ACI Airport Traffic Forecasting Manual: A practical guide addressing best practices

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**Introduction**

The goal of this document is to provide an overview of best practices in airport traffic forecasting including recommendations on collection and analysis, and presentation of forecasts for various timelines. Adoption of these practices will provide a good baseline for estimating future traffic flows (passenger and cargo) over the short and long run and support strategic decisions on infrastructure development; the ultimate goal being to ‘right-size’ the airport to balance future demand with the airport’s infrastructure and resources.

ACI produced its first forecasts in 2000, and there have been bi-annual updates since that time, in recent years in collaboration with the firm DKMA. The initial motivation for ACI to produce forecasts came from a belief that passenger and freight forecasts produced by other industry stakeholders, including airframe and engine manufacturers, were totally “demand-driven”. ACI’s focus was on a more balanced approach which took into account airport capacity constraints as well as the demand part of the equation. Not surprisingly, ACI’s subsequent forecasts showed lower rates of growth than other industry stakeholders.

In the early years, ACI’s forecasts were based on a survey of some 300 airport members. Responses were collated, checked for quality and credibility, and then aggregated by region by ACI staff. When DKMA became involved in the forecasts, two veteran forecasters brought new skills to the table, and the forecasts became a “blend” of methodologies including data from the sample of airports, econometric variables, and estimates based on airline capacity considerations. This methodology is explained in Chapter 1.

This manual should be considered a document open for comment and review by ACI members worldwide. Suggestions, comments, amendments or changes can be emailed to the editor, ACI World’s Senior Business Advisor, Paul Behnke at pbehnke@aci.aero.

ACI World wants to thank Stan Maiden of BAA for his distinguished leadership of the ACI Statistics and Forecasting Advisory Group over the past decade and for his contributions to this document, including the chapter on econometric modelling. ACI also is grateful to Matthew Greenfield of BAA (London Heathrow Airport), for producing the chapter on ultra short-term forecasts and to DKMA for their papers on methodology and capacity constraints.
ACI’s airport traffic forecasts – factors behind the numbers

Objective of ACI’s Airport Traffic Forecast Report
The ACI Airport Traffic Forecast Report (ATFR) is an essential tool for airport operators in optimizing use of current facilities and making decisions on new airport development projects. Similarly, aviation businesses seek good insight into the locations where they can expand their business ventures within the airport community. In other words the ATFR is a resource for all airport operators and aviation decision makers in charting future plans. The report highlights traffic from the long-term perspective of the airport industry and is an unconstrained forecast.

Data and timeframe covered
- Development of worldwide passenger traffic
- Traffic projections by region
- Individual forecasts for over 140 countries
- Forecast traffic growth between world regions
- Freight and aircraft movements
- The forecast covers 20 years

Methodology
ACI surveys its members to gather their views on the short- and long-term outlook of the global passenger and cargo markets. The results of this survey are the foundation of the forecast which is created by the ACI/ DKMA forecasting team. In its latest edition 250 airports, handling over half of the world’s traffic, submitted inputs.

The following approach is used to prepare the long-term traffic figures:
- The survey results are aggregated by country and world region;
- The passenger traffic for each country is further broken down to form country-to-region traffic flows;
- These figures are cross-checked against historical trends and data from other sources;
- Results considered reasonable become inputs into the model.
For the short and medium-term forecast, the forecast team can divert from the survey results and the idea behind this is that the forecasts provided by the participants do not always adequately reflect the industry cycles and when this is the case, the forecast team can make some adjustments in an attempt to better reflect these. The fact that participants do not anticipate the industry cycles does not reflect poorly on them but instead highlights the fact that the environment in which they operate can change very quickly, meaning that long-term trends remain valid but that short and medium-term trends need to be revised. For example, most experts expected a recession in 2009 but who, say six to nine months ago, would have expected such a drastic decline?

The following approach is used to prepare the short and medium-term traffic figures:

- The short-term is a monthly bottom-up model.
- Based on projected monthly airline capacity development, the team assumes a load factor to derive traffic figures.
- The medium-term forecast is also a bottom-up model based on regressions prepared at a country level. The regressions are based on annual data (traffic and economic development) and broadly speaking if the regressions and the survey results are similar the survey are kept, but if important differences emerge, analyses are undertaken to see which one is most likely to be correct.

The ATFR is a top down (long-term) and bottom up (short- to medium-term) forecast and the last step is to reconcile the forecasts to create one seamless forecast.

While the forecasts are unconstrained, in the 2007 edition, ACI surveyed its members to understand when they face constraints, what form these take. Results are presented in chapter 2. The constraints can be analyzed to create a ‘capacity-gap’ where airport capacity may fall short of future demand, creating, at minimum, congestion, and at maximum, diverting traffic to other airports or to other transport modes. In 2010, ACI and DKMA were predicting a significant capacity gap for 2020, particularly at large hub airports in North America, Europe and the Asia-Pacific region.
2 Capacity constraints on demand: ACI’s approach

In its 2007 forecasts, ACI surveyed its members to analyze the constraints they faced in building for future demand. Results can be seen in Figure 1 below.

