ICAO CAPACITY & EFFICIENCY NO COUNTRY LEFT BEHIND

ASBU implementation: Cost Benefit Analysis and Financial assessment tools .

ACAO-ICAO EUR/NAT and MID ASBU Symposium

(Marrakech, Morocco, 10-13 December 2018)

Sarantis Poulimenakos,
Regional Officer, ANS Implementation
Technical Assistance Program Manager
ICAO European and North Atlantic Office

Thea Graham,
Manager, ICAO and Global Initiatives
Office of International Affairs
Federal Aviation Administration

Context

- Introduction/evaluation techniques
- ICAO guidelines
- NAT EFFG experience/SB ADSB Business case
- The AN-Conf/13 “checklist”

Introduction

- Every major decision taken by a State, airport or air navigation service provider (ANSP) should be supported by analyses to demonstrate the costs and benefits accruing from investment in aviation infrastructure.
- Aviation service providers, aviation service users and, beyond aviation, the wider global community would greatly benefit from these analyses.

- For that purpose, there is a need for States to strengthen their capacity to analyze high-quality, disaggregated aviation data which can be used to accurately estimate the requirements (financial and otherwise) for identified projects, reduce investment risks and uncertainty, and evaluate the return on investments (ROI).

Evaluation techniques

- Different types of evaluation techniques can be used for planning and decision making: business case, economic impact assessment, or cost-benefit analysis.

ICAO GUIDELINES

Background

- Twelfth Air Navigation Conference (**AN-Conf/12**), in November 2012,
- Sixth Worldwide Air Transport Conference (**ATConf/6**), in March 2013.
- The **Council, approved recommendations** ATConf/6, at the 9th Meeting of its 199th Session,
- Establishment of a multi-disciplinary working group linked to the implementation of the aviation system block upgrades (**MDWG-ASBUs**).

Tasks for the MDWG-ASBUs

a) establish an inventory of **best practices** in existing **operational and financial incentives**;
b) determine the **parameters and definitions** of, for example, service priority policies;
c) establish **an inventory of existing financing schemes**;
d) evaluate to the extent possible the **effectiveness** of the afore-mentioned;
e) develop guidance material for business cases and CBA;
f) consider **how the policies might be applied** in practice at a State level or regional level; and
g) consider **how the findings could be reflected** in existing ICAO policies, guidance material and GANP as well as in coordination mechanisms.

