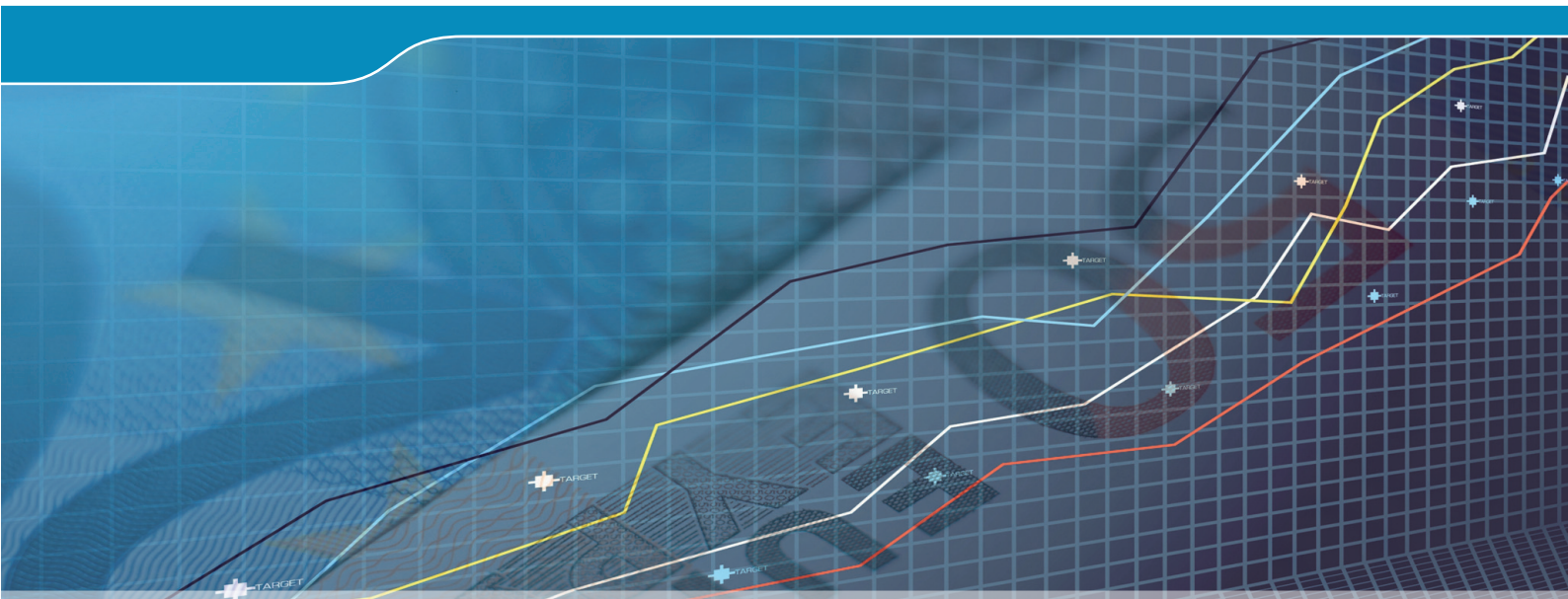


Standard Inputs for EUROCONTROL Cost Benefit Analyses

Edition Number: 4.0
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Cooperative Network Design



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Abstract		
<p>This document provides values for commonly used data items in cost-benefit analyses, together with details of the sources and a discussion of the applicability and use of the values.</p> <p>The values have been compiled from publicly available documents. They are average values and may not be appropriate in all circumstances.</p>		
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DOCUMENT APPROVAL

The following table identifies all management authorities who have successively approved the present issue of this document.

AUTHORITY	NAME AND SIGNATURE	DATE
Martine Blaize Head of Performance & Methods		22/10/09
Ian Middleton Deputy of Centre of Expertise	 IAN MIDDLETON	29 Oct 09
Bo Redeborn Director of CND		30/10/09

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION NUMBER	EDITION DATE	REASON FOR CHANGE	PAGES AFFECTED
0.1	31/07/02	Working Draft	All
1.0	23/09/02	Revised and upgraded to Released Issue	All
2.0	02/04	Updated to 2004 values	All
3.0	06/07	Updated to 2006 values	All
4.0	10/09	Updated to 2009 values	All

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INTRODUCTION

This document provides a set of standard inputs for commonly used data items in EUROCONTROL cost-benefit analyses (CBAs). The standard inputs will save time in the development of CBAs and will also help to achieve a greater consistency and comparability between different CBAs.

The data items are listed in the summary on page 7 along with a value, or range of values, for each. In some cases, where the value would quickly become outdated or where large datasets are involved, a reference to a source is given.

The standard inputs have been compiled from publicly available documents. They are **average** values and will not be appropriate in all circumstances.

The remainder of the document gives details of the sources and a discussion of the applicability and use of the values.

Details per Data Item

For each data item, the following information is given:

Explanation: A brief definition and explanation of the meaning of the parameter.

Value: The recommended value of the item as listed on Page 5. In some cases, there may be differing values from other sources in addition to this recommended value. These values will be given here for comparison.

Date: The date when the data was published as valid.

Source of data: The source of all values of data above.

Discussion: Any details as to how the value was computed or derived. This information is not available in all cases.

Applicability: Details of the group over which the value has been averaged (eg Europe) and advice on when and how to use value (eg valid under certain assumptions only).

Comparison with other industries: If data is available, the value is compared to values for similar parameters used for road or rail CBAs.

Comments: Any issues or further comments regarding the source or derivation of the value are noted. The degree of confidence in the value and limitations to its use are discussed.

Inflation and Exchange Rate Conversion

All values (unless otherwise indicated) are given in euro at 2008 price levels and have been inflated from values given in the source documents using the June value of the harmonised index of consumer prices (HICP) presented on the EUROSTAT web site. The annual change in the index is shown below. The values of the index are available on:

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=teicp000>

Year	Rate
mid-2008 to mid-2009	0.6%
mid-2007 to mid-2008	4.3%
mid-2006 to mid-2007	2.1%
mid-2005 to mid-2006	2.4%
mid-2004 to mid-2005	2.0%
mid-2003 to mid-2004	2.3%
mid-2002 to mid-2003	1.8%
mid-2001 to mid-2002	1.7%
mid-2000 to mid-2001	2.7%
mid-1999 to mid-2000	1.9%
mid-1998 to mid-1999	1.0%
mid-1997 to mid-1998	1.5%

Values in pounds sterling and US dollars have been converted to euro using the following euro foreign exchange reference rates for 1 December 2008 published by the European Central Bank:

Currency	Exchange rate
Sterling	1.17357
Dollars	0.70751

The exchange rates are available on:

www.ecb.int/stats/exchange/eurofxref/html/index.en.html

For further information

For any questions relating to this document, please contact EUROCONTROL via the EUROCONTROL CBA website:

www.eurocontrol.int/ecosoc/public/standard_page/cba.html

SUMMARY

Page	Item	EUROCONTROL recommended value (2009 price levels)
Operational Values		
9	Delay costs	Refer to page 9
15	Cost of distance flown	Average cost € 8.8 per km Marginal cost € 10.7 per km
16	Passenger value of time	€ 43 - € 55 per hour
19	Cancellation cost	Refer to page 19
20	Diversion cost	Refer to page 20
21	Passenger distribution	Business 49% Personal convenience 16% Tourism 35%
22	Flight duration	1.46 hours
23	IFR flight distance	824 km
24	Passenger load factor	65% - 82%
26	Overall load factor	69%
27	Rate of fuel burn	Refer to page 27
29	Aircraft operating costs	Refer to page 29
Accident-related		
31	Accident/incident statistics	Refer to page 31
32	Value of avoided fatality	Refer to page 32
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Economic		
35	Cost of fuel	Refer to page 35
36	Exchange rates	Refer to page 36
37	Discount rate	8% (for constant price cash flows)
Environmental		
38	Amount of pollutants released by fuel burn	Refer to page 38
39	Cost of pollutants	Refer to page 39
42	Cost of noise	€ 65 - € 333 per aircraft event

Standard Inputs for EUROCONTROL Cost Benefit Analyses

Page	Item	EUROCONTROL recommended value (2009 price levels)
Traffic and Capacity		
45	Fleet size	Refer to page 45
47	Fleet age	Refer to page 47
49	Traffic statistics and forecasts	Available from EUROCONTROL STATFOR
51	Number of flights	10.1 million flights in ECAC during 2008
53	Value of an additional flight	€ 700
54	Delay statistics	Refer to page 54
55	Distance flown by charging area	Refer to page 55
57	Medium term capacity planning	Refer to DMEAN, ECIP and LCIP documents
Ground Infrastructure		
58	CNS infrastructure	Refer to page 58
60	Asset lives	Refer to page 60
61	ATM cost-effectiveness indicators	Refer to page 61
62	Ground handling times	29 - 90 minutes
General information		
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DELAY COSTS

Explanation

The average cost per minute to the airline of delaying a passenger air transport aircraft.

Value [1]: The following values are based on a methodology, first presented by the University of Westminster in a report published in 2004, and updated during 2008 by means of a series of technical discussion documents.

	Tactical without network effect		Tactical with network effect		Strategic	
	Ground	Airborne	Ground	Airborne	Ground	Airborne
Delay costs per minute (€)						
Fuel costs	0	35	0	35	2	38
Maintenance costs	0	1	1	1	-	12
Crew costs	8	8	9	9	9	9
Ground and passenger handling	-	-	-	-	-	-
Airport charges	0	-0	0	0	-	-
Aircraft ownership costs (DRL)	-	-	-	-	14	14
Passenger compensation	22	22	39	39	-	-
Direct cost to an airline	30	65	49	84	25	73
Passenger opportunity cost	22	22	39	39	-	-
Overall cost	52	87	88	123	25	73

“-“ indicates the item is not relevant whilst “0” means that the cost is less than €½ per minute

Date: 2008

Source: University of Westminster for the EUROCONTROL PRC, ‘Evaluating the true cost to airlines of one minute of airborne or ground delay’, May 2004

www.eurocontrol.int/prc/gallery/content/public/Docs/cost_of_delay.pdf

Updated in Technical Discussion Documents 5, 6 & 9 for the EUROCONTROL CARE INO III programme, October, November & June 2008 respectively.

Value [2]:

	Marginal Crew Costs	Total Crew Costs
Primary delay ¹ cost	€ 50	€ 82
Reactionary delay cost	€ 35	€ 35
Composite (primary + 2/3 of reactionary)	€ 73	€ 105

(Adjusted from 1999 prices)

Date: Study estimated 1999 costs.

Source: “Costs of Air Transport Delay in Europe”, ITA, November 2000

www.eurocontrol.int/prc/gallery/content/public/Docs/stu2.pdf

Value [3]:

	Long Delay	Short Delay
Airborne Delay	€ 49	€ 23
Ground Delay	€ 31	€ 6

(Adjusted from 2000 sterling prices)

Date: Values are based on 1997 financial data, adjusted in the source document to 2000 prices and further adjusted in this document to 2009 prices.

