



**WORKING PAPER**

**TENTH SESSION OF THE STATISTICS DIVISION**

**Montréal, 23 to 27 November 2009**

**Agenda Item 14: ICAO Strategic Objectives and associated metrics**

**REVIEW OF THE DIFFERENT KEY PERFORMANCE INDICATORS**

(Presented by the Secretariat)

**SUMMARY**

During its 35th Session, the Assembly took the decision to increase the effectiveness and efficiency of ICAO. In order to monitor the improvements in the working methods of the Organization, Strategic Objectives were defined. These Objectives set out ICAO's priorities for the medium term and provide a global framework for international civil aviation. ICAO regards monitoring the ongoing relevance of the Strategic Objectives as highly important with a view to keeping them current. As part of the ongoing process to work on the improvement of the effectiveness and efficiency of ICAO, High Level Indicators (HLIs) were established which would be useful to the Council to ascertain overall progress towards achievement of the Strategic Objectives of the Organization as well as to better assess the civil aviation environment as it relates to the Strategic Objectives. Some of these HLIs are common to other metrics used by the air transport industry under the denomination of Key Performance Indicators (KPIs). This paper reviews the different HLIs built in ICAO as well as the KPIs used by the air transport industry stakeholders, and assesses the need to define common metrics for monitoring the development of civil aviation, notably in the fields of Environmental Protection and Efficiency (including development).

Action by the division is in paragraph 5.

**1. INTRODUCTION**

1.1 The International Civil Aviation organization (ICAO) has aims and objectives, specified in the Chicago Convention<sup>1</sup> which established the Organization. Broadly, those aims and objectives are to

<sup>1</sup> ICAO, as contained in Article 44 of the Convention is to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport so as to meet the needs of the peoples for safe, regular, efficient and economical air transport. ICAO has 190 member States, who become members of ICAO by ratifying or otherwise issuing notice of adherence to the Chicago Convention.

develop the principles and techniques of international air navigation and to foster the planning and development of international air transport. In ICAO, experts in different fields are ensuring that States implement or are assisted so that they can implement what has been established as Standards and Recommended Practices (SARPs) in the Annexes to the Chicago Convention.

1.2 With a view to setting its course in line with rapidly evolving trends of globalization and regionalization, ICAO has embarked on implementing an innovative Business Plan, making the Organization results-based and performance driven. The Business Plan translates the Organization's six Strategic Objectives into action plans and establishes a link between planned activities and performance assessments.

## 2. ICAO CURRENT STRATEGIC OBJECTIVES

2.1 In order to implement its vision, the Organization established the following Strategic Objectives for the period 2005-2010:

- A. Safety - Enhance global civil aviation safety.
- B. Security - Enhance global civil aviation security.
- C. Environmental Protection - Minimize the adverse effect of global civil aviation on the environment.
- D. Efficiency - Enhance the efficiency of aviation operations.
- E. Continuity - Maintain the continuity of aviation operations.
- F. Rule of Law - Strengthen law governing international civil aviation.

2.2 It was agreed that these Strategic Objectives need to be kept current with changing circumstances and that ongoing refinements and improvements to the Strategic Objectives could be made as necessary.

2.3 In that context, High-level indicators (HLIs) were recognized as useful to help the Council to determine overall progress towards achievement of the Strategic Objectives of the Organization, and a number of HLIs were considered as possible metrics that could help assess the civil aviation environment. These HLIs, provided on an annual basis, are described in Appendix A.

2.3 The Strategic Objectives are linked to another important function of ICAO described in the Chicago Convention (in Article 67) and in the Appendices B, C and G of Resolution A36-15, which is to provide statistics, forecasting and economic analyses. Therefore, the need for ICAO to collect and disseminate statistics has been confirmed by the Council through its decision to implement the concept of management by objectives, which necessitates performance measurement of the Organization's activities.

## 3. HIGH LEVEL INDICATORS

3.1 One of the key considerations in setting any objective is whether it can be measured, and several good indicators have been considered for most of the ICAO Strategic Objectives. In respect of two of the Strategic Objectives - Continuity and Rule of Law, no meaningful indicators were identified.

3.2 As shown in Appendix B, some indicators have been identified as being valuable, but have not been built as no data were available at the time of their identification. It was however recommended that the corresponding data be collected, so that these indicators can be used.

3.3 With regard to providing performance indicators for each Strategic Objective, there is one denominator data which is used to compute exposure data. The first background indicator<sup>2</sup> is extremely meaningful for ICAO, as it gives an overall view of the aviation context and its development over the last decade and thus relates to many HLIs, especially those measuring safety, environment and efficiency.

3.4 At the same level, the indicators used by international organizations, notably ACI, are related to passenger and aircraft movement numbers as well as to freight expressed in metric tons, while the monitoring is on a monthly basis compared to the previous year. In IATA, several historical indicators are provided on an annual basis (5 years trend) and declined on a regional basis.

3.6 Regarding Safety monitoring, ICAO publishes the accident rates and identifies potential trouble spots duly reflected in the two HLIs that are used to measure safety trends, namely, fatal accident rate in scheduled operations and global safety reporting culture.

3.7 Other organizations such as IATA publish annual Safety trends and the indicators used are quite different as shown in Appendix C, as these are based only on Western built jets and are related to hull loss and not to fatal accident.

3.8 The third HLI related to Safety that was recommended but not built was the level of implementation of the eight critical elements of a safety oversight system. The responses to the State Aviation Activity Questionnaire (SAAQ)<sup>3</sup> are used to develop a database conversion for transforming qualitative fields into quantitative figures. The statistical analysis initiated by ICAO to cross-link the European Co-ordination Centre for Aviation Incident Reporting Systems (ECCAIRS) accident database and the Universal Safety Oversight Audit Programme (USOAP) database, enables ICAO to have equivalent levels of performance management for all the regions, as shown in Appendix D. One of the immediate benefits to ICAO is the availability of a regional Safety indicator.

