International Forum for Aviation Research

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Daejeon, Korea
September 29th, 2016
History & Objectives of IFAR

- Established in 2010
- 10 organizations (2010) → 26 members (2016)

Objectives:

- Networking & Information Exchange
- Technical Cooperation
- Education of Next Generation of Aeronautical Researchers
IFAR Summit

IFAR Summit

2010 – Berlin (DLR)
2011 – Paris (ONERA)
2012 – Nagoya (JAXA)
2013 – Moscow (TsAGI)
2014 – Zhuhai (CAE)
2015 – California (NASA)

7th IFAR Summit
September 27-29th, 2016
Daejeon, Korea

Korea Aerospace Research Institute
IFAR Technical Activities – 5 Focus Areas

Non-competitive aviation research & development related to global technical challenges

- Climate Change
- Alternative fuels
- Air Traffic Management
- Weather Impact
- Noise
Alternative Aviation Fuels

- Alternative Fuel flight: NASA
- Exhaust gas composition: NASA, DLR
- Dynamics the DC-8 wake: NRC
- Analysis and ground test of HEFA fuel: JAXA

ACCESS II Campaign (May 2014)
Global Growth in Aviation Shifting to Asia-Pacific Region

Global Air Passengers by Region (% of Total)

2014 Global Aviation Industry
3.3B Passenger Trips
North America and Europe combined is half of all Passenger Trips
58M Jobs
$2.4T GDP

2034 Global Aviation Industry, est.
7B Passenger Trips
Asia-Pacific Passenger Trips equal to North America and Europe combined
105M Jobs
$6T GDP

Sources: International Air Transport Association, Air Transport Action Group, Boeing

Over 36,000 New Aircraft required over the 20 year period
Need for acceleration of ATM efficiency
Air Traffic Management

■ Problems
  ➔ Delays result in excess fuel/noise/emission, and lost productivity
  ➔ Operational needs are only addressed at regional level
  ➔ ICAO Aviation System Block Upgrades (ASBU) 2 (2018) and 3 (2023) are not sufficiently defined
  ➔ Limited research collaboration

■ Objective of IFAR ATM Working Group
  ➔ 12 member initiative on ATM Operations to inform *ICAO* “Aviation System Block Upgrades (ASBU)” 2 and 3
  ➔ Capture global challenges and research capabilities
  ➔ Enable Collaboration

March 2016 – ATM Workshop @ NavCanada
“Globally Addressing Air Traffic Management Challenges”

1. Regional perspectives from:
   1. North America (Dr. Jaiwon Shin, NASA)
   2. Europe (Mr. Michel Peters, NLR)
   3. Asia (Dr. Eung-Tai Kim, KARI)

2. IFAR’s ATM Working Group activities (Akbar Sultan, NASA)
Cooperation is an essential building block for our common aviation future

Please send your question via SMS to +49 162 269 2474

THANK YOU!
IFAR Air Transport Efficiency ATM Working Group

Regional Perspectives and impact of IFAR WG for Global Harmonization

For the 7th IFAR Summit and ICAS
Daejeon, Korea
Operations: North and South America

[Map of USA with Air Route Traffic Control Centers]

- Equipment: 1%
- Closed Runway: 5%
- Volume: 15%
- Other: 2%

[Pie chart]
- Weather: 77%
- Volume
- Equipment
- Closed Runway
- Other
Operations: North and South America
Operations: North and South America
Figure 1: Overview of NAS Far-Term Concept of Operations
Transformation: North and South America

Corporate Objectives

Safety record: top decile globally
ANS customer service charges: bottom quartile, and decline over long term
Modern, cost-efficient technology: top quartile
Provide value to our customers: improving operational efficiency through technology and service
People: create a productive and fulfilling workplace
Environment: Contribute to reduced aviation footprint

Operational Challenges

Weather uncertainty
Human workload limits capacity, throughput, and precision delivery
Interactions: arrivals, departures and surface
Prediction uncertainty (trajectory, aircraft count, aircraft location)
Mixed equipage
Trade-off between environment and capacity/throughput