**Figure 1**

*Sources of Constraints for Airports Region*

Survey Results

As mentioned at the beginning of the chapter, one of the innovations that ACI introduced this year was to specifically survey its members to better understand what they perceive as the elements which could fuel their growth in the future and on the contrary, what elements could be barriers to this growth.

In terms of positive factors, participating airports were asked to rank seven factors by importance; one being the most important and seven the least important. As can be seen in Figure 2 the various regions have different rankings except when it comes to the economy which is seen as the most important factor in all regions except Africa who instead ranks tourism as its number one driver. In most other regions, expect the Middle
East, tourism is seen as an important factor. Hence two of the traditional variables which have historically fuelled growth in the industry are still anticipated to rank high in the future.

It is interesting to note that in four regions, the low cost expansion ranks high (either 2nd or 3rd) except in the Middle East and in Africa. Given that low costs have so far had limited exposure in those two regions those results would tend to make sense. Elements which are important for the Middle East, aside from the economy, are the hubbing activity, open sky and expansion of base carrier. Since the region tends to focus its development around long haul activity catering among other things to 6th freedom passenger it would seem logical to have these elements rank high since they are the cornerstones, although not a guarantee, for this strategy to be successfully implemented in the region. It is interesting to note that some markets, such as Dubai, have signed some open sky agreements and lifted foreign ownership restrictions but the majority of the countries in the region are still highly regulated in terms of ownership, traffic rights and even pricing policies. This high level of regulation is one reason, although many other reasons exists, why low costs have had limited in-road in the region.

Figure 2

*Ranking of Positive Influencing Factors*

Source: ACI
Of course negative factors will inevitably come into play in the near and longer term future (see Figure 3) and with this in mind, participants were asked to rank nine elements by order of importance where one is the most important factor and nine the least important. In this case, there is no clear consensus; each region clearly has different concerns when it comes to what could dampen their prospects.

For three regions, fuel ranks as their number one concern. Those three regions are North America, Asia and the Middle East. For the last two regions, given that a significant portion of their operations centres around long haul (where fuel tends to be a bigger cost centre) this makes sense. In North America, aside from fuel, participants are also worried about bankruptcies and external shocks. Once again, given that North America has been the slowest to rebound from this deep downturn and still has important carriers operating under bankruptcy protection, one would expect these types of results.

In Europe, aside from concerns centred on fuel, participants also worry about airport competition and infrastructure. Low cost expansion has without a shadow of a doubt benefited passengers, but from an airport point of view, since in some cases low cost have established their operating bases in small secondary airports, this has meant overlapping catchment areas and increased competition between airports. As for infrastructure, several airports are either facing now, or in the near future, infrastructure limitations. Infrastructure concerns ranks high in most regions except in Latin America and to a lesser degree in North America.
Figure 3

Ranking of Negative Influencing Factors

Source: ACI
3 Ultra short-term forecasting to optimize operational performance

Ultra-short term forecasts to optimise operational performance
Matt Greenfield (BAA – Lead Forecaster)
3rd March 2011
Heathrow

Benefits of an Accurate Short Term Forecast

- Accurate resource plans $\rightarrow$ saves money
- Shorter security queues
- Avoid delayed departures
- Minimise stress
- Swift and enjoyable passenger experience
- Reflects well on Airline and Airport

Heathrow
There are several reasons that we, as an airport, would like to have as accurate a short term forecast as possible. Primarily, it leads to optimal resource plans for our security operation, which means we have sufficient guards to avoid queues but do not spend more than necessary by having security lanes open when they are not required. Getting passengers through security smoothly helps to avoid delayed departures and minimizes stress for our customers (both airlines and passengers). Finally, a swift and enjoyable passenger experience reflects well on both the airline and the airport.

**Short Term Forecasting Timeline**

- **Weekend Forecast:** 24-hour forecast
- **First publication of next week’s forecast (every Monday):** 5-day forecast
- **Every Wednesday:** 15-minute flow forecast for next week
- **Every Sunday:** 5-day forecast for the following 5 days

**Forecasting Steps:**
- **Every Sunday:** Final internal/external information (5-day forecast)
- **Every Wednesday:** Final internal/external information (15-minute flow forecast)
- **Every Monday:** Final internal/external information (5-day forecast)

**Example (for 03/05/11):**
- **Wed 30/06/10:** 10+ months
- **Wed 17/11/10:** 9 months
- **Wed 09/02/11:** 3 months
- **Mon 28/02/11:** 3 weeks
- **Wed 30/06/10:** 3 days
- **Mon 28/02/11:** 1 day

**NB:** Accuracy improves as we get closer to the date in question; as we have more (and more accurate) data with which to work.