3.9 With regard to the implementation of the Strategic Objective C linked to Environment, ICAO is actively participating in defining the fuel efficiency metric that will help the Organization in setting its guidance policy in terms of environmental matters.

3.10 As the calculation of emissions are correlated to fuel consumption, the HLI retained was global fuel consumed, fuel consumption per Available Tonne-Kilometre (ATK) or per Revenue Tonne Kilometer (RTK).

3.11 No final metrics to measure trends in the level of aviation emissions has been yet defined either by the Group on International Aviation and Climate Change (GIACC) or the Committee on Aviation Environmental Protection (CAEP), although two options for fuel efficiency metrics have been endorsed: a) Liters of fuel consumed / RTK; and b) Fuel Mass consumed / payload x distance

3.12 In terms of fuel consumption, there is a lack of accurate historical data, as CAEP has been using models while ICAO has developed an in-house fuel consumption formula, linked to OAG data. Fuel consumption is estimated from each airline's information provided by OAG (scheduled operations) associated with a fuel consumption formula specific to each aircraft type. From these fuel consumption figures, it is possible to estimate global fuel- consumption/emissions for any airline on each

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<sup>2</sup> traffic development of scheduled airlines of ICAO Contracting States expressed in Tonne-Kilometres Available and Performed and in number of Departures

<sup>3</sup> This Questionnaire is available in the STA/10 site

scheduled flight sector flown, by taking into account the aircraft type operating the flight. The detailed methodology is described in GIACC/2 IP2<sup>4</sup>.

3.13 In parallel with its support to airport and air navigation services planning, ICAO needs to monitor the efficiency of airports and air navigation services operations through, for instance, the follow-up of their percentage weight in the airline operating costs. This HLI enables ICAO to keep its guidance material updated to maintain its leadership role in the economic field.

3.14 Optimized CNS/ATM systems exist by technology progress and result in fuel saving opportunities, hence Environment and Efficiency make use of one common HLI.

3.15 Another contributing indicator to the achievement of this Strategic Objective is the indication of the percentage of air transport conducted under liberal arrangements. This indicator is highly useful to ICAO in the promotion of air transport liberalization, and the way forward could be the opportunity to assess the regional differences in the progress of liberalization.

3.16 Different types of regional indicators could be developed, by matching Air Services Agreements (ASAs) information with traffic data, as shown in Appendix E. The first tracks the development of liberalization in terms of number/percentage of liberalized country-pair routes, while the second compares the network of liberalized ASAs with the actual network operated by airlines.

#### 4. **RECOMMENDATION STAP/14-15**

4.1 The panel noted the need to define common metrics that could be used by the air transport industry stakeholders for monitoring the development of civil aviation activities. For efficient performance measurement, the indicators provided must be based on reliable information, while the format of data collection needs to stay simple and relevant. In order to strengthen its support to States, ICAO is willing to implement a process to develop new global and regional HLIs, notably through the increase of data coverage, and by keeping in mind that the Strategic Objectives which are the necessary links that guide the Organization's interaction with other organizations and external parties and are expected to evolve with each Business Plan. A future consideration would be the need to build common indicators that could be used both by ICAO and by the different air transport industry stakeholders.

#### 5. **ACTION BY THE DIVISION**

5.1 The division is invited to:

- a) note the current HLIs used by ICAO to monitor the progress towards achievement of its Strategic Objectives achievement; and
- b) offer views on the possible convergence of the HLIs used by ICAO and the KPIs used by the other air transport industry stakeholders.

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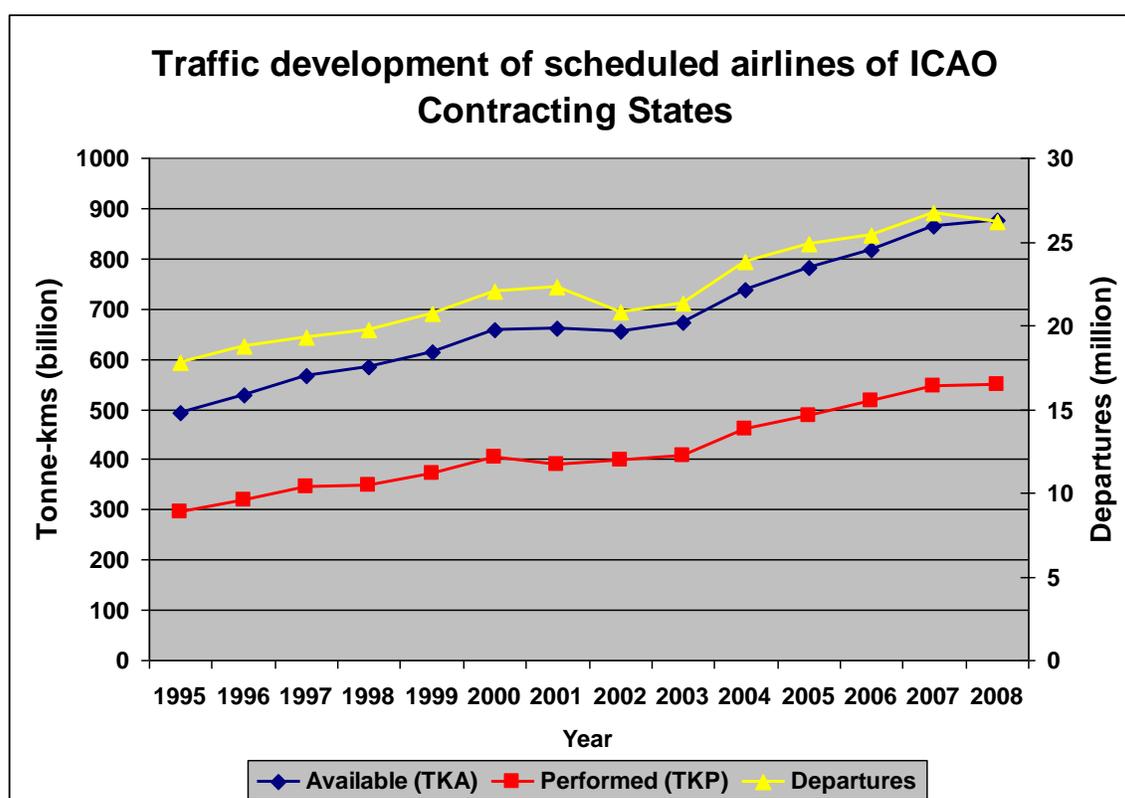
<sup>4</sup> This paper is available in the STA/10 site