Source: "Delay costs based on UK Airline actual P&L figures", SS4 Working Paper on Delay Cost Methodology, UK Civil Aviation Authority, Spring 2000

Value [4]:

Airborne Delay	€ 47
Ground Delay	€ 29

(Adjusted from 2000 prices)

Date: Values based on 2000 data.

Source: "Cost of a minute delay (in Europe) – 2000 update", IATA, 2000

Value [5]: GA aircraft costs: AOPA Germany surveyed its members on the cost of delay for GA aircraft. Values are presented in terms of operating cost per flight hour or revenue per flight hour. These are not necessarily the 'costs of delay' but may be useful in assessing the impact of delay on GA users.

Private travel	Sight-seeing	Sport	Business	Training	Aerial work	Air rescue	State aircraft	Other	Total
€ 130	€ 144	€ 85	€ 846	€ 187	€ 843	€ 2009	€ 1435	€ 893	€ 332

Date: Values are for 2001

Source: AOPA Germany

Discussion

Source [1]: The University of Westminster Report, commissioned by the EUROCONTROL Performance Review Unit (PRU), was issued in 2004 and was supplemented in 2008 by a series of Technical Discussion Documents produced for the EUROCONTROL Experimental Centre as part of a programme to develop a decision-support tool for managing flight delay costs. This work represents the most recent and comprehensive appraisal of the cost of delays in the air traffic management system. It contains a detailed assessment of the delay costs for 12 specific aircraft types and also derives an estimate of the average delay cost per minute in Europe. The appraisal considers the length of the delay, where the delay is incurred and whether only the initial delay is considered or whether

the cost of reactionary knock-on effects (network effect) is included. It also considers tactical delay, ie actual observed delays and strategic delay, ie the buffer built into schedules to allow for an anticipated level of delay.

The *direct cost to an airline* represents actual monetary payments. The *passenger opportunity cost* represents the loss of potential future earnings for a single airline but, when considering the cost of delays for the whole fleet, the loss to one airline would, to a large extent, be a gain to others. However, the opportunity cost may be considered to be a valuation of the cost of delay to passengers. The passenger value of time may therefore be considered to be implicitly included in the *overall cost* value and should therefore not be included in addition to this. If one is only interested in the direct airline costs, the *direct cost to an airline* value should be used.

The values shown above are derived from a model based on the University of Westminster approach. Users may download the model and modify the value of the assumptions used. The model is available at:

www.eurocontrol.int/ecosoc/public/standard_page/documents.html

Source [2]: The Institut du Transport Aérien (ITA) study of the cost of ATFM delays in Europe was an earlier task commissioned by the Eurocontrol Performance Review Unit. ITA considered not only overt delays, ie the difference between actual and scheduled arrival times, but also the delay represented by the difference between actual and optimal schedules. The values presented below consider only overt delay.

The study is based on 1999 data and distinguishes between the cost of an initial or primary delay and the cost of consequential or reactionary delay. In deriving a cost per minute of delay, the report presents an operating staff cost element based on total crew costs and on marginal crew costs. The 'Marginal Crew Costs' values include estimates of the incremental effect of delays on crew costs. The 'Total Crew Costs' values include crew costs valued at the overall average crew cost per minute for all operations. For primary, ATFM delay (en-route or airport), the value based on marginal crew costs is suggested as being more realistic.

The study does not, however, distinguish between airborne and ground delays and thus the values are effectively a weighted average of the two. A summary of the results is presented below.

COSTS FOR AIRLINES (€/minute at 1999 price levels)	Primary Delays		Reactionary Delays
	Marginal Crew Costs	Total Crew Costs	
Aircraft operating costs	3.46	3.46	
Operating staff costs	7.07	32.82	1.92
Structural costs	7.77	7.77	4.73
Passenger driven costs	2.71	2.71	2.71
Hub & connection additional costs	14.63	14.63	14.63
Induced long term airline costs	4.50	4.50	4.50
Total	40.14	65.89	28.49

The PRU Annual Report 1999¹ indicated that 29% of delays could be classified as ATM related primary delay and 21% as ATM related reactionary delay. Thus for every minute of primary delay there is approximately 2/3 minute of reactionary delay. Assuming that a minute of primary delay generates 2/3 minute of reactionary delay and adjusting to 2009 price levels, a composite total airline unit cost of delay can be derived, as indicated below.

COSTS FOR AIRLINES (€/minute)	Primary Delays		Reactionary Delays
	Marginal Crew Costs	Total Crew Costs	
Total	40.14	65.89	28.49
At 2009 price levels	49.78	81.72	35.34
Reactionary effect (2/3 of 35.34)	23.56	23.56	-
Total	73.34	105.28	-

Source [3]: The main source of costing data was Table 2.6 of UK Civil Aviation Authority publication CAP672, which contains a detailed revenue and expenses account for all major UK airlines over their 12 month accounting period.

Cost categories affected by airborne delays were selected. Under short delays (less than 20 minutes) many of the costs can be omitted, as they are unlikely to arise.

	Airborne Delay		Ground delay	
	Long delay	Short delay (<20min)	Long delay	Short delay (<20min)
Flight crew salaries, allowances & expenses	✓		✓	
Cabin crew salaries, allowances & expenses	✓		✓	
Fuel and Oil	✓	✓		
Flight Equipment Insurance	✓		✓	
Rental of flight equipment	✓		✓	
Maintenance and Overhaul	✓	✓		
Flight Equipment Depreciation	✓	✓		
Handling charges & parking fees			✓	✓
Passenger services (eg meals)	✓		✓	

¹ Available on www.eurocontrol.int/prc/gallery/content/public/Docs/prr3.pdf

Costs per hour of delay were calculated by adding up the relevant costs and dividing by total operational hours (ie time from aircraft moving from loading block to aircraft arriving at unloading point).

This gave values of:

- Airborne delay: £34.15 /min for long delays
£16.43 /min for short delays
- Ground delay: £21.73 /min for long delays
£4.16 /min for short delays

Source [4]: The IATA Airlines Economic Task Force suggested that the cost per minute of delay be taken as being the same as the average aircraft direct operating cost per minute and presented values based on a collection of member airlines' costs. The difference between the ground and airborne costs is accounted for by the fuel and maintenance costs. Delay costs produced on this basis do not, therefore, take account of induced costs (eg passenger compensation) or the difference between primary and reactionary delay.

The original IATA delay cost estimates were based on a cost table compiled by the IATA Cost committee in 1996 (see page 29). IATA have subsequently advised on revisions to the final delay cost value. There is no consideration of the penalties associated with late delivery of cargo as this type of data is not yet readily available. In June 2002, IATA advised that the values based on 2000 costs were as follows:

- Ground cost of ATFM delay: € 24 per minute
- Cost of additional flight time/delay in the air: € 40 per minute

Source [5]: These values are the results of a questionnaire sent out in 2002 to 400 German aircraft owners, which were chosen in an anonymous and representative way by DFS. The figures are for 2001. Cost-figures for "Sport" are low because gliders and ultralights are included. Many business flights are not commercial because companies use their own aircraft in corporate aviation.

Applicability

All values are for average European flights.

Comments

The cost of delay is an important and controversial value as it is frequently used to quantify the benefits of investments in Air Traffic Management/Communication, Navigation, and Surveillance and, hence, to justify these investments. For ECAC studies, the EUROCONTROL Agency recommends the use of Source [1] as its values have been adopted in key performance indicators presented by the Performance Review Commission and agreed by the Agency Permanent Commission.

Authors of cost benefit analyses will find the Westminster Report a valuable source of information for assessing delay costs but must choose the appropriate delay category for their particular study and should also update the values to allow for changes since 2002. To assist with this, EUROCONTROL has prepared a delay model.

See www.eurocontrol.int/ecosoc/public/standard_page/documents.html

Delay costs do not necessarily accrue linearly with time. It may be considered prudent to apply the values from Source [1] to delays of 15 minutes and above but to apply a zero cost to delays below 15 minutes. Arguably, the values from sources [2] and [4] are only applicable to 'long' delays since they include costs that are unlikely to arise for short delays (eg crew salaries and expenses). Source [3] quotes different values for long and short delays.

The knock-on effects of delay should be considered. Sources [1] and [2] quote separate values, whilst Source [3] has used the PRC 69% estimate for the knock-on effect. Source [4] does not take this effect into account.

Different sources include different costs in their evaluation. Source [1] states that "comparison with the IATA evaluation (ie source [3]) would prove extremely difficult, if not impossible, since IATA evaluation does not include ground personnel, ground equipment, passenger driven and hub and connection additional cost items".

It should be noted that the values in source [5] are now quite old and are based on the results of a questionnaire which may or may not be representative. In addition, there may be a considerable range of values for each category. Therefore, these numbers should be treated with great caution.

The use of the value of delay savings as a method of evaluating the benefits of ATM investments may be less appropriate once changes in the level of service reach such levels that the air transport system will make structural changes to its behaviour.

COST OF DISTANCE FLOWN

Explanation

The average cost to an airline of flying a kilometre with a passenger air transport aircraft.

Value: Average cost per kilometre - € 8.8
Marginal cost of an incremental kilometre - € 10.7

Based on data and a methodology presented by the University of Westminster in a report published in 2004 and updated during 2008.

Date: 2008

Source: University of Westminster for the EUROCONTROL PRC, 'Evaluating the true cost to airlines of one minute of airborne or ground delay', May 2004

www.eurocontrol.int/prc/gallery/content/public/Docs/cost_of_delay.pdf

Updated in Technical Discussion Documents 5, 6 & 9 for the EUROCONTROL CARE INO III programme, October, November & June 2008 respectively.

Discussion

The value is based on the same data and methodology used to derive Value [1] for the cost of delay (see page 9), but the data is used to derive the cost of flying a kilometre rather than flying for a minute.

PASSENGER VALUE OF TIME

Explanation

The value to a passenger of time spent travelling.

Value [1]: € 43 - € 55 per hour per passenger (adjusted from 1999 prices)

Date: Study estimated 1999 costs.

Source: "Costs of Air Transport Delay in Europe", ITA, November 2000
www.eurocontrol.int/prc/gallery/content/public/Docs/stu2.pdf

This source is recommended by EUROCONTROL.

Value [2]:

	Private Travel	Business Travel
Travel time	€ 25 per hour	€ 32 per hour
Waiting time between departures	€ 3 per hour	€ 11 per hour

The value of time (VOT) for delays is assumed to be 50% higher than the VOT for travelling time. (Values adjusted from 1999 prices).

Date: Values based on a study performed in 1997 (Ramjerdi et al).

Source: "Methods for Economic Appraisal in the Norwegian Aviation Sector", NCAA, October 1999

Value [3]:

	Air Carrier	General Aviation
Personal	€ 17	€ 23
Business	€ 31	€ 33
All purposes	€ 24	€ 28

(Adjusted from US\$ 1998 prices)

Date: 1998 costs.

Source: "Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs", FAA, 1998

Discussion

Source [1]: The average value of time was estimated based on the estimated distribution of passengers according to travel purpose as defined in "Passenger distribution", page 21.