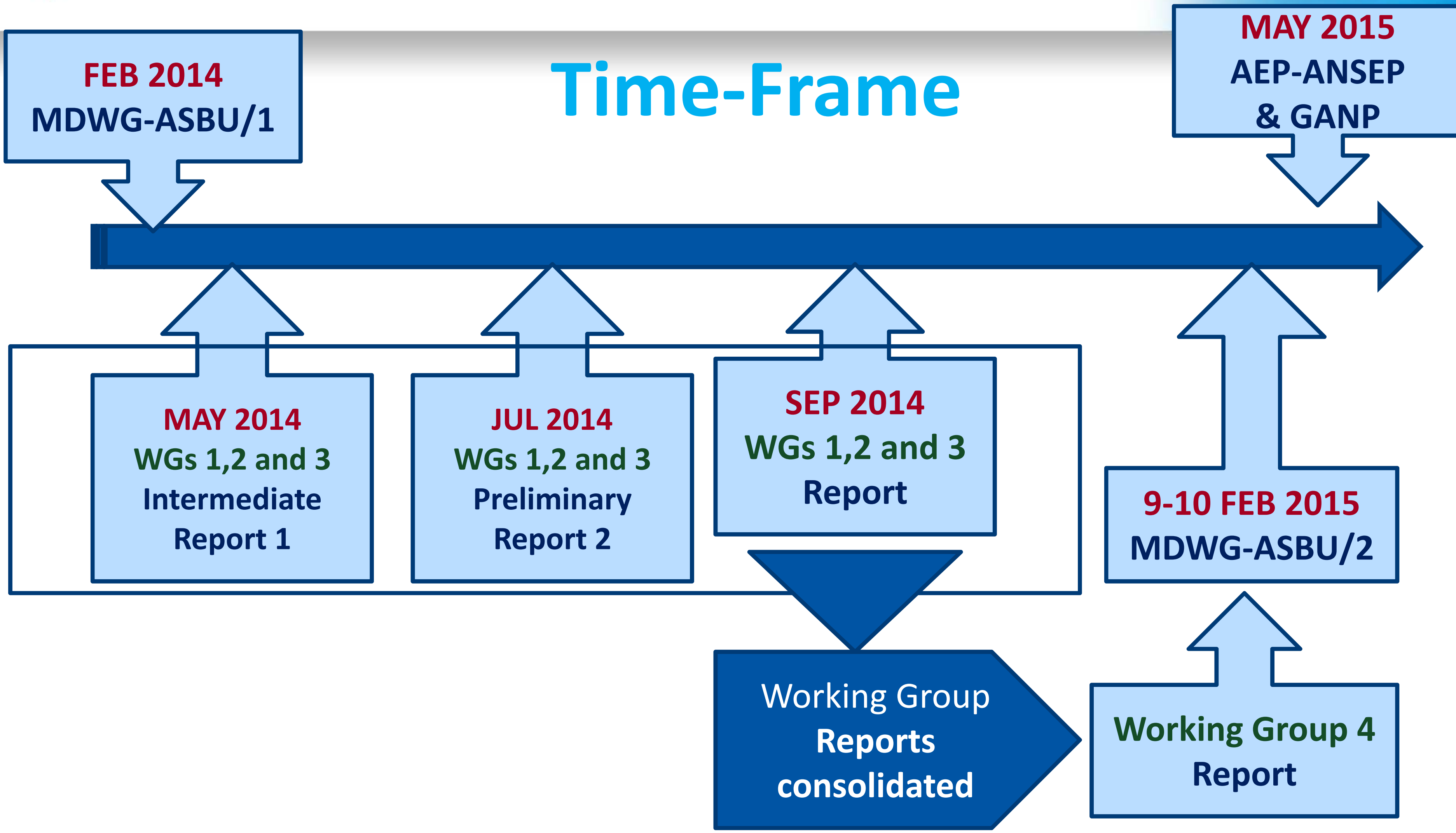
AEP/ANSEP
determine if and how the existing guidance could be amended to incorporate the findings of the working group

GANP
determine what, if any information should be included in the next edition of the Global Air Navigation Plan

4 sub-working groups

- **WG 1:** Identification of best practices for incentives (including operational and financial incentives) supporting the implementation of ASBUs
- **WG 2:** Business cases and Cost-Benefit Analysis for ASBUs implementation
- **WG 3:** Schemes to finance the ASBUs implementation
- **WG 4:** ICAO Policies

Time-Frame



A39/Updated GANP /Appendix 8

2016–2030 Global Air Navigation Plan

- Doc 9750-AN/963
  Fifth Edition – 2016
- Appendix 8 Financial and coordination aspects of implementation
- This appendix was developed to provide the States and the different stakeholders with financial guidance for the implementation of the ASBUs.

- The information was provided by the ICAO (MDWG-ASBU) which developed guidance material on how to set up implementation, considering economic impact assessment, business cases, cost benefit analysis, financial instruments, incentives and the relation with ICAO policy documents, to assist States, stakeholders and regions to implement the ASBU.

Business Case

- A business case describes the rationale for undertaking – or not – a programme or group of projects.
- It should facilitate coordination with all parties involved in the investment decision and to provide supporting information to secure funding and financing for assets deployment.
- A business case often includes, among other components, a **Cost Benefit Analysis (CBA)** and **an Economic Impact Analysis (EIA)**.

Business case analysis helps an organization analyze priorities and develop an economic solution. The business case should answers the following:

- What and where is the problem that needs to be addressed or resolved?
- What are the alternatives that could address this problem?
- What is the timeline for the improvements?
- Who are the stakeholders?
- What are the costs, benefits, and risks associated for each alternative?
- Based on the above, what is the recommended course of action?