**RMS – forecasting with IT**

- **Passenger on Aircraft Forecasts (POA):**
  - Flight level
  - Scheduled time of arrival/departure
  - Transfers and non-transfers
  - Calculate transfers using Passenger Manifest Data
  - Subtract from POA to give non-transfers
  - Verify by comparing to search area counts of non-transfers

- **15-minute Flow Forecasts:**
  - Calculate transfers using Passenger Manifest Data
  - Subtract from POA to give non-transfers
  - Verify by comparing to search area counts of non-transfers

- **Create Plan:**
  - Apply reporting pattern
  - Split into 15 minute time slices
  - Include queue data

- **Send to resource planners / immigration
- Create resource plan
At Heathrow, we follow three stages of forecasting that we call:

- Forecasting with IT – using bespoke software to produce a forecast
- Forecasting with intelligence – using our own knowledge and experience to improve on the preliminary forecast
- Forecasting with facts – using airline booking information to fine tune the forecast

**Forecasting with IT**

Our bespoke software package builds the forecast in the following stages:

- All passengers (including transfers and non-transfers) on each aircraft, at their time of departure or arrival
- Splitting transfers and non-transfers (validated against counts of passengers at security search areas)
- Applying a reporting pattern (the length of time before their flight that a passenger reports to security search) and splitting the forecast into 15 minute sections.

**Working Files – forecasting with intelligence**

- Evidence that we improve on RMS accuracy
- Consider load factors, passenger volumes, transfer percentages and airline data
- Account for effects of holidays / weather / terminal moves / sporting events etc.
- Use knowledge, intuition and past experience

**Forecasting with intelligence**

By using our knowledge, experience and intuition, we are able to improve on the accuracy of our software. We use several methods that consider recent trends and project these forward. We are then able to select the optimal combination of these methods to produce what we believe to be our most accurate forecast.
Our experience allows us to consider factors that the software cannot know about – disruption due to weather; sporting events; airlines moving terminal; holidays etc.

**Airline Data – forecasting with facts**

- **Received in various forms**
  - Type of data (Actual booked loads / Airline forecasts)
  - Period covered (1 / 2 / 3 weeks out)
  - Frequency (Daily -> Weekly -> Sporadic)
  - Detail (Flight by flight -> Day Totals)

- **Important to have >50% of Terminal (the more, the better)**
  - coverage (generally) directly proportional to forecast accuracy

- **Still have to account for rest of terminal**

**Forecasting with facts**

Several airlines at LHR provide our team with information about the number of passengers they currently have booked. We can then place less reliance on historical trends and more on factual information. However, there is still a lot of mathematical work to do to convert the number of bookings for a particular airline into the number we expect them to fly on the day, and then to convert the knowledge we have about a group of airlines into a total for the rest of the terminal (i.e. those airlines that have not sent data).

It is important, for the data to be significant, that over 50% of the terminal’s total passenger numbers are covered – and the more the better as coverage is directly proportional to forecast accuracy.
Dealing with Disruption

<table>
<thead>
<tr>
<th>DISRUPTION</th>
<th>BEFORE</th>
<th>DURING</th>
<th>AFTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worldwide (eg – volcanoes / SARS)</td>
<td>Warning</td>
<td>Reliable updates</td>
<td>Quantify losses</td>
</tr>
<tr>
<td></td>
<td>Pre-empt effects</td>
<td>Accurate forecasts</td>
<td>Predict recovery</td>
</tr>
<tr>
<td>Meteorological</td>
<td>Warning</td>
<td>Reliable updates</td>
<td>Quantify losses</td>
</tr>
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<td></td>
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<td>Accurate forecasts</td>
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<tr>
<td>Industrial Action</td>
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<tr>
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<td>Accurate forecasts</td>
<td>Predict recovery</td>
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</tbody>
</table>

It is important that we learn from each of these and devise methods to more accurately forecast similar events in the future.

One of the most important factors to consider when forecasting is how we deal with disrupted periods. At these times, the airport is often in the spotlight with significant press coverage and passengers are more attuned to the quality of their experience. One factor that need not be an issue for the airport at a time of disruption is the quality of our security operation – however, it is vital that we have an accurate forecast.

We categorise disruption in one of three ways:

- Worldwide (volcanoes, SARS etc)
- Meteorological (snow, high winds, fog)
- Industrial Action (strikes)

The more warning we can provide, the better the operation will be prepared. The table details whether we get warning of the disruption happening and whether we are able to predict the severity of any impact on passenger flows. It then discusses the quality of any updates we receive as the event progresses and how well we are able to forecast the continued impact on passenger flows. It finishes by considering the period after the disruption, whether we can quantify the losses in passenger numbers and how accurately we can predict a recovery from the impacts.
Accuracy – are we getting better?

The accuracy of forecasts at LHR is measured in several ways, the most commonly used of which is the average day total error (how far from the actual day total was the forecast?)

One interesting point to note is that it is more difficult to predict transfer search areas. This is due to a number of factors including varying yield management techniques by airlines, less clear trends and a complete lack of booking information.

As our processes have improved and we have gained a greater understanding of the influencing factors, you can see that our accuracy has greatly improved and continues to do so – both in terms of absolute error and consistency – with average day total errors now around 3%.
STATISTICS PANEL (STAP)  
FOURTEENTH MEETING  
Montréal, 23 to 27 March 2009  

Agenda Item 8: Review of the data required for the purposes of restructuring the ICAO forecasting activities  

DATA REQUIREMENTS FOR FORECASTING ACTIVITIES  
(Presented by the Secretary)  

SUMMARY  

This working paper presents the restructuring of ICAO forecasting activities, discusses the related data requirements and identifies their potential sources. The focus in this paper is placed on requirements for air traffic and fleet forecasts. Requirements for the forecasting of licensed personnel, airport capacity, airspace capacity and funding are covered by other working papers presented to the panel.  