Purpose	VOT per hour (€)	
	Low	High
Business	47	63
Personal convenience	28	33
Tourism	20	23
Average	34	44

Note that the difference between “personal convenience” and “tourism” is not defined in the source document.

Values were then inflated to give 2009 prices.

Source [2]: The value of travel time that might alternatively be spent working has been calculated by applying gross wage costs. For leisure travel, the approach has been to apply the net wage rate, since that is the amount the wage earner must sacrifice to have additional leisure time.

The values in the source document are assumed to have been adjusted to 1999 prices. These values were then inflated to give 2009 prices.

Source [3]: The value of passenger time saved or lost as a result of investments in transportation facilities or regulatory actions. It is based upon guidance furnished by the Office of the Secretary of Transportation (OST) (“Departmental Guidance for the Valuation of Travel Time in Economic Analysis,” Office of the Secretary of Transportation Memorandum, April 9, 1997).

For air carrier passengers, the time values are derived from the Air Transport Association of America Air Travel Survey, last conducted in 1993, escalated by the increase in median annual income to U.S. households from 1993 to 1995 as reported in Bureau of the Census, Current Population Reports, Money Income of Households, Families, and Persons in the United States, Series P-60. The value for personal travel is 70 percent of the weighted average of annual income categories in the survey for “visit friends,” “sightseeing,” and “other” travel divided by an assumed 2000 hours of work per year. The value for business travel is 100 percent of the annual income category in the survey for “business” divided by 2000 hours of work per year. When considering general aviation passengers as a separate category, a value of 70 percent of the median hourly income of AOPA members is established for personal travel and 100 percent of median hourly income for business travel.

The fractions of 70 percent and 100 percent were recommended by a panel of transportation economists. High and low values representing a plausible range of values based on variation in panel member opinions are provided for use in conducting sensitivity analysis.

	Air Carrier (cost per hour)	General Aviation (cost per hour)
Personal	\$19.50	\$26.30
Business	\$34.50	\$37.50
All purposes	\$26.70	\$31.10

Comments

Source [3] gives marginal values ie value of passenger time saved or lost. Source [2] gives separate values for time spent travelling and value of time for delays. It is unclear whether source [1] gives values which are marginal values or average values.

CANCELLATION COST

Explanation

The average cost of cancelling a commercial scheduled flight.

Value [1]: Typical values are:

- 50 seat narrow body aircraft - € 3,400
- 120 seat narrow body aircraft - € 16,000
- 400 seat wide body aircraft - € 75,000 (intercontinental flight)

Date: Derived from an analysis of 2006 data

Source: Data supplied by airline members of SESAR evaluation team.

Value [2]: € 7,000 per cancellation (adjusted from 1999 prices)

Date: Value was developed in 1999.

Source: "EGNOS Multi-Modal Costs and Benefits, A study of the aviation case in ECAC" European Tripartite Group, Version 2.0, 13 December 1999

www.eurocontrol.int/ecosoc/public/standard_page/airspace.html

Discussion

Source [1] The values refer to cancellation on the day of operation and include:

- service recovery costs (passenger vouchers, drinks, telephone, hotel)
- interline costs (rebooking revenue)
- loss of future value (individual passenger delay expressed in value)
- operational savings (fuel, en-route charges, crew facilities, handling outstations, lounges outstations, board supplies)

Costs not included are ground handling costs, missed connection compensation, denied boarding compensation and luggage delivery costs.

Source [2] The value was developed for the EGNOS CBA in order to assess the cost to commercial airlines of the disruption caused by low visibility at airports where a Category I ILS was not available.

Applicability

ECAC

Comments

Note that these values should be treated as rough estimates. There is no consideration of the penalties associated with late delivery of cargo as this type of data is not yet readily available.

DIVERSION COST

Explanation

The average cost of a diversion for commercial scheduled traffic.

Value [1]: Regional flights € 750 - € 5,400
 Continental flights € 1,000 - € 8,000
 Intercontinental flights € 5,400 - €59,000

Date: Derived from an analysis of 2006 data

Source: Data supplied by airline members of SESAR evaluation team.

Value [2]: € 5,000 per diversion (adjusted from 1999 prices)

Date: Values were developed in 1999.

Source: "EGNOS Multi-Modal Costs and Benefits, A study of the aviation case in ECAC," European Tripartite Group, Version 2.0, 13 December 1999
www.eurocontrol.int/ecosoc/public/standard_page/airspace.html

Discussion

Source [1] Typical values are:

- 120 seat narrow body aircraft € 5,000
- 400 seat wide body aircraft € 17,000

Source [2] The value was developed for the EGNOS CBA based upon a study by the STNA for France and modified on the advice of IATA. The basic elements in the derivation of the value are shown below.

Time lost (min)	Cost/min (€)	No of passengers	Cost/pax/hr (€)	Total (€)
50	24	43	80	4 067

Applicability

ECAC

Values are average European values. Actual values may vary considerably depending on location.

Comments

There is no consideration of the penalties associated with late delivery of cargo as this type of data is not yet readily available.

PASSENGER DISTRIBUTION

Explanation

Average passenger traffic distribution according to travel purpose.

Value:

Motive	Proportion
Business	49%
Personal convenience	16%
Tourism	35%

Date: November 2000.

Source: "Costs of Air Transport Delay in Europe", ITA, November 2000

www.eurocontrol.int/prc/gallery/content/public/Docs/stu2.pdf

Discussion

Distribution was estimated based on several surveys carried out by ITA, among the population of the major European countries.

Applicability

Europe

FLIGHT DURATION

Explanation

Average flight hours per flight in EUROCONTROL area.

Value: 1.42 hours.

Date: Values are based on 2008 data

Source: "Performance Review Report, PRR 2008", Performance Review Commission, May 2009

www.eurocontrol.int/prc/public/standard_page/doc_prr.html

Discussion

Figure 8 paragraph 2.2.3 of the source gives the number of flights and flight hours:

IFR flights in Europe	10.1 million
IFR flight hours in Europe	14.3 million

Dividing the number of flight hours by the number of flights gives a value of 1.42 for the average flight hours per flight.

Applicability

Aircraft operating under IFR in Europe.

IFR FLIGHT DISTANCE

Explanation

Average distance per flight.

Value: 876km (473Nm) in EUROCONTROL States.

Date: Based on 2008 data

Source: "Performance Review Report, PRR 2008", Performance Review Commission, May 2009

www.eurocontrol.int/prc/public/standard_page/doc_prr.html

Discussion

Figure 8 in paragraph 2.2.3 of the source gives the number of IFR flights and total distance flown in 2007:

IFR flights in Europe	10.1 million
Distance charged (km)	8,851 million

Dividing the distance charged by the number of flights gives an average distance per flight of 876km.

Applicability

Aircraft operating under IFR.

PASSENGER LOAD FACTOR

Explanation

The percentage of seating capacity that is utilised.

Value [1]: International scheduled air traffic: 75%

Date: Value for the year to September 2009

Source: International Air Transport Association (IATA) web site - Pressroom
www.iata.org/pressroom/facts_figures/traffic_results/2009-09-29-01.htm

Value [2]: European routes: 70.5%

Long haul: 82.4%

Date: Values for the year 2007

Source: "Summary Report, Operating Economy of AEA Airlines 2007",
Association of European Airlines (AEA), December 2007
<http://files.aea.be/RIG/Economics/DL/SumRep07.pdf>

Value [3]: Regional scheduled services: 64.5%

Date: Average value for 2008

Source: European Regions Airline Association (ERA) press release "Crisis hits
regional airlines as demand slumps", 1 April 2009
www.eraa.org/news/erapressreleases/090401_Traffic_Figs_Year-End_08.php

Value [4]: Low cost airlines: 82.9%

Date: June 2009

Source: European Low Fares Airline Association (ELFAA) web site
www.elfaa.com/statistics.htm

Discussion

The value is computed by dividing revenue passenger-kilometres flown by available seat-kilometres flown on revenue passenger services.

Applicability

Source [1]: International scheduled air traffic. Domestic flights are excluded. The source also provides values for major geographical regions.

Source [2]: AEA airlines

Source [3]: Regional scheduled services

Source [4]: Low fares airlines

Comments

The AEA Summary Report and ELFAA web site, noted above, provide a range of operating statistics for member airlines. Similarly, a wide range of statistics for IATA and ERA member airlines is available at:

www.iata.org/pressroom/facts_figures and
www.eraa.org/fly-europe/statistics.php respectively.

OVERALL LOAD FACTOR

Explanation

The percentage of total capacity for passengers, freight and mail that is sold and utilised.

Value: 69.1%

Date: Value for 2007

Source: Association of European Airlines (AEA) web site - Research and Statistics

www.aea.be/research/traffic/index.html

Discussion

The value is computed by dividing total revenue tonne-kilometres actually flown by total available tonne-kilometres.

Applicability

All AEA airlines.

Comments

The AEA web site, noted above, provides a wide range of operating statistics for AEA member airlines.

RATE OF FUEL BURN

Explanation

Average rate of fuel burn for aircraft.

Value [1]: Fuel burn (kg/hr) by phase of flight:

Phase	APU only	statnry ground	active taxi out	en-route			arrival management		
				50% low	65% base	80% high	50% low	65% base	80% high
load (% max payload weight)	n/a	from 50% to 80%	from 50% to 80%	50% low	65% base	80% high	50% low	65% base	80% high
B737-300	115	690	900	2 355	2 436	2 523	2 656	2 731	2 814
B737-400	115	690	900	2 337	2 410	2 498	2 504	2 588	2 676
B737-500	115	690	900	2 169	2 224	2 288	2 483	2 530	2 584
B737-800	115	690	900	2 485	2 572	2 668	2 038	2 187	2 229
B757-200	150	820	1000	3 195	3 311	3 417	2 685	2 789	2 867
B767-300ER	150	1 120	1400	4 514	4 726	4 941	3 735	3 908	4 093
B747-400	280	2 700	3400	9 484	9 809	10 125	7 198	7 421	7 647
A319	120	630	720	2 240	2 304	2 374	1 791	1 854	1 919
A320	120	630	720	2 279	2 355	2 429	2 002	2 074	2 151
A321	120	730	840	2 695	2 788	2 885	2 524	2 625	2 728
ATR42	95	102	120	419	433	447	382	392	404
ATR72	95	240	300	628	630	640	498	504	512

Date: May 2004

Source: "Evaluating the true cost to airlines of one minute of airborne or ground delay", University of Westminster, May 2004

www.eurocontrol.int/prc/gallery/content/public/Docs/cost_of_delay.pdf

Value [2]: Chapter B851 of the emission inventory guidebook (http://reports.eea.eu.int/EMEP_CORINAIR4/en/B851vs2.4.pdf) gives values for emission factors and fuel consumption during different phases of flight including taxi for different aircraft types using three different levels of accuracy and complexity. Fuel burn for the "Very Simple" methodology given on a representative aircraft basis are:

Domestic: - LTO (kg/LTO) – Average fleet (B737-400)	825
International: - LTO (kg/LTO) – Average fleet (B767)	1 617
- LTO (kg/LTO) – Average fleet (short distance, B737-400)	825
- LTO (kg/LTO) – Average fleet (long distance, B747-400)	3 400

Date: Chapter is dated December 2001

Source: "EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition September 2003 UPDATE"

<http://reports.eea.eu.int/EMEPCORINAIR4/en/page002.html>

Value [3]: 4.4 tonnes per flight

Date: Value for year 2001

Source: "Forecasting Civil Aviation Fuel Burn and Emissions in Europe, Interim Report, EEC Note No. 8/2001", EUROCONTROL Experimental Centre, May 2001

http://www.eurocontrol.int/eec/public/standard_page/DOC_Report_2001_015.html

Discussion

Source [3]: Table 5 of the source document gives EUROCONTROL fuel burn study predictions:

	1999	2005	2010	2015
Daily flights	22 175	29 271	35 083	40 707
Fuel (tonnes)	99 219	125 987	144 356	155 744

This gives - 4.474 tonnes per flight for 1999 and
- 4.304 tonnes per flight for 2005
- 4.417 tonnes per flight is the interpolation for 2001.

