Use of "Big Data" in ICAO and the United Nations

ICAO Headquarters, Montréal

18 January 2016

Informal briefing to the Council

- Reflections on Big Data — ***By D/ADB***
- Big Data and the UN — ***By D/ATB***
- Big Data and Aviation — ***By D/ATB***
- ICAO's engagement — ***By D/ANB***
- Way Forward — ***By D/ADB***

Reflections on Big Data | Big Data and the UN | Big Data and Aviation | ICAO's Engagement | Way Forward

The term "Big Data" is often used synonymously with other related concepts such as business intelligence (BI) and data mining.

Big Data

- Large volume of data
- Day-to-day necessities of a corporation
- **Purpose** :
  - Analysis for accurate insights
- **Objective** :
  - Better decision-making
  - Strategic business moves

Volume

In 2020 – 50 times the amount of data in 2011.

Velocity

Large amount of data must be dealt with in a timely manner.

Variety

Data comes in many various formats.

Big Data are a source of information and intelligence that have been gathered from a recorded action or from a combination of records.

- **Records of Supermarket purchases (Walmart tracts > 1 mil. Transactions/hour)**
- **Road tolls, train, ship, aeroplane, mobile tracking devices, navigation systems**
- **Telephone operators and satellite sensors and electronic images**
- **Credit and debit payments, trading and settlement platforms**

The list seems endless as more and more information becomes public and digital.

SOUTHWEST

- Analysis of sensor data to identify patterns indicating potential malfunction or safety issue.
- Enables making reparations without interrupting flights or putting passengers at risk.

BOEING

- Perform ASBU analysis for operational efficiency.
- Improve performance and customer experience.

KAYAK

- Creation of a predictive model for users of flight price fluctuation within the upcoming week.
- Tracking of flights improve the algorithm.

UNION PACIFIC

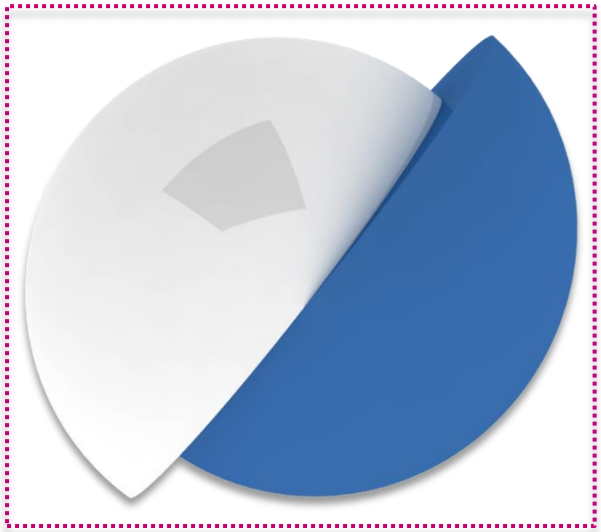
- Prediction of potential derailment days.
- Derailment reduced by 75%.

AIRBUS

- Optimize fleet management and operations.
- Enhance operational efficiency.

Factors facilitating advancements in Big Data

- Reduced costs of data collections, storage and processing
- New sources of data & improved access to existing data
- Broad spectrum of utility for collected data
- Creative and powerful new methods to exploit Big Data



Advantages

- Significant increase in scope and coverage
- Significant decrease in costs
- Improving accuracy , transparencies and timeliness
- Leapfrog to more efficient technology for countries without proper statistical programs
- More cost effective and productive technology

Challenges

- Methodologies and definitions to match that of official statistics
- Perceptional differences
- Public Private Partnerships (PPPs)
- Capacity building

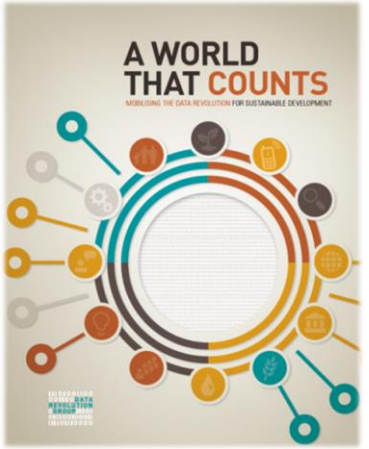
Big Data & the United Nations

- A transformative tool for official statistics
- Potential to improve accuracy and reduce costs for official statistics
- UN Global Working Group to:

*"provide strategic vision, direction, and coordination of a global programme on Big Data for **official statistics**, to promote practical use of sources of Big Data for official statistics, while finding solutions for their challenges, and to promote capacity building and sharing of experiences in this respect."*

Mobilizing Data Revolution for Sustainable Development

"Data are the lifeblood of decision-making and the raw material for accountability. Without high-quality data providing the right information on the right things at the right time; designing, monitoring and evaluating effective policies becomes almost impossible."



(Statement of Independent Expert Advisory Group on the Data Revolution appointed by UN Secretary General, August 2014)

PRINCIPLES GOVERNING INTERNATIONAL STATISTICAL ACTIVITIES

- Endorsed by the Committee for the Coordination of Statistical Activities – 2005
- Reaffirmed – 2014
- Endorsed by the Economic and Social Council -2013 (Resolution 2013/21) and by the United Nations General Assembly - 2014 (Resolution A/RES/68/261).

1. High quality international statistics for all
2. Impartiality & Professionality
3. Publicity
4. Transparency
5. Timeliness, Cost-efficiency, Reduced burden on data providers
6. Strict confidentiality, use mandated by legislation
7. Addressing misinterpretation and misuse of statistics
8. Effective statistical standards
9. Coordination of international statistical programs
10. Cooperation

ICAO's mandate by the UN system

Charter of the UN

The agreement between the UN and ICAO stems from Art. 57 of the UN Charter :

- specialized agencies having wide international responsibilities in economic, social and related fields shall be brought into relationship with the United Nations .

