59	38	28	**-10**	Wochenende und baden-würtembergtische Feiertage; Umstellung von Konzept "Nord" auf Konzept "Nacht Ost"
21:00	23:59	20	28	**8**	Umstellung von Konzept "Nacht Nord" auf Konzept "Nacht Ost"
Starts					
06:00	06:59	16	20	**4**	Umstellung von Konzept "Nacht Nord" auf Konzept "Süd"; *)
07:00	08:59	44	20	**-24**	Wochenende und baden-würtembergtische Feiertage; Umstellung von Konzept "Nord" auf Konzept "Süd"
20:00	20:59	44	30	**-14**	Wochenende und baden-würtembergtische Feiertage; Umstellung von Konzept "Nord" auf Konzept "Nacht Ost"
21:00	23:59	16	30	**14**	Umstellung von Konzept "Nacht Nord" auf Konzept "Nacht Ost"

*) die Kapazität von Konzept "Nacht Nord" ist die Kapazität bei Idealem Mix von Landungen und Starts. Je nach Nachfrage der Anzahl und Bewegungsart kann die Kapazität stark differieren

The table clearly reflects both a total loss of slot capacity and the extent to which the reductions are concentrated at certain times of day. Furthermore, when considering the aggregate figure for the full day it should be noted that where additional slots have become available they are typically at times of the day when demand is less (i.e. after 21.00). We analyse the implications in more detail below.

Assessing the DVO Implications

Much has been suggested about the negative impact of the DVO on the operations of Zurich airport, but before considering the implications it should be stressed that the proposed State Contract would also have had an adverse impact on the operation of the airport, although it is academic to attempt to quantify it. Moreover, the complication with trying to quantify either the theoretical impact of the State Contract or the actual impact of the DVO is that traffic volumes have decreased during the relevant period (to the extent that traffic volumes in 2004 – in terms of departing and arriving flights – were still well below the levels of 2000), and operational adjustments (such as the new ATC measures introduced by Skyguide) have been implemented to alleviate the problem. In addition, the home carrier Swiss has changed its traffic pattern beginning this summer and moved a substantial portion of its early morning arrivals from before 7am to between 8 and 9am. Thus the underlying impact will have been 'masked', particularly on weekdays.

The likely implications of any measures to limit the hours of usage at an airport are:

1) The absolute loss of take-off and landing slots (capacity) which can be calculated and to which a value can be attributed in terms of lost revenue to the airport operator.
2) An increase in delays/reduction in punctuality as demand levels are accommodated within the reduced capacity. This can also be calculated (in terms of lost minutes), and the associated cost estimated for:
    - Passengers
    - Airport operator
    - Airlines
3) A potential reduction in the competitiveness of the airport relative to alternatives where punctuality may be higher. The cost of this, however, can only be fully quantified where the movement of passengers or the movement of routes to another airport can be **directly** attributable to a decline in punctuality. This is difficult to identify.
4) Costs associated with changes in procedures to accommodate the new operating circumstances (e.g. ATC procedures and training, runway navigation systems and taxiways). Such costs can be quantified relatively easily from actual expenditures but it is important to extract any overlaps with capital expenditure that might otherwise have taken place.
5) Increases in pollution levels (both emissions and noise) as a consequence of changes in ATC and flight patterns. This can also be quantified to the extent that data can be downloaded from certain aircraft types and analysed against flight patterns that might otherwise have been adopted. However, placing a cost on this is complex and data for airlines using Zurich airport other than Swiss is not available.