Key Focus Areas

Dynamic Airspace Configuration to best balance supply to demand
Proactive collaboration with carriers and airports to maximize predictability and efficiency
Arrivals: integrated scheduling, sequencing, merging & spacing
Integrated arrival/departure operations
Surface operations optimization
Technology transition
Transformation: North and South America

ATM Implementation Plan

PCA 351-3 “National ATM Implementation Plan”
PROJECT SIRIUS

- Latest version: March 2012
- Oriented to new technologies integration, development of solutions and application of new procedures to improve the aerial navigation services in the airspace under Brazilian responsibility

  - Rational use of the airspace
  - Improvement of the ATM efficiency
  - Reduction of emissions
  - Reduction of noise
  - Reduction of crew and controllers workload
  - Reduction of service costs
  - Improvement of the service quality
Research: North and South America

- NASA: in support of NextGen and beyond
  - Optimized pushback/taxi scheduling, and surface movement
  - Optimal Profile Descent and ADS-B enabled Terminal Spacing and Sequencing; Full Gate-to-gate TBO
  - Realtime Systemwide Safety Assurance
  - UAS Traffic Management

- NRC Canada and NavCanada
  - Working and traveling on aircraft
  - Enhanced Flight Deck Situational Awareness
  - Reduced Cabin & Flight Deck Energy Consumption
  - Crew Fatigue Monitoring and Mitigation
  - Prevent landing/takeoff runway excursions

- IAE, ICEA, and DECEA
  - Optimization of the FIR/UIR and ATS network ...RNP4 in the Atlantic region and RNP2 in the continental region
  - PBN Implementation on approach phases of flights; Remote ATS
  - Optimization of rotary wings special routes (Sao Paolo is one of the worlds busiest rotary wing air taxi hubs)
  - Integration of UAVs into non-segregated airspace
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Operations: Europe
Operations: Europe

- Area – $25 \cdot 10^6 \text{ km}^2$
- Length of airways is 678 507 km
- Number of airways is 869
- 7 large and 29 regional ATM centers
Transformation: Europe

SESAR’s performance ambition

SECURITY
- Ensuring high levels of security

COST
- Efficiency
  - Up to 40% reduction in air navigation services costs per flight

CAPACITY
- Up to 30% reduction in departure delays
- Up to 10% additional flights landing at congested airports
- A system capable of handling up to 100% more traffic

SAFETY
- Improvement by up to a factor of 4

OPERATIONAL
- Efficiency
  - Up to 6% reduction in flight time
  - Up to 10% reduction in fuel burn

ENVIRONMENT
- Up to 10% reduction in CO₂ emissions
- Postive impact on noise and air quality
Transformation: Europe

What is needed to achieve this ambition

Four areas

- Optimised ATM network services
- High-performing airport operations
- Advanced air traffic services
- Enabling aviation infrastructure

- Automation support: Automation and use of data communications
- Integrated systems: Lean and modular systems, easily upgradable and interoperable
- Integration of all vehicles: All air vehicles fully integrated in ATM environment (incl. RPAS)
- Sharing of information: Information shared digitally via data services
- Flight- and flow-centric operations: Airspace users fly their preferred business and mission trajectory in a flow and network context
- Virtualisation: Virtualisation allowing more dynamic resource allocation
Transformation: Europe

CleanSky
Developing new generations of greener aircraft

- Design Studies, Rig Testing, Modelling
- Engine / System Demonstrators
- Airframe Demonstrators
- Flying Demonstrators

↓ CO₂/NOₓ
↓ noise
Research: Europe

• NLR:
  – Airport surface movement and conflict prediction/resolution
  – Improvement navigation in low visibility; Enhanced Visual Operations (synthetic vision)
  – RPAS surface operation integration

• Onera:
  – IESTA Environmental Modeling; 4D Trajectory Contract Management
  – Very Low Altitude UAS Traffic Management

• DLR:
  – Air Traffic Management and AMAN/DMAN/SMAN integration
  – Remotely Piloted Aircraft Systems; Airport and Ground Traffic Management
  – Validation Methodology

• TsAGI:
  – 4-D Trajectory Management; New instrumentation for air traffic controllers
  – Aircraft icing; Wake Vortex Safety