- Key elements of Business Case analysis:

1. A business case begins with identifying a shortfall or gap.
2. The next step is to document the existing operational/technical performance of the system and develop an overarching strategy to replace, upgrade, or enhance the current system.
3. The third step is to determine the magnitude of the shortfall and estimate the expected improvement of the initiative.
4. The fourth step is to determine the cost(s), benefit(s)/effectiveness, risks and timeline to address the shortfall.
5. The final step is to recommend a course of action.

Cost Benefit Analysis (CBA)

- A CBA may be defined as a methodology that reflects both the public and private benefits and costs of a project.
- These benefits include the positive impact of aviation infrastructure investments, such as increased economic activity generated by infrastructure expansion.

- A cost-benefit analysis (CBA) will make the business case more concrete.
- It identifies the investment option that best conforms to the economic goal of maximizing net societal benefits.
- It examines all costs and benefits related to the production and consumption of an output, whether the costs and benefits are borne by the producer, the consumer or a third party.
- A CBA takes into account benefits and costs of a project, both public and private. Private costs and benefits of the airspace users, air navigation service providers and airports, as parties involved, are important as these actors have to organize their own investments.
- A CBA might become positive with the public funding.

Economic Impact Analysis (EIA).

- On a strategic level, an economic impact assessment (EIA) could be a good starting point. An EIA may be defined as a methodology aimed at identifying the cumulative economic impact of a project.
- An EIA will help determine whether a project should be carried out with respect to national or regional economic development, even if it does not generate positive net benefits in any traditional sense.

- Guidance on business cases, CBA and EIA is available in the Manual on **Air Navigation Services Economics (Doc 9161) and the Airport Economics Manual (Doc 9562).**
- Additionally, the Secretariat developed the communications, navigation, and surveillance (CNS)/air traffic management (ATM) **Database and Financial Analysis Computer System (DFACS),** an interactive and analytical decision-making tool to assist ANSPs and airspace users to build, evaluate and compare the economic case for alternative options or scenarios for the implementation of air navigation systems.
- DFACS is being enhanced to serve as a business case evaluation tool encompassing both airport and air navigation services infrastructure. The enhanced DFACS application and user manual will be available, at no cost, for download by States.

The recent NAT EFFG experience:

The NAT Space Based ADS-B Business Case

In light of the GANP, the PIRGs are expected to provide guidance to States on regional priorities and which modules provide the best solutions for the operational shortfalls identified within the region. Figure highlights the responsibilities of the PIRGs to align regional priorities with the GANP. Noteworthy to the mission of the NAT Economic, Finance and Forecast Group (NAT EFFG) is the responsibility of performing business case analysis with from the NAT System Planning Group (NAT SPG).