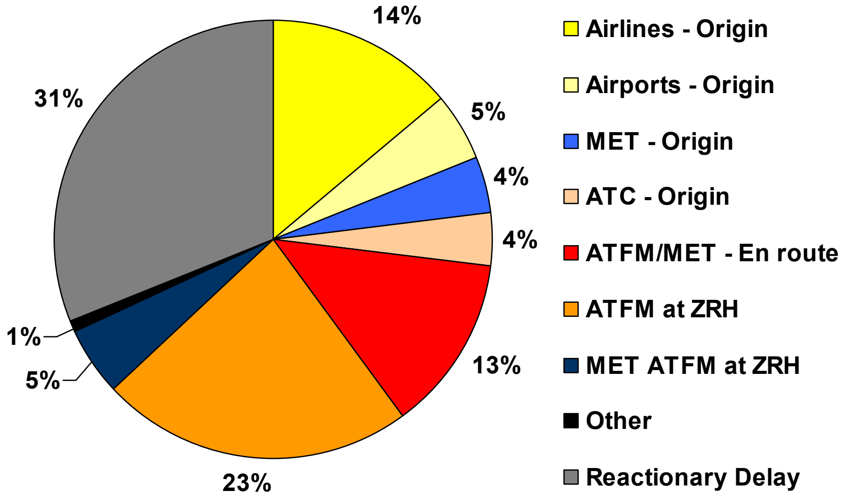
Many stakeholders within the Swiss aviation industry have a view of the situation and some have undertaken specific exercises to consider the implications of the DVO. We have reviewed these exercises and collated the ideas and data they contain in order to arrive at our conclusions. The results are summarised below.

Skyguide

The Swiss air navigation service provider, Skyguide, has collated data from various official and proprietary sources (including Eurocontrol's Central Flow Management Unit and Central Office for Delay Analysis in Brussels, and the Association of European Airlines) to reflect arrival and departure delays at Zurich airport (expressed in minutes delay per month and per flight) and attribute its causes.

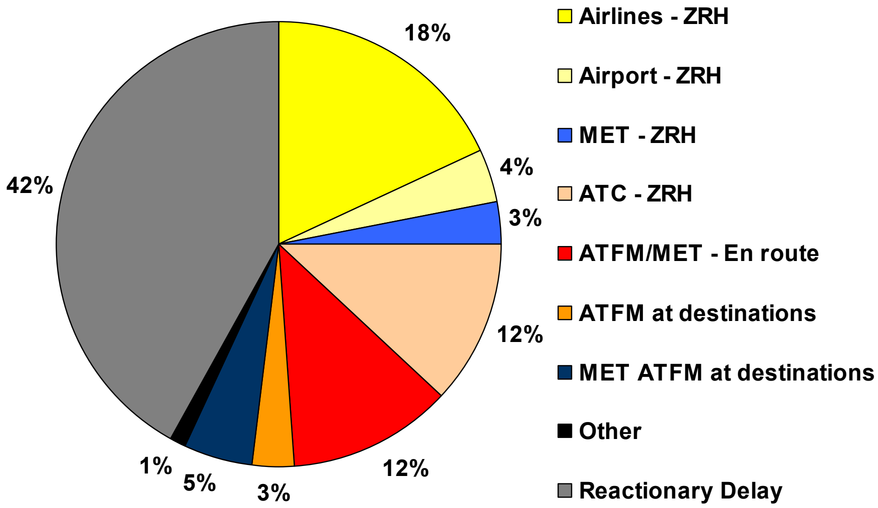
Arrival Punctuality

Arrival delay drivers on flights bound for ZRH (Jan–Sept 2004)



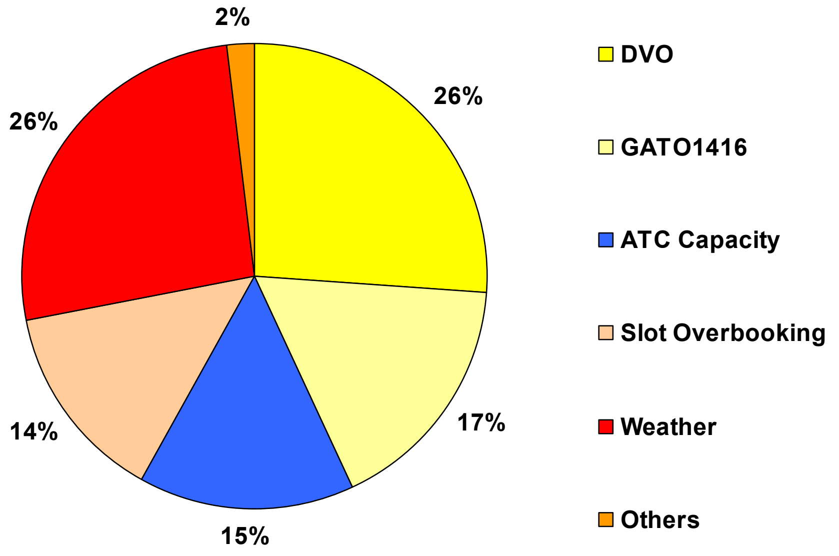
Departure Punctuality

Departure delay drivers at ZRH (Jan-Sept 2004)



As the charts demonstrate, the two major drivers of arrival delays for the period January to September 2004 are Reactionary Delays and ATFM Delays at Zurich airport. As a result of the delay attribution process that is carried out, Skyguide has been able to identify the proportion of ATFM delays attributable to the DVO which is shown as 26% (or a total of 167,029 minutes) for 2004.