## APPENDIX A

### HIGH-LEVEL INDICATORS

#### Aviation Context – Background Indicator

- Development in aviation capacity traffic and in the number of departures of the scheduled airlines of ICAO contracting States.

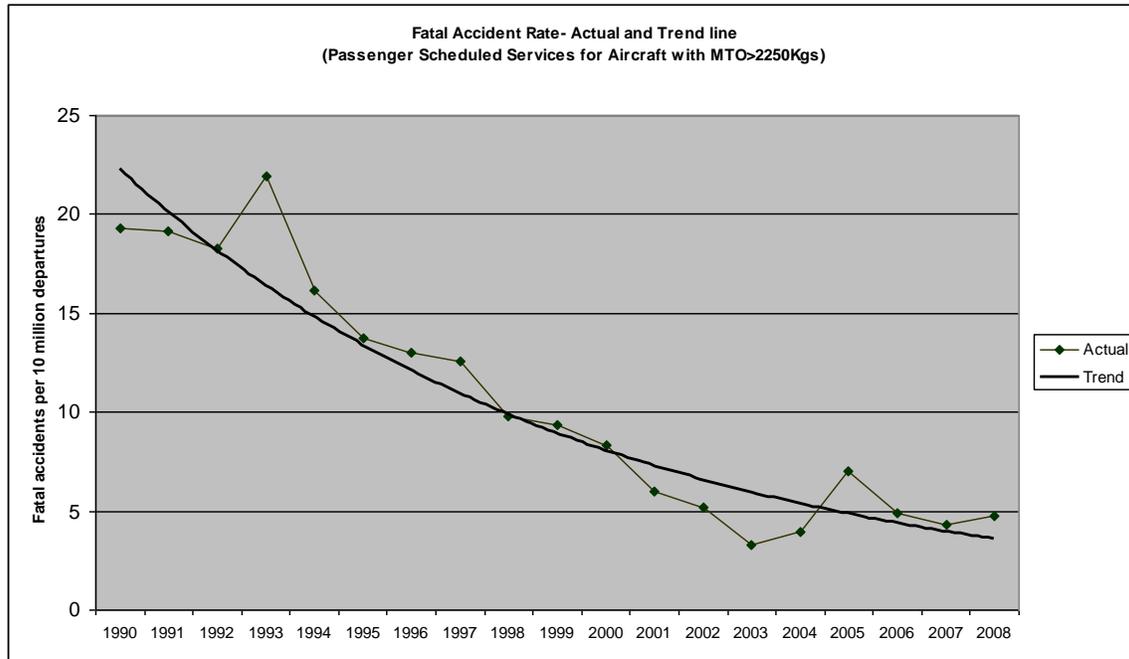


#### Explanation

- This component provides a view of the overall aviation context and thus relates to many high level indicators. The chart above shows the development in capacity (tonne kilometres available – TKA), traffic (tonne kilometres performed – TKP) and in the number of departures of the scheduled airlines of ICAO contracting states over the period 1995 – 2008. In terms of annual average change, TKA increased at 4.5 percent. TKP at 4.9 percent and the number of departures at 3 percent per annum. These data provides the broad context relating to the efficiency of ICAO’s initiatives in the development of Civil aviation over the last twelve years.

### High level indicator for A - Safety<sup>5</sup>

- A1 Level of Safety, Trend line indicator for fatal accident rates per million departures.

