Contributing to Efficient Air Traffic Operations

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1. Aviation and Environment
2. What is Air Traffic Control (ATC)?
3. ATC’s contribution to efficient flights
1. Aviation and Environment
CO2 emission from International Aviation

Source: ICAO 2013 Environmental Report
CO2 emission from Int’l Aviation

Future Aviation Demand

Source: ICAO 2013 Environmental Report

CO2 Emission = Fuel Efficiency × Activity
Global CO₂ emissions (2011):

- **International Aviation**: 1.5% (470 Mt)
- **Iran**: 1.7%
- **Korea**: 1.9%
- **Canada**: 1.7%

Total: 31.3 billion tons

Characteristics of Int’l Aviation sector

- Flying over different countries and int’l waters
- Code share flights etc.

Difficulty in allocating emissions to countries

Working through ICAO (Kyoto Protocol)
International Civil Aviation Organization (ICAO)

- Created in 1944 upon the signing of the Chicago Convention
- Setting standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as environmental protection.

Headquarters in Montreal, Canada
Global aspirational goals for CO2 emissions reduction in Int’l aviation sector (ICAO Assembly Resolution in 2010)

- Improving fuel efficiency by 2% annually
- Stabilizing its global CO2 emissions at 2020 levels

Each state’s actions contributing to global goals

- Aircraft technology
- Alternative fuels
- Operational improvements
- Market-based measures (MBMs)
2. What is air traffic control (ATC)?
For safe and efficient flight, Air traffic controllers manage aircraft through all aspects of their flight.

**Characteristics of Air transportation**

1. **move in 3D**
   - Laterally / Vertically

2. **travel at High speed**
   - Cruise speed of a commercial jet: 800 km/h
   - Speed of helicopter (relatively low): 200 km/h

3. **cannot stop**
   - For safety, aircrafts cannot change speed sharply and stop in mid-air.

4. **affected by Weather**
   - Aircrafts are subject to weather conditions such as cloud, precipitation, wind, and fluctuation of atmospheric pressure.
   - They cannot see other aircrafts and obstacles especially in cloud.
Air Traffic Control (ATC) from departure to arrival

ATC service from control tower

ATC service using Radar system

ATM Centre

Air Traffic Management

Departure Airport

Destination Airport

Arrival sequencing

Departure sequencing

GPS

MTSAT

Guided landing

Position info.
satellite communications
Surveillance
ATC instructions

Air Traffic Management

(ATM Centre)
Example: Haneda to Fukuoka
Designated Departure/En route/Approach path

En route chart
Domestic Air Traffic Flow

Total Number of aircraft (per day)

Domestic flight 2,300
International Air Traffic Flow

Total Number of aircraft (per day)

Int'l flight
1,290

Overflight
520

Area of Responsibility

< Air Traffic Control >

FUKUOKA FIR
(Flight Information Region)

Europe/Russia
80

South East Asia
50

Guam/Australia
70

Korea
330

Beijing etc.

Taiwan
290

Shanghai etc.
180

Hawaii
40

West coast of USA
190

Anchorage
60

East coast of USA

Created from flight plans in 2012(Nov.)
Aircraft operating in Japan around 6p.m.
Air Traffic in Metropolitan Area

HANEDA

NARITA
3. ATC’s Contribution to efficient flights
Efficient flight by shortening flight path and time is effective for reduction of fuel consumption and CO2 emission.

It also improves convenience for users.

**ATC’s Contribution**

- Providing optimized routes
- Air Traffic Flow Management
- Developing Future Air Traffic System
<Conventional navigation>

navigating directly to and from ground-based navigational aids (navaids)

Zigzag path
flexible and optimum routing with satellite navigation, freeing airplanes from reliance on ground-based navaids
Deployment of RNAV Approach in Airport

Introduction of higher accuracy RNAV Approach (RNP-AR Approach) shortens flight paths to the runway and improves access to Airport.

RNP-AR Approach

Mountainous area

Conventional Approach

Strong West Wind

Odate-Noshiro Airport (Akita)
KUMAMOTO Airport Example

Kumamoto Airport

Conventional ROUTE

26.5nm (49km) REDUCTION OF FLIGHT DISTANCE COMPARED TO CONVENTIONAL APP.
RNP-AR Approach Route through Mount ASO (caldera and somma)

Kumamoto Airport

俵山 1095m
杵島岳 1326m
乌帽子岳 1337m
久住山 1787m
矢護山 942m
大船山 1786m
高岳 1592m
根子岳 1433m

Kumamoto Airport Example ②

KAZMA
ASONO

NIGHT ROUTE
CDO (Continuous Descent Operations)

CDO: an arriving aircraft descends continuously with minimum engine thrust
⇒ Saving fuel burn

Conventional step down approach:
Increasing engine thrust during level flight
⇒ using fuel

Introducing at Kansai Int’l air port and Naha airport
**Rush hour / Bad weather conditions etc.**

- Arrival demand exceeds an airport capacity
  - Airborne holding
  - Wasting fuel

**Introducing ATFM**

- Assigning ground delay and/or time for over fix
  - Reduction in airborne holding
  - Improved operational efficiency

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**Air Traffic Flow Management (ATFM)**
Air Traffic Flow Management (ATFM)

Without Air Traffic Flow Management

Traffic Volume > Capacity of a destination or airspace...

Air Traffic congestion!
Appropriate departure time **EDCT** will be assigned to aircraft *before airborne*

*Expected Departure Clearance Time: Calculated Take Off Time including ground delay*
However,

Unexpected airborne delay often causes congestion ...

Air Traffic Flow Management for in-flight aircraft (=SCAS) is necessary.
CFDT* will be assigned to aircraft **while airborne**

*Calculated Fix Departure Time

Pilot shall cross **Fix A** at **CFDT** by adjusting speed etc.

- In-flight time adjustment
- Assign to both domestic and international
- Under the trial for HANEDA
Efficient Use of JASDF Training Airspace

- JASDF training areas
- Airspace restrictions (JASDF/U.S. Forces)
- CDR (Conditional Route)

New-Chitose to Fukuoka

- CDR ×
- CDR ○
Optimized Oceanic routes

NOPAC (NOrth PACific) **fixed route** system → no consideration for weather condition

For more efficient flight...

**Flexible oceanic routing procedures** enables efficient oceanic flights in response to upper level wind and other conditions.
Optimized Oceanic routes

PACOTS (PACfic Organized Track System)

Image: Tokyo to West coast of U.S.

Routes established on a daily basis by Air Traffic Controllers considering upper wind forecast and adverse weather area
Flexible routes developed for each individual flight by the Airlines considering weather and other operational conditions at the time of departure.
DARP (Dynamic Airborne Reroute Procedures)

Flexible in-flight rerouting for each individual flight calculated by the Airlines taking advantage of updated forecast of upper wind etc.

Image: Tokyo to West coast of U.S.
Development of Future Air Traffic Systems

Trajectory-based Operation (4DT) concept

- Weather
- Air traffic Volume
- ATC Capacity etc.

4D (3 spatial dimensions + time) flight based on highly accurate prediction of path

Accurately estimated passing time and optimized route

Optimization of overall air traffic
ご清聴ありがとうございました。

Thank you for your kind attention.