ATFM Delays Zurich Airport (2004)



For the 7-month period January to July 2005, Skyguide has identified the corresponding ATFM delay breakdown on a pro-forma basis at about ⅓ each for "DVO", "GATO1416" and "Weather" related causes, respectively. Including the delays attributable to the implementation of the last DVO phase (shift of holding zones into Swiss airspace in April 2005), however, the aggregate proportion of ATFM delays due to the DVO increases to 47% (or a total of 135,521 minutes up to July). It should also be noted that the 2005 year-to-date ATFM delay minutes attributable to the DVO would have been higher but for (i) a 10-15% actual capacity expansion (representing an increased Acceptance rate of 3-4 arrivals per hour) due to efficiency improvements in traffic flow management introduced by Skyguide this spring and (ii) the shift in its morning flight pattern by the home carrier Swiss beginning this summer.

However, there are a number of limitations to this analysis:

1) A high proportion of delays (31% of arrivals and 42% of departures during the first 9 months of 2004) are classified as reactionary delays, i.e. where there is a knock-on effect arising from other factors which could include the DVO but not exclusively so.
2) ATFM delays represent only a minor proportion of the overall delays as shown above. More importantly, they are measured (even for arrivals) against an airline's request for a take-off slot, not against the actual airline schedule for landings and departures.
3) Skyguide and other parties have implemented measures to help alleviate the impact of restrictions imposed by the DVO. At the same time, traffic volumes have declined from the levels experienced at the beginning of the decade. Such developments clearly are beneficial, but do not alter the fact that a specific number of slots have been lost which, even if not required today, would have been utilized at some stage in the future. These slots have a value.
4) The proprietary delay attribution process introduced by Skyguide in mid 2003 can only allocate one cause for a delay and thus where other factors are involved the DVO effect may be masked.

Slot Coordination Switzerland

Slot Coordination Switzerland (SCS) was established in 2004 with the intention of providing an independent organisation for the allocation and coordination of take-off and landing slots at Zurich and Geneva airports. SCS uses 'declared' capacity data from Unique Zurich Airport as a basis for the seasonal planning and slot allocation and the ongoing slot management process. Following the requests submitted by airlines, SCS allocates slots in accordance with EU and Swiss regulation and IATA guidelines pursuant to a detailed priority list, taking account of historical rights, changes to historical slots, requests by new entrants, and requests for changes and additions by existing carriers.

It subsequently monitors the actual and timely usage of the slots by airlines, reviewing various databases such as airport information systems, airline schedules published in reservation systems, and operating performance data.

Data provided by SCS shows that the declared daily arrival capacity at Zurich airport (based on 30-minute control intervals) has fallen from 606 in summer 2002 to 558 in summer 2005, representing a reduction of about 8%. If non-DVO related causes are excluded, however, the reduction is only about 2%. For departures, the corresponding declared daily slot capacity figures show a slight decrease from 621 in summer 2002 to 614 in summer 2005, but no material change on a like-for-like basis if one excludes capacity adjustments caused by new airport operating rules in the intervening period.