• CIRA:
  – Traffic Avoidance, Enhanced Collision Avoidance, Continuous Descent and Curved Approach
  – 4D Trajectory Management; Airborne Merging and Spacing
  – RPAS Integration
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China

- Exponential aviation demand growth
- Increasing number of overflights between rest of Asia Pacific and Europe going through exponential growth
Operations: Asia

- Fukuoka FIR between US and Asia: flyover traffic about 15% of all air traffic
- International flights and over-flights increased
- The number of aircraft exceed air traffic control capacity around 2025
- Promotion of inbound tourism, and growth of Low Cost Carriers
- Short Domestic flights (< 2 hrs.)
- Efficiency of terminal operations
Korea

- Extremely limited airspace
- Two major airports close to each other
  - Short distance from Shanghai FIR Boundary with Incheon FIR
- Military and other restricted zones, in addition to the demilitarized zone and the capital area defense zone
- Very little airspace to maneuver for traffic and absorb delays
- High dependency on Japan and China’s ATM systems
- Several air routes which are among the world’s ten busiest air routes.
Operations: Asia

India

- Over 442 air access locations
- 80+ fully operational airports
- Evenly distributed across the country
- Some airport at higher elevations
- A few airports handle majority of the traffic
- Overflights for the Middle East to Asia, and Europe to Australia flight corridors
- 200,000 overflights with a mix of short and long routes (2014)
Transformation: Asia

China

- ATM System Construction
- Airspace management reform
- ATM support capability
- ATM operation security

The Goal: Move from

- Civil and military aviation respective operation to coordinated operation
- Extensive airspace management to intensive pattern
- Large scale infrastructure construction to focus on efficiency
Japan

- CARATS 2025 target
  - Increase safety level 5 times
  - Reduce fuel consumption and CO2 emissions per flight by 10%
  - Double ATC capacity in congested airspace
  - Improve service level by 10%

Transformation: Asia

For effective and efficient work on our future ATM systems, we need,
1. Collaboration among industry, academia and government;
2. Collaboration between operators and air navigation service providers;
3. International collaboration to realize seamless air traffic;
4. Collaboration among co-users of air space (Civil, Military); and
5. Collaboration with local communities
Transformation: Asia

South Korea

- Modernizing of air navigation system (CNS/ATM, aviation tech.)
- Future ATM plan (2011)
- Working group (Nov. 2011) as a group of researcher from academia and civil aviation organization ➔ draft NAREA
Research: Asia

- **CAE:**
  - Communication
  - Performance based NAV (PBN)
  - Interval Management and Conflict Detection
- **KARI:**
  - Arrival and Departure Manager
  - UAS Integration into Controlled Airspace based on TBO concepts
  - ADS-B validation system
- **JAXA:**
  - Disaster-relief operations
  - Wake vortex and wind shear forecasting technology
  - Noise abatement operation technology
  - GPS/INS integrated navigation technology
- **NAL:**
  - Performance Based Navigation
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Global Need for Coordination and Collaboration

- Both differences and similarities in operational challenges
- Similar goals and objectives in transformation of the ATM system
- Research efforts have similarities & complementary in nature

- Complementary collaboration
- Global harmonization
- Impact and inform global mid and long term roadmaps (national efforts & ICAO)
IFAR Air Traffic Management Working Group Progress

- Captured the regional operational environments, challenges, and modernization efforts
- Captured national R&D efforts and capability
- Identified potential areas of collaboration between members
  - Some bilateral engagement already underway
- Begin engagement with the national ICAO ATM Requirements and Performance Panel (RPP) representatives
- Begin informing ICAO ASBUs with research results
- Form a Users Forum of regulators, ANSPs, airlines, airports, and industry
  - Share results
  - Gain subject matter input
  - Collaborative activities and joint deliverables
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ICAS-IFAR Award

- To honor an individual who has made a significant contribution to Aeronautical Science within his/her doctoral thesis (Ph.D. or equivalent)

- Eligibility:
  - Within 2 years of the date after the PhD was obtained
  - Under 40 years old at nomination date

- Selected by IFAR Evaluation Team & ICAS Honors & Awards Committee

- The 2016 Award Winner was selected out of 12 candidates nominated by IFAR members worldwide