Comments

The EUROCONTROL Global Fuel Burn Project has developed a method for forecasting commercial flight volumes, fuel burn and emissions. Forecasts have been generated for the years 2005, 2010 and 2015, within the European Civil Aviation Conference (ECAC) airspace.

More detailed information is available from EUROCONTROL BADA (Base of Aircraft Data): www.eurocontrol.int/eec/public/standard_page/proj_BADA.html

BADA (Base of Aircraft Data) is an aircraft performance database. It provides a set of ASCII files containing performance and operating procedure data for 186 different aircraft types. For 71 of these aircraft types this data has been developed using reference sources such as Flight Manuals, Operating Manuals, etc. These are the so-called directly supported aircraft. For the other 115 types, the data is specified to be the same as one of the directly supported aircraft. BADA is maintained and developed by the EUROCONTROL Experimental Centre (EEC) in Brétigny, France.

Rates of fuel burn for different phases of flight for individual engine types may be found in the manufacturers' datasheets in the ICAO Engine Emissions Databank at:

www.caa.co.uk/default.aspx?catid=702&pagetype=90

AIRCRAFT OPERATING COSTS

Explanation

The average cost of operating an aircraft per block hour.

Value: Aircraft operating costs (average per block hour).

Aircraft type	Total operating costs (€ per block hour)
A300-600	4,757
A319	2,857
A320	3,012
A321	3,344
A330-200	4,905
A330-300	5,040
A340-300	5,398
A340-600	6,427
ATR-42	1,518
ATR-72	1,992
B-727-200	3,470
B-737-200	2,633
B-737-200C	3,679
B-737-300/700	2,641
B-737-400	2,982
B-737-800	2,098
B-737-500	2,751
B747-100	10,278
B-747-200	11,164
B-747-400	8,960
B-757-200	3,558
B-767-200	4,263
B-767-300	4,503
B-777-200	5,498
BAE 146-300	3,425
CRJ-100	1,920
CRJ-200	1,499
DC-9-10	2,678
DC-9-30	2,858
DC-9-40	2,170
DC-9-50	2,317
DC-10-10	6,925
DC-10-30	7,908
DC-10-40	7,194
DHC 8-100	1,430
EMB-120	1,387
ERJ-135	1,185
ERJ-145	1,340
MD-11	6,116
MD-80	3,028
MD-87	2,412
MD-90	3,626
L-1011-500	5,549

(Adjusted from 2000 prices and converted to euro from US\$)

Date: Summer 2000

Source: ICAO Base-line Aircraft Operating Costs, Summer 2000

www.icao.int/icao/en/ro/allpirg/allpirg4/wp28app.pdf

Discussion

The figures provided above are the costs per hour, calculated by ICAO, for operating a number of aircraft models.

ACCIDENT/INCIDENT STATISTICS

Explanation

The number of aviation accidents and incidents per year.

Source [1]: Eurocontrol, SRC Document 2: Ed. 4.0 “Aircraft Accidents/Incidents and ATM Contribution: Review and Analysis of Historic Data”, May 2005

www.eurocontrol.int/src/gallery/content/public/documents/deliverables/srcdoc2_e40_ri_web.pdf

Source [2]: ASN Aviation Safety Database

<http://aviation-safety.net/database/>

Source [3]: Performance Review Commission

www.eurocontrol.int/prc/public/standard_page/doc_prr.html

Discussion

Source [1]: SRC Document 2 presents a comprehensive summary of data on accidents and incidents largely derived from:

- “World Aircraft Accident Summary”, Civil Aviation Authority (CAA) [now published by Airclaims Ltd. - ISSN 1366-6800]
- “ADREP” database, International Civil Aviation Organisation
- “Aviation Safety Network” database: aviation-safety.net/index.shtml

In addition, further information on ATM safety is provided on the Safety Regulation Commission web site: www.eurocontrol.int/src/public/subsite_homepage/homepage.html

Source [2]: The ASN Aviation Safety Database contains a large volume of incident statistics classified by time, cause, location and aircraft type.

Source [3]: The annual performance review reports issued by the Performance Review Commission provide an annual review of ATM safety performance in Europe.

VALUE OF AVOIDED FATALITY

Explanation

The average value of an avoided statistical fatality.

Value [1]: € 4.3 million per fatality averted (adjusted from US\$ at 2007 price levels)

Date: 2008

Source: "Revised Departmental Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses", US Department of Transportation, February 2008

www.faa.gov/regulations_policies/policy_guidance/benefit_cost/

Value [2]: € 2.5 million (adjusted from 1999 prices)

Date: 1999

Source: "Methods for Economic Appraisal in the Norwegian Aviation Sector", Norwegian CAA, October 1999

Value [3]: Proposed UNITE (UNification of accounts and marginal costs for Transport Efficiency, project funded by 5th Framework RTD Programme) value of statistical life (VOSL) by country and compared to official values in the state concerned (adjusted from 1998 prices):

Country	Official values in use (€m)	UNITE VOSL (€m)
Austria	1.93	2.13
Belgium	0.51	2.12
Denmark	0.65	2.27
Estonia	n.a.	0.81
Finland	1.14	1.95
France	0.78	1.89
Germany	1.11	2.06
Greece	0.18	1.26
Hungary	n.a.	0.94
Ireland	1.32	2.07
Italy	n.a.	1.92
Luxembourg	n.a.	3.35
Netherlands	0.16	2.15
Norway	1.90	2.44
Portugal	0.04	1.42
Spain	0.07	1.53
Sweden	1.89	1.94
Switzerland	n.a.	2.31
United Kingdom	1.94	1.93

Official values based on EUNET from 1994

Date: 1998

Source: "The Cost of Unsafety", ASTER WP3, prepared by NEI Transport, Airclaims and NLR for the European Commission DG Transport and Energy, March 2001

Discussion

Source [1]: The source document reviews a number of studies of the value of a statistical life and derives a mean value to be used by analysts in the US Department of Transportation when assessing the benefit of preventing fatalities.

The benefit of preventing a fatality is measured by the Value of a Statistical Life (VSL), defined as the value of improvements in safety that result in a reduction by one in the expected number of fatalities. Estimates of VSL are derived from the concept of individual willingness to pay (WTP) for small reductions in risk.

Comments

Values may be compared with examples of actual payouts from aircraft accidents:

- The estimated compensation paid to each of the families of the victims of the Concorde disaster in 2001 was of the order of \$1million.
- Singapore Airlines offered to pay compensation of \$400,000 each to the families of those killed when one of its Boeing 747 airliners crashed in Taiwan in 2000. The relations of the victims were believed to be seeking \$600,000 each.

VALUE OF AVOIDED INJURIES

Explanation

The average value of avoiding injuries.

Value: A proportion of the value of a statistical life (see Value of Avoided Fatality, Value [1]), depending on the severity of the injury. Injuries are categorised according to the Abbreviated Injury Scale (AIS).

MAIS Level	Severity	Fraction of VSL
MAIS 1	Minor	0.0020
MAIS 2	Moderate	0.0155
MAIS 3	Serious	0.0575
MAIS 4	Severe	0.1875
MAIS 5	Critical	0.7625
MAIS 6	Fatal	1.0000

MAIS (Maximum Abbreviated Injury Scale) refers to the highest level injury received by an accident victim.

Date: 2008

Source: "Revised Departmental Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses", US Department of Transportation, February 2008

www.faa.gov/regulations_policies/policy_guidance/benefit_cost/

Discussion

Injuries are classified into six categories on the Abbreviated Injury Scale (AIS), from AIS Code 1 for minor injuries to AIS Code 6 for fatal injuries. To establish a valuation for each injury level, the level is related to the loss of quality and quantity of life resulting from an injury typical of that level. This loss is expressed as a fraction of a fatality. Willingness to pay (WTP) to avoid an injury of a particular level is estimated by multiplying the fraction by the value of life.

The technique relies on a panel of experienced physicians to relate injuries in each AIS level to the loss of quality and quantity of life involved, a scaling termed Quality-Adjusted Life-Years (QALYs). Besides the psychic disutility represented by lost QALYs, lost market earnings and household productivity have been estimated and assigned to AIS categories.

For a fuller description of the method refer to the source document.

COST OF FUEL

Explanation

Current price of aviation fuel.

Source [1]: IATA Fuel price analysis

www.iata.org/whatwedo/economics/fuel_monitor/price_analysis.htm

Source [3]: US Energy Information Administration

www.eia.doe.gov/emeu/international/contents.html

Source [4]: Aviation Research Group

www.aviationresearch.com/Free/fuel_survey.asp

Source [5]: Air Nav

<http://airnav.com/fuel/report.html>

Discussion

Information on fuel prices is available in two forms, as a spot price at a port and as a retail price at an airport. The spot price is that paid by traders for fuel delivered at the port. The airport retail price is that offered to aircraft operators and includes the costs of transport to the airport, taxes, fees and suppliers margins, etc. This may be the price paid by small aircraft operators but large operators are normally able to negotiate substantial discounts with suppliers. These discounts are commercially sensitive and not generally disclosed.

Source [1]: The IATA web site provides jet fuel prices for the major regions of the world, together with analysis and commentary. The values are based on Platts Energy Market Data (www.platts.com).

Source [3]: The US Energy Information Administration web site provides kerosene-type jet fuel spot price data for three harbour regions in the USA together with Rotterdam and Singapore.

Source [4]: The Aviation Research web page gives results of a fuel price survey of US fuel suppliers performed monthly. This survey is conducted by Aviation Research Group/US Inc (ARG/US) and reflects prices reported from Fixed Base Operators in several regions of the USA. Prices are full airport retail prices and include all taxes and fees.

Source [5]: The Air Nav web page presents a summary of airport retail prices for the most recent 84 days for nine US locations.

Useful factors

- 1 US gallon = 3.7854 litres
- density of kerosene = 0.81 gm/cc
- Thus 1 tonne of fuel has a volume of 1 235 litres or 326 US gallons.