However, whilst this supports the thesis of declining capacity, the shortcomings of this data are:

- It consists of daily data that does not fully reflect the peaks and troughs of demand (in particular demand pressures at the beginning of the day)
- It does not isolate the reduction in slots specifically attributable to the DVO (other factors such as the new FOCA safety requirements in relation to the Go-Around and Take-Off procedures for runways 14 and 16 and measures introduced to comply with new airport operating rules are included as well)
- It understates the actual capacity shortage at certain times of the day due to the deliberate practice by SCS of adhering to the original capacity figures despite the DVO restrictions on weekends/Southern German holidays, which has a knock-on effect in terms of delays and punctuality

It should also be noted here again that the full DVO impact was suppressed by a backdrop of declining demand, mainly due to the capacity reductions at the home carrier Swiss: The number of slots actually allocated to airlines at the initial submission shows a reduction in total slot demand of about 22%, from 953 in summer 2002 to 746 in summer 2005. Nevertheless, a comparison of the declared slot capacity limits before and after implementation of the DVO shows a decrease in the hourly arrival rate between 6 and 7am in the morning (based on 30-minute control intervals) from 16 during the Summer 2000 timetable to 9 during the corresponding period in 2005, a reduction of over 40%.

Swiss International Air Lines

As the home carrier and hub operator at Zurich airport and with some 46% of the airport's used take-off and landing slots, Swiss has the greatest vested interest in the capacity of Zurich and the efficiency with which it can be exploited. In particular, its function as a hub operator requires the widest-ranging and most efficient connectivity between long-haul and short-haul flights in order for it to be competitive both with other European network carriers and within the Lufthansa Group. The vast majority of connecting passengers at Zurich airport are flying Swiss. They account for about half of all Swiss passengers at the airport. Punctuality is the key to effective and competitive connectivity and to that end, it forms a component of the Swiss staff remuneration.

In response to the measures of the DVO, Swiss has carried out a study of the implications in terms of both the operational and the economic impact. As with the other stakeholders, Swiss has collated AEA data reflecting the adverse trends in punctuality of Swiss operations based at Zurich airport, relative to those of other hub carriers at other European airports. However, what is more interesting about the work carried out by the Swiss team is that it goes on to isolate the delay causes and attribute an economic value to them.

Swiss has identified adverse trends in punctuality and delay data by analysing sample months in 2003, 2004 and 2005 to measure the scale of delay incurred and attribute a reason to it with an estimate of the associated cost. The approach taken is summarised as follows:

- Identify the number of Swiss aircraft movements within the DVO-restricted period
- Track the individual aircraft for delays, taking advantage of the ability to download data directly from the Airbus aircraft systems

- Allocate direct airline costs to the delayed aircraft (incremental fuel and variable maintenance) and indirect airline costs (network, passengers, operational irregularity and brand damage)
- Quantify the level of incremental emissions and pollution

On the basis that the data is largely derived from the computer systems of the individual aircraft, its reliability is high whilst the assumptions in relation to costs made by Swiss look conservative. In particular:

- Only those direct airline operating costs that are charged by distance flown have been included in the incremental cost allocation process.
- Costs associated with increased concentrations of traffic (e.g. requirement for incremental rolling stock on the skyway system and/or security staff during peak traffic times, or the lack thereof) have **not** been included.
- As with other lost revenue items, the cost resulting from an average 5-minute increase in block times for flights using slots within the DVO-restricted period has been reduced by 50%. Some 80% of Computer Reservation System sales are taken from the first page of the programme but the increase in block times has moved Swiss to the third page. While rising, direct sales via the internet currently still account for a low percentage of total sales.
- Hidden costs such as the required change in rostering by suppliers have been excluded.

Moreover, this data relates purely to the operations of Swiss and does not reflect the cost of delays to passengers and the airport operator, or the value of lost slots.

Unique Zurich Airport

In addition to the comprehensive study undertaken by Unique in December 2003, a further exercise has been conducted to identify the likely costs of the DVO which centers on data collated within the in-house computer system “ZEUS”. This system has standardised interfaces for information systems that are fundamental to the efficient operation of the airport and forms the heart of the operational management of the facility on a day-to-day basis by the Airport Steering Group.

The system allows Unique to identify and quantify delays to which codes have been attributed and then to apply a value to the delay for three sets of stakeholders:

- The airport operator – on the basis of stand-cost per annum
- The airline - on the basis of an aircraft seat-cost per hour
- The passenger – on the basis of passenger goodwill erosion per hour of delay

Thus it is potentially possible to identify the overall cost of delays attributable to a particular cause.

