Australia Indonesia Partnership
Kemitraan Australia Indonesia

AIR TRAFFIC MANAGEMENT MASTER PLAN FOR INDONESIA

FINAL REPORT




INDONESIA
INFRASTRUCTURE
INITIATIVE

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July 2011

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AAMA	Australian Airspace Monitoring Agency
A-SMGCS	Advanced Surface Movement Guidance and Control System
ABAS	Aircraft-Based Augmentation System
ACC	Area Control Centre
ADC	Aerodrome Control
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AFS	Aeronautical Fixed Service
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	Inter-Facility Data Communications
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
AIM	Aeronautical Information Management
AMAN	Arrival Manager
AMC	Airspace Management Cell
AMHS	Aeronautical Message Handling System
AMSS	Aeronautical Mobile-Satellite Service
ANS	Air Navigation Services
ANSP	Air Navigation Services Provider
AO	Aerodrome Operations
AOM	Airspace Organisation Management
AoR	Area of Responsibility
APAC	Asia Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
AP1	PT Angkasa Pura 1
AP2	PT Angkasa Pura 2
APP	Approach Control
APW	Area Proximity Warning
ASEAN	Association of South-East Asian nations
ASM	Airspace Management
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCO	Air Traffic Controller
ATFCM	Air traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATMSDM	ATM Service Delivery Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
AUO	Airspace User Operations
AWOS	Automated Weather Observation Stations
BASARNAS	Indonesian Search and Rescue Agency
BLU	Public Service Agency

CAA	Civil Aviation Administration
CASR	Civil Aviation Safety Regulations
CATT	Civil Aviation Transformation Team
CBA	Cost Benefit Analysis, Cross Border Area
CBT	Computer Based Training
CCD	Continuous Climb Departure
CDA	Continuous Descent Approaches
CDM	Collaborative Decision Making
CDR	Conditional Route
CDTI	Cockpit Display of Traffic Information
cFLAS	Contingency Flight Level Allocation Scheme
CM	Conflict Management
CNS	Communications, Navigation and Surveillance
COTS	Commercial off-the-shelf
CPDLC	Controller-Pilot Data Link Communications
CTR	Control Zone
CVOR	Conventional VHF Omni-directional Range
CWP	Controller Working Positions
D-ATIS	Digital-Automatic Terminal Information Service
DCB	Demand and Capacity Balancing
DG	Director General
DGCA	Directorate General of Civil Aviation
D-VOLMET	Digital Meteorological information for aircraft in flight
DMAN	Departure manager
DME	Distance Measuring Equipment
DVOR	Doppler VHF Omni-directional Range
EFB	Electronic Flight Bag
FANS	Future Air Navigation Services
FDPS	Flight Data Processing System
FIR	Flight Information Region
FL	Flight Level
FMS	Flight Management System
FMP	Flow Management Position
FPL	Flight Plan
FSS	Flight Service Sector
FUA	Flexible Use of Airspace
GATMOC	Global ATM Operational Concept
GBAS	Ground-Based Augmentation System
G2G	Gate-to-Gate (Process)
GDP	Gross Domestic Product
GNSS	Global Navigation Satellite System
GPI	Global Plan Initiative
GPS	Global Positioning System
HF	High Frequency, Human Factors
HRM	Human Resource Management
IATA	International Air Transport Association
IAVW	International Airways Volcano Watch

ICAO	International Civil Aviation Organization
ICVM	ICAO Coordinated Validation Mission Report
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INACA	Indonesia National Air Carriers Association
IndII	Indonesia Infrastructure Initiative
IOS	Indian Oceanic Sector
IP	Internet Protocol
ITU	International Telecommunication Union
JAATS	Jakarta Advanced Air Traffic Control System
JICA	Japan International Cooperation Agency
KPA	Key Performance Area
KPI	Key Performance Indicators
LoA	Letter of Agreement
MAATS	Makassar Advanced Air Traffic Control System
MET	Meteorological services for air navigation
METAR	Meteorological Report
MLAT	Multilateration
MoT	Ministry of Transport
MP	Master Plan
MSSR	Monopulse Secondary Surveillance Radar
MSAW	Minimum Safe Altitude Warning
MTCD	Medium Term Conflict Detection
NDB	Non-Directional Beacon
NOTAM	Notice to Airmen
OPMET	Operational Meteorological information
OPSUP	Operational Supervisor
PBN	Performance-Based Navigation
PCA	Prior Coordination Area
PDCA	Plan Do Check Act (concept in Quality Management)
PSR	Primary Surveillance Radar
PRM	Precision Runway Monitoring
PRNAV	Precision Area Navigation
QM	Quality Management
QoS	Quality of Service
RCA	Reduced Coordination Airspace
R&D	Research and Development
RMA	Regional Monitoring Agencies
RDPS	Radar Data Processing System
RNAV	Area Navigation
RNP	Required Navigation Performance
RPL	Repetitive Flight Plan
RTA	Required time of Arrival
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minimum
SAR	Search and Rescue
SARPs	Standards and Recommended Practices