Agreement between the UN and ICAO

Article XIII - Statistical services (Salient features)

- *UN and ICAO agree to cooperate and combine efforts to secure the greatest possible utilization of statistical information and minimize burden on reporting entities.*
- *ICAO recognizes the UN as the central agency for matters related to standardization, improvement and dissemination of statistics serving the general purposes of all international organizations.*

UN Global Working Group (GWG) on Big Data for Official Statistics :

- 18 Member States
  - *States on the ICAO Council: Australia, Brazil, Cameroon, China, Egypt, Italy, Mexico, United Republic of Tanzania, United Arab Emirates, United States of America*
- 10 International agencies
- 8 Task teams to implement the mandates
- 2 International conferences

GWG Mandates

1. Advocacy and Communications
2. Linking Big Data and SDGs
3. Access and Partnerships
4. Training, Skills, and Capacity Building
5. Cross-Cutting Issues
6. Mobile Phone Data
7. Satellite Imagery
8. Social Media Data

ICAO is a member of GWG

The report was prepared in accordance with the United Nations' Economic and Social Council Decision 2015/216.

It will be presented to the UNSC in New York City (New York) in March 2016.

Reflections on Big Data | **Big Data and the UN** | Big Data and Aviation | ICAO's Engagement | Way Forward

ITU International Telecommunication Union	Use of mobile data – population displaced by epidemics and natural disasters
UNIDO United Nations Industrial Development Organization	Industrial statistics; employment index
Universal Postal Union	End to end predictability for international e-commerce
The World Bank	Developmental indicators
Food and Agriculture Organization of the United Nations	Remote sensing for agricultural statistics and forecasting

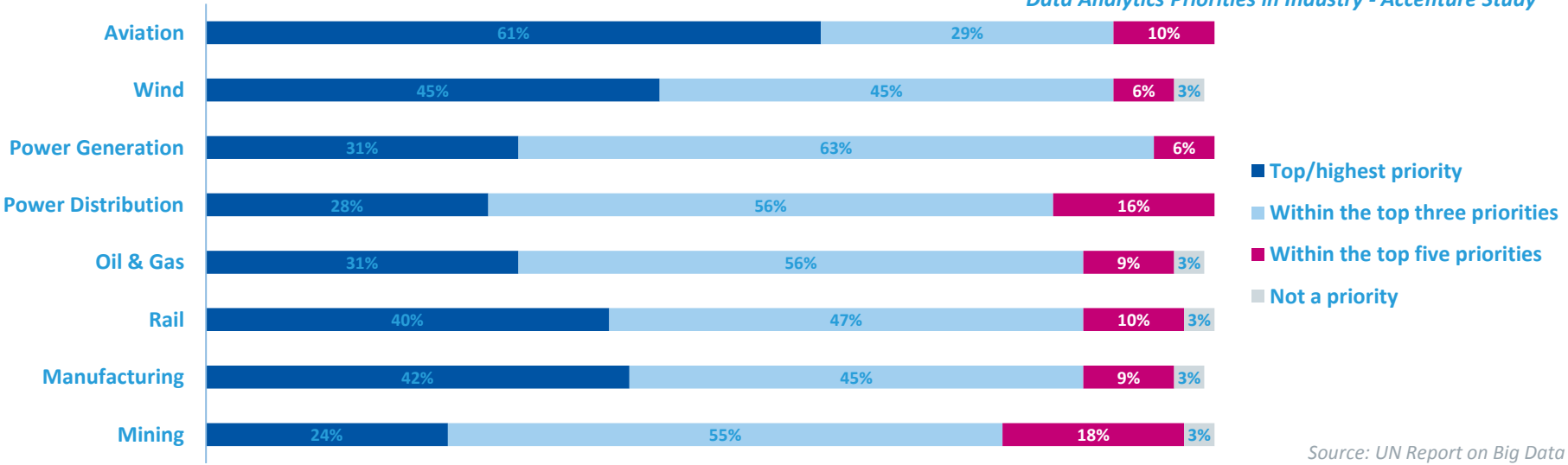
Other international agencies

OECD Better Policies for Better Lives	Geospatial and web data for OECD statistics – transport studies , environmental indicators, economic studies, and governance indicators
European Central Bank Eurosystem	Macroeconomic nowcasting
eurostat	Integration of big data into EU official statistics

