Statisticians should be wary of using operational codes in databases

When existing operational codes are adapted for aviation statistics databases, problems arise. That is why ICAO's new integrated statistical database automatically augments any operational codes submitted by States with unique and permanent codes for unmistakeable record identification.

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AS EVEN the first-time airline passenger would know from a glance at his baggage tag, the air transport industry favours the use of codes to identify aerodromes. Indeed, the industry has generated a whole series of codes as a short-hand notation to identify aircraft operators and types as well as airports. These codes are used to meet various operational requirements.

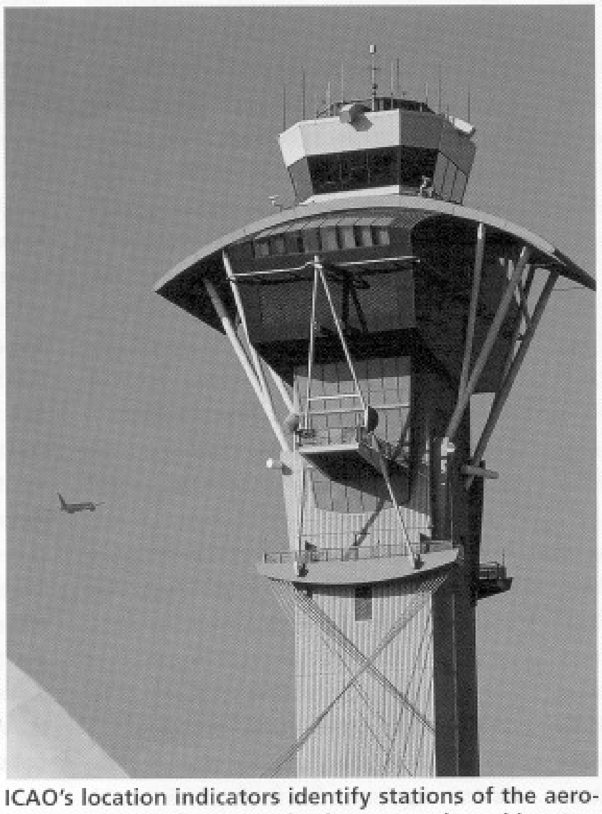
The existence of operational codes has created a temptation to extend their application to areas for which they were never intended, such as statistical databases, but with poor results. This is because the most important criterion for any statistical database is that the codes employed have to be permanent and unique over time. In practice, this is not the case for existing operational codes. In such systems codes need only be correct and typically distinct on the day they are used, and they do not always represent a unique entity over an extended period of time, a characteristic that must raise the concern of any statistician.

Perhaps the best way to illustrate the situation is to examine the operational codes issued by ICAO and the International Air Transport Association (IATA), or by States in cooperation with ICAO, and the issues that may arise when these are adopted as the sole identifier for a data record in a statistical database.

Location indicators

The purpose of ICAO Document 7910, *Location Indicators*, is to identify all of the stations which form part of the worldwide aeronautical fixed telecommunication network (AFTN) used to exchange messages and/or digital data between these stations. In other words, the location indicators are the equivalent to phone numbers or e-mail addresses. It happens that most of these AFTN stations are located at airports, therefore these codes are also used to identify aerodromes, in particular those used for international operations.

ICAO location indicators are composed of four letters (e.g. CYUL for Montreal's international airport). The first letter indicates the area in which the communications centre is located; the second designates the State or territory in which the centre is situated (larger States may use more than one letter to identify different areas in their territory); and the last two letters are assigned to assist in the process of routing the message to the communications centre.

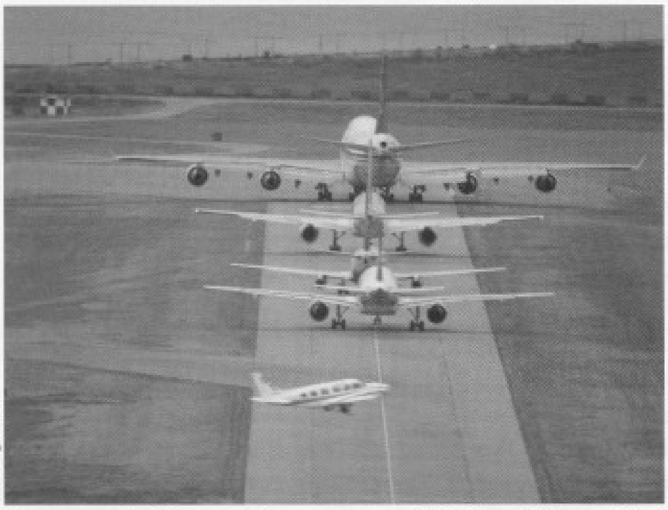

Jim Jorgenson

ICAO's location indicators identify stations of the aeronautical fixed telecommunication network, and international airports. Nevertheless, the codes are often pressed into service to identify all airports found in statistical databases.