SBAS	Satellite-Based Augmentation
SDM	Service Delivery Management
SID	Standard Instrument Departure
SMS	Safety Management System
SSR	Secondary Surveillance Radar
SSP	State Safety Programme
STARs	Standard Instrument Arrival
STCA	Short Term Conflict Alert
SUP	Supplement
SWIM	System Wide Information Management
TLS	Target Level of Safety
TMA	Terminal control Area
TRA	Temporary Reserved Area
TSA	Temporary Segregated Area
TS	Traffic Synchronisation
VDL	VHF Digital Link
VCS	Voice Communication System
VFR	Visual Flight Rules
VHF	Very High Frequency
VHF-ER	Very High Frequency-Extended Range
VMC	Visual Meteorological Conditions
VoIP	Voice over IP
VOR	VHF Omni-directional Radio Range
VSAT	Very Small Aperture Terminal
WAM	Wide Area Multilateration
WGS-84	World Geodetic System — 1984
WAFS	World Area Forecast System
WRC	World Radio Communication Conferences
UTA	Upper Control Area

HOW TO READ THIS DOCUMENT

This Air Traffic Management (ATM) Master Plan for Indonesia is structured in the following way:

Chapter 1: Introduces the objective of the ATM Master Plan and describes how the document is structured. The chapter also describes the current state of the Indonesian ATM system.

Chapter 2 and Chapter 3: Present a description of future ATM concepts and a visionary outlook both in general terms but also for Indonesian ATM. The chapter also introduces the necessity for Indonesian ATM to adapt to a performance-based approach and develop targets for different key performance indicators within established key performance areas. Anticipated concepts of operation for each term if recommended activities are implemented can be found here.

Chapter 4: Gives an overview of the forecast traffic demand for Indonesia based mainly on the Report on Traffic Analysis, the ATM Planning Review and the ASEAN Open Sky Study.

Chapter 5 to Chapter 11: Based on different groups of ATM domains, where International Civil Aviation Organization Global Plan Initiatives constitute the platform, findings and recommendations necessary to accommodate the future airspace users need are presented. The recommended activities are finally summarised in a proposed time schedule, to be regarded as a core "road map" or "tentative implementation schedule" for actions to be taken.

Chapter 12: Gives a description of the transition of aeronautical information service to aeronautical information management, with recommended activities.

Chapter 13: Gives a description of how human resource management needs to be developed including recommended activities, to be regarded as a tentative implementation schedule.

Chapter 14: Gives a description of how the concept of contingency needs to be developed including recommended activities, to be regarded as a tentative implementation schedule.

Chapter 15: Gives a description of how quality and safety management needs to be developed including recommended activities, to be regarded as a tentative implementation schedule.

Chapter 16: Describes the current ATM situation and contains a number of maps describing current airspace organisation and communication - navigation - surveillance infrastructure.

Chapter 17: Contains an analysis of air traffic overflying Indonesian airspace, the conflict potential with domestic traffic and the ATM implications.

Chapter 18: Analyses the impact on the ATM system of non-scheduled, military and general aviation traffic, including flight schools.

Chapter 19: Contains statistics and forecasts for the number of movements in different airspace sectors until 2025.

Chapter 20: Contains references.

Chapter 21: Is Annexe 1, analysing the equipment standard of aircraft using Indonesian airspace.

Chapter 22: Is Annexe 2, containing estimates of investment costs, derived from heuristic unit costs and the equipment vintages accounted for in Chapter 16.

Chapter 23: Is Annexe 3, with organisation charts for Ministry of Transport, Directorate General of Civil Aviation, PT Angkasa Pura 1 and PT Angkasa Pura 2.