Action: The panel is invited to:  
a) note the data requirements for ICAO forecasting activities as endorsed by the Air Transport Committee; and  
b) identify the most effective ways to collect this data.  

1. RESTRUCTURING OF ICAO FORECASTING ACTIVITIES  

1.1 The Air Transport Committee of the Council of ICAO endorsed, during its 183rd session in early 2008, a Secretariat proposal to review ICAO's forecasting activities in order to ensure a better alignment with ICAO Strategic Objectives and enhance the value of the forecasts to their users. The outcome of this is expected to lead to a wider global coverage, increased consistency and improved quality of ICAO's forecasts.  

1.2 The Air Transport Committee discussed the results of the review during its 185th session held in October 2008 and approved the proposed new forecasting process as described in the Appendix (AT-WP/2037).
2. DATA REQUIREMENTS FOR AIR TRAFFIC FORECASTS

2.1 The new traffic forecasts will be prepared using econometric modelling based on a bottom up approach, starting at the route group level and building up to the regional and global levels. The main data requirements for this process include historical origin-destination passenger and freight traffic data; demographic and socio-economic data and the related forecasts; historical data and forecasts for airline ticket prices (or average yields) and data on competing services.

2.2 Historical Traffic data

2.2.1 In principal, historical data on true origin and destination of passenger and freight traffic should be used as a basis for the traffic forecasts. This data however may not be easily accessible due to the difficulty to trace the true origin and/or destination of the passenger. The use of a combination of data sources and the analysis of passenger true origin and destination is therefore required. In the following paragraphs, a description of the potential sources to be explored is provided.

2.2.2 Two data sets in the ICAO statistics program, OFOD and TFS, may be used towards this end. However, each set has its own limitations.

2.2.3 The On-Flight Origin and Destination (OFOD) shows on an aggregate basis, the number of passengers, freight and mail tonnes carried between all international city-pairs on scheduled services. A city-pair is defined as two cities between which travel is authorized by a passenger ticket or part of a ticket (a flight coupon) or between which shipments are made in accordance with a shipment document or a part of it (freight bill or mail delivery bill). These data are collected on a quarterly basis. If the ticket has multiple flight coupons, the identification of the true origin and destination requires the reconstruction of the passenger itinerary as determined by the successive flight segments according to the various flight coupons. This is not possible using the OFOD data set alone.

2.2.4 The Traffic by Flight Stage (TFS) contains annual traffic on-board aircraft on individual flight stages of international scheduled services. A flight stage is the operation of an aircraft from take-off to its next landing. An international flight stage is a flight stage with one or both terminals in the territory of a State, other than the State in which the air carrier has its principal place of business. The data, classified by international flight stage, shows for each air carrier and aircraft type used, the number of flights operated, the aircraft capacity offered and the traffic (passengers, freight and mail) carried. All passenger, cargo and mail traffic onboard the aircraft is reported regardless of whether it is loaded or off-loaded at one of the terminals, which makes it difficult to identify the true origin or destination.

2.2.5 Alternatively, Market Information Data Tapes (MIDT) is a commercial data source of passenger bookings made through all the major global distribution systems (GDSs) and which can be used to recreate the passenger itinerary post-departure, effectively indicating in most cases his/her true origin and destination. The four major GDSs are Sabre, dominant in North and South America, Amadeus, dominant in Europe, Galileo and Worldspan. China-based TravelSky is dominant in Asia. However, even when combined, data from the various GDSs does not provide a full world coverage. Direct sales and online bookings, which by-pass the GDSs and are estimated to represent about 30 per cent of all bookings made in 2004, continue to grow as airlines encourage their use by passenger and travel agencies. MIDT may therefore offer complementary but expensive data, as a set of data for only one city-pair could reach an amount in dollars showing a five digits number.

2.2.6 Another possible source is the IATA Passenger Intelligence Services ("PaxIS") which is an airline passenger market intelligence database with data captured through IATA Billing and Settlement Plan ("BSP"). BSP is a worldwide system facilitating the settlement operations for airlines and travel
agents. IATA estimates that over 80 per cent of worldwide airline revenues are ticketed via IATA travel agencies in the BSP system.

2.2.7 For forecasts based on market segmentation, more detailed data covering traffic by class, fare type and traffic of low cost carriers, etc., would be needed.

2.2.8 It is important to note that OFOD, TFS, MIDT and BSP data covers only scheduled traffic. Other sources need to be found and used for non-scheduled traffic.