The primary purpose of the ICAO location indicator, as noted above, is to identify a communications facility. This could be situated at a civil airport or a military base, in an air traffic control centre or in a civil aviation administration office. In some major centres there may be "location indicators" for communications centres associated with particular services, such as meteorological services, in the same physical location. Similarly, in the case of airports that combine military and civil operations, often the location indicator identifies the communications facility associated only with the military installation.

The information presented in Document 7910 is not always very clear as to which entity the code belongs to. Cross-checking this information with other sources is sometimes rendered more complex for location indicators from States with non-Latin based languages. In these cases, names are often converted on the basis of their phonetic sound, and the spelling used by ICAO may differ from that used by others.

The structure of the example code cited above does not assure uniqueness over time. In a few cases, States have changed not only the last two letters of the code, but also the first two, thus rendering the code useless for identifying records in a statistical database.



Jim Jorgenson

Any organization creating a new statistics database that includes aircraft types would do well to acquaint itself with the naming standard adopted by CAST/ICAO

States also make use of the location indicators in the national *Aeronautical Information Publication* (AIP) to identify designated international aerodromes and heliports as required by ICAO Annex 15. The convenience of using these codes to identify aerodromes has prompted many States to extend this system to most of the aerodromes in their territory, including some that are not part of the AFTN system. In Document 7910, the codes of these aerodromes are identified with an asterisk.

IATA, too, has location indicators to identify aerodromes. These are used to identify international and domestic aerodromes with commercial operations. Again, while these are fairly stable, there is no guarantee that they will remain unique. Published by IATA in the *Airline Coding Directory*, at one time these location indicators were much more numerous than those shown by ICAO. Today, most of the IATA indicators have an ICAO equivalent, but despite this development, the two systems are not interchangeable.

Operator codes

The ICAO three-letter system of designators for aircraft operators, authorities and services became effective in 1987. Prior to that time ICAO, in coordination with IATA, had been issuing the more familiar two-letter designator still in use by IATA.

As long ago as the late 1970s, it was clear that there were not enough two-letter designators to meet the needs of an expanding air transport industry. And although ICAO and IATA initially agreed to move to a three-letter system for this reason, IATA member airlines twice requested postponement of the implementation. ICAO eventually decided to unilaterally proceed with the new system for international aeronautical communications; the assigned three-letter codes are listed in ICAO Document 8585.

In the meantime, IATA had to stretch its system to accommodate the higher number of codes required. Codes were changed from two letters to two alphanumerical characters. Subsequently, IATA allowed the use of the numbers 1 and 0, characters which had been proscribed from the character set as they could be easily confused with I and O respectively. Finally, it introduced the use of "controlled duplicates," whereby two air carriers — usually operating in different geographical regions — share the same code. In addition, the codes which become available as carriers cease operations are reassigned very quickly to new operators. Despite these complications, airlines so far prefer to retain the current automated system and avoid the cost of converting to three-character codes.

As with location indicators, from a statistical standpoint the main problem with the existing coding systems for aircraft operators is that neither assures uniqueness. As in the case of IATA, ICAO three-letter air carrier designators of operators which cease to exist are reassigned to new air carriers. What's more, the use of these codes extends beyond commercial air carriers to cover other types of aircraft operators as well as civil aviation authorities and ground services.

ICAO codes are created or deleted at the request of States. States do not, however, always keep ICAO informed in a timely manner, and consequently not all international operators have a three-letter code prior to commencing operations. Similarly, in a few cases, ICAO may still show codes for operators long after they have ceased to exist.

Any attempt to use the IATA codes to identify air carriers in a statistical database usually proves problematic. These codes are not sufficiently stable to allow for even a 12-month data series, never mind one of several years' duration. Any entity that has tried to use the airline schedules available from some vendors to analyse air carrier data over a period of time would soon realize what a mistake it made in tying its system to the IATA codes. For example, if the same code were used by more than one air carrier during the period studied, spurious data from the previous owner of the code would creep into the data set being analysed, and this misinformation could colour the results without the analyst necessarily being aware of the fact.

Type designators

ICAO publishes aircraft type designators to be used for air traffic services (ATS). These codes, listed in Document 8643, are primarily intended for use in flight plans and associated ATS messages. A different designator for an aircraft variant or subtype will only be allocated when there is a significant difference in performance that has an impact on air traffic services. The latter fact is the real key to why these designators are not very useful for statistical databases.