All recommendations are numbered in one sequence from 1 to 169.

The ATM Master Plan will mainly answer the question “what" needs to be done to the year 2025 and beyond. This constitutes the road map or the tentative implementation schedule. "How" these things should be done is indicated, but must be further elaborated in design and specification documents.

EXECUTIVE SUMMARY

This summary is centred on the visions, conclusions and recommendations resulting from the analyses in the main text. The rationales for recommending - or not recommending - a specific action are not summarised and neither are the descriptions of present situation. Regarding forecasts, it is sufficient to note that the number of movements requiring air traffic management (ATM) will increase substantially, although opinions differ widely regarding the growth rate.

Why a new ATM plan?

The overall objective of the ATM Master Plan project is as follows:

- This Master Plan document is expected to constitute a strategic road map for Indonesia in its development of future ATM.

The need for a new ATM Master Plan is driven by a number of factors, not least the fact that the current one is from 1994 and lacks recurrent updates. International Civil Aviation Organization (ICAO) Global Plan Initiatives (GPI), other strategic policy documents, growing air traffic, technological progress and gradual liberalisation of civil aviation combine to further increase the need. There are also severe limitations in the present ATM system, getting gradually more pronounced as traffic grows:

- Airspace management is hampered by rigid sectorisation and route structure.
- Air traffic flow management (ATFM) is performed in a haphazard manner as no national or regional ATFM unit is established.
- Air traffic control (ATC) capacity is fully utilised at some airports, area control centres and approach sectors.
- Capabilities of modern aircraft are not fully utilised by the ATM system.

In general, these shortcomings do not compromise safety but they have a detrimental impact on the overall capacity of Indonesian airspace. Phrased differently, safety can be maintained but at the expense of capacity. To accommodate future growth without jeopardising safety, massive investments and a huge number of actions are required. A new ATM Master Plan must not only bring ATM planning up to date; it must also be useful in the ICAO 2025-and-beyond concept. Major overhauls every 10 or 15 years will not suffice. *The first recommendation of the Team is to perform a review of the plan twice a year and to do major updates every second year.*

Stages and components

A total of 12 areas are covered in this document. All recommendations are categorised into three planning stages:

- Short term: up to 2015
- Medium term: from 2016-2020
- Long term: from 2021-2025 and beyond

The general structure of the report is determined by the 23 GPIs defined by ICAO. All of these GPIs have been sorted into three groups:

- Airspace organisation and management (AOM) and air traffic flow and capacity management domains: 7 + 1 GPIs
- Communication, navigation and surveillance (CNS) domains: 2 + 3 + 4 GPIs
- Aerodrome and system-wide information management domains: 3 + 3 GPIs

Developing forecasts is not a part of this project. The main text summarises, briefly, two forecasts produced by LFV Aviation Consulting and the Indonesia Infrastructure Initiative (IndII) Open Sky consultant Mott McDonald. Minor differences in methods and results between these two sources have no bearing on the ATM Master Plan.

Visions

The ATM Master Plan aims at realising a number of visions for the future Indonesian ATM. In this summary, the visions are somewhat abbreviated.

- **Airspace organisation vision**: All airspace is organised in a flexible and dynamic way. Dynamic, four-dimensional, user-preferred trajectories are accommodated and the air traffic services (ATS) route structure is mainly performance-based.
- **Airspace management vision**: A special process is balancing the needs of different airspace users. An airspace management cell manages pre-tactical airspace allocation while a body of representatives sets the strategic framework for cooperation.
- **Aerodrome operations vision**: Airport infrastructure per se is not an ATM component but airport capacity has a direct bearing on ATM capacity, at least when the former is strained. Jakarta Soekarno-Hatta Airport, Medan, Makassar, Bali and Surabaya have increased runway throughput by additional taxiways and improved surface guidance. At Jakarta, independent arrivals/landings to both parallel runways have been normal procedures for many years. A third runway is under construction. Five major airports are certified Eco-airports or Green airports and more are in the process. Continuous descent approaches are used frequently. A departure manager position reduces the taxi times. The staffing situation is satisfactory and the vacancy level is quite low.