The ZEUS system has been in operation for about 2 years. Clearly it is a very comprehensive tool which already has commercial opportunities in terms of applications with other airports, but it is still subject to refinements:

- The system has yet to be adjusted to allocate ‘reactionary’ delays to the original causes so may understate the extent to which a particular factor such as the DVO has been responsible for delays
- As the airport operator, Unique is departure-orientated whilst DVO delays are inbound in their origin. Consequently in looking specifically at DVO-related issues, it is necessary to identify why an outbound flight was delayed
- The different costs that are allocated to units of delay may require further refinement

Quantifying the Implications

As pointed out in the previous section we have considered the implications of the DVO under the 5 categories of:

- Loss of take-off and landing slots
- Increases in delays and reductions in punctuality
- Reduction in competitiveness
- Changes in procedures
- Increases in pollution

and adopting the exercises and data of several organisations we have attempted to quantify the effect in terms of a total cost.

Valuation Approach & Limitations

Reflecting upon the way in which we have collated the DVO costs it is important to acknowledge that we have two different 'types' of data:

1) **Historic** data reflecting costs identified/incurred to date (incremental, 'one-off' operating costs and capital expenditure in relation to the adoption of the DVO)
2) **Current** data reflecting the impact of ongoing additional operating and environmental costs and delays to passengers currently being incurred

However, historic data relating to incremental operating costs (e.g. delay costs and environmental costs) incurred from the earlier stages of DVO implementation are missing as some of the procedures for tracking and quantifying the DVO impact were not in operation in the early stages. Regarding the implications of growth in air traffic at Zurich airport (not only will costs increase as traffic volumes grow but such cost increases are unlikely to be linear as throughput rises), we have not attempted to estimate an escalation of costs as a result of traffic growth but have attempted to reflect the 'ongoing' cost of the DVO based upon the costs currently being incurred.

To give an indicative net present value (1) for the ongoing costs we have capitalised current annual costs on a notional multiple (2) and discounted back via the implied discount factor of the relevant weighted average cost of capital (3). Any such attempt to reflect future costs may be open to interpretation as to the appropriate assumptions to apply (multiples, discount rates, cost escalation, etc.). Furthermore, it still fails to accommodate the cost implications of further growth in traffic volumes. However, as with other aspects of this project, we remain of the view that the approach is conservative.

(1) The net present value (NPV) is the value in today's money of a future stream of income or costs
(2) We have used a 10x multiple to 'capitalise' the costs as a reasonable reflection of the likely ongoing nature of them
(3) The formula for the weighted average cost of capital (WACC) is the cost of equity x equity as a percentage of debt plus equity PLUS the after tax cost of debt x debt as a percentage of debt plus equity

Loss of Slots

Because of the complexities of quantifying runway capacity (already discussed in an earlier section), determining the level of slots lost to the DVO can only be an estimate and the current best estimate (1) is 6 slot pairs per day. These slot pairs lost at Zurich airport equate to 2,190 landings per annum which in turn equate to a "bottom line" profit loss of CHF9.6m. (2)

CHF 9.6m pa x multiple of 10 and discounted at 6.5% = CHF 50.0m

The proximity of take-off and landing slots, in terms of the time of day that they are available, is crucial to their application and ultimately their value to airlines. By way of a cross-check based on the average value of recent slot sale transactions (3), the estimated cost of the lost slots would be in the order of CHF 45m. If air traffic demand picks up, however, Unique estimates it could loose on weekends an additional 12,410 landing slots per annum over the medium term, which would equate to an incremental loss of profit projected at more than 5x the current CHF 9.6m "bottom line" impact (2).

(1) Source: Unique. See also Unique study of December 2003

(2) Source: Unique, based on estimate of marginal contribution from internal accounting figures

(3) Assuming 50% of the estimated price paid for 16 pairs of daily slots at London Heathrow in 4 transactions between 2003 and 2004 (CHF 7.5m)

Increased Delays/Reduced Punctuality

In attempting to identify the costs associated with increased delays and reduced punctuality, the prime source of data is the ZEUS computer system operated by Unique. We have used this for quantification of the impact of delays to passengers and the airport operator, but for quantifying the cost of delays to airlines we have taken operational data collated by Swiss.