EXCHANGE RATES

Explanation

Current exchange rates.

Source [1]: Foreign Exchange Currency Converter: www.oanda.com/convert/classic

Source [2]: European Central Bank: www.ecb.int/stats/exchange/eurofxref/html/index.en.html

Source [3]: Financial Times: <http://markets.ft.com/ft/markets/currencies.asp>

Discussion

Source [1]: The current rates for 164 states may be found using the currency converter. This is a multi-lingual currency converter with up-to-date exchange rates provided by leading market data contributors and is filtered for validity.

Source [2]: The European Central Bank calculates daily euro foreign exchange reference rates, based on weighted averages of bilateral euro exchange rates against 22 major trading partners of the euro area.

Source [3]: The Financial Times web site provides current market prices (within 10 minutes) for major trading currencies and previous day closing market prices for all world currencies. There is also a currency converter.

DISCOUNT RATE

Explanation

The annual rate used to discount a stream of cash flows in order to calculate their Net Present Value (NPV).

Value: 8% (for constant price cash flows)

Date: 2006

Source: Recommendation by EUROCONTROL

Discussion

A discount rate has three components:

- a basic, risk free time value of money (traditionally of the order of 2.5%)
- compensation for the erosion of the principal by inflation
- a premium for risk

The inflation element should only be included if the cash flows are expressed in 'money of the day' and should be excluded if the cash flows are expressed at constant price levels.

The assessment of the risk premium depends on the judgement of the investor and could only be analysed over a portfolio of investments. In the case of investment in an air traffic management system, the risk being evaluated is the risk that the system will operate successfully and generate the benefits expected. It is not related to the commercial viability of aircraft operators using the system.

Applicability

The value is used in EUROCONTROL business cases for investment in ATM and is applied to costs incurred and benefits achieved by air traffic service providers, aircraft operators and any other parties involved.

Comparison to other industries

In the pre-public/private partnership era, the UK Government required NATS to generate a real (ie without inflation) return of 8% on its investments. In the USA a real rate of 7% is required. Within Europe, Cyprus, at 9%, requires one of the higher rates.

For a discussion of practice in the USA, see the White House Office of Management and Budgets Circular A-94, 'Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs': www.whitehouse.gov/omb/circulars/a094/a094.html

Comments

Since the choice of discount rate is a matter judgement, it is recommended that in project appraisal the sensitivity analysis should include consideration of the effect of differing discount rates. Note that the Internal Rate of Return (IRR) is the discount rate that will give an NPV of zero and thus gives the effective overall return on an investment over the period considered.

AMOUNT OF POLLUTANTS RELEASED BY FUEL BURN

Explanation

Amount (mass) of pollutants released by the combustion of aviation fuel.

Value [1]: The Emission Inventory Guidebook (gives values for emission factors (for CO₂, CH₄, N₂O, NO_x, CO, NMVOC, SO₂) and fuel consumption during different phases of flight including taxi for different aircraft types using three different levels of accuracy and complexity. Emission factors for the “Very Simple” methodology given on a representative aircraft basis are:

		SO ₂	CO ₂	CO	NO _x	NM-VOC	CH ₄	N ₂ O
Domestic	LTO (kg/LTO) - average fleet (B737-400)	0.8	2,600	11.8	8.3	0.5	0.1	0.1
	Cruise (kg/tonne) - average fleet (B737-400)	1.0	3,150	2.0	10.3	0.1	0	0.1
International	LTO (kg/LTO) - average fleet (B767)	1.6	5,094	6.1	26.0	0.2	0.0	0.2
	LTO (kg/LTO) - average fleet (short distance, B737-400)	0.8	2,600	11.8	8.3	0.5	0.1	0.1
	LTO (kg/LTO) - average fleet (long distance, B747-400)	3.4	10,717	19.5	56.6	1.7	0.2	0.3
	Cruise (kg/tonne) - average fleet (B767)	1.0	3,150	1.1	12.8	0.5	0.0	0.1

LTO is an abbreviation for the Landing and Take-Off cycle.

Extracted from <http://reports.eea.eu.int/EMEPCORINAIR4/en/B851vs2.4.pdf>, table 8.2

Source: EMEP/CORINAIR Emission Inventory Guidebook - 2007

European Environment Agency, December 2007

<http://reports.eea.eu.int/EMEPCORINAIR4/en/page002.html>

Value [2]: CO₂: 3,149 kg per kg fuel
H₂O: 1,230 kg per kg fuel
SO₂: 0.84 g per kg fuel

Source: “Forecasting Civil Aviation Fuel Burn and Emissions in Europe, EEC Note No. 8/2001”, Eurocontrol Experimental Centre, May 2001

www.eurocontrol.int/eec/public/standard_page/DOC_Report_2001_015.html

Value [3]: The ICAO Engine Emissions Databank provides a summary table of emissions for individual engine types with supporting data in the manufacturers’ datasheets.

Source: ICAO Engine Emissions Databank

www.caa.co.uk/default.aspx?catid=702&pagetype=90

COST OF POLLUTANTS

Explanation

The cost of CO₂ and other aircraft emissions.

Value [1]: ECX CFI Futures contract
www.europeanclimateexchange.com/pages/page435.php

Value [2]:

	Medium	Low	High
CO ₂ (per tonne)	€ 35.5	€ 11.8	€ 58.9
H ₂ O (per tonne)	€ 9.9	€ 3.2	€ 16.5
NO _x (per kg)	€ 4.3	€ 1.5	€ 7.1

Adjusted from 1999 prices

Date: 2001

Source: "Economic incentives to control the global environmental impact of European aviation/Level of the incentive", CE, Solutions for environment, economy and technology, Delft, The Netherlands. Draft preliminary study, 2 May 2001.

Value [3]: € 35 - € 140 per tonne of carbon with a central value of € 70 (adjusted from US\$ at 1999 prices).

Date: 2000

Source: "Valuing the External Costs of Aviation", UK Department of the Environment, Transport and the Regions (DETR), December 2000

Value [4]: € 45 per tonne CO₂ in year 2000, increasing to € 90 in 2010.

Date: 1999

Source: "Methods for Economic Appraisal in the Norwegian Aviation Sector", NCAA, October 1999

Value [5]: € 2.9 per 1,000 passenger kilometres
 € 17.0 per tonne kilometre

Date: 2004

Source: "External Costs of Transport", University of Karlsruhe, October 2004

Discussion

Source [1]: The EU Emissions Trading Scheme (ETS) commenced on 1 January 2005. The legal framework underpinning the European carbon market (Directive 2003/87/EC) grants the holder of one EU Allowance (EUA) the right to emit one tonne of CO₂. The amount of EUAs allocated to each emitter in the scheme are set out in National Allocation Plans prepared by the Member States and approved by the European Commission.

These plans determine the total quantity of CO₂ emissions that member states grant to companies. Participating companies can buy or sell emission allowances, thus creating a market in emission allowances and a market price.

Allowances are traded as contracts. One contract represents 1,000 tonnes of CO₂ EU Allowances/Certified Emissions Reduction units (EUAs/CERs). The value of an EUA contract stood at €15 in December 2008. A future contract for December 2012 was priced at €18.

Source [2]: The report provides an international overview of shadow prices for aircraft emissions based on the 1992 estimate by the Intergovernmental Panel on Climate Change (IPCC) of emission indices and their effects. Values were presented in euro at 1999 price levels.

Source [3]: The Intergovernmental Panel on Climate Change quoted a range of \$5 to \$125 per tonne of carbon (1990 US\$) applied to the marginal damage costs of CO₂ emissions over the period 1991-2000. Extending the range to the period 2001-2010 would increase these estimates to \$7 to \$154 per tonne of carbon.

Based on a review of relevant literature the DETR identified a range of \$40 to \$160 with a preliminary central value of \$80. This proposed range is intended to take into account the high level of uncertainty concerning the impacts of climate change and their associated distributional issues, and reflects the disproportionately higher probability of extreme climatic events.

Source [4]: Used "indirect political willingness to pay" and took the Kyoto agreement as a "constraint". Then calculated the price or tax on CO₂ that would be necessary to fulfil the Kyoto agreement for Norway's part. This means that CO₂ emissions should be stabilised on the 1990-level from 2010 on. Calculations were made by means of the macro-economic model GODMOD (Jensen 1998). The calculations showed that it would be necessary to charge € 90 per tonne CO₂ in 2010 to stabilise on the 1990-level. The main underlying assumption is that an international agreement forces all industrialised countries to charge CO₂ emissions to fulfil their part of the Kyoto agreement. If it is assumed that the charge is 0 in 1990, with a linear increment, the charge in year 2000 will be € 45. This may be seen as a compromise between the present and the future, not allowing either to take all the costs.

Source [5]: The values are taken from an extensive study by the University of Karlsruhe into the cost of transport to third parties. It is based on data collected in the 15 European Union member states in 2000, together with Norway and Switzerland, and covers other modes of transport in addition to aviation. The study considers a range of cost categories including accidents, noise, air pollution, climate change and congestion.

Applicability

Source [1]: EUROCONTROL member states

Source [2]: This source is considered to be of the most use, since for longer term strategic studies (such as CBA) the prevention cost method should be used (ie not damage cost, stated preference nor revealed preference).

Source [3]: These estimates of the external costs attributable to climate change are worldwide figures that are specific neither to a particular country nor the aviation industry.

COST OF NOISE

Explanation

Estimated noise costs per aircraft event (ie landing or take-off).

Value [1]:

Aircraft Type	Marginal Damage Costs (€)
A 310	67
A 340	152
B 737-400	67
B 747-400	333
B 757	88
B 767-300	107
B 777	65
MD82	96

Adjusted from sterling 2000 prices

Date: December 2000

Source: "Valuing the External Costs of Aviation", DETR

Value [2]: A change in noise disturbance is worth €10.9 per year per 1% reduction per person, (adjusted from 1999 prices).

Date: Based on data from 1995. Assumed adjusted to 2000 values.

Source: "Methods for Economic Appraisal in the Norwegian Aviation Sector", paper presented to the EUROCONTROL Cost Benefit Advisory Group, Norwegian Civil Aviation Authority, October 1999

Note that these values should be used with caution since they are subject to significant margins of error, as described under "comments".

Value [3]: € 2.2 per 1,000 passenger kilometres
€ 10.9 per tonne kilometre

Date: 2004

Source: "External Costs of Transport", University of Karlsruhe, October 2004

Discussion

Source [1]: The approach, known as hedonic pricing, measures householders' willingness to pay to reduce noise through house purchase prices. This attempts to identify

the premium that, other characteristics being equal, is paid for a quieter house in terms of rent or purchase price. The results of hedonic pricing studies of noise are often summarised with “noise sensitivity depreciation index (NSDI)”, which provides a measure of the percentage change in house price associated with a unit change in noise quantity measured in dBA Leq.