Big Data & Aviation

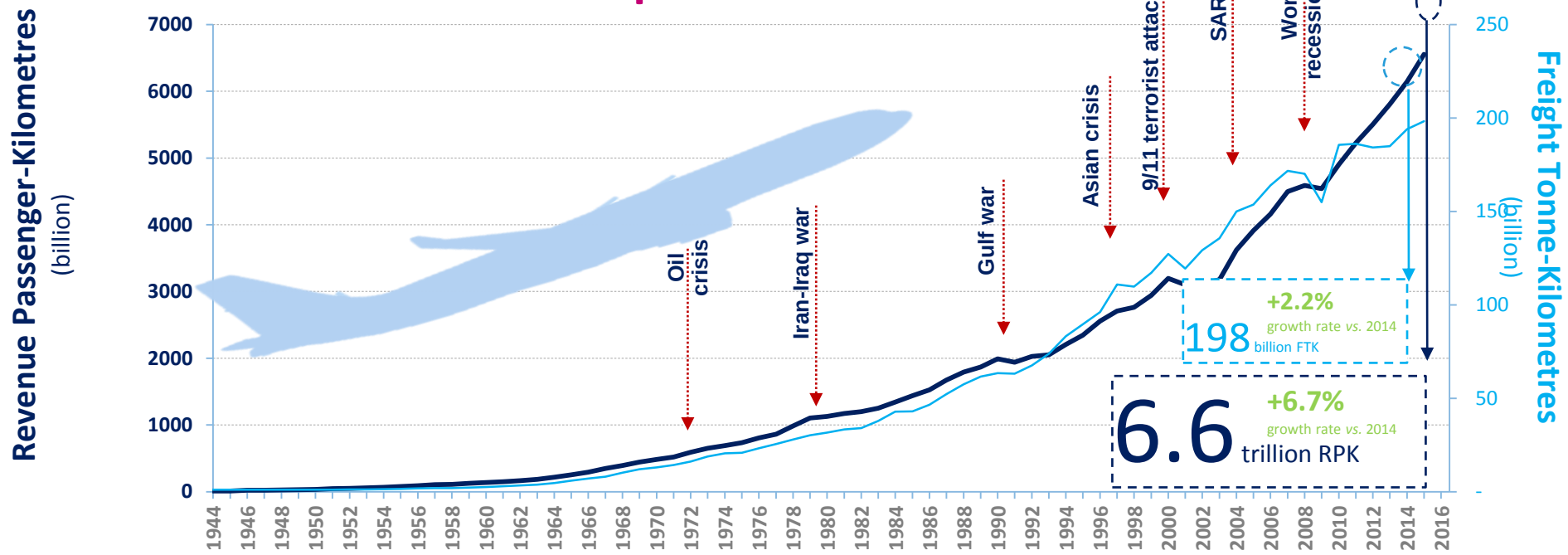
Big Data analytics has become the highest priority for the aviation industry

Data Analytics Priorities in Industry - Accenture Study



Source: UN Report on Big Data

Air Transport Growth in 2015*



Source: ICAO

**preliminary results*

Big Data & Aviation

- **191 Member States**
- **33 million flights per year**
- **3.3 billion passengers per year**
- **3 927 airports worldwide with scheduled services in 2014**
- **1 400 scheduled commercial airlines**
- **54 495 city pairs**
- **173 ANSPs**
- **26 000 aircraft in service**

Source: 2014 State of air transport

Benefits of Big Data

- Granular Information from all airlines/airports
- Data reflecting Real Aircraft Movements
- True Passenger Origin and Destination
- Internationalization of Data
- Clear Comparability between Different Data Sources

Big Data for improved connectivity

Connectivity components

Market Access

- Optimal use of ANS (ASBUs)
- Airline activities
- Optimal use of airport systems
- Inter-modality
- Optimal use of aircraft
- Facilitation

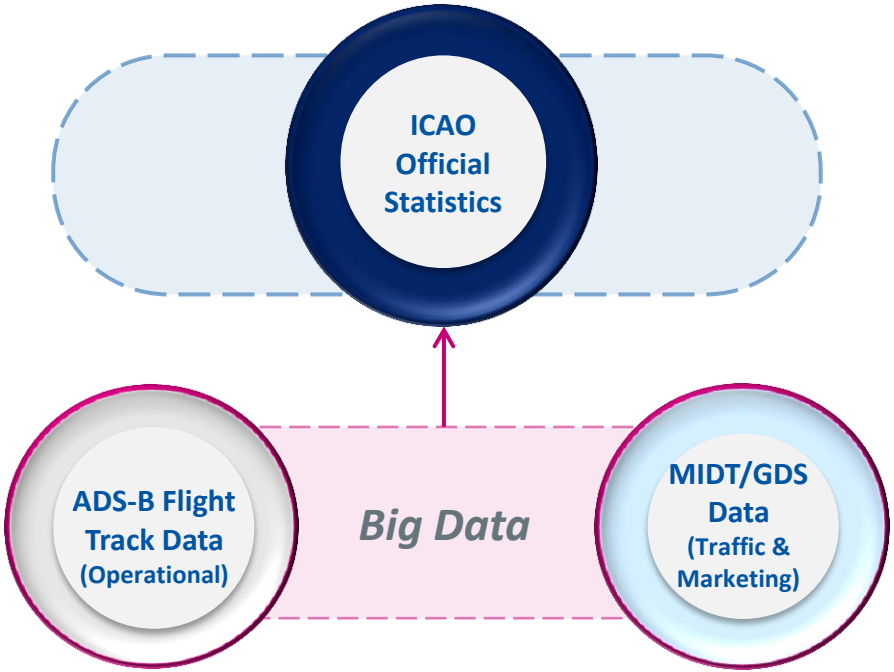
Supporting regulatory framework

Market Access

- Multilateral Agreements
- Bilateral Agreements
- Regional frameworks
- Traffic liberalization (pax and cargo)

Market Access

- Air Carrier Ownership & Control
- Taxes
- ASBUs
- Charges
- Facilitation / Security
- Consumer Protection
- Fair Competition



For the first time, a low cost and high efficiency opportunity exists toward gaining insights from the big data that cannot be done using localized data sets:

- Informed policy making
- Implementation
- Meet Strategic objectives
- Give States what is needed
- Improve coverage to nearly 100%
- Reduce costs