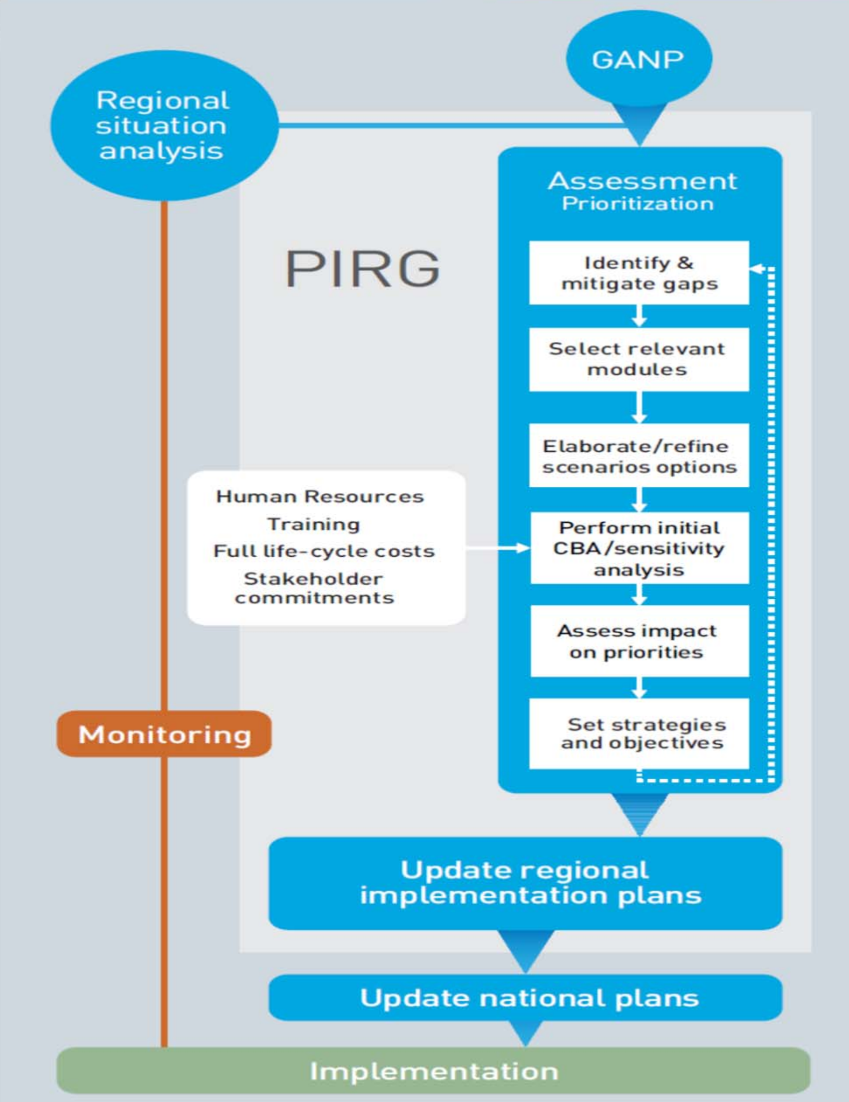
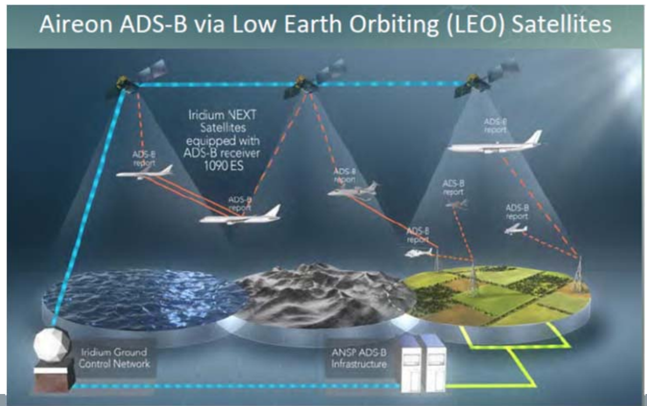


Figure 2: Regional planning

ICAO NAT Region Background

- NAV CANADA announced the intent to reduce aircraft separation minima with Space Based ADS-B out via Low Earth Orbiting Satellites in the ICAO North Atlantic (NAT) Region in November 2013 at the ICAO NAT Economic and Finance Group 25 meeting
  - Preliminary fuel savings per flight reported to be 388 kilograms
  - Separation reduction expected to be 15 nm longitudinal and 30 nm lateral
- NAT Systems Planning Group/50 tasked the NAT EFG to complete a full business case analysis (BCA) of SB ADS-B for the NAT Region.



NAT Space Based ADS-B Business Case Analysis Team

Leadership

NAV CANADA

Federal Aviation Administration

Consultants

BOEING

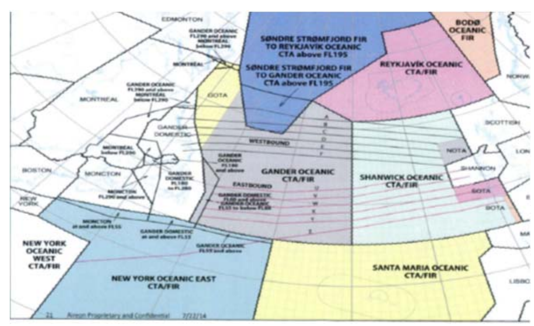
Virginia Tech Engineering Education

MIT

PURDUE UNIVERSITY

CSSI, INC. Moving Research to Reality

ANSPs & Operators Support



IATA

Overview and Main Assumptions

Complete the Business Case for ICAO NAT SB ADS-B:

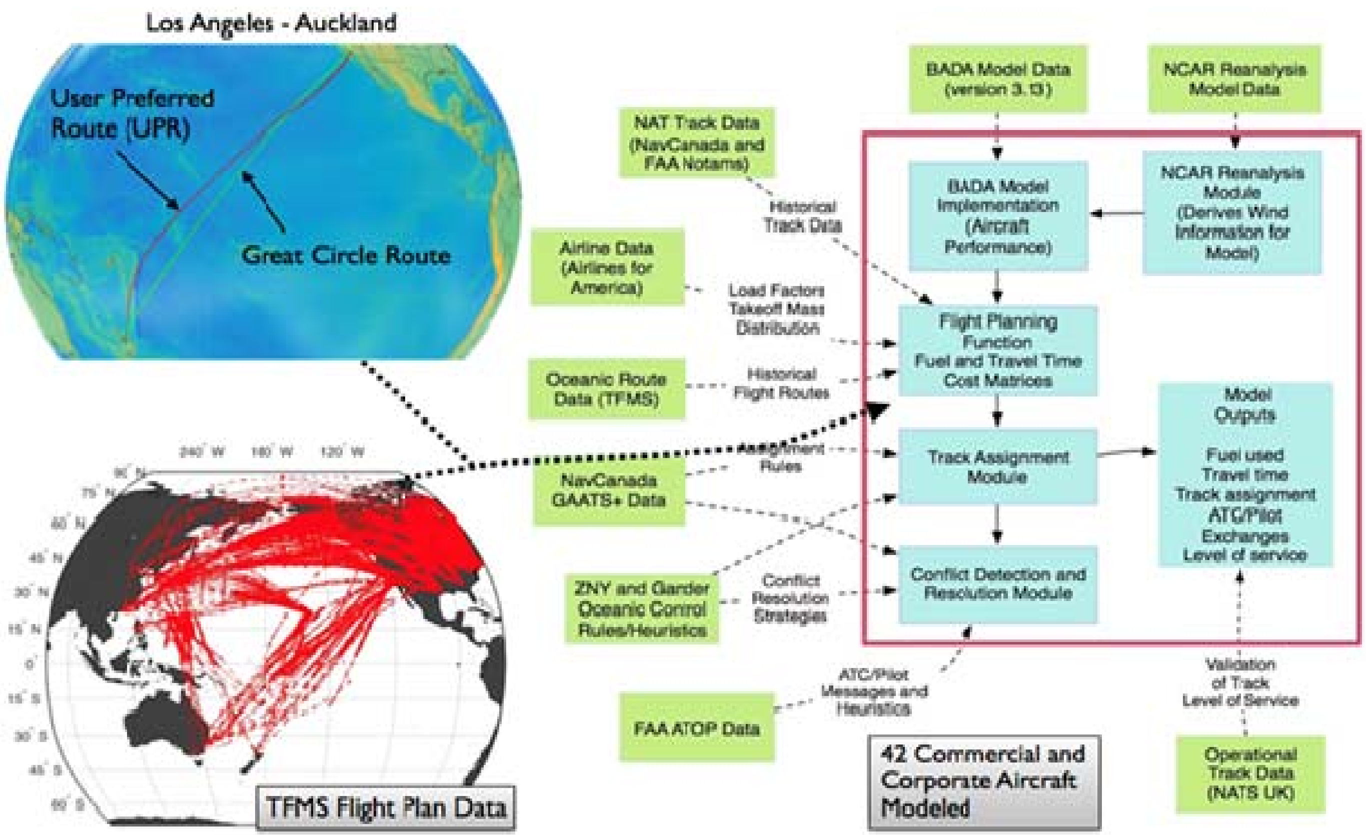
- Including Benefits, Costs, and Risk Estimates

- Geographic: ICAO NAT High Level Airspace (HLA)
- Time: 19-year period from 2015-2033
  - 4 years of pre-implementation (one-time) costs (2015 through 2018 inclusive)
  - 15 years of lifecycle (ongoing) costs (2019 through 2033 inclusive)
- Stakeholders: ANSPs and aircraft operators