2.3 **Passenger surveys**

2.3.1 States, airports and airlines regularly conduct passenger surveys in the framework of their marketing activities. Only samples of passengers are surveyed to collect information such as the origin, the destination, the purpose of travel, the passenger’s travelling habits, preferences, income level, etc. A proper sampling method needs to be designed in order to ensure the representativeness of the samples. The use of such data to identify the true origin and destination of the passenger, while relatively easy on a domestic or regional level, is more complex at the global level. In particular, a global and regular coverage is required. *The collection by ICAO of the summary results of such surveys, including origin-destination traffic may be useful for some of the routes.*

2.4 **Tourism data**

2.4.1 The United Nations World Tourism Organization (UNWTO) collects and disseminates data on tourism visits, which can be used to identify the country of origin (for inbound tourism) or country of destination (for outbound tourism). The definition of a tourism visit (or tourism trip which is made up of one or several visits) covers all purposes of travel including business, leisure and personal motives.

2.5 **Border crossing data**

2.5.1 Data on border crossing collected by border authorities (police, customs, immigration, etc.) may cover the true origin (or destination) of the passenger as well as the purpose of travel. This data is not easily accessible in many States.

2.6 **Historical demographic and socio-economic data and forecasts**

2.6.1 The factors affecting long term demand for passenger air travel include demographic and socio-economic factors, such as the size and spending ability of a city, country or region and the ethnic and linguistic ties between areas. The size of the market may be measured by be measured by the population and/or the Gross Domestic Product (GDP) or the Gross National Income (GNI) while the spending ability may be measured by the personal disposable income and/or the income distribution. The spending ability may also be affected by the variations in the exchange rate of the currencies of two countries. The ethnic and linguistic ties may be measured by the population of one area born in another area or the population of one area speaking the same language as the other area. Trade (imports and exports) between two areas may also be an influencing factor for passenger air travel but is more important to demand for air freight.

2.6.2 While most of the demographic and socioeconomic data required is readily available through various sources, some data such as income distribution and data on ethnic and linguistic ties may not be available for all countries.
2.7  **Historical ticket price data**

2.7.1 In general, for each flight there are multiple fare classes which leads to the conclusion that there is no single ticket price for any given flight. In addition, airline fares may be published or unpublished. While public access to published fares is straightforward, only the air carrier and the travel agents concerned have access to unpublished fares.

2.7.2 Determining historical average ticket price data by route is possible but very complex. This requires access to historical ticket sales data through MIDT or BSP, which may track the price printed on the ticket which again may be different from the price actually paid by the passenger.

2.7.3 One alternative is to use average “passenger yield”, which is equal to the ratio of the total passenger revenues by the total traffic. WP/12 (Impact of reporting of air carrier financial data on traffic forecasts) analyses the impact that accounting and reporting of certain financial items has on the estimation of average yields. Yield data is considered sensitive by the airlines and is difficult to collect by route. Network-wide yields are available but less useful to forecasting.

2.7.4 ICAO estimates average yields by major international route group based on confidential survey data collected in the framework of the series of “Studies on Regional Differences in International Airline Operating Economics”. The major route group average yields are aggregates that cover only international traffic and may not be suitable for detailed analyses.

3.  **DATA REQUIREMENTS FOR FLEET FORECASTS**

3.1 The fleet forecasting process serves to convert the passenger and air freight forecasts into number of aircraft departure by generic aircraft category leading to the corresponding number of aircraft. In addition to the passenger and freight traffic forecasts by city-pair or by route group, the data required for fleet forecasts includes historical data on average load factors, number of aircraft movements, average aircraft seating capacity and average aircraft utilization.

3.2 In the fleet forecasting process, average load factors serve to convert traffic into capacity. The average aircraft seating capacity may be estimated using TFS data.

3.3 Data on the number of aircraft movements by origin and destination is collected by ICAO through Form C (TFS). This data is also available from the Official Airline Guide (OAG).

3.4 The average aircraft seating capacity may be estimated using TFS data or the OAG. Historical data on the number of aircraft movements and the average aircraft seating capacity are used to explore the ways in which airlines respond to traffic growth (by increasing frequency, aircraft seating capacity or both).

3.5 Average aircraft utilization can be estimated using data extracted from ICAO Form D (Fleet and personnel). In the fleet forecasting process, this data is needed to convert the number of hours flown by generic aircraft category into number of aircraft.

3.6 Base year data including the fleet in service and aircraft movements data is also required. In addition to IRCA, discussed in WP/8, several commercial aircraft data sources are available on the market such as Airclaims, ACAS and Back Aviation Solutions. Data on aircraft movements will be made available through the aircraft movements database addressed in WP/10.
3.7 In parallel, availability of fleet forecast is the basis of deriving licensed personnel (pilots, maintenance engineers and air traffic controllers) forecasts as well as more sophisticated modelling of airport constraints, in addition to the ones identified by the traffic forecast. Indeed, as traffic grows, demand for licensed personnel increases and issues linked to airport capacity constraints become more critical. The failure to properly identify and remove any bottleneck through the adoption and implementation of adequate and timely measures, may adversely affect the safety of airline operations.
EXECUTIVE SUMMARY

The Air Transport Committee, during its 183rd session, endorsed a Secretariat proposal to review ICAO’s forecasting activities in order to ensure a better alignment with ICAO Strategic Objectives and enhance the value of the forecasts to their users. The outcome of the reviewed activities, if implemented, would lead to a wider global coverage, increased consistency and improved quality of ICAO’s forecasts. The review spanned over the first half of 2008 and the various entities interested in the forecasts within ICAO were requested to provide their inputs, comments and suggestions. This paper describes the present ICAO forecasting activities including their shortcomings, and proposes a new forecasting process with the corresponding implementation timeline and required resources.