Values found for NSDI range between 0.5% and 1%. Pearce and Pearce derived estimates of the marginal willingness to pay (MWTP) per aircraft event for each aircraft type by adopting the NSDI value of 0.6%. By applying this value to the average house price within the Heathrow airport 57dBA daytime contour and by multiplying it by the number of resident households, an estimate was derived of overall MWTP for a 1dBA Leq reduction in the area. This figure was converted into a daily MWTP. In order to derive estimates of MWTP for the reduction of a daily movement of each aircraft type, the impact on Leq of each aircraft type was multiplied by the daily overall MWTP.

Source [2]: Values based on a WTP analysis performed in 1994 at Fornebu airport close to Oslo (Thune-Larsen 1995).

Source [3]: The values are taken from an extensive study by the University of Karlsruhe into the cost of transport to third parties. It is based on data collected in the 15 European Union member states in 2000, together with Norway and Switzerland, and covers other modes of transport in addition to aviation. The study considers a range of cost categories including accidents, noise, air pollution, climate change and congestion.

Applicability

Source [1]: Thought to be UK specific.

Source [2]: Norway.

Comparison to other industries

Comparable values of road noise are available from a study carried out in the UK by the Centre for Social and Economic Research on the Global Environment of the University of East Anglia for the Scottish Executive, “The Effect of Road Traffic on Residential Property Values: A Literature Review and Hedonic Pricing Study”, 2001.

Comments

These estimates of noise damage costs are subject to significant margins of error, due to a number of sources of inaccuracy in the derivation:

- Hedonic pricing analysis has to contend with a great many factors which cannot be fully identified by statistical methods. In addition, this method relies on an equilibrium assumption, whereby households are able to choose from a complete range of price levels and house characteristics and the housing market is cleared.
- The whole disbenefit estimated by hedonic pricing, which would in principle include night noise disbenefits, has been attributed to daytime movements.

- The noise certification levels used by Pearce and Pearce may be higher or lower than actual levels.
- WTP values are not likely to be uniform across the population, and there is likely to be an element of self-selection with people less adverse to noise (and aviation industry workers) choosing to live around airports. This means that caution should be taken in applying the results to people not currently affected by aircraft noise.
- If average damage costs are higher than marginal damage costs, estimates based on marginal damage costs will result in an underestimate of total damage costs.
- Some of the studies in the literature used to derive WTP values are now dated.

FLEET SIZE

Value [1]: Number of aircraft operating in controlled airspace in Europe, by aircraft type.

Aircraft type	Number of aircraft	Percentage of total	Cumulative percentage
A320	853	5.1%	5.1%
B738	621	3.7%	8.8%
A319	557	3.3%	12.1%
B744	527	3.1%	15.3%
B763	369	2.2%	17.5%
B772	364	2.2%	19.6%
B752	309	1.8%	21.5%
A321	300	1.8%	23.3%
A332	297	1.8%	25.0%
B733	274	1.6%	26.7%
PA34	235	1.4%	28.1%
C130	235	1.4%	29.5%
F900	232	1.4%	30.9%
BE20	219	1.3%	32.2%
A343	214	1.3%	33.4%
CL60	211	1.3%	34.7%
B737	210	1.3%	36.0%
GLF5	209	1.2%	37.2%
C172	195	1.2%	38.4%
H25B	193	1.2%	39.5%
P28A	186	1.1%	40.6%
GLF4	186	1.1%	41.7%
B734	186	1.1%	42.9%
SR22	181	1.1%	43.9%
B77W	181	1.1%	45.0%
C56X	167	1.0%	46.0%
MD11	165	1.0%	47.0%
AT72	164	1.0%	48.0%
B735	163	1.0%	48.9%
C525	157	0.9%	49.9%
DA42	148	0.9%	50.8%
Others	8,251	49.2%	100.0%
Total	16,759	100.0%	

Date: March 2009

Source: CFMU flight plans and PRISME Fleet data

Value [2]: Military fleet statistics

Aircraft type	ECAC	USA	Totals
Combat aircraft	3332	3828	7160
Large aircraft	1124	2362	3486
Light aircraft	2282	1801	4083
Helicopters	4487	5325	9812
Paramilitary	396	157	553
Totals	11621	13473	25094

Date: June 2008

Source: Military Statistics 2008, Eurocontrol Civil-Military ATM Coordination Directorate

http://www.eurocontrol.int/mil/public/site_preferences/display_library_list_public.html#6

Value [3]: Numbers of airframes operating under Visual Flight Rules (VFR)

Type of airframe	Number
Aeroplanes	15,000
Helicopter	3,600
Glider	24,000
Balloons	4,000
Microlights	40,000
Others	2,000
Total	88,600

Date: November 2008

Source: "Assessment of Airborne Impact for Civil A/C". Study carried out for EUROCONTROL by Aeroconseil in relation to the 8.33 kHz Channel Spacing Programme.

Comment

The numbers of aircraft presented in Value [1] were derived from flight plans submitted to the EUROCONTROL Central Flow Management Unit (CFMU) for flights in March 2009. Thus these aircraft were active in European airspace at that time. The information was analysed using the EUROCONTROL PRISME Fleet database to derive the aircraft types. Since the numbers in Value [1] are based on flight plans, they exclude many of the aircraft from Source [2] and, particularly, Source [3] which do not fly in controlled airspace and therefore do not submit flight plans to the CFMU.

The 16,759 aircraft in Value [1] comprise 390 different aircraft types. Of these, 50% were one of the 31 aircraft types listed.

FLEET AGE

Explanation

Age of aircraft operating in Europe.

Value: Number of aircraft by build year

Build year	Number of aircraft	Flights in March 2009
Before 1966	22	321
1966	12	166
1967	17	109
1968	22	270
1969	17	194
1970	17	108
1971	9	140
1972	16	104
1973	25	329
1974	36	416
1975	40	544
1976	33	506
1977	39	458
1978	49	657
1979	66	995
1980	84	1,586
1981	81	1,551
1982	96	2,113
1983	47	1,119
1984	54	1,244
1985	71	3,096
1986	112	5,534
1987	151	7,341
1988	198	11,041
1989	284	20,887
1990	381	24,352
1991	471	34,541
1992	440	24,483
1993	368	20,825
1994	272	18,439
1995	256	19,938
1996	341	28,054
1997	378	24,474
1998	471	32,489
1999	585	40,675
2000	530	38,631
2001	544	37,023
2002	391	28,647
2003	398	25,680
2004	403	31,156
2005	448	33,049
2006	549	41,088
2007	652	47,606
2008	554	46,796
2009	90	5,462
Unknown	6,639	105,137
Total	16,759	769,374

Date: March 2009

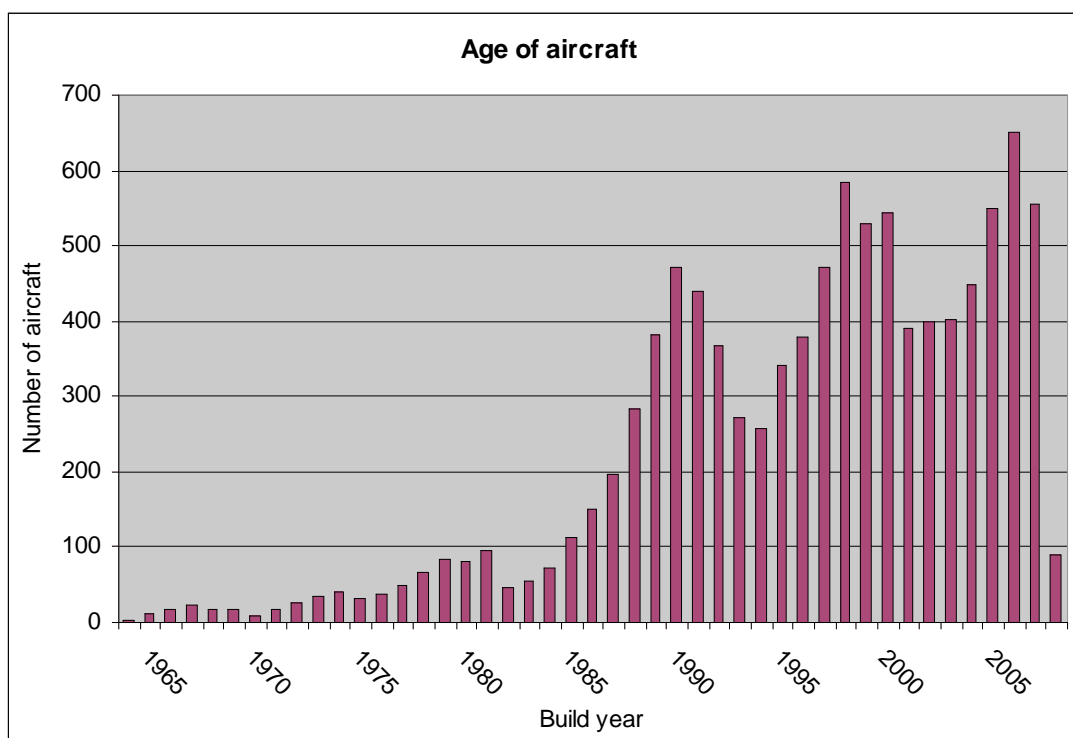
Source: CFMU flight plans and PRISME Fleet data

Comment

The numbers of aircraft were derived from flight plans submitted to the EUROCONTROL Central Flow Management Unit (CFMU) for flights in March 2009. Thus these aircraft were active in European airspace at that time. The information was analysed using the EUROCONTROL PRISME Fleet database to derive the aircraft ages. Since the numbers are based on flight plans, they exclude aircraft which do not fly in controlled airspace and therefore do not submit flight plans to the CFMU. The table also shows the total number of flights carried out during March 2009 by the all aircraft in each age group.

The 6,639 aircraft whose age was unknown were aircraft not recorded in the PRISME database. These were largely aircraft based outside Europe, together with some smaller aircraft not flying regularly in controlled airspace and some new aircraft not yet entered into the database. The small number of aircraft shown for 2009 is due to the data being collected for March, when only a proportion of the year's deliveries of new aircraft had been made.

There are a significant number of old aircraft still in operation in Europe, the oldest in the March data being built in 1936. However, aircraft older than 20 years tend not to be very active. Aircraft up to 20 years of age tend to average just over 2 flights per day but, beyond this age, the usage falls steeply. There is a significant cyclicality in the purchase of aircraft, which is illustrated in the figure below.



TRAFFIC STATISTICS AND FORECASTS

Explanation

Actual and forecast numbers of flights.

Source: Eurocontrol Statistics and Forecasts Service (STATFOR)
www.eurocontrol.int/statfor/public/subsite_homepage/homepage.html

Discussion

The objective of the Air Traffic Statistics and Forecast (STATFOR) service is to provide statistics and forecasts on air traffic in Europe and to monitor and analyse the evolution of the Air Transport Industry.