- **Vision for demand-capacity balancing**: ATFM forms part of a centralised flow management unit. Balancing is made for the entire South-East Asia using all airspace. Technical support tools have enabled the airspace to be used equitable by all users.
- **Vision for traffic synchronisation (TS)**: TS is made on the day of operation and fully integrated with demand-capacity balancing and conflict management. Arriving traffic is sequenced by very narrow timeslots being part of the dynamic trajectory. Sequencing between flights is delegated to flight deck to optimise runway throughput.
- **Vision for airspace user operations:** It is an integrated part of ATM where real-time data are always available. Aircraft capabilities allow user-preferred 4-D trajectories.
- **Vision for conflict management (CM)**: CM will have a negotiated trajectory approved well in advance. It should be conflict-free, meaning no further separation provision should be needed. Requirements for separation provision will be primarily handled by the airspace users.
- **Vision for service delivery management**: The future role of ATC will move from a managerial role to a more monitoring one, where airspace users will assume an increased ATM role.

These visions are based on the 11 key performance indicators" (KPI) identified by ICAO Doc 9883 plus a 12th KPI added by the Team – human performance:

- Societal outcome KPIs:
  - Safety
  - Security
  - Environmental sustainability
- Operational performance KPIs:
  - Cost-effectiveness
  - Capacity
  - Efficiency
  - Flexibility
  - Predictability
- Performance-enabling KPIs:
  - Access and equity
  - Participation
  - Interoperability
  - Human Performance

Recommendations

With a steady foundation in the visions forged throughout the continuous cooperation with ATM stakeholders, the 23 GPIs, the 12 KPIs and a thorough scrutiny of the present situation, the Team has developed a total of 169 recommendations covering 11 different areas.

Airspace organisation and management

This extensive field comprises 34 out of 169 recommendations. The main focus is in the short term but nine recommendations pertain to the medium term and seven are long term. Most recommendations address organisational matters, calling for review, reorganisation, development, updating, implementation or improvement of structures which in most cases already exist. Consequently, a number of these recommendations can be implemented - or at least prepared - within existing Directorate General of Civil Aviation or PT Angkasa Pura 1 and Pura 2 frameworks. Rapid progress could probably be enjoyed, at least in the short term, without the organisations incurring major cost increases and in many cases there may be a cost saving potential through rationalisation. Barring a few exceptions like introduction of performance-based navigation etc., the AOM area recommendations do not rely on heavy hardware investments and do not require elaborate cost-benefit analysis. Many recommendations are independent of others and can be undertaken in parallel. However, the Team wishes to emphasise that the recommendations really do require considerable human resources, devotion and purposefulness.

Air traffic flow and capacity management

This area comprises 10 recommendations out of which six are short term, three medium term and only one long term (a regional central flow management unit, the establishment of which is a complicated task). ATFM is a fairly narrow field in ATM and as with the AOM above, most recommendations address organisational matters. A particular issue is filling the notable void regarding present-day capacity of various airspace sectors. The required data are of course to be found somewhere but to retrieve, collate, analyse and present it is a demanding task and so is drawing the correct conclusions. Nevertheless, this is a crucial exercise as decisions on the huge investments foreseen must be based on correct assessments of existing capacity.

Most recommendations require human resources more than hardware investments, although in the long run, establishing centralised ATFM units and the CFMU above entails heavy investments in ATS equipment.

Communications

In this area, 15 recommendations are presented. With only minor exaggeration, the situation can be described as top-of-the-line equipment in almost all airliners, modern but not always best-practice equipment in most ground communication centres but outright archaic connections between the two. Ground-to-air communications are still heavily, although nowadays not entirely, dependent on amplitude-modulated very high frequency (VHF) voice radio technology. Still, this is best-practice technology throughout the world in the sense that a transfer to more advanced, e.g. digital, communication cannot possibly justify its immense investment costs. The Team has no apprehensions about the planned VHF investments in VHF as there are no viable alternatives, but recognises that VHF technology suffers inter alia from a lack of frequencies allocated worldwide and poor range, limited basically by the line of sight. Even so this is still the best practice for most air navigation services providers throughout the world. Long-range communication still utilises somewhat unreliable equipment for high frequency (HF) transmission although satellites by now offer better solutions. Consequently, the recommendations are focused on improving the existing ground systems, honing VHF ground-to-air communications to the extent possible, gradually introducing better technologies in this field and phasing out HF systems. For obvious reasons, the ground-to-air improvement possibilities are limited by the equipment standard of the airframes. Likewise, airlines will not invest in aircraft equipment before there are equivalents on the ground.