**Action:** The Committee is invited to review and endorse the proposed forecasting process as stated in paragraph 3.

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<thead>
<tr>
<th>Strategic Objectives:</th>
<th>This working paper relates to Strategic Objectives A, C and D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial implications:</td>
<td>No financial implication for the current ICAO budget (paragraph 5 refers).</td>
</tr>
<tr>
<td>References:</td>
<td>AT-WP/2031</td>
</tr>
</tbody>
</table>
1. **BACKGROUND**

1.1 Pursuant to the endorsement by the Air Transport Committee (183rd Session) of the Secretariat proposal to review ICAO forecasting activities, the Secretariat conducted this review during the first half of 2008. The main purpose of this initiative is to ensure a better alignment of these activities with ICAO Strategic Objectives and enhance the value of the forecasts to their users (planning and implementation regional groups (PIRGs), the Committee on Aviation Environmental Protection (CAEP) and others). Implementation would also lead to a wider global coverage, increased consistency and improved quality of ICAO’s forecasts in parallel with a better allocation of ICAO forecasting resources.

1.2 In the course of this review, all the various forecast users within ICAO were invited to provide their inputs and notably their suggestions regarding any change that could make the forecasts more pertinent to their specific use.

2. **ICAO'S CURRENT FORECASTING ACTIVITIES**

2.1 Forecasts are the basis of any effective planning, and in the case of ICAO’s work, forecasts support the efficiency of aircraft operations (Strategic Objective D), aviation environmental protection (Strategic Objective C) and, to a lesser extent, aviation safety (Strategic Objective A). Air traffic and fleet forecasts are useful both for air navigation services planning (and hence for the efficiency of aircraft operations) and for environmental analyses, while proper prediction of licensed personnel, training and maintenance facilities requirements supports the objective of improved safety.

2.2 The Organization’s current forecasting activities are governed by Appendix C of Assembly Resolution A36-15, *Consolidated statement of continuing ICAO policies in the air transport field*. In conformity with this resolution and the preceding relevant resolutions, the Secretariat has been developing long-term and medium-term global and regional forecasts of passenger and of freight traffic by region of airline registration, as well as passenger traffic forecasts for major route groups and global aircraft movement forecasts. The most recent long term forecasts are in Circular 313, *Outlook for Air Transport to the Year 2025*, published in 2007, while the most recent medium term forecasts, for the period 2007-2009, are available on the ICAO website www.icao.int/icao/en/atb/ead/fep/forecastmed.htm.

2.3 In addition, the Secretariat has been providing extensive support to the regional traffic forecasting groups (TFGs) in four ICAO regions (Africa and Indian Ocean, Asia/Pacific, Caribbean and South America and Middle East). This includes the organization and chairing of meetings, provision of statistical data, modelling, development of forecasts and writing of reports.

2.4 The Secretariat has also been providing significant support to the Forecasting and Economic Analysis Support Group (FESG) of CAEP, mainly by leading its Traffic Forecast Group in the development of traffic and fleet forecasts, the latest of which (covering the period up to the year 2036) was finalised in February 2008.

2.5 Although the review of the current forecasting activities has led to the conclusion that the forecasts currently produced are relevant and useful, two notable shortcomings were identified. Firstly, some inconsistencies have been noticed in the multiple forecasts that ICAO currently produces under its ambit in response to various users’ needs. In addition, the current forecasting activities do not produce all
the required deliverables; in particular, no forecasts are produced for requirements in terms of licensed personnel, airport capacity, airspace capacity and funding.

3. **PROPOSED FORECASTING PROCESS**

3.1 The review led the Secretariat to conclude that there is a need to produce a single set of ICAO forecasts responding to the requirements of the various ICAO forecast users.

3.2 The proposed unified forecasts will provide a harmonized ICAO vision of the future of civil aviation and support the achievement of ICAO’s Strategic Objectives. They will cover the following areas: passenger and freight traffic and aircraft movements, aircraft fleet as well as requirements in terms of licensed personnel, airport capacity, airspace capacity and funding. These forecasts will be developed regularly by the Secretariat based on relevant methodologies, parameters and assumptions, and the FESG as well as the TFGs will be invited to use them.

3.3 For most analyses and planning applications related to civil aviation, a 20 year forecast time horizon is needed. Some applications may require longer time horizons, but for accuracy reasons, a 20-year time horizon is recommended, while extended forecasts for specific items can be conducted on an ad-hoc basis.

3.4 It is noteworthy that the full set of forecasts can be produced on a yearly basis if the necessary resources are made available. Otherwise, it will be delivered once every triennium, prior to each session of the Assembly.