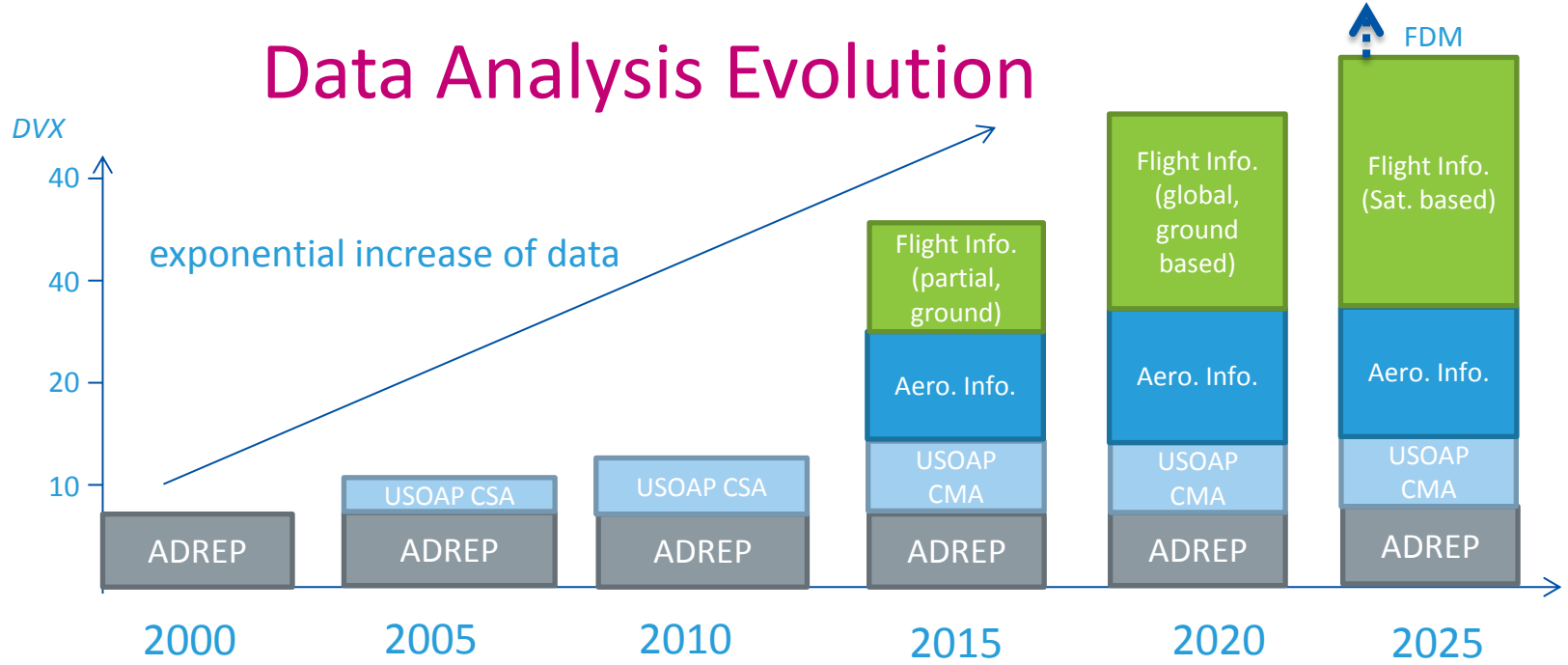
Analysis Needs

Global Aviation Safety Plan (GASP) Objective by 2027:

All States implement **predictive risk capabilities** as necessary to support future Air Navigation Systems.

From **Reporting** to **Detection**

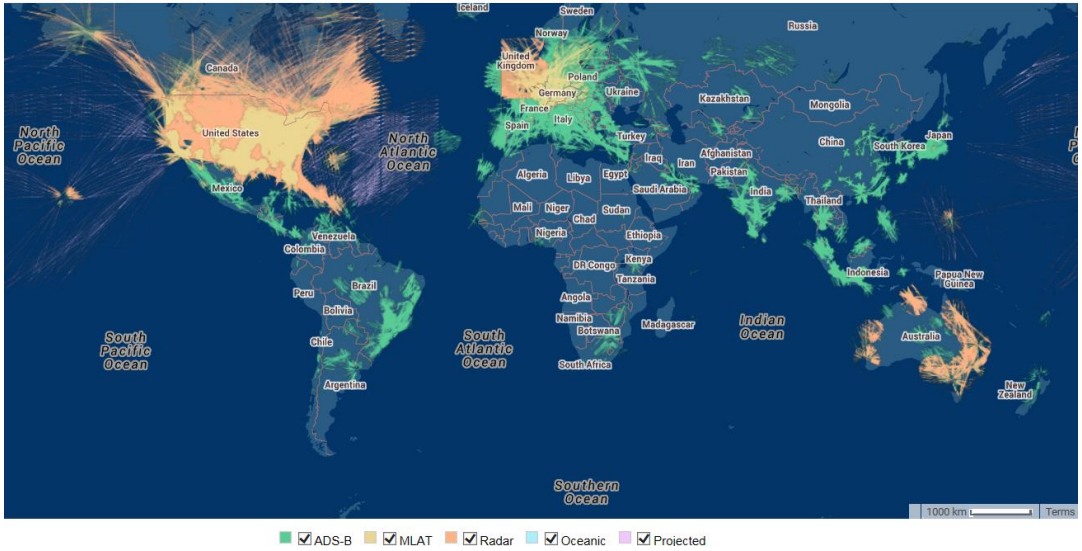
Data Analysis Evolution



DVX: Data volume Index, volume of data available compared to 1960

Automatic dependent surveillance – broadcast (ADS–B)