Overview and Main Assumptions (2)

- Technology: Space-based ADS-B
  - Includes air traffic management (ATM) technologies necessary to implement reduced separation (proposed 15 NM longitudinal / 15 NM lateral) between eligible aircraft pairs (equipped with ADS-B Out, CPDLC, and RNP-4)
- Baseline separation by FIR: RlatSM (23 nm) and RlongSM (5 minutes/40 nm), except NY and Santa Maria which are based on 30/30 nm
- Modeling assessments focus on year 2020, when ADS-B Out and data link mandates are expected to be in full effect in NAT HLA (assume 100% equipage)

Benefits Modeling: Global Oceanic (GO) Model



Benefits Modeling Results

Case	Separation Criteria	Benefits
Scenario 1 Fixed Mach Baseline Separation	23/40 nm (30/30 nm in NY/SM)	Baseline case
Scenario 2 Fixed Mach Reduced Separation	15/15 nm	147 kilograms of fuel saved 0.2-minute reduction in travel time
Scenario 3 Variable Mach Number Reduced Separation	15/15 nm	169 kilograms of fuel saved 0.3-minute reduction in travel time
Scenario 4.1* User Preferred Routes (UPR) and Fixed Mach Number	15/15 nm	388 kilograms of fuel saved 1.9-minute reduction in travel time
Scenario 4.2* User Preferred Routes (UPR) and Variable Mach Number	15/15 nm	412 kilograms of fuel saved 2.4-minute reduction in travel time

*** UPR is not in current NAT CONOPS, future implementation require additional changes in communication technology and ATM procedures besides enhanced surveillance via SB ADS-B.**

Cost Assessment - General Assumptions

- NAT HLA traffic counts will increase 3.4% in accordance with 21 September 2016 North Atlantic FIR Traffic Forecast.
- Average flight hours in the NAT HLA assumed to remain at about 3.1 hours (2016 TFMS) for the 15 years of lifecycle cost analysis.
- Assumed that ANSPs will be assessed a signal fee of $40 USD per equipped flight hour (unless noted otherwise by ANSP).
- SB ADS-B signal fees begin accruing in 2019.
  - 97.5% ADS-B out equipage in 2019; 100% ADS-B out equipage in 2020 and thereafter.
- Aircraft operator costs for SB ADS-B signal will be determined by a pay model determined by individual ANSPs.
- Annual lifecycle costs begin in 2019. Pre-implementation one-time costs begin in 2015 and end in 2018.

Cost Model: Aircraft Operator

Operator / Aircraft Cost Categories		Initial Costs	Recurring Costs
SB ADS-B equipment	Avionics equipment	●	
	Installation	●	
	Certification	●	
	Aircraft downtime	●	
	Maintenance		●
CNS Service costs*	Additional CNS costs (ADS-C / CPDLC) related to SB ADS-B		●
Flight Operations Costs	Pilot training	●	●
	Dispatcher training	●	●
	Operations Manuals	●	●
	Dispatch Systems	●	●
	Operational penalty or missed opportunity for unequipped aircraft (this will be part of benefits assessment)		●

**This cost is not included in the analysis as additional research on CPDLC/ADS-C messaging frequency and cost is necessary.*

Cost Model: ANSP

ANSP Cost Category	Initial Costs	Annual Recurring Cost
Systems Engineering	●	●
ATC hardware upgrades and software development	●	
SB ADS-B operations and maintenance		●
ATC policy and regulations	●	●
ATC personnel and training	●	●
International coordination	●	●

Cost Model: SB ADS-B Signal Fees

Cost Category	Initial Costs	Annual Recurring Cost
SB ADS-B signal fees		●

NAT HLA 19-Year Cost Estimate

NAT SB ADS-B 2015-2033 Cost Estimate (Constant $USD)