The 15 communications recommendations are much more hardware-intensive than the previous 44 AOM and ATFM recommendations. Careful planning must be undertaken and cost-benefit analysis applied on major new investments. Replacement investments could probably be undertaken in a more rule-of-thumb manner; VHF may be outmoded but will stay in place for a long time.

Navigation

This area comprises 14 recommendations, most of which pertain to ground-based navigational aids like non directional beacon (NDB), VHF omni-directional range (VOR), instrument landing system and distance measuring equipment (DME). The NDB system is rooted in 1930s technology and its importance for commercial aviation is almost negligible. Still, the Team recommends that it is partly maintained for a few years and only gradually phased out from 2014 onwards. No new NDB stations should be installed and in case an existing station needs heavy repair, decommissioning should be contemplated. The VOR, like the airport instrument landing system, were certified by ICAO in 1949 and the distance meter DME in 1959 but they carry their age with flying colours, performing surprisingly well in modern-time versions. In the long run they will all be replaced or made redundant by satellite navigation (global navigation satellite system [GNSS]), but this system has been notably sluggish in permeating the civil aviation community, even if performance-based navigation (PBN) and area navigatin (RNAV) have been introduced. One reason may be that the only operative GNSS system so far is the US-controlled GPS; another that local or wide-area augmentation is sometimes required, Step 1 of GNSS augmentation is recommended for 2014 and step 2 for 2018-2020. From the present-day horizon, it is recommended that VOR and DME be retained for the foreseeable future - beyond 2025.

The recommendations in the navigations field are not as hardware-intensive as for communications. For RNAV and required navigation performance it is more a human resource requirement then a hardware investment.

Surveillance

Twenty-one recommendations apply to the surveillance field. Present-day surveillance is almost entirely based on radar, with only minor elements of satellite-based solutions like automatic dependent surveillance (ADS). Radar, as a system, can be described as a complicated and expensive way of detecting information on aircraft position, speed, heading, altitude and intention. Since the introduction of airborne GNSS systems in the 1990s, all these data are already available in the cockpit, with a much higher degree of accuracy, and could be transmitted to the ground station at negligible costs. Hence the ultimate replacement of radar in the surveillance world is already known.

As with GNSS in navigation, surveillance technology based on satellites (GNSS and communication) permeates the civil aviation industry slowly, but the Asia-Pacific area is at the forefront. Indonesia has 30 ADS-B (broadcast) ground stations, Singapore is implementing, Malaysia has immediate plans, Australia has full upper level coverage and participation and there is data sharing between Indonesia and Australia. Most recommendations therefore focus on improving existing radar systems while slowly introducing ADS-related techniques. During the transition period multilateration could be used as a more economical replacement for conventional radar. Only in the long term beyond 2025 is a phase-out of conventional radar envisaged.

The surveillance recommendations entail heavy investments, to which the same approach as with navigations should be applied. In addition, the technical development must be monitored closely to ensure that investments are made in the technology most likely to dominate the future.

Aerodrome

This section refers to the airside part of the airport sector in general and not each and every airport. Formally, aerodrome infrastructure is not part of the ATM community but airport *capacity* has a direct impact on ATM capacity. An enhanced airport infrastructure that increases the airport capacity will also bring positive effects on ATM capacity.

There are 16 recommendations, all but one staged for short- or medium-term action and in most cases addressing activities already existing in one form or another. Recommendations in the airport section have to be coordinated with the airport authorities, since it involves airport infrastructure initiatives in order to increase ATM capacity. The most demanding task is to increase capacity at the five major airports. This will require investing billions of US$ in runway architecture improvements, terminals and other infrastructure. The road to success in the aerodrome area is lined with pitfalls, easily consuming prodigious amounts of money to no avail. Airport investments must be very carefully planned, applying social cost-benefit analysis on the entire programme and not only on the isolated project. As indicated to IndII in the Bali airport project, standard investment assessment methods are available and can be adapted to Indonesian conditions with reasonable costs and efforts.

System-wide information management

In this field, the Plan contains 14 recommendations, eight of which short term, three medium term and three long term. Some of these offer easily caught benefits at very low costs, e.g. improved flight plan management and web-based information. Significant investments are probably required only for the recommended medium- and long-term improvements of weather information systems.