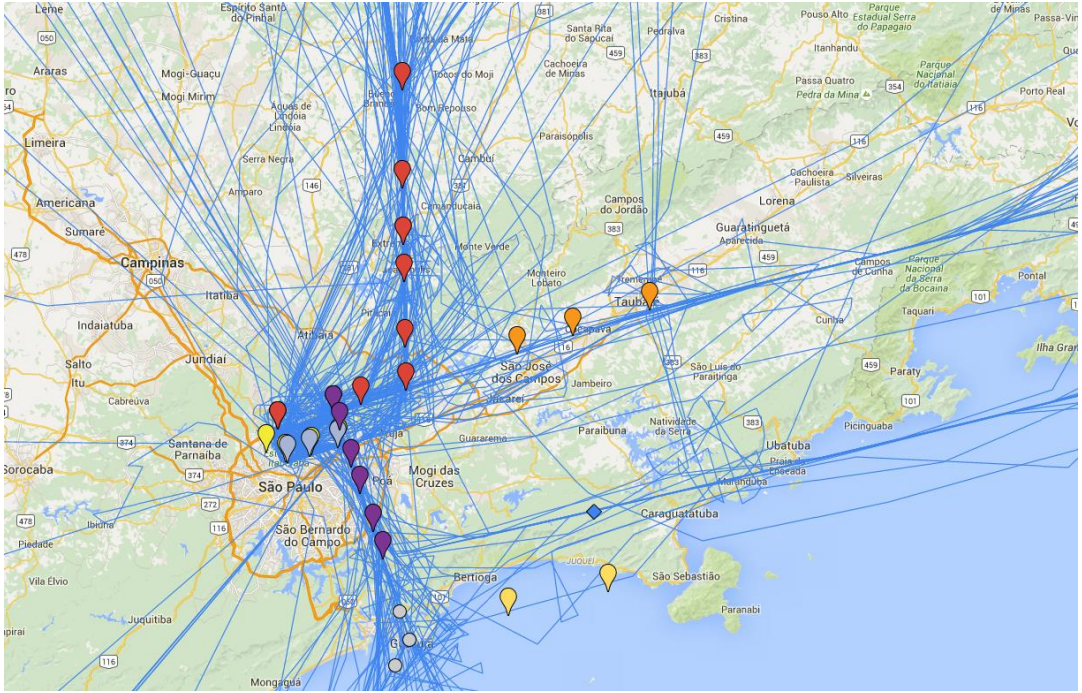
- 70% of commercial fleet are equipped with ADS-B
- 90% of all commercial scheduled flights are equipped
- 72 GB of data collected per month (1MB per minute)
- Potential for detection of **safety events, hot spots** and **ASBU block implementations**



Pilot Project 1

Effective use of PBN procedures

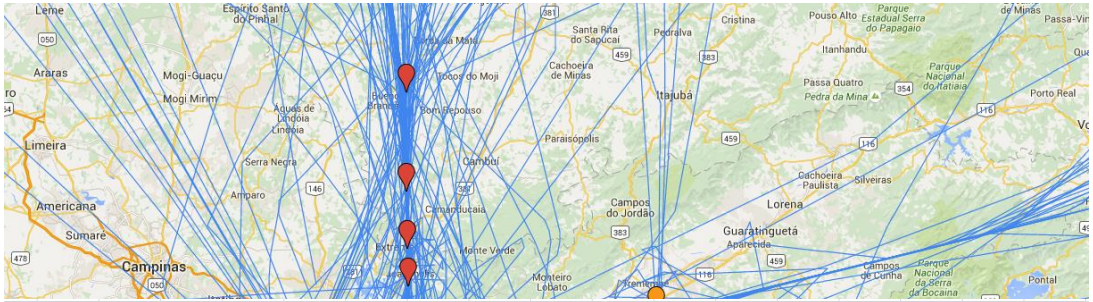
- ***Objective***: Detection of the effective use of PBN standard arrival (STAR) and instrument approach (IAP) procedures.
- Recording of actual arrival flight paths into an international airport over 24 hrs.
- Mapping actual flight paths with "Fly Over Fixes" on STARs and IAPs.
- Quantification of % of flights using specific arrival procedures.

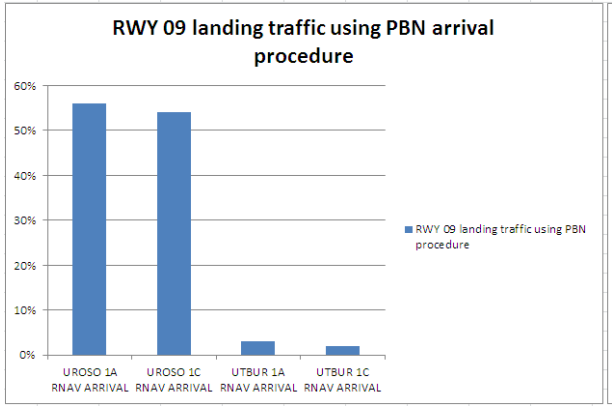


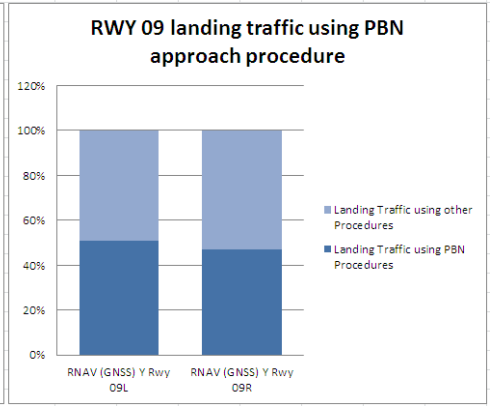
Pilot Project 1
Effective use of PBN procedures

Analytical Steps

1. Recording and sequencing of actual arrival flight paths into an international airport over 24 hours.
2. Mapping actual flight paths with flown "RNAV Airspace Fixes" and " "Fly Over Fixes" on STARs and IAPs derived from approach procedures.
3. Quantification of % of flights using specific arrival procedures.
4. Publication of results.