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Summary. Systematic variance analysis helps an airline to identify whether decisions taken with the intent of increasing revenue traffic are achieving the desired results. If not, such analysis helps identify areas that call for attention.

On the operating cost side of the ledger, variance analysis helps the airline exercise cost control, and provides management with a true picture of the cost of efforts to increase revenue traffic and profitability. Finally, variance analysis is a good platform for keeping track of exchange variances and managing exchange-related risks.

While all airlines practice some form of revenue analysis, the level of detail and amount of investment in information technology depends on the size of the airline and the complexity of daily transactions. A well-planned variance analysis could ensure management has the right information streams to make decisions that enhance the airline's competitiveness and profitability in these times of excess capacity, pressure on yields and rising costs. □

Integrated information system

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required because a system of statistical information should not be closed, but needs to interrelate with other systems and have its degree of influence or dependence assessed. This interrelationship is established through parallel, supra and complementary systems.

Parallel systems. The importance of a company is most evident when its performance is compared with others in the same field. Similarly, by using standardized statistical data such as that collected by ICAO, the development of a country's aviation industry can also be measured in relation to aviation in other countries. This requires comparable indicators which have been constructed within known generalized parameters, since an indicator which cannot be compared serves no purpose.

Suprasystems. The aviation sector generates wealth and is part of a national economy and, ultimately, of the world economy. Its contribution to these two larger economic systems should be understood and compared using either the economic indicators of the larger system or of the ultimate objective, the quality of life.

Complementary systems. Complementary systems concern economic components affecting the aviation industry, such as the price of fuel and the cost of insurance, to name two factors having the greatest influence in recent years. Similarly, the services of the aviation industry are a part of other industries such as, in Colombia's case, tourism and the export of perishable flowers. Complementary information allows a company to increase productivity by facilitating access to the best data available.

The integrated aviation statistical system described above can be used by States in the economic oversight of their air transport system. By including data from all the stakeholders in a single system, planners at both government and industry levels are able to monitor the capacity of the air transport system as a whole against actual requirements, and make informed economic decisions as to when any individual element of the system may need to be modified to meet the expected higher demand. Analyses of comprehensive data may indicate the need for longer or new runways, enlarged or new terminals, or additional or new air traffic control (ATC) equipment.

The traffic and service quality data collected by an integrated system also assist the nationally based carriers to monitor the demand for air services to foreign destinations as well as their competitiveness with respect to foreign carriers. Moreover, such a statistical system can provide a civil aviation administration with the economic data needed to substantiate the case for additional funding from a central government or financial institution despite competition for development funds with other sectors within the country or region. □

Statistical databases

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For ATS purposes, aircraft are grouped in terms of certain performance characteristics such as similar rate of climb and descent, wake dissipation, and so forth. However, for economic analyses, the main criteria are payload capacity and composition (i.e. passengers and/or cargo). Aircraft performance is also important, but mainly in relation to average stage length, block speed and annual aircraft utilization.

IATA has its own aircraft type codes. Its system is more appropriate for use in economic analyses, but in some cases is not very precise, particularly with subtypes, as these may only acquire a new code when there is a sufficient number of subtypes in service to warrant such a change.

With respect to aircraft types, there is no simple solution. Any entity starting a new database would do well to acquaint itself with the standard adopted jointly by the Commercial Aviation Safety Team (CAST) and ICAO (http://www.intlaviationstandards.org/). The level of detail that one may want to use will depend on how the data are to be used. Often it might be sufficient to limit the designator to the master series (e.g. Boeing 777-200), as described at the CAST/ICAO website.

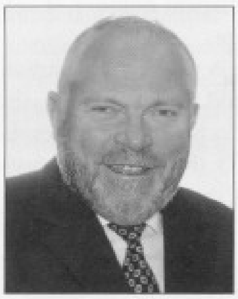
One important recommendation made by CAST/ICAO is to use the same designator assigned by the aircraft's manufacturer. With this approach, database managers may wish to add an extra field for the aircraft designator to indicate the nature of the payload, as this information — passenger, combi or all-cargo — is not always obvious from the manufacturer's designation. For example, while many all-cargo aircraft have a letter F in the designator, this is not always the case.

ICAO solution. It is clear from the above review of existing operational codes that, while it may be tempting to make use of ICAO or IATA operational codes for statistical purposes simply because these systems already exist, this approach should be avoided. At a minimum, before adopting an existing coding system, database administrators would be well advised to consider the system's primary purpose and should not take for granted that it will meet statistical requirements.