Statistics: Currently STATFOR collects and publishes air traffic statistics on a monthly basis in the following form:

- Daily Figures: These are issued for one calendar month and present departure, arrival, domestic flights for each country (and country grouping) on a daily basis. They extract details on trans-Atlantic and non-Atlantic flights. This report highlights peak days in each flight category.
- DAIO Reports (International Departures, International Arrivals, Internals and Overflights): Compares the current year's number of IFR (Instrument Flight Rules) flights with preceding year on a monthly basis per state or region grouping in total and in the sub-categories: (international) departures, (international) arrivals, internals and over-flights.
- TAP Reports (Total Average Peak Day): Compares current year's number of IFR flights with preceding year on a monthly basis per state or region. The figures compared are the DAIO totals, average number of flights and peak days.

The format in which statistics are presented will change during 2009.

Forecasts: STATFOR produces three sets of forecasts:

- Short-term forecasts

The short-term forecasts capture recent trends month by month and project these into the immediate future, up to two years ahead. Short-term forecasts are published four times a year.

- Medium-term forecasts

Medium-term forecasts look seven years ahead and build on the short-term forecasts. The medium-term forecasts combine flight statistics with economic growth and with models of other important drivers in the industry such as costs, airport capacity, passengers, load factors, aircraft size etc. The forecasts give a comprehensive picture of anticipated air traffic development in Europe. Using high- and low-growth scenarios, a likely range for growth is presented. The medium-term forecast is published once per year.

- Long-term forecasts

Long-term forecasts are published every two years. The long-term forecasts look at a range of distinct possible scenarios for how the air traffic industry might look in 20 years time. This

allows a range of 'what if?' questions to be explored, for factors inside the industry (e.g. the growth of small business jets, or of point-to-point traffic) or outside (e.g. the price of oil, or environmental constraints).

STATFOR issues a Forecast Monitor Report on a regular basis which tracks the progress of the STATFOR short-term forecast against actual traffic trends.

The STATFOR Industry Monitor is a regular e-mail briefing on the air transport and related industries, produced on a subscription basis for EUROCONTROL Member States and associated organisations. It covers matters of relevance for understanding air transport statistics or preparing air transport forecasts. The Industry Monitor is produced at least monthly.

Summary traffic statistics for ECAC are also presented on a regular basis in the Performance Review Reports published annually by the Performance Review Commission.

See www.eurocontrol.int/prc/public/subsite_homepage/homepage.html

NUMBER OF FLIGHTS

Explanation

The number of IFR flights carried out in Europe.

Value [1]: Monthly flights by origin and destination in 2008

Month	Arrivals	Departures	Internal	Overflights	Total
January	68,934	68,939	623,441	7,410	768,724
February	64,039	64,102	614,408	6,344	748,893
March	69,168	69,098	628,696	7,685	774,647
April	72,698	72,617	693,980	8,172	847,467
May	77,902	77,850	734,074	7,668	897,494
June	82,148	81,996	756,650	7,274	928,068
July	87,230	87,295	765,819	7,550	947,894
August	89,628	89,721	745,204	7,927	932,480
September	79,857	79,775	744,526	7,634	911,792
October	76,094	76,595	711,443	8,553	872,685
November	67,025	67,214	588,322	8,925	731,486
December	66,068	66,306	551,641	8,317	692,332
Total	900,791	901,508	8,158,204	93,459	10,053,962

Date: January 2009

Source: EUROCONTROL STATFOR statistics

Value [2]: Flights by type of operator in 2008

Operator	Number of flights
Traditional scheduled airlines	5,879,480
Low cost airlines	1,998,129
Business aviation	755,546
Charter flights	640,072
All cargo	344,122
Military	167,460
Other	269,153
Total	10,053,962

Date: January 2009

Source: EUROCONTROL STATFOR statistics

Value [3]: Flights by age of aircraft in March 2009

See Value [1] in the section on Fleet age on page 47.

Value [4]: Flights by aircraft type in March 2009

Aircraft type	Number of flights	Percentage of total	Cumulative percentage
A320	86,816	11.3%	11.3%
B738	69,815	9.1%	20.4%
A319	69,725	9.1%	29.4%
A321	28,877	3.8%	33.2%
B733	26,697	3.5%	36.6%
AT72	21,312	2.8%	39.4%
B737	17,345	2.3%	41.7%
DH8D	15,502	2.0%	43.7%
B735	15,482	2.0%	45.7%
B734	15,324	2.0%	47.7%
CRJ2	12,878	1.7%	49.4%
B744	12,585	1.6%	51.0%
B752	11,817	1.5%	52.5%
E145	11,133	1.4%	54.0%
B763	10,472	1.4%	55.3%
RJ85	10,216	1.3%	56.7%
F100	9,784	1.3%	57.9%
B772	9,418	1.2%	59.2%
MD82	9,116	1.2%	60.3%
RJ1H	9,034	1.2%	61.5%
A332	8,934	1.2%	62.7%
DH8C	8,106	1.1%	63.7%
CRJ9	8,089	1.1%	64.8%
F50	7,808	1.0%	65.8%
CRJ1	7,686	1.0%	66.8%
AT45	7,231	0.9%	67.7%
DH8A	7,050	0.9%	68.7%
B736	6,694	0.9%	69.5%
A343	6,539	0.8%	70.4%
Others	227,889	29.6%	100.0%
Total	769,374	100.0%	

Date: March 2009

Source: CFMU flight plans and PRISME Fleet data

Discussion

Value [1] shows the typical fluctuation of traffic during the year, peaking in July. The lowest level usually occurs in February but, in 2008, the difficult economic situation led to a lower value in November. Value [2] indicates that almost 80% of traffic is accounted for by scheduled flights. Military flights, which cover only those operating as General Air Traffic (GAT) and exclude Operational Air Traffic (OAT), accounted for only 2% of the total.

During March 2009, 390 different aircraft types operated in Europe. However, 70% of the flights were carried out by the 29 aircraft types shown in Value [4]. The number of flights for *Other* aircraft types includes some flights by aircraft not identified in the PRISME database and which, therefore, may include additional flights by the specified aircraft types.

The Performance Review Commission publishes traffic analyses in the annual Performance Review Reports. (See www.eurocontrol.int/prc/public/subsite_homepage/homepage.html)

VALUE OF AN ADDITIONAL FLIGHT

Explanation

Value of an additional flight.

There is no commonly accepted standard for the value of a flight. The value will vary over time and between routes and the estimates presented below must be treated with caution.

Note that the values have **not** been corrected to 2006 price levels as they are more dependent on volatile market forces than general inflation.

Value [1]: € 700

Date: September 1999

Source: IATA Cost Benefit Task Force

Value [2]: Domestic flights € 807
Inter-European flights € 1,613
Inter-continental flights € 9,680

Date: September 1991

Source: Study on Airport Slot Allocation by SD-Scicon for the UK Department of Transport

Discussion

IATA consider that the value of a flight may be defined by proxy as the average profit per flight. Using data from the IATA Airline Economic Task Force, they produced a value of €700. However, this does not fully account for the cost of ownership of an aircraft as it excludes items such as interest, taxation and full asset replacement costs. In addition, it was noted that it was difficult to produce a typical value since airline profitability has varied considerably from year to year. As the value of €700 is based on airline profits, it does not include any value to society or passengers.

The SD-Scicon values, which are now rather old, were also based on airline profitability and, crucially, assumed that the value of a slot must be recovered by an airline in 18 months. A change in this value would significantly change the value ascribed to the slot. Slots exchanged at Heathrow in 1998 imply that the value of a trans-Atlantic flight was, at the time, about €5000, assuming the same 18 month recovery period. However, on the basis of a 5 year recovery period, the value would fall to €1700 or to €1000 with a 10 year recovery period.

In economic terms, a more theoretically correct method of valuation would be based on passengers willingness to pay and the elasticity of demand for air transport.

DELAY STATISTICS

Explanation

Reports on number of flights and levels of delay.

Source [1]: EUROCONTROL Central Office for Delay Analysis (CODA):

www.eurocontrol.int/corporate/public/standard_page/cb_traffic_delays.html

Source [2]: EUROCONTROL Central Flow Management Unit (CFMU):

www.cfm.eurocontrol.int/cfm/public/standard_page/data_provision_reporting.html

Discussion

Monthly and annual reports on the numbers of flights and the levels of delay are available on these web sites. CFMU only has data for ATFM delay, whereas CODA has information on delay due to other causes.

More detailed reports may be requested from the CFMU Relations, Quality and Performance Team. Where the data is available it will be provided within two weeks of request.

Delay statistics for ECAC are also presented on a regular basis in the Performance Review Reports (published annually by the Performance Review Commission).

See: www.eurocontrol.int/prc/public/subsite_homepage/homepage.html

DISTANCE FLOWN BY CHARGING AREA

Explanation

Geographical distribution of traffic.

Value: The table sets out the total distances flown in each charging area in 2008.

Charging Area	Distance flown (km)	Increase 2007 to 2008	Average growth 2004 to 2008
Albania	24,147,968	4.1%	8.5%
Austria	210,673,779	1.5%	6.4%
Belgium - Luxembourg	172,475,671	0.9%	4.5%
Bosnia and Herzegovina	41,080,774	7.9%	
Bulgaria	121,841,924	7.8%	7.3%
Croatia	99,209,337	4.0%	8.1%
Cyprus	89,321,814	12.2%	7.7%
Czech Republic	150,427,778	5.1%	4.3%
Denmark	121,583,914	(1.4%)	2.0%
Finland	62,283,329	3.0%	1.6%
France	1,505,070,656	(0.2%)	3.3%
FYROM	14,985,819	1.8%	5.2%
Germany	1,041,109,367	2.0%	4.7%
Greece	316,984,384	5.0%	4.5%
Hungary	145,853,711	0.1%	4.1%
Ireland	199,295,168	(0.3%)	8.2%
Italy	724,381,855	(0.4%)	2.8%
Lithuania	31,087,285		
Malta	25,034,762	12.1%	8.1%
Moldova	7,444,089	24.2%	18.9%
Netherlands	196,679,331	(1.7%)	3.6%
Norway	136,072,171	5.4%	4.5%
Poland	242,431,706		
Portugal Lisboa	187,377,744	1.5%	3.6%
Portugal Santa Maria	166,836,262	4.9%	4.7%
Romania	201,293,939	2.0%	3.4%
Serbia - Montenegro	134,191,475		
Slovak Republic	56,436,208	6.3%	5.6%
Slovenia	29,348,418	6.7%	10.9%
Spain - Canarias	111,901,790	0.4%	3.8%
Spain - Continental	770,993,066	(1.6%)	5.2%
Sweden	266,506,623	5.4%	4.3%
Switzerland	130,994,059	0.2%	3.4%
Turkey	476,180,666	7.7%	9.9%
United Kingdom	806,201,936	(0.1%)	3.4%
Total	9,017,738,778	5.5%	

Date: March 2009

Source: "Report on the Operation of the Route Charges System in 2008", EUROCONTROL Central Route Charges Office, March 2009.

www.eurocontrol.int/crco/gallery/content/public/docs/other/crco_report_2008.pdf

Discussion

The Report on the Operation of the Route Charges System is published by the CRCO on an annual basis and provides data on traffic volumes and ATM costs for the states for which the CRCO collect en-route and terminal charges.