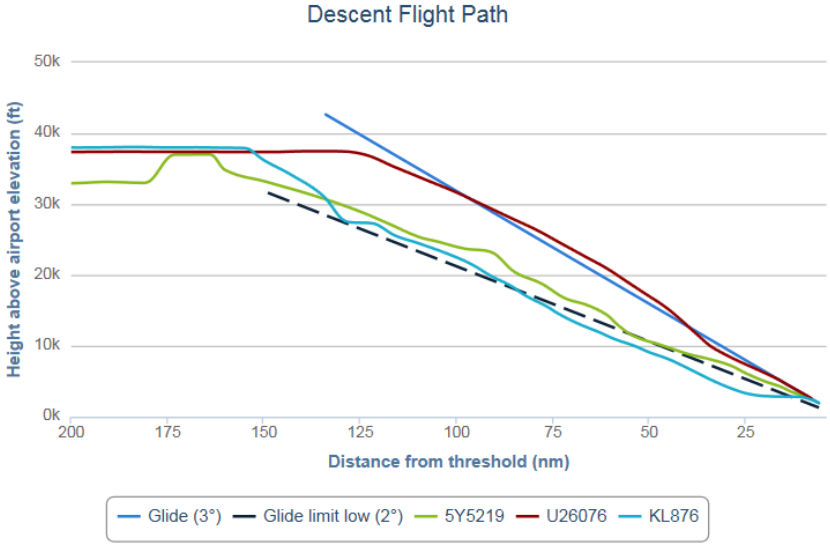




Non validated data – for demonstration purposes only

Pilot Project 2
Descent Operations

- ***Objective***: Detection of effective continuous descent operations (CDO).
- Analysis of 48 hours of flights, last 200NM, into any international aerodrome.
- Elaboration of **criteria** for CDO detection and quantification of **optimization.**

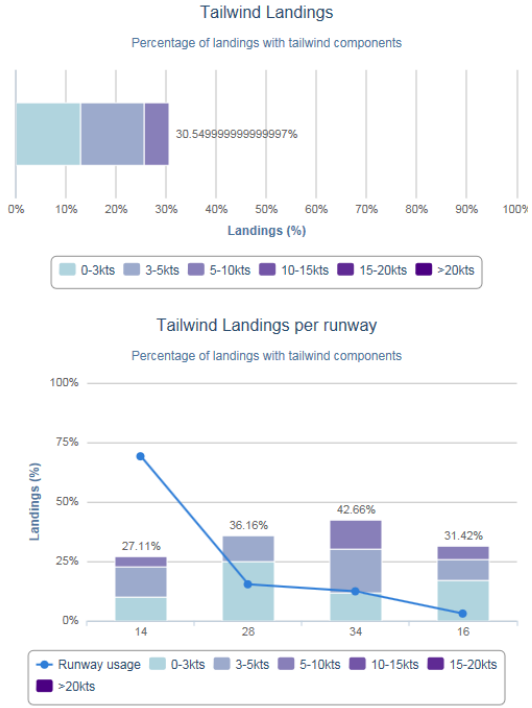


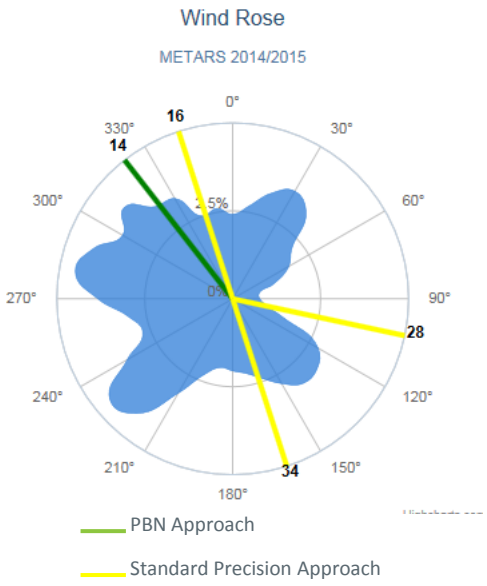
Show 10 entries Search: kl876

Flight	Airport	Date	Descent Altitude	Glide intercept altitude	Descent Type	Optimization (%)
KL876	EHAM	2015-04-16T16:56:35.000Z	38078	2821	Leveled	73

Pilot Project 3
PBN Arrivals

- ***Objective***: Quantification of risk of tail landings .
- Analysis of 30 days of METARS combined with actual arrivals on any international aerodrome.
- Decoding of METAR wind and speed information.
- Quantification of **% of flights per runway having tailwind** of a certain strength.





Pilot Project 4

ADS-B for ASBU analysis

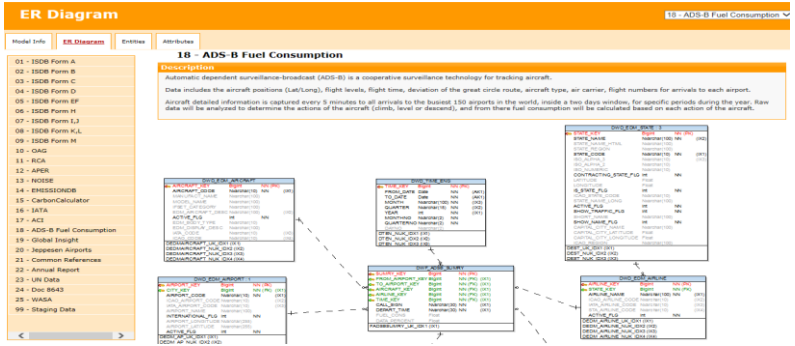
Pre implementation: provide customized analysis to respond to the needs of States and for the MDWG-ASBUs
Example: provide average route distance vs. great circle distance