During the design of a new aviation statistics database that ICAO deployed in 2002, the issues posed by operational codes had to be addressed. While it may not be desirable, nonetheless statistical data received from States, air carriers, airports and air navigation service providers regularly make use of the ICAO or IATA operational codes. Since such codes are not useful for identifying historical records, the new ICAO integrated statistical database (ISDB) reference files for air carriers and airports allow both the ICAO and IATA codes (where these exist) to be entered, but also employs a unique, permanent machine-generated code for record identification. For air carriers in particular, the use of the machine-generated code has allowed ICAO to recognize over time a continuous data series for a specific air carrier regardless of how many times it changed name or ICAO/IATA codes.

As explained above, the use of some of the location indicators and air carrier three-letter codes issued by ICAO is being extended into areas for which these were not necessarily intended. In some cases, the initial intent to limit their application to international operations is being overridden by usage. The time may be right to formally review the purpose and popular usage of the codes to determine whether this would merit a properly planned extension to all activities. As a plus, such clarification might also bring some order to how States issue location indicators or request three-letter codes from ICAO. □

Council appoints ANC President


Bjørn Ramfjord

Bjørn Ramfjord, of Norway, has been appointed President of the ICAO Air Navigation Commission (ANC) for a period of one year commencing 1 January 2007. Mr. Ramfjord has been a member of the ANC since May 2005.

An air traffic controller with management and business experience, Mr. Ramfjord served with the Norwegian Civil Aviation Authority (CAA) for a period of five years before becoming a Commissioner. His activities included chairmanship of various working groups, including a group responsible for implementing reduced vertical separation minimum (RVSM) operations in Norway. Mr. Ramfjord was involved in auditing of air traffic services (ATS) units in Norway, and also played a role in implementing new noise abatement procedures for Oslo's Fornebu Airport.

Mr. Ramfjord obtained his controller's licence in 1971. After serving for a few years at different control towers and gaining experience at Tower, Approach and Radar Approach positions, he became the Training Manager at Fornebu Control Tower. He was appointed Chief Air Traffic Controller of the Fornebu Tower in 1991, and served as Head of Air Traffic Control (ATC) at the airport from 1993 to 1996.

In addition to training as a controller in both Norway and the United Kingdom, Mr. Ramfjord completed a business administration programme at the Norwegian School of Management in Oslo. He has experience as a consultant in the ATC field, collaborating with industry to develop an advanced ground movement guidance and control system. His consultancy work has included training of controllers in Australia, China (Hong Kong) and Malaysia.

Mr. Ramfjord has been a member of several Eurocontrol teams, among them a licensing review group concerned with the implementation of controller licensing in the 42 member States of the European Civil Aviation Conference (ECAC). □

Incident report

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• The pilots correctly determined the aircraft's take-off performance for a take-off from Runway 06L had it been at full length, but this calculation was incorrect at its reduced length.

• The pilots had no means of determining take-off performance for the aircraft from Runway 06L at reduced length.

• The aircraft was more than nine tonnes overweight to conduct a reduced thrust take-off from the reduced runway length available.

• The taxiing instructions issued to the flight crew by Manchester ATC did not include a specific holding point.

• The version of the *Manual of Air Traffic Services* (MATS), Part 1, current at the time of the incident did not require a specific holding point to be included in taxiing instructions.

• Radio communications between Manchester ATC and the flight crew regarding the lining up point on Runway 06L were misinterpreted by both parties.

• The aircraft was lined up on Runway 06L via holding point AG using a non-standard technique.

• The pilots used a non-standard technique to set take-off power at the commencement of the take-off roll.

• Seven vehicles associated with the work-in-progress were on Runway 06L at the time of take-off; closest to the aircraft's point of rotation was a rubber-removal vehicle with a height of 14 feet.

• The pilots only became aware of the presence of vehicles as they crested the rise in the runway just prior to the aircraft attaining rotation speed, V_r.

• The aircraft was rotated at the pilots' calculated V_r speed.

• After becoming airborne, the aircraft passed within 56 feet of the vehicle.

• The pilots did not believe they had been involved in a serious incident and so did not make a report to their company, the CAA or the AAIB.

• Both MA plc and Manchester ATC senior management were made aware of the incident on the day of its occurrence, but did not necessarily appreciate its true significance at the time.

• The incident was witnessed by some ATC and airport operations staff.

• No report was made by any members of MA plc or Manchester ATC immediately following the incident.

• The incident was reported seven days after its occurrence to the AAIB by NATS on receipt of a report by Manchester ATC.

Causal factors. The crew of G-XLAG did not realize that Runway 06L was operating at reduced length due to work-in-progress at its far end, until their aircraft had accelerated to a