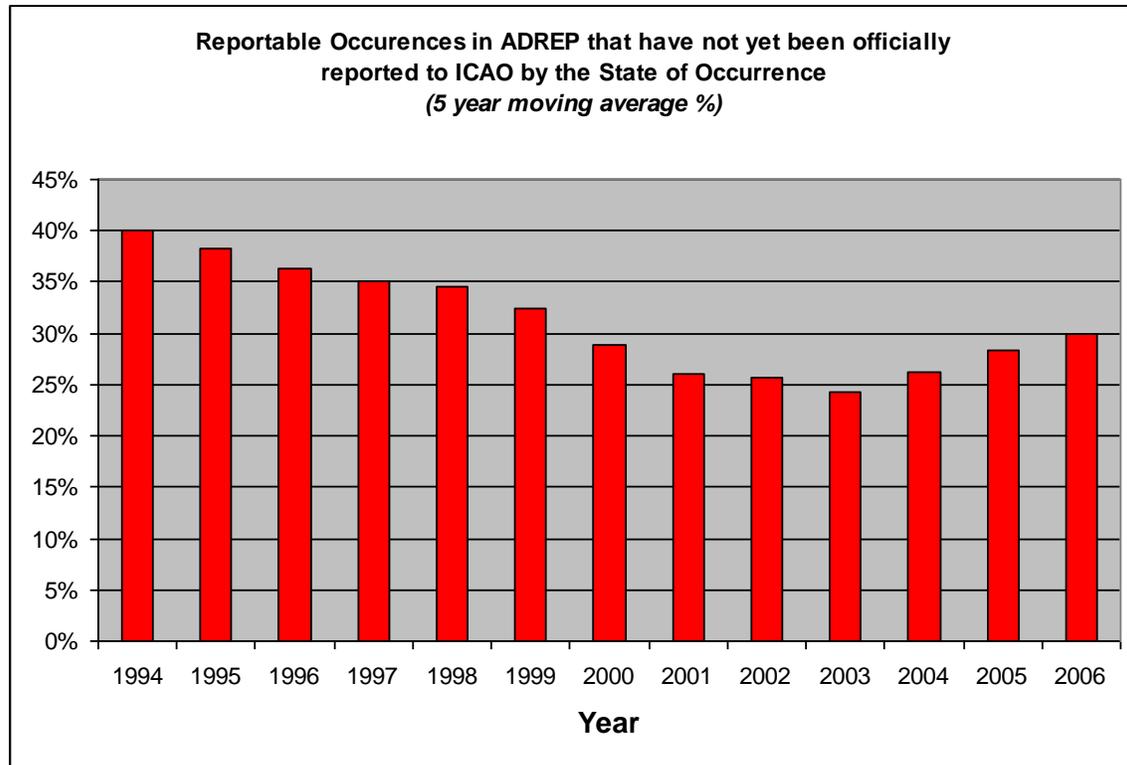


### *Explanation*

- ICAO has collected data for many years on fatal accident rate per departure for all air transport operations with aircraft maximum take off mass (MTOW) over 2 250 Kg. Data on fatal accidents are considered reliable with a more complete data set being reported to ICAO and or available from other sources.
- The above trend has been generated for passenger scheduled services with operations by aircraft having MTOW over 2 250 Kg and involved in passenger fatalities, the primary cause for which was “accidents” and not acts of unlawful interference.
- The trend line has been generated using a low dampener to discern real trends. The trend is overall a declining one. For the immediate future the trend indicates accident rates per departure levelling off at the rates noticed for the year 2008.

<sup>5</sup> 2008 Safety data extracted from ECCAIRS and is provisional.

- A.2 Global safety reporting culture (Percentage of ICAO States notifying ICAO of accident/serious incident).

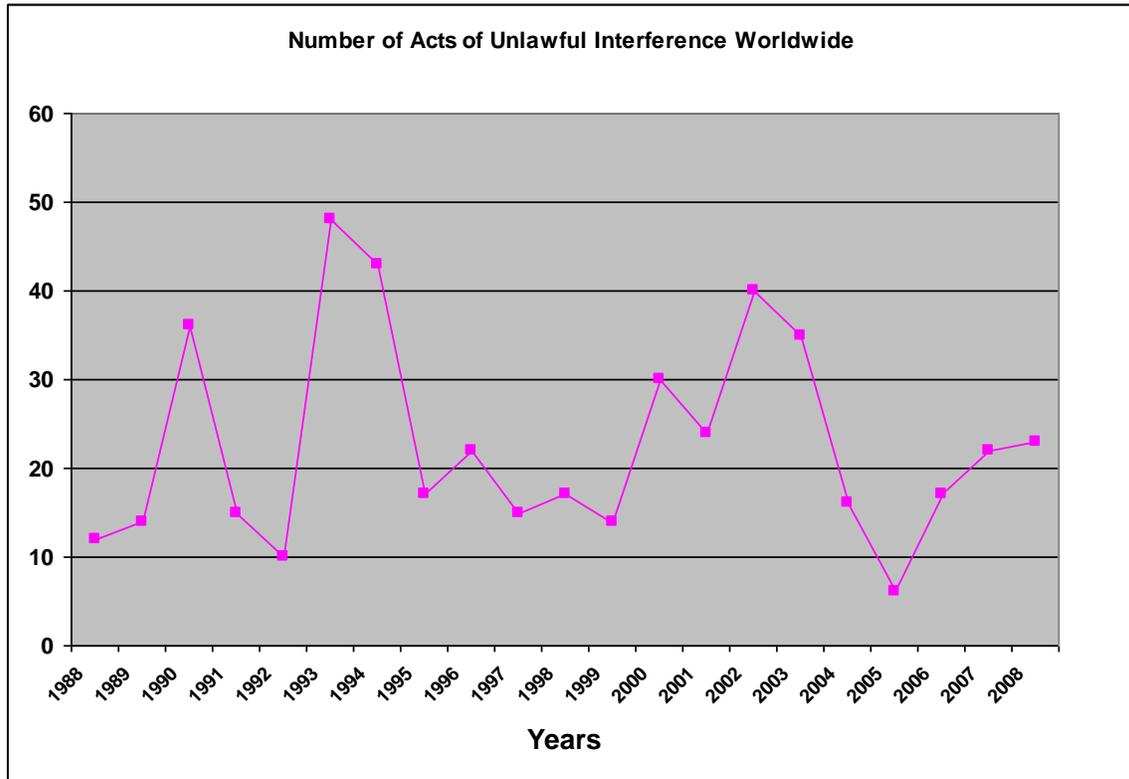


### *Explanation*

- A reportable occurrence is one that qualifies as an accident or serious incident as per Annex 13 and involves a commercial or general aviation operated aircraft with a MTOW over 5 700 Kg.
- ADREP records on reportable occurrences that have not been officially notified to ICAO by the State of occurrence have been derived through reliable industry sources such as Airclaims, Lloyds or the Flight Safety Foundation's Aviation Safety Network.
- For the time period 1 January 1990 to 31 December 2006, ADREP has records on reportable occurrences in 162 Contracting States, of these, 68 have more unofficial records in ADREP than officially notified ones.