3.5 The above proposal concerns only long-term forecasts. An annual (web-based) report outlining the recent developments in the air transport industry, including a medium-term forecast of passenger air traffic and airline finances will continue to be produced.

4. **IMPLEMENTATION**

4.1 Given the limited resources available, a phased approach is proposed. During the first phase corresponding to the current triennium, the Secretariat will develop methodologies and forecasts of passenger and freight traffic and aircraft movements by route group for a 20-year time horizon, under three scenarios: most likely, high and low. The forecasts will thereafter be aggregated to the regional and the world levels. The Secretariat will also initiate the development of methodologies to produce other forecasts, notably fleet and licensed personnel.

4.2 Later in the triennium, the Secretariat intends to organize a global workshop on civil aviation forecasts to present the preliminary air traffic and aircraft movement forecast results with the associated underlying methodologies, assumptions and parameters, while participants will also be invited to present their own forecasts and to give their feedback. Forecast users, major air transport stakeholders as well as other organizations and experts involved in aviation forecasts will be invited to attend this workshop.

4.3 During the second phase that will be undertaken in the next triennium, the Secretariat will continue to develop and implement the fleet forecast methodology and the associated software tool as well as the relevant methodologies needed to forecast licensed personnel, airport capacity, airspace capacity and funding requirements.
4.4 A crucial element in the achievement of any forecasting activities is the availability of the relevant data, and ICAO is uniquely placed in this respect as it has the opportunity of enhancing its existing data collection during the upcoming Statistics Division meeting (scheduled for October 2009).

4.5 Regular reports on the progress of the implementation of the proposed forecasting process will be provided to the Committee during subsequent sessions.

5. FUTURE REQUIREMENTS

5.1 The resources required to successfully implement the proposed forecasting process include human resources, data input and software tools. Measures are being taken to ensure the availability of data input and software tools, including training, in this current triennium. In order to ensure a complete, timely and successful implementation of the second phase (during the next triennium) it is expected that additional human resources will be required. There is a great potential market for this unique independent set of fleet forecasts, as they are useful to different private entities that would not have access to the detailed results of the aircraft manufacturers’ forecasts. Bearing in mind the revenue-generating opportunity of this venture, a business case will eventually be made for the funding of any additional resources needed to support the activities of market research, development of methodologies, modelling and forecasting.

— END —
**Introduction**

Econometric models are designed to explain the statistical relationship between various economic driving forces and a particular economic output such as the demand for a good or service.

They have been used to forecast the growth in air travel demand since the early 1970’s, when BAA developed a series of models to predict growth at a wide range of European airports as part of a study commissioned by the Western European Airports Association.

Since then this approach to air traffic forecasting has continued to be developed and applied in BAA’s own operations at its seven UK airports as well as in numerous consultancy and management projects within the UK and internationally. The UK Department of Transport and major aircraft manufacturers have used such models in various forms for many years.

The notes that follow are drawn on the BAA’s experience of developing them, defending them at numerous Public Enquiries into new airport developments, and applying them over a period of 40 years in the UK and overseas.

It should be stressed that there are many circumstances in which econometric modelling is not appropriate to airport traffic forecasts and many others where it alone is not sufficient without further understanding of the interplay between demand and capacity. The notes begin with guidance as to the favourable and unfavourable factors which might influence the use of econometric modelling for traffic forecasting purposes.

**Factors favourable to the use of econometric modelling**

The following factors are the key criteria in selecting this methodology:
a) **Time Horizon**

Econometric-based forecasting methods are best suited to longer term forecasting needs. Their effectiveness tends to be superior to extrapolative methods for forecast periods greater than five years and to be used up to horizons of around 25 years. They can also be useful in shorter term forecasts as a cross check against the output of other forecasting methods.

b) **Availability of Airport Data**

It is useful, but not essential, to understand the factors that may explain the pattern of historic traffic growth at an airport in order to construct an appropriate forecast model. That being so it follows that airports with more comprehensive traffic data (which would ideally enable breakdowns by geographical market supported by either survey data or reliable estimates as to passenger characteristics) would gain most from adopting an econometric forecasting approach.

c) **Airport Size**

Although it is hard to quantify with any precision how large an airport should be to benefit from an econometric approach to forecasting, airports with traffic levels of 1 million passengers per annum or more would generally be more appropriate. The main reason for this is that smaller airports are often more highly sensitive to the strategies of a single airline or the vagaries of a limited number of markets or traffic segments.

Larger and more diverse airports are thus more suited to the technique.

**Advantages and disadvantages of the Econometric approach**

**Advantages**

- Greater confidence can be attached to the forecasts produced for the reason that the approach has at its core the key factors which have been demonstrated to drive air traffic growth.
- Given that in the long-run airlines can be assumed to provide aircraft capacity to match the growth in passengers it is important to begin the forecast process by projecting the growth in passengers rather than growth in aircraft movements and/or seats.
• The process is transparent and once established it is a simple matter to change various input assumptions and quantify the sensitivity of the forecasts to any change.
• The process automatically produces segmented forecasts which can be more relevant to airport functions such as Retail Operations.
• If it is necessary to convince internal or external parties of the merit of the forecasts the econometric approach has the advantage of credibility in the eyes of many bodies within and outside the air transport industry.