AIS/MET transition into AIM

This transition process is addressed by 18 recommendations with their centre of gravity in the short term. The Team entertains some apprehensions regarding the quality and reliability of aeronautical information services (AIS) data, accuracy of obstacle charts, sufficiency of staff training etc and most recommendations focus on improved quality in these areas. Immediate action is required in several cases.

The costs for following the recommendations will mainly be related to personnel, not physical investments.

Human resource management

A part of this area is covered in the previous sections on system-wide information management and AIS/meteorological services for air navigation transition into aeronautical information management. Only four recommendations, spread over all three horizons, remain in the human resource management field. As expected, all of these address training and staffing issues. There are no physical investments involved.

Contingency

This area concerns the ability and readiness of the ATM system to deal with unforeseen threats to, mainly, safety. There are six recommendations, all pertaining to the short and medium terms. The main emphasis is on planning; to determine what to do in unexpected events before they occur. There is however one major issue relating to ATM infrastructure – to make an interim life extension for the Jakarta Advanced Air Traffic Control System. This action is justified also for other reasons than contingency planning, but it will require heavy investments.

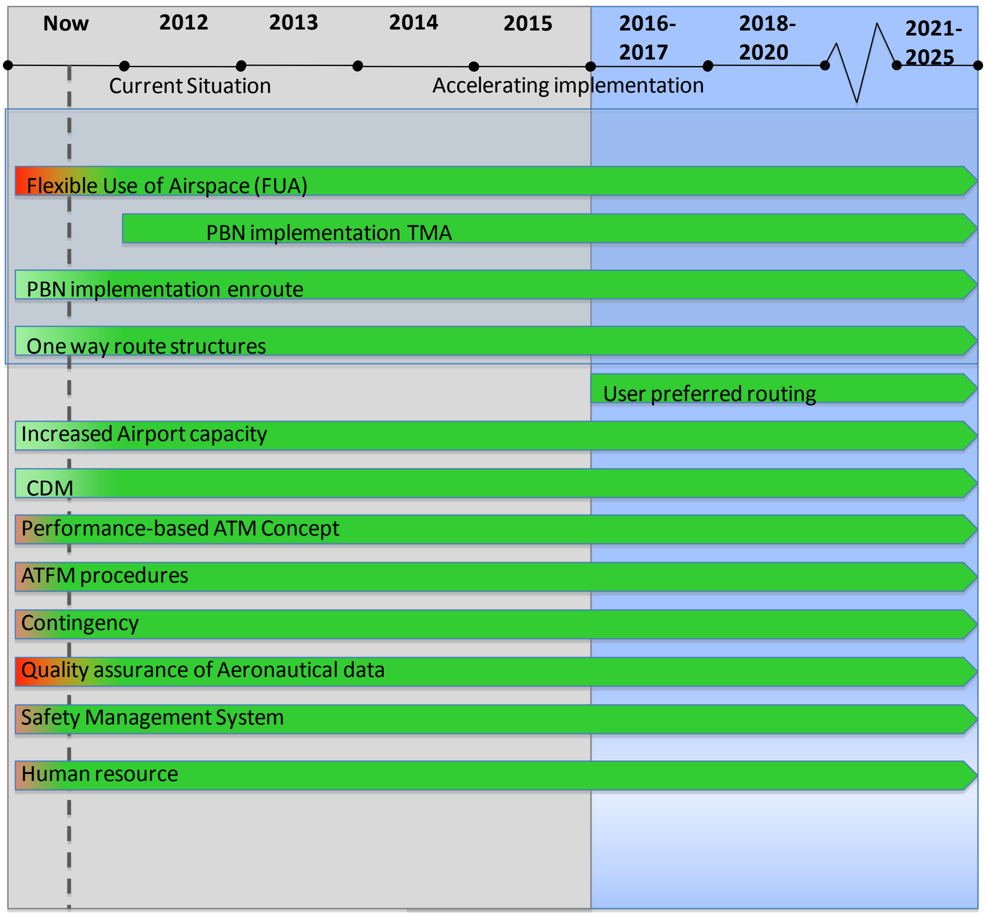
Safety and quality management system

The final 17 recommendations concern the safety and Quality Management System (QMS) field. 14 of these are short-term, but due to the continuous-process character of many safety and QMS items, four of these extend into medium and long term. By and large no physical investments are required but considerable human resources are required for at least some recommendations.