Passenger Delays By taking passenger delay hour data (1) during DVO times +30 minutes from the morning and the evening periods (where notably the latter is worse on weekdays) and for the Winter and the Summer timetable, it is possible to arrive at an average of 187 passenger delay hours per day for a weekday. A similar exercise for a weekend day produces a substantially worse figure of 834 passenger delay hours per day. This data aggregates to a total of 135,356 passenger delay hours per annum. At an estimated cost per passenger hour (2) of about CHF 50 this in turn aggregates to an annual cost of some CHF 6.8m. This has been capitalised using a 10x multiple and discounted to a NPV (3).

CHF 6.8m pa x multiple of 10 and discounted at 5.5% = CHF 39.0m

To this should be added the impact of **Reactionary Delays** (i.e. subsequent delays that result from the initial DVO-related delay). It is difficult to determine which reactive delays were exactly caused by the DVO on a daily basis without a thorough analysis of every flight. However, by way of a conservative approach given that reactionary delays can last throughout the day, if we assume an average 1.5 aircraft hour delay on the first outbound wave after the DVO restricted time on a weekend morning (the most significantly affected period) (4) and apply this to an average flight passenger load factor of 80, it would imply a further 12,480 passenger delay hours per annum. At an estimated cost per passenger hour (2) of CHF 50 this aggregates to a further annual cost of CHF 0.6m.

CHF 0.6m pa x multiple of 10 and discounted at 5.5% = CHF 3.5m

Airport Costs One of the main impacts of delays on the airport operator is the reduced utilisation of infrastructure, specifically aircraft stands. It has been conservatively estimated (4) that as a consequence of the DVO Unique requires about 3.5% more stands and this clearly manifests itself in the form of higher annualised operating costs. Assuming an annual cost (including maintenance & other operating expenses, depreciation and interest cost) of about CHF 1.8m per Dock Stand system (stand plus associated bus, finger dock, etc. infrastructure) and about CHF 0.7m per Open Stand system, and a 43%/57% split between Dock Stands and Open Stands amongst the total of 55 operational stands, then the 'additional' DVO-related capacity would amount to an incremental annual cost of CHF 2.2m.

CHF 2.2m pa x multiple of 10 and discounted at 6.5% = CHF 11.5m

Airline Costs – Swiss (5) In assessing the cost of delays incurred by Swiss we have taken the incremental **direct costs** the company attributes to the DVO (Fuel and Variable Maintenance at CHF3.68m p.a.) and the "Passenger" and "Operations" components of the incremental **indirect costs**

(CHF 3.28m p.a.). These have been capitalised using a 10x multiple and discounted to a NPV by applying an average WACC for the major European airlines as a discount rate.

CHF 6.96m pa x multiple of 10 and discounted at 6.5% = CHF 36.3m

Airline Costs – Other Carriers (6) Specific data for airlines other than Swiss is not available. However, on the assumption that Other Airlines would incur similar incremental direct costs as Swiss (CHF 3.68m p.a. for Fuel and Variable Maintenance) and reflect similar **indirect "Passenger" costs** (CHF 0.4m p.a.), the pro rata cost to Other Airlines would be in the order of CHF 4.8m per annum.

CHF 4.79m x multiple of 10 and discounted at 6.5% = CHF 25.0m

(1) Source: ZEUS data

(2) Derived by Unique from the costs Eurocontrol calculates per minute delay of an average European flight

(3) Discount rate derived from 10-year risk-free rate plus estimated equity risk premium of ca. 3.5%

(4) Source: Unique

(5) Source: Swiss, but excluding "Network" costs and "Image" costs which have been accounted for under Reduced Competitiveness

(6) Source: Swiss, but excluding "Operations", "Network" and "Image" costs for non-home carriers. Pro rata data on the basis of Other Carriers representing 54% of all flights into/out of Zurich airport

Reduced Competitiveness

This is possibly the most difficult component of the DVO implications to quantify but in light of an exercise conducted by Swiss, it is possible to quantify two aspects of indirect costs attributable to the DVO that reflect a decline in competitiveness for Swiss as the Zurich hub airline. These are "Network" costs and "Image" costs. In the Swiss analysis "Network" costs include lost revenue factors such as poorer CRS positions and reduced offerings of city pairs whilst "Image" costs reflect the assessed revenue impact of factors such as poorer punctuality and negative PR. Taking a conservative 50% of estimated "Network" costs at CHF 3.5m per annum and estimated "Image" costs of CHF 5.72m per annum, applying a 10x multiple to the aggregate and discounting the result at 6.5% (1) gives an estimated NPV of CHF 48m.