MEDIUM TERM CAPACITY PLANNING

Explanation

ATM capacity forecasts and targets.

Source [1]: European Medium - Term ATM Network Capacity Plan Assessment 2010-2013
www.eurocontrol.int/cef/public/site_preferences/display_library_list_public.html

Source [2]: European Single Sky Implementation - Years 2010-2014
www.eurocontrol.int/essip/

Source [3]: Local Single Sky Implementation (LSSIP) documents prepared for each country including capacity forecasts.
www.eurocontrol.int/lssip

Discussion

Source [1] provides a medium-term outlook of the capacity situation at network and local level, identifying possible bottlenecks and giving early indication of the need for additional measures, details of network interactions and improvements required at network level.

Source [2] explains the ESSIP planning process and describes the current set of implementation objectives in context of the operational improvements and benefits that they bring to the European ATM network. It also contains the agreed capacity profiles for air traffic centres and selected terminal airspace in each of the ECAC States for the next five years.

The ESSIP implementation objectives and stakeholder lines of action cascade down into the States' LSSIP documents, one for each state, provided as Source [3]. The LSSIP documents reflect the national plans and implementation actions needed to realise each objective.

[Note: password access is required for Source [3] files. Access is granted to ACG members, LSSIP contact persons and EUROCONTROL staff using their internet access codes].

CNS INFRASTRUCTURE

Explanation

The number of radar and navigation aids located in ECAC.

Value [1]: Navigation aids

Country	DME	NDB	NDB-DME	TACAN	VOR	VOR-DME	VORTAC	Total
Albania	1	3				1		5
Armenia		9				2		11
Austria		17				11		28
Belgium		15		4	1	12	1	33
Bosnia & Herzegovina		9		2		5	1	17
Bulgaria		21				8		29
Croatia	1	26				7		34
Cyprus		3		2		2		7
Czech Republic	1	21				10		32
Denmark		9		4	2	9	1	25
Estonia	1	9				4		14
Finland	1	33				24		58
France	1	69		24	32	54	5	185
FYROM		3	1			3		7
Georgia		13				2		15
Germany	39	98	2	21	14	40	12	226
Gibraltar				1				1
Greece		46		24	1	44		115
Hungary		43		1	1	9		54
Iceland	2	39				2	1	44
Ireland	1	14	2			7		24
Italy	1	83		22		48	11	165
Latvia						6		6
Lithuania		5		1		4		10
Luxembourg		3				2		5
Malta	2	2				1		5
Moldova		4				1		5
Netherlands	2	15		9	1	9		36
Norway	2	83	3	15		37		140
Poland		36			2	20		58
Portugal		25		6	1	11	6	49
Romania		25				15		40
Slovak Republic	1	15				5		21
Slovenia		7				2		9
Spain	3	83	2	15	1	77		181
Sweden	3	33			5	26		67
Switzerland	2	6				12		20
Turkey	1	54	5	26	1	48	1	136
Ukraine	4	113				8		125
United Kingdom	14	90	4	25	2	49		184
Total	83	1182	19	202	64	637	39	2226

Date: April 2009

Source: World Aeronautical Database (<http://worldaerodata.com/>). Collated and summarised by EUROCONTROL.

Value [2]: Civilian radar

	Primary	CSSR	MSSR	Total
Albania	-	-	1	1
Armenia	3	3	-	6
Austria	4	-	7	11
Belgium	7	4	2	13
Bosnia & Herzegovina	-	-	1	1
Bulgaria	5	-	6	11
Croatia	1	1	2	4
Cyprus	2	-	3	5
Czech Republic	1	-	2	3
Denmark	4	-	6	10
Estonia	-	-	2	2
Finland	2	2	7	11
France	11	-	19	30
FYROM	1	-	2	3
Germany	22	-	29	51
Greece	7	-	12	19
Hungary	3	-	3	6
Ireland	4	-	7	11
Italy	13	8	12	33
Latvia	1	-	3	4
Lithuania	3	1	2	6
Luxembourg	1	-	1	2
Malta	2	-	2	4
Moldova	3	2	1	6
Netherlands	3	3	4	10
Norway	5	-	13	18
Poland	5	-	9	14
Portugal	1	-	5	6
Romania	6	-	7	13
Slovak Republic	1	-	2	3
Slovenia	2	1	1	4
Spain	12	3	21	36
Sweden	3	-	12	15
Switzerland	2	-	8	10
Turkey	4	8	4	16
Ukraine	38	19	-	57
United Kingdom	19	3	25	47
Total	201	58	243	502

Date: 2004

Source: EUROCONTROL RASCAL database

Comments

Source [1]: The World Aeronautical Database provides a full worldwide listing of navigation aids and airports at <http://worldaerodata.com/>.

Source [2]: These are the number of civilian radars in the database. It is possible that there may be some radars not included in the database and, in particular, the database does not contain information on military radar. A new data collection campaign is planned by EUROCONTROL during 2009.

ASSET LIVES

Explanation

The number of years used in deriving the amortisation of investment expenditure for the purpose of the calculation route charges.

Value:

Freehold buildings, including related works services	between 20 and 40 years
Leasehold buildings	over the period of the lease
Furniture and fittings	between 10 and 15 years
Motor vehicles	between 4 and 10 years
Electronic equipment (including telecommunications equipment)	between 7 and 15 years
General equipment	between 7 and 10 years
Computer equipment	between 3 and 10 years
Basic software and, if appropriate, application software	between 3 and 8 years
Aircraft	between 10 and 20 years

Date: August 1999

Source: "Principles for Establishing the Cost-Base for Route Facility Charges and the Calculation of the Unit Rates", EUROCONTROL Central Route Charges Office, August 1999

Comments

Asset lives used in cost benefit analyses should reflect the anticipated life of the specific equipment concerned. The above data provides normal bounds for classes of equipment.

ATM COST-EFFECTIVENESS INDICATORS

Explanation

Key performance drivers of cost-effectiveness.

Value: The ACE Benchmarking reports comprise factual data and analysis on cost effectiveness and productivity for the Air Navigation Service Providers (ANSPs) within EUROCONTROL member states. The report describes a framework for the analysis of cost-effectiveness:

The key performance drivers of cost-effectiveness are:

- productivity
- employment costs
- support costs

There is a wide variation in values across ANSPs, but the European system averages for ATCO productivity, employment costs and support costs are:

ATCO-hour productivity, expressed as flight-hours per ATCO-hour	0.74
Employment costs per ATCO-hour	€ 93
Support cost ratio - the ratio of total ATM/CNS costs to employment costs of ATCOs	3.2

Date: Data from 2007

Source: ATM Cost-Efficiency (ACE) 2007 Benchmarking Report, PRC, May 2009

www.eurocontrol.int/prc/gallery/content/public/Docs/ACE_2007_Benchmarking_Report.pdf

Discussion

The key performance drivers of financial cost-effectiveness for each ANSP are illustrated in Figures 5.6, 5.7 5.11 of the source document. There is a wide variation in each of the components:

- productivity ranges from 0.14 to 1.86
- employment costs vary from € 5 to € 184 per ATCO-hour
- support costs ratios vary from 1.7 to 12.9

ATCO employment costs per composite flight-hour, a combination of productivity and employment costs, range from € 29 to € 331 per composite flight hour for the ANSPs evaluated.

GROUND HANDLING TIMES

Explanation

The number of minutes handling time required for turnround of an aircraft.

Value:

Aircraft category	Low	Base	High
Heavy	60	75	90
Medium	41	51	61
Light	29	36	43

Date: 2005

Source: Airport CDM Cost Benefit Analysis, EUROCONTROL Experimental Centre, September 2005

www.euro-cdm.org/library/cdm_cba_2005.pdf

Discussion

This study used values for airside turnround manpower costs extracted from "User Costs at Airports in Europe, SE Asia and the USA", Cranfield College of Aeronautics, February 1998, ISBN 1-871564-97-2. The values used are shown below as an example and relate to the airports considered in the report.

Aircraft category	Airside turnround manpower cost - Low	Airside turnround manpower cost - Base	Airside turnround manpower cost - High
Heavy	€ 3,119	€ 3,553	€ 5,533
Medium	€ 977	€ 1,656	€ 2,518
Light	€ 306	€ 671	€ 1,149

ACRONYMS

ADREP	Aircraft Accident/Incident Reporting System
AEA	Association of European Airlines
AIS	Abbreviated Injury Scale
ANSP	Air Navigation Service Provider
AOPA	Aircraft Owners and Pilots Association
APO	Office of Aviation Policy and Plans
APT	Airport Throughput
APU	Auxiliary Power Unit
ARG	Aviation Research Group
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
BADA	Base of Aircraft Data
BHDOC	Block Hour Direct Operating Costs
CAEP	Committee on Aviation Environmental Protection
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CFI	Carbon Financial Instrument
CFIT	Controlled Flight Into Terrain
CFMU	Central Flow Management Unit
CNS	Communications, Navigation and Surveillance
CODA	Central Office for Delay Analysis
CORINAIR	Core Inventory of Air Emissions
CRCO	Central Route Charges Office
DAIO	International Departures, Arrivals, Internals and Overflights
DCMAC	Directorate of Civil-Military ATM Co-ordination
DETR	Department of the Environment, Transport and the Regions
DFS	Deutsche Flugsicherung
EATMP	European Air Traffic Management Program
ECAC	European Civil Aviation Conference
ECIP	European Convergence and Implementation Plan
ECX	European Climate Exchange
EEC	EUROCONTROL Experimental Centre
EGNOS	European Geostationary Navigation Overlay Service
EMEP	European Monitoring and Evaluation Programme
FAA	Federal Aviation Administration
GA	General Aviation
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IPCC	Intergovernmental Panel on Climate Change

Standard Inputs for EUROCONTROL Cost Benefit Analyses

IRR	Internal Rate of Return
ITA	Institut du Transport Aerien
LTO	Landing/Take-off Cycle
MWTP	Mean Willingness to Pay
MTOW	Maximum Take-off Weight
NAPS	National Air Pollution Surveillance Network
NATO	North Atlantic Treaty Organisation
NATS	National Air Traffic Services
NCAA	Norwegian Civil Aviation Authority
NPV	Net Present Value
NSDI	Noise Sensitivity Depreciation Index
OST	Office of the Secretary of Transportation
PRC	Performance Review Commission
PRR	Performance Review Report
PRU	Performance Review Unit
RVSM	Reduced Vertical Separation Minima
SCG	Stakeholder Consultation Group
SRC	Safety Review Commission
STATFOR	Air Traffic Statistics and Forecasts
STNA	Service Technique de la Navigation Aerienne
TAP	Total Average Peak
UK CAA	UK Civil Aviation Authority
UNITE	Unification of accounts and marginal costs for transport efficiency
VFR	Visual Flight Rules
VOSL	Value of Statistical Life
WAAS	Wide Area Augmentation System
WTP	Willingness to Pay

A comprehensive glossary of acronyms and abbreviations is available at:

www.eurocontrol.int/eatm/gallery/content/public/library/acronyms.pdf



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