During implementation: measure the pace of implementation and monitor operational improvements

Post implementation
- measure the benefits: reduce time, reduction of fuel consumed

Presentation and briefings to the MDWG-ASBUs

ADS-B data is crucial to monitor the ASBU implementation and efficiency



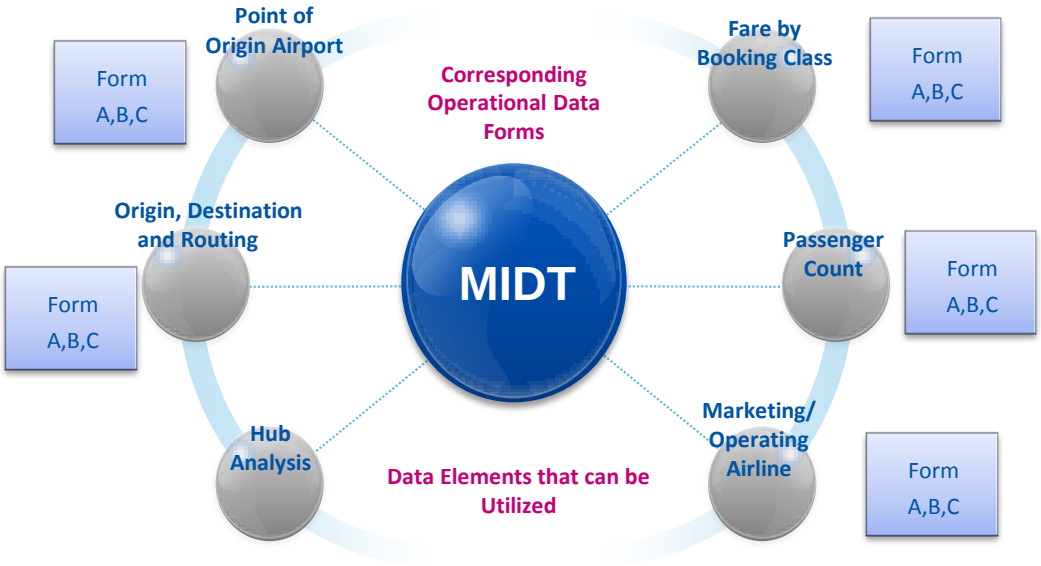
ADS-B fuel consumption already integrated in EDM

http://intranet.icao.lan/ICT/infrastructure/EDM/HTML/ADS-B_data_and_Fuel_consumption/MImage.html#ERD_18

http://www.icao.int/sustainability/Pages/ASBU-Implementation.aspx

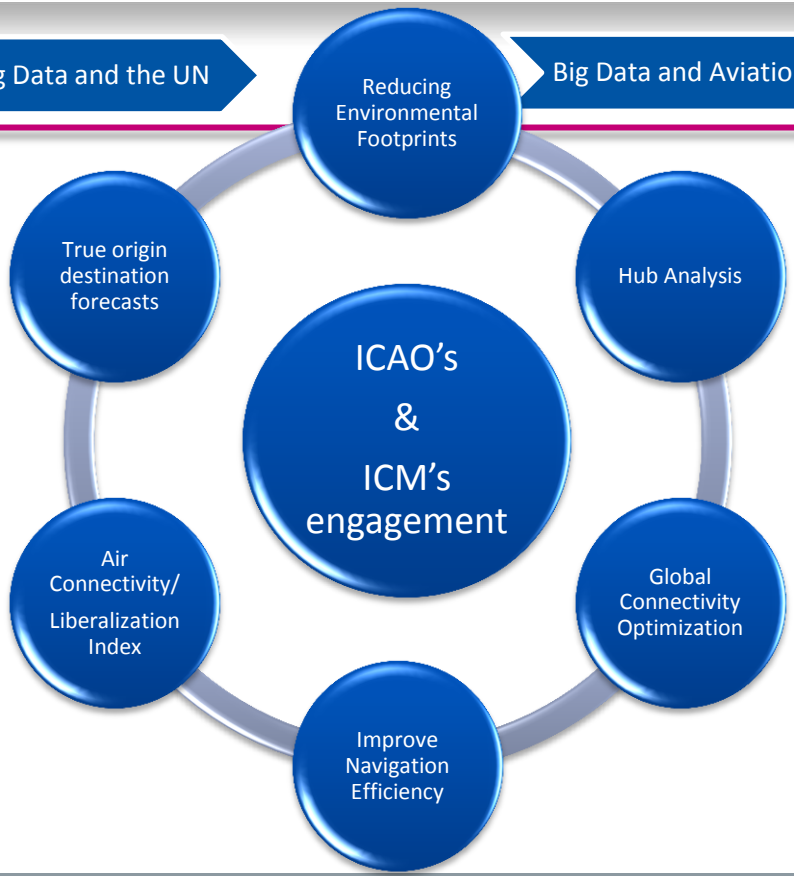
Pilot Project 5
MIDT Data

Marketing Information Data Transfer (MIDT) are the bookings made in the global distribution systems (GDS) covering 3.3 billion passengers on more than 3 million departures with the ability to see their true origin/destination.