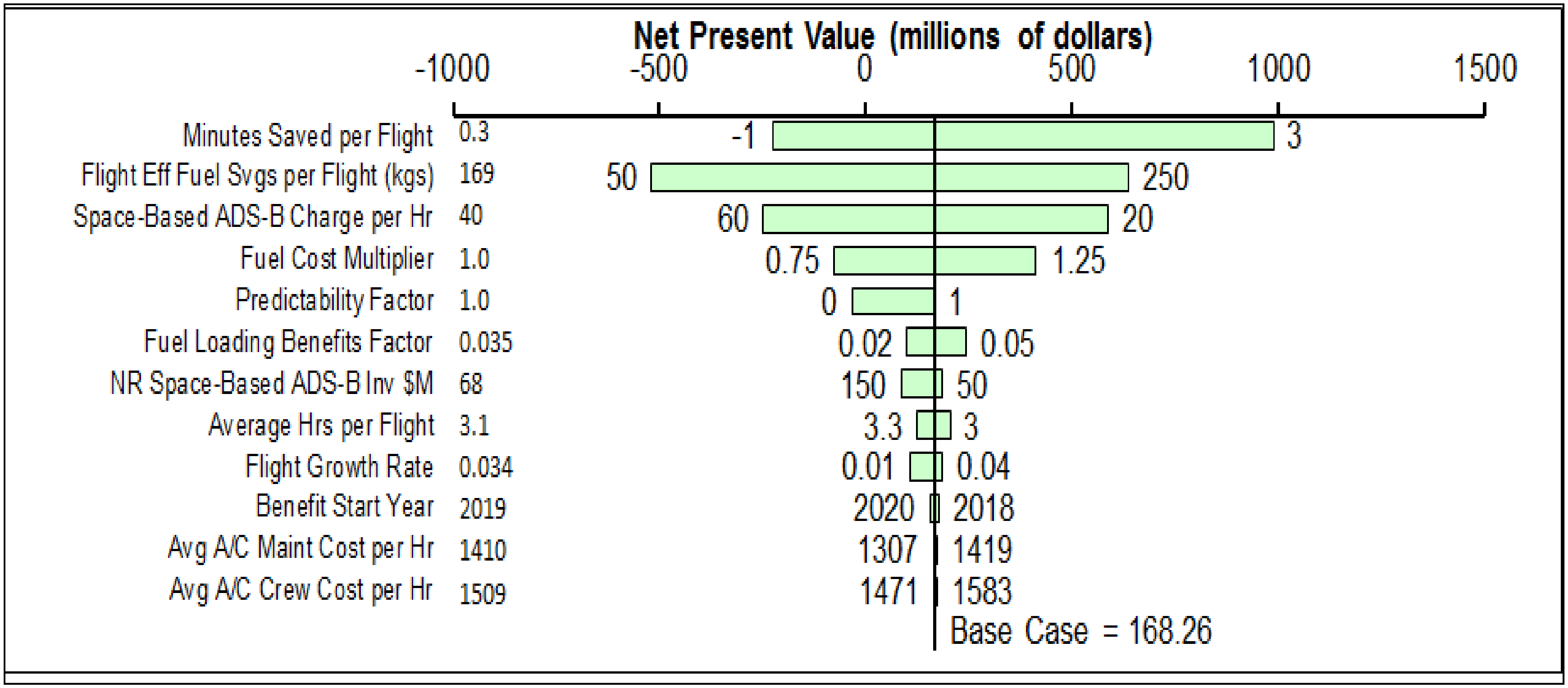
Cost Category	One-Time Cost ($USD Millions)	Ongoing Cost ($USD Millions)	Total ($USD Millions)
ANSP*	$67.9	$1.1	$69.0
Signal Fees	$0	$1,270.2 – $1,390.7	$1,270.2 – $1,390.7
Total Costs	**$67.9**	**$1,271.3 - $1,391.8**	**$1,339.2 – $1,459.7**

Notes: * ANSP survey response rate: 50%. Respondents: U.S., Portugal, Iceland. ANSP cost data for Canada and UK obtained from working paper delivered at 1-2 March 2017 BCA workshop. Only two respondent ANSP respondents specified 15/15 costs.