CHF 9.2m x multiple of 10 and discounted at 6.5% = CHF 48.0m

Whilst Swiss only represents 46% of all flights into/out of Zurich and other carriers could suffer both network costs and image costs as a result of delays, we do not have any data for non-hub carriers and have therefore taken the conservative approach in not including any costs for them.

(1) Discount rate of 6.5% derived from average of major European airlines

Procedural Changes

As a result of the DVO several organisations that interface with Zurich airport have calculated both one-off costs (capital expenditure and operating expenses) and recurring operating costs that are deemed to be directly attributable. These are as follows:

Skyguide No recurring incremental operating costs have been identified but one-off capital expenditure of CHF 11m relating mainly to Instrument Landing Systems and one-off operating costs of CHF 3m have been calculated.

CHF 11m capital expenditure + CHF 3m operating costs = CHF 14m

Unique Again, no recurring incremental operating costs (other than the aircraft stand costs mentioned above) have been identified but one-off capital expenditure of CHF 65m relating mainly to taxiways, lighting systems, etc. have been calculated and indicative one-off operating costs of CHF 3-7m have been cited.

CHF 65m capital expenditure + CHF 5m operating costs = CHF 70m

Swiss No one-off capital expenditure or one-off operating costs have been identified but recurring incremental operating costs have been computed which are discussed in the earlier sections on Increased Delays/Reduced Punctuality and Reduced Competitiveness, respectively.

Environmental Costs

Taking data supplied by Swiss, the suggested impact of increased **emissions** is as follows:

Swiss The estimated increase in the annual level of nitrogen oxide generated by the Swiss fleet as a result of the DVO is 47.1 tonnes and the estimated annual level of incremental carbon dioxide is 9,276 tonnes. “Market” values for such units of pollution from aircraft are not available but if we apply values from industrial plants (1) (2) as a proxy we can attribute a cost (3).

47 tonnes pa of NOx @ $2,400 pt x multiple of 10 and discounted at 5.5% = CHF 0.8m
9,276 tonnes pa of CO2 @ €22 pt x multiple of 10 and discounted at 5.5% = CHF 1.9m

Other Airlines For the airlines other than Swiss that represent 54% of all flights into/out of Zurich airport, if we assume the same relatively young fleet of aircraft (a conservative assumption) and pro rata the data above, the NPV of the cost of the incremental emissions would be in the order of CHF 3.1m.

Pro rata cost for Other Carriers = CHF 3.1m

With regard to incremental **noise pollution** attributable to the DVO an independent report conducted for Unique (4) suggests additional direct costs for formal expropriations and noise insulations in the order of CHF 180m to CHF 220m on the basis of current noise law and the respective court rulings.

Estimated 17% increase in people exceeding noise threshold = CHF 200m

(1) NOx market price in NorthEast and MidWest US quoted by Cantor Fitzgerald Environmental Brokerage
(2) London Energy Brokers’ Association Carbon Index for trades in EU emissions allowances
(3) Discount rate derived from 10-year risk-free rate plus estimated equity risk premium of ca. 3.5%
(4) Report by EMPA of July 2005 on DVO-related noise costs at Zurich airport

Collating and summarising these individual cost components (see the table below) produces an estimated aggregate value of some CHF 500m.

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Preliminary Valuation of DVO Cost Components – Conservative Case

	CHF m
Loss of Slots	**50.0**
Increased Delays/Reduced Punctuality	
Passenger Delays	42.5
Airport Costs	11.5
Airline Costs - Swiss	36.3
Airline Costs - Other Carriers	25.0
	115.3
Reduced Competitiveness	**48.0**
Procedural Changes	
Skyguide	14.0
Unique	70.0
	84.0
Environmental Costs	
Emissions - Swiss	2.7
Emissions - Other Carriers	3.1
Noise	200
	205.8
Total	**503.1**

The table above is based on the following DVO-related **non-recurring costs** identified to date and **currently** estimated **annual** DVO costs:

	CHF m
Costs to Date	
Procedural Changes (CapEx & Operating Costs)	84.0
Estimated Noise Costs	200.0
	284.0
Ongoing Annual Costs	
Loss of Slots	9.6
Passenger Delays (incl. Reactionary)	7.4
Airport Costs	2.2
Airline Costs	11.8
Reduced Competitiveness (Swiss)	9.2
Environmental Costs	1.0
	41.2

Conclusions and Recommendations

In the context of the information and data that has been made available to us (see above), we have arrived at an estimated value arising from the DVO in the order of CHF 500m. However, this is based upon what are deemed to be very conservative (even defensive) assumptions and a number of mitigating factors have reduced the impact. Moreover, this estimate is the aggregate of costs identified to date and the net present value (NPV) of future recurring costs based upon current flight activity. It does not reflect the possible cost implications of an increase in passenger volumes at Zurich airport. Our conclusions and recommendations are as follows:

1. Costs

    - Conservative assumptions. In many instances we believe that the assumptions implicit in the data we have been provided with are very conservative and rather than representing a 'base' case, may well reflect more of a 'lowest' case scenario.
    - Cross-reference of data sources. For certain components of DVO-related costs we have been provided with data from more than one source, but have only used one set of data in each such case to avoid double-counting. As and when the various data systems are updated and further refined, a reconciliation of multiple data sources would clearly be useful from the point of cross-referencing (even though it can produce inconsistencies).

2. Limitation on future growth potential

    Whilst it has been possible to identify costs incurred to date and costs currently being incurred by airport users, it has not been possible to quantify the implications of future traffic growth. Undoubtedly some of the 'surplus' capacity within the airport system has been utilised to offset the effects of the DVO and incremental traffic at certain times of day could have a disproportionate effect on the efficient operation (and therefore cost) of the airport.

3. Long-term plan for future airport usage and expansion

    It may seem obvious to state that operational constraints are an integral component of future levels of airport capacity but it nonetheless needs to be stressed that both the implications of the DVO in its current form and possible increases in the extent of the DVO need to be considered as integral components of future airport development plans.

List of Abbreviations

Acceptance Rate	Landing capacity per hour (or other specified time period)
'Actual' Capacity	see definition on page 5
AEA	Association of European Airlines
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Movement or Air Transport Movement
Block Time	Time from push-back from departing airport gate to arrival at destination gate
CAT	Category of landing aid system
CO2	Carbon Dioxide
Control Interval	Time period (expressed in minutes) determining the maximum admissible number of landings and/or departures during the specified length of time (5, 10, 30 or 60-minute intervals at Zurich airport)
'Coordinated' Capacity	see 'Declared' Capacity as defined on page 5
CRS	Computer Reservation System
'Declared' Capacity	see definition on page 5
DVO	Durchführungsverordnung zur Luftverkehrsordnung – Ordinance on air traffic regulation which became effective in several stages from October 2001 to April 2005 and which initiated the setting of limits in relation to the use of airspace over Southern Germany
Equity Risk Premium	Difference between the expected equity market rate of return and the Risk-Free Rate of return
Eurocontrol	European Organisation for the Safety of Air Navigation
FOCA	Federal Office for Civil Aviation (BAZL – Bundesamt für Zivilluftfahrt)
GATO 14/16	Go-Around and Take-Off procedures for runways 14 and 16 – safety regulation at Zurich airport introduced by the Federal Office for Civil Aviation
IATA	International Air Transport Association
Localiser	Instrument landing system informing the pilot about aircraft's lateral position
MET	Aeronautical Meteorology
NOx	Nitrogen Oxide
NPV	Net Present Value – value in today's money of a future stream of income or costs
PR	Public Relations
Reactionary Delay	Knock-on effect of original delay

Risk Free Rate	Interest rate that can be obtained by investing in financial instruments with no risk (in this report assumed to be the relevant 10-year Government bond rate)
SCS	Slot Coordination Switzerland
'State Contract'	Proposed (but never ratified) bilateral airspace agreement between Switzerland and Germany regulating the use of German airspace for flights to and from Zurich airport, intended to replace the previous administrative agreement between the two countries of 1984 on air approaches to Zurich which was terminated by Germany effective May 2001
'Theoretical' Capacity	see definition on page 5
WACC	Weighted Average Cost of Capital – see formula on page 13
ZEUS	In-house computer information system of the airport operator Unique (Flughafen Zurich AG)