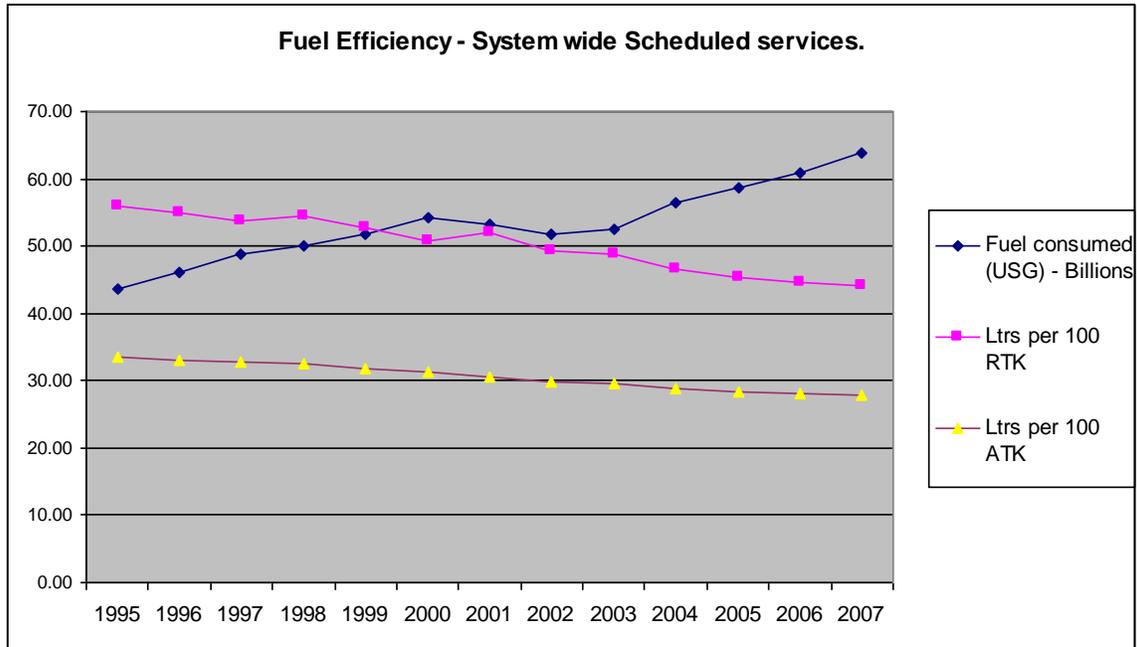
**High level indicator for B – Security**

— **B.1** Number of acts of unlawful interference against civil aviation worldwide.