NPV Inputs

- SB ADS-B charges per hour: $USD 20/40/60
- Incremental Communication Costs: $USD 0
- Flight Crew Costs: $USD 1,509/hour
- Maintenance Costs: $USD 1,410/hour
- Predictability Factor (full benefit): 1
- Fuel Loading Factor: 3.5%
- Implementation Investment: $USD 150 Million
- Fuel Price: US EIA Energy Outlook 2017
- Benefit Year: 2019
- Traffic growth: 3.4%
- Discount rate: 7%

Net Present Value – 2019-2033



Assumptions: 617,309 flights , 3.1 hours per flight and benefits phased in over 3 years (50%, 75%, 100% by year 3)

Summary of BCA Results (2015-2033)[1]

Category	($USD Millions)
Total Benefits (Present Value)	1,069
Total Costs (Present Value)	901
Net Present Value	168

Benefit/Cost Ratio: 1.19

[1] In constant 2016 $USD and present value discount factor is 7% (OMB)

AN-Conf/13-WP/22

- During the AN-Conf/13 Secretariat presented a cost-benefit analysis (CBA) checklist to support the development of air navigation infrastructure through the aviation system block upgrade (ASBU) framework and to assist in securing funding and financing for asset deployment.

APPENDIX

CHECKLIST FOR COST-BENEFIT ANALYSIS FOR INFRASTRUCTURE INVESTMENT PROJECTS

AN-Conf/13-WP/22
Appendix
English only

APPENDIX

CHECKLIST FOR COST-BENEFIT ANALYSIS FOR INFRASTRUCTURE INVESTMENT PROJECTS

COMPONENT	DESCRIPTION	NOTES
Objective	This section should present the desired outputs of the project. For example, in the case of an investment in a new radar system, the objective of providing surveillance should be described in terms of expected improvements, including: • enhanced safety; • increased system capacity; • reduced costs; • better weather detection; and • increased traffic.	A common mistake when describing the objective is to focus on inputs required to accomplish the project rather than the desired outputs.
Scope	The scope needs to identify the following: • timescale; • geographic area; • relationship to other projects; • development stage; and • cost estimates.	This section needs to identify affected airspace users. Identification will help to avoid double counting or omission of costs and benefits. Changes in the aviation sector impact many different stakeholders. It is therefore essential that the CBA identify the impact for different stakeholders. This is particularly important as the non-quantifiable and non-financial factors may differ significantly between different stakeholders.
Assumptions	In aviation, assumptions usually cover: • aircraft fleet characteristics; • levels of aircraft activity; • equipment life; • passengers/shipment revenues; • cost of fatalities/injuries; and/or • cost of passenger time.	
Base case and alternatives	The base case provides the benchmark against which the proposed project or investment can be measured. It is the "do-nothing" or "maintain status quo" option, describing what is likely to occur in the absence of the project being evaluated.	Any option viewed as providing an improvement to the status quo should be included as a project alternative.

COMPONENTS:

- Objective
- Scope
- Assumptions
- Base case and alternatives
- Time horizon
- Benefits and costs (identification)
- Benefits and costs (comparison)

a) States and air navigation service providers (ANSPs) to perform a cost-benefit analysis (CBA) when defining optimum solutions for improved performance of the air navigation system through the use of the aviation system block upgrades (ASBU) framework;

b) States and ANSPs that do not have a process already in place to use a simplified mechanism, such as the checklist available in the GANP Portal for cost-benefit analysis of air navigation infrastructure investment projects, to support improvements as described in the aviation system block upgrade (ASBU) framework

c. ICAO to support the implementation of cost-benefit analysis through dedicated workshops/Technical assistance activities

ICAO


North American Central American and Caribbean (NACC) Office Mexico City
South American (SAM) Office Lima
ICAO Headquarters Montréal
Western and Central African (WACAF) Office Dakar
European and North Atlantic (EUR/NAT) Office Paris
Middle East (MID) Office Cairo
Eastern and Southern African (ESAF) Office Nairobi
Asia and Pacific (APAC) Sub-office Beijing
Asia and Pacific (APAC) Office Bangkok
THANK YOU