Master Plan itinerary

The graph below indicates the location in time of the major Master Plan activities.

Figure 1: The Master Plan highlights



Cost estimates

The Plan contains crude cost estimates for hardware investments, based on fairly detailed data on equipment vintages, some guesswork regarding expected life spans and unit prices for CNS equipment. A special estimate has been made for the replacement of Jakarta Area Control Centre.

CHAPTER 1: ATM MASTER PLAN OBJECTIVES

The Republic of Indonesia is a huge archipelagic country in South-East Asia spreading more than 5000 km from west to east and more than 1800 km from north to south. It is therefore very dependent on a well-functioning air transport system. In fact, the whole Asia-Pacific region is dependent on Indonesia's air transport since about half of the flights to and from the Australian continent cross Indonesian airspace. Consequently, a smooth and well-functioning Indonesian air traffic management (ATM) system is of crucial importance to this giant region.

1.1 INTRODUCTION AND VISION

This Master Plan document is expected to constitute a vehicle and a strategic road map for Indonesia in its development of future ATM. It is one in a sequence of related foundation documents and will replace the previous ATM Master Plan from 1994. Many activities from the predecessor are not yet implemented and if still valid, they have been retained in this updated plan. The document has a special focus on how operational procedures and technologies comply with current International Civil Aviation Organization (ICAO) Global Plan Initiatives (GPI) and other strategic ICAO documents. Current achievements are reflected in order to form a starting point for the evolutionary implementation of the ATM concept components towards the more visionary ICAO-2025-and-beyond concept. Some domains need however urgent actions and are described in the Short Term Recommendations of each chapter.

The first recommendation of the Team is to perform a review of the plan twice a year and to do major updates every seconded year.

The need for this document for ATM in Indonesia is driven by:

- Law no. 1/2009 on Aviation
- The requirement for the present ATM concepts and infrastructure to absorb the forecast growth in demand (Traffic Analysis; Deliverable 1.)
- Inputs from the Indonesian ATM Planning Review (Deliverable 2)
- Inputs from National Strategy for the Implementation of ASEAN Open Sky policy
- User expectations in terms of improved flexibility, punctuality, reduced costs and reduced risk of delays
- The need to fully exploit current and emerging technologies, while improving capacity and safety and reducing environmental impact
- The need to update the old "Master Plan and Feasibility Studies in the Area of Air Traffic Control" with a new ATM Master Plan

- The results of proposals put forward by the Directorate General of Civil Aviation (DGCA),PT Angkasa Pura 1 (AP1) and PT Angkasa Pura 2 (AP2) staff participating in ATM Master Plan working groups

The document describes the main solutions possible to implement within each of the three timeframes, considering both a technical perspective and more importantly the operational perspective.

The general vision is for Indonesia to have a safe, efficient and flexible ATM system capable of meeting expected growth in traffic and also to provide cost-effective services to airspace users. It is important that requirements for safety, security and national defence are met together with initiatives that balance the increasing importance of environmental factors.

1.2 METHODOLOGY AND STAKEHOLDER INVOLVEMENT

The consultants have during time on site in Indonesia had access to an office in DGCA's premises in Jakarta and through Indonesia Infrastructure Initiative also access to secretarial support. The consultants have in the process of development of an ATM Master Plan interviewed a number of experts and managers from the DGCA. In addition, valuable inputs have been received from an established counterpart group. Visits have been made to the headquarters of AP 1 and AP 2, where additional information was obtained. Visits to operational units, like Jakarta Area Control Centre (ACC)/Approach Control (APP), TWR, Ujung Pandang ACC as well as Surabaya TWR/APP have supplemented the knowledge of current situation, capabilities and deficiencies. International Air Transport Association (IATA) HQ in Singapore was visited to hear a major stakeholder's view on ATM in Indonesia and opinions on future necessary actions. To get a local view, Indonesia National Air Carriers Association (INACA) was visited in Jakarta. LFV Aviation Consulting has also previously produced two reports: Report on Traffic Analysis (Deliverable 1) and Report on Indonesian ATM Planning Review (Deliverable 2), where future traffic predictions are made and current situation described.

In order to get more involvement and participation from as many stakeholders as possible, four working groups were established in consultation with the counterpart group. These four working groups were established based on different air navigation service (ANS) domains.

WG 1: Airspace management (ASM)/air traffic flow management (ATFM)

WG 2