## High level indicator for C – Environment

- **C.1 Tonnes of fuel burned (and CO<sub>2</sub> generated) per 100 RTK/ATK**

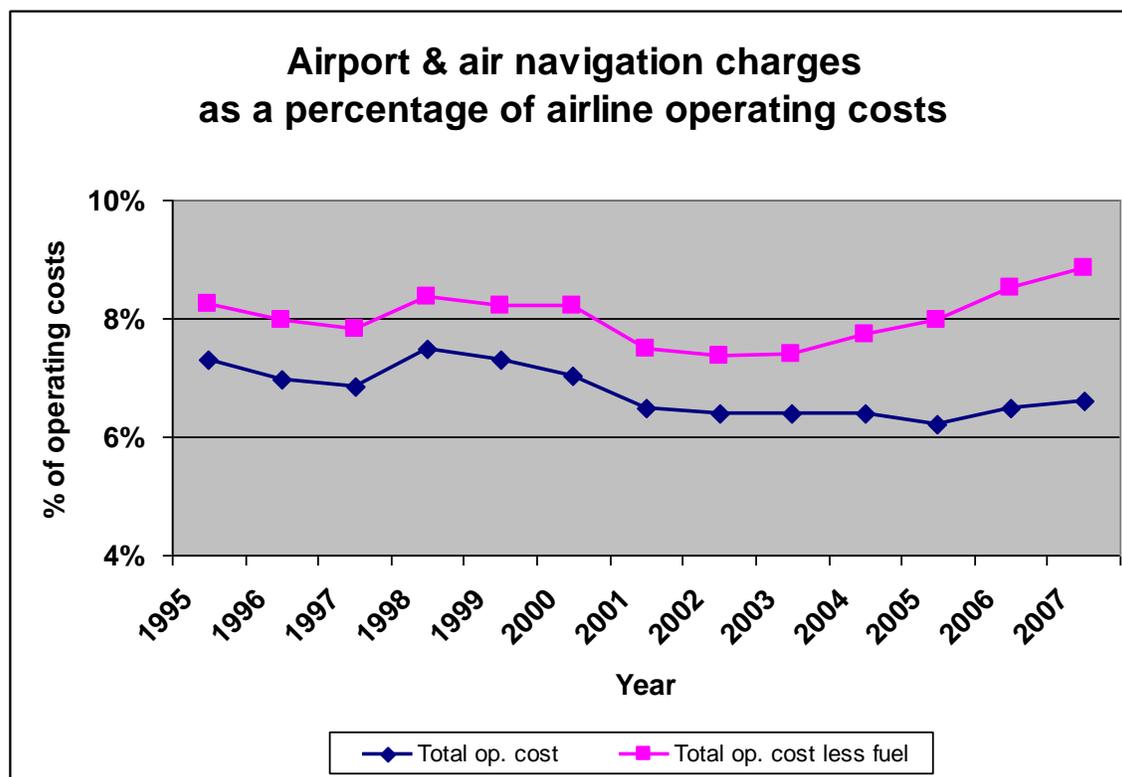


### *Explanation*

- Aircraft engines emit a range of gaseous and particulate by-products (emissions) that contribute to various environmental impacts. Some emissions are related to components in the fuel, such as sulphur, some are related to the high-pressure, high-temperature oxidizing environment of the engine, such as oxides of nitrogen (NO<sub>x</sub>), and some are simply by-products of the oxidation reaction that occurs in the combustion process itself, carbon dioxide (CO<sub>2</sub>). Given this variability, there is no one measure that accurately quantifies the environmental impact of aircraft engine emissions. However, all emissions are correlated to some degree to the amount of fuel burned. Therefore, from a high-level perspective, tracking the change in fuel burn in absolute terms provides an indication of the change in the magnitude of the environmental impact of aviation emissions. Since Carbon emissions are directly correlated to hydrocarbon fuel burn (unit of fuel X 3.16 = unit of CO<sub>2</sub>), tracking fuel burn gives precisely the same relative perspective as tracking Carbon emissions.

**High level indicator for D – Efficiency and Development**

- **D.1** Airport and air navigation charges as a percentage of airline operating costs.



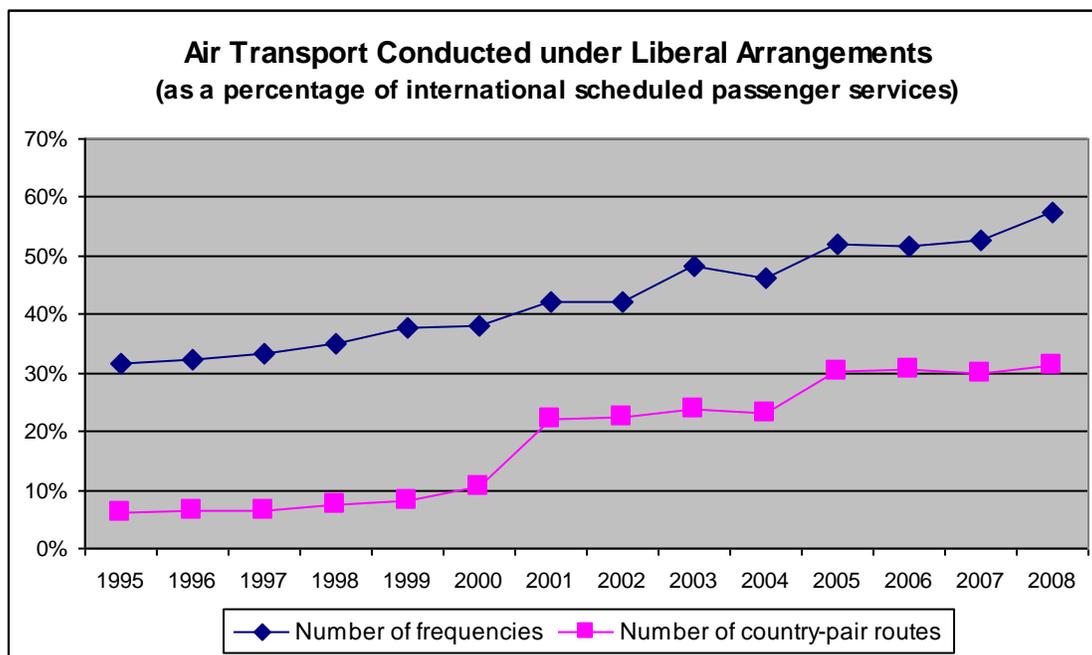
**Explanation**

— This indicator illustrates the increased efficiency and improved cost-effectiveness in the provision and operation of airports and air navigation services, which is in its turn one of the results of the ongoing commercialization and privatization process of airports and air navigation services entities. It also reflects upon ICAO’s leadership role in the economic field and the related policy and guidance material being kept updated and promoted by the Organization. However, it should be noted that the improvements in efficiency and cost-effectiveness of the service providers are relative to the improvements by air carriers and the changes shown in the percentage of these costs in the total operating costs of air carriers (after excluding fuel costs) suggests that the change in efficiency and cost-effectiveness of airports and air navigation services entities is in line with the changes introduced by the air carriers themselves.

- **D.2** Tonnes of fuel burned per 100,000 ATK
  - Explanation and data: see HLI for the Environment. Tracking the change in fuel burn on a rate basis (tonnes of fuel/100,000 RTK/ATK’s) provides a picture of the relative change in fuel-efficiency of the commercial aviation sector. By following these two

measures in a time series, it is possible to form a high-level perspective of how environmental effects of international aviation are changing over time. Since Carbon emissions are directly correlated to fuel burn (unit of fuel X 3.16 = unit of CO<sub>2</sub>), tracking fuel burn gives precisely the same relative perspective as tracking Carbon emissions.

- D.3 Percentage of air transport conducted under liberal arrangements



### *Explanation*

- Air services agreements between States govern the operation of international air transport services. The number of liberalized agreements reflects changes in the economic regulatory environment. The data measures used in this table track the development of liberalization and can be used to assess the impact and extent of liberalization on the efficient operation of international air transport services.
- Since the mid-1990s, there has been a significant increase in the number of States which have accepted liberalized bilateral or multilateral arrangements. In terms of the impact or extent, in 2008, about 31 per cent of the country-pairs with non-stop scheduled passenger services and about 57 per cent of the frequencies offered were between States which have embraced liberalization (compared with about 7 and 35 per cent, respectively, a decade ago). To create a more favourable economic regulatory environment for the sustainable development of international air transport, there is a need for ICAO to promote and facilitate air transport liberalization, and assist States where needed, while at the same time ensuring that safety and security are not compromised.