Air Transport Diagnostics Project Purpose

Joint research project of ICM and ICAO



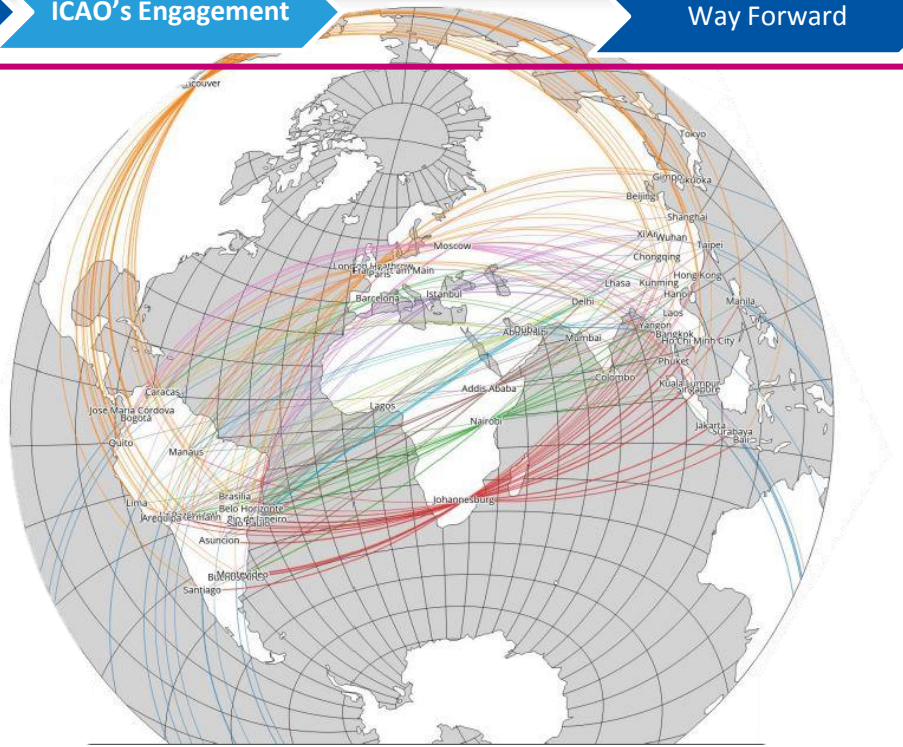
Partnership with the Interdisciplinary Center for Mathematical and Computational Modelling (ICM) of the University of Warsaw.

Using latest technologies, ICM and ICAO are working on a Air Transport Diagnostics Project.

Air Transport Diagnostics Project

- Detour factor reduction
- Improve navigation, economic and energy efficiency
- Liberalization to meet unserved consumer demand
- Increased connectivity

Optimized Global Network



South America-South East Asia **optimized connection model case**
- distant markets/out of nonstop commercial aircraft range capability

Source: Global Air Transport Diagnosis Concept, ICM

The Air Transport Diagnostics Project is focused on global optimization and it could be a potential area of interest for a wide spectrum of entities :

- Central and Regional Governmental Institutions
- Airlines, Airports, ANSPs
- Environmental Agencies
- Aircraft Manufactures
- Other aviation services and equipment providers

Next Steps

Deliverables	Purpose
Monitoring of airspace and airports on crisis zones	Improve safety
Monitoring of airspace complexity and density	Improve safety
Monitoring of en-route aircraft separations	improve safety and operational efficiency
Measuring and monitoring of airspace congestion	improve safety and operational efficiency
Trending of in-flight declared emergencies	Improve safety
Identify airspace hotspots to correlate with loss of separation events	Improve safety
Identify terrain hotspots to correlate with loss of terrain clearance	Improve safety

Next Steps

Deliverables	Purpose
Complete data set of operational and traffic data	Near 100% coverage of data encompassing scheduled, non scheduled , charters and business jet operations. Complete COD for CAEP and environmental work.
True Origin Destination traffic	Better traffic and fleet forecasts for CAEP, improved planning and implementation (navigation and safety)
All freighter traffic route flow traffic	Cargo forecasts for CAEP, Improved cargo utilization
Social and economic impacts of disruptions	Developmental assistance, implementation and IWAF tool
Fuel Burn based on actual trajectory data and operations	Environmental tasks, cost benefits of more efficient routes, pre and post implementation monitoring
ICAO ICM Air Transport Diagnostics Project	Global connectivity optimization, ICAN agreements , more liberalization of air space
Price elasticity analysis	Policy impacts on demand
Business Analysis projects	DOC 7100, ASBU analysis

Future Developments

These main reasons lead ICAO to engage in …

Future Developments

Work With UN GWG Task Forces

Modernize Data Collection & Analysis Program

Work on Big Data Projects in line with other UN agencies

Collaboration with National Accounting Offices of States

Capacity Building & Assistance to States

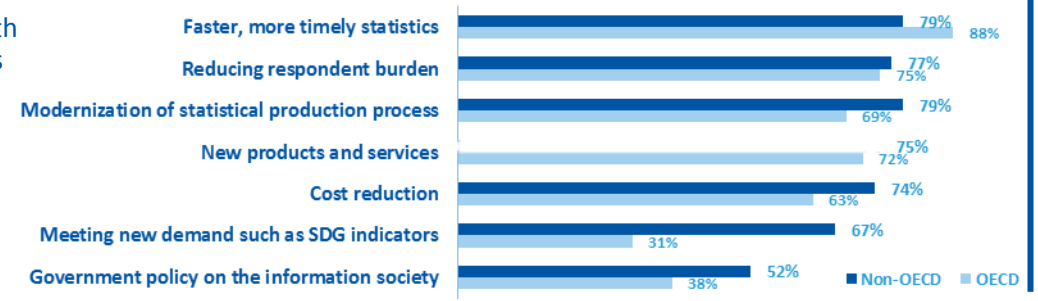
Incorporation of Big Data in an official statistics program (EDM)

Collaboration with RASGs, PIRGS, ROs and other IO.

Bringing substantive benefits to the global aviation system and to States

These main reasons lead ICAO to engage in …

Main Reasons & Benefits of Using Big Data



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