Disadvantages
• The process is data hungry. It is necessary to have good traffic data in terms of accuracy and detail and ideally to have access to supplementary data on passenger characteristics such as country of residence, journey purpose etc.
• It is more complex than simple extrapolation or delphi techniques and therefore requires more resources in terms of manpower and computing.
• Ideally the process benefits greatly from the involvement of experienced forecasters with an appreciation of both mathematics and economics. Equally the quality of output is likely to improve significantly with each successive forecast round. Econometrics is therefore not a short term or one-off ‘fix’.

The Process
Any airport wishing to apply an econometric forecasting approach is advised to begin by examining its historic traffic and survey data in order to create a breakdown of total passengers by route area and type of passenger (business: leisure or local / resident: foreign resident for example). By comparing the growth patterns of each element against relevant economic measures such as GDP, trade and personal consumption it should be possible to establish which are the most important economic drivers and the sensitivity of traffic demand to the pressure of these drivers.

The process of doing this should also highlight the impact of any external events on the growth pattern and indicate whether any effects are still being felt at the time the forecast is made.
Creating the Base
Having established the key variables and the relationship between their rate of change and the relevant traffic segments they influence, the next step is to segment the traffic for a base year. This would normally be the most recent full calendar or financial year for which the most comprehensive statistical and survey data is available. As a matter of detail BAA also uses a separate matrix to prepare forecasts of transfer passengers because their growth is influenced by a different combination of drivers.

Selecting the Variables
Having populated the various segments of traffic which go to make up the base year traffic, the next step is to use judgement (aided by any previous regression analyses) to select the appropriate variables. These variables will typically consist of one or more of the following, GDP, Consumer Expenditure, Foreign Trade volumes, air fares, exchange rates.

Adopting Assumptions about Future Trends in Variables
With the chosen variables in place it is then necessary to introduce assumed rates of annual change in each of them. Reference material to support the judgements is easily found in publications of the IMF, OECD etc. or monthly forecasting publications such as Consensus. If in doubt about the values to adopt, it is best to prepare alternatively pessimistic and optimistic sets of input assumptions to test the sensitivity of the resulting forecasts to alternative views of the future.

Air Fares
On the ‘price’ side of the equation the only variable is air fares. Unlike the economic variables of GDP and personal consumption neither historic or forecasts of future air fare trends are published in any degree of detail. In the circumstances it might be suitable to refer to ICAO, IATA or aircraft manufacture forecast reports to establish historic trends.

Looking forward, the forecaster will have to consider the following issues, separately for different segments, before coming to a view about future air fare trends. The key issues are:

- levels of competition and liberalization
- potential for efficiency savings and technological gains
Choice of Elasticity Values

The concept of elasticity in this context means the degree to which the change in one variable will, everything else being equal, stimulate change in a particular traffic segment. In effect it is the gearing in the model which converts the energy of the economic driver into the speed of the forecast traffic growth.

There are two types of elasticity used in these models. The first are the ‘income’ elasticities which translate changes in the GDP, Trade and Consumption variables into traffic demand. Typically income elasticity values would range from 1.0 when applied to mature market segments through to 2.5 in the case of rapidly emerging markets. Median values of around 1.5 would be normal.

The price elasticities are those which translate increases in air fares to lower passenger demand and lower fares to higher passenger demand, so for the purposes of the calculation the sign is reversed. Experience shows that values of -0.2 to -0.5 are appropriate for the impact of given fare changes on business travel, while values of -0.5 to -0.8 would apply to leisure travel. In the case of low cost short haul travel these price elasticities can rise to -1.2.

Treatment of Uncertainty

In summary, at the heart of an econometric forecast is the concept that if a given set of economic parameters change in the future as assumed, and if the relationships between their rate of change and traffic response is as assumed, then the forecasts provided will be reasonably accurate.

However, in the real world the unforeseen always happens. This might be a different economic climate, a sudden change in oil prices leading to higher fares or a more rapid maturing in the rate of growth in a particular market. For the purpose of advising airport management teams, the forecaster should always attempt to reflect the level of uncertainty by providing a range of
forecasts according to reasonable combinations of optimistic (in terms of traffic growth) and pessimistic assumptions.

**Treatment of Non-Economic Impacts**

In individual cases there may well be other factors which may be expected to encourage or deter growth. These include such issues as:

- competition with other airports (impacts either negative or positive)
- competition with other modes of transport, usually rail
- political change (including opening up of previously war-affected countries or the opposite)
- imposition of constraints or lifelong constraints in the form of hotel accommodation
- airport capacity constraints

These issues can either be dealt with by incorporation in the spreadsheet model or can be used to manually adjust the model outputs.

**Continuing Model Development**

Once the first results have been produced and can be compared with actual traffic volumes it is essential to identify any significant variations and attribute these either to a failure of the input variable assumptions or to the relevant elasticity values. This exercise if repeated should lead to steady improvement in the forecasting capability of the model.