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## APPENDIX B

### INDICATORS WHICH DO NOT HAVE DATA CURRENTLY AVAILABLE OR MAY REQUIRE SPECIAL DATA COLLECTION

#### High-level indicators for A – Safety

- A3. Level of implementation of the eight critical elements of a safety oversight system
  - *Explanation:* This indicator could be in place as soon as ICAO has enough data to provide reliable information (likely in 2009).

#### High-level indicator for C – Environment

- C2. Number of residents in the vicinity of major airports exposed to noise at or above DNL 65 dB
  - *Explanation:* People usually react to noises which disturb their daily activities. This “annoyance” depends on combined factors such as the intensity, frequency and duration of the noise and on the time of day where the noise is produced. Two factors influence the number of people affected by significant noise level around airports: the noise levels accrued from the operation of aircraft and the land-use planning and control which preclude encroachment at the vicinity of airports. In general, most land uses in the vicinity of airports are considered to be compatible with a day-night average sound level (DNL) that does not exceed 65 dB. To evaluate the impact of aircraft noise and its evolution over time, the number of people affected by significant aircraft noise is estimated as the number of people in the vicinity of major airports exposed to noise at or above DNL 65 dB.
- C3. Distribution of aircraft in the in-service fleet by NO<sub>x</sub> characteristics\*
  - *Explanation:* Different from CO<sub>2</sub>, the production of NO<sub>x</sub> is loosely correlated with fuel burn. NO<sub>x</sub> is a reactive gas emitted from jet engines. The rate of NO<sub>x</sub> formation is primarily a function of the combustion temperature, pressure ratio and dwell time of the air within the combustor. Engines are certified to specific standards which, inter alia, quantify the amount of NO<sub>x</sub> produced within the LTO cycle. This indicator proposes to track the in-service fleet on the basis of the proportion of the fleet that is equipped with engines distinguished on the basis of the relative rate of production of NO<sub>x</sub>.

#### High-level indicator for D – Efficiency and Development

- D4. The number (percentage) of major international traffic flows wherein performance-based navigation operations are conducted

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\* Further work is required to define the NO<sub>x</sub> performance characteristics and to obtain access to the privately held proprietary database.

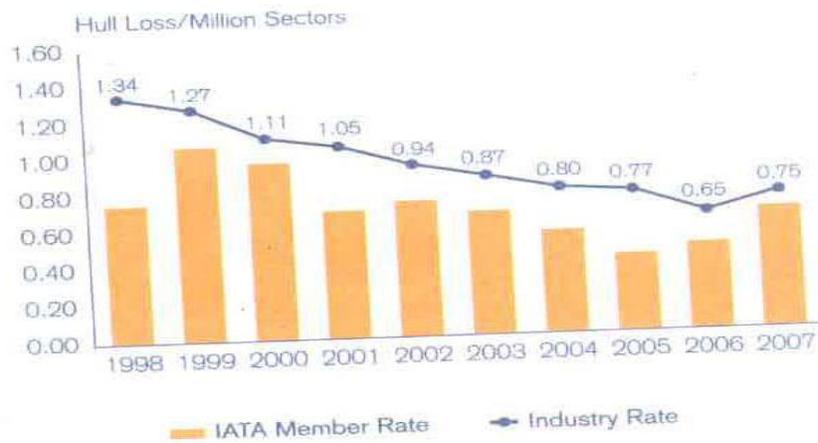
- *Explanation:* The above will be measured on the basis of implementation of required navigation performance (RNP) and area navigation (RNAV) route structures and reduced vertical separation minimum (RVSM), and appropriate infrastructure and supporting regulatory environment

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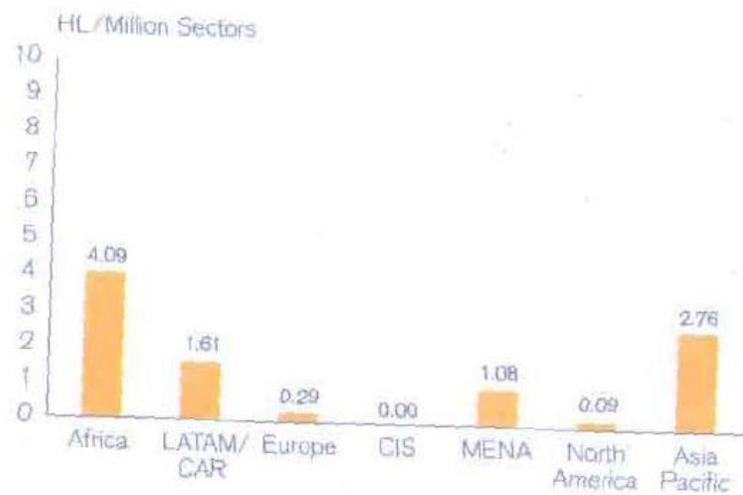
## APPENDIX C

### IATA SAFETY INDICATORS

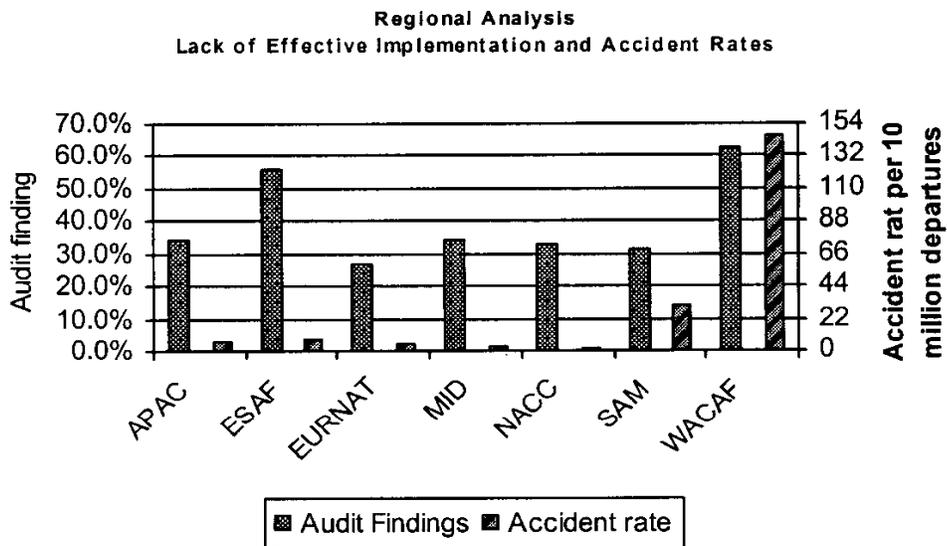
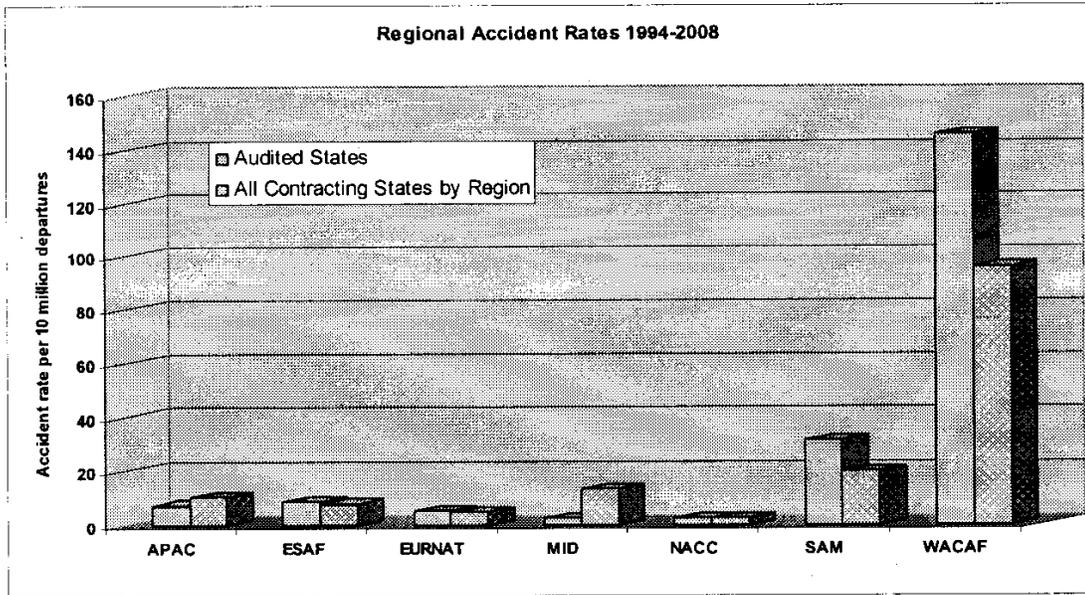
**Western-built Jet Hull Loss Rate  
IATA Member Airlines vs. Industry**



**Western Jet Loss Rate by Region  
Year 2007**



**APPENDIX D**  
**REGIONAL INDICATORS FOR SAFETY**



APPENDIX E

Figure 1. Liberalized Country-Pair Routes with Non-Stop Scheduled Passenger Frequencies

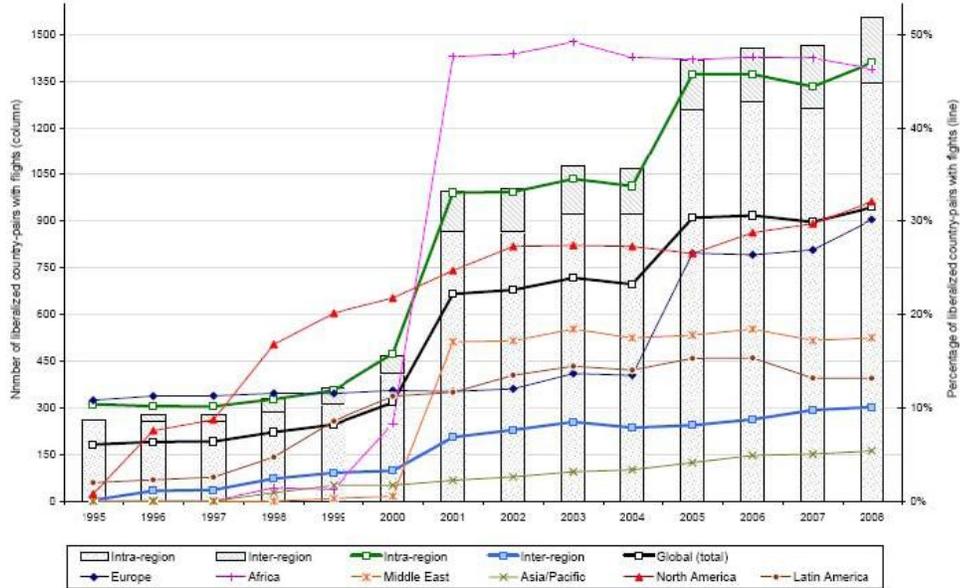


Figure 3. Regulatory Network of Liberalization vs. Actual Network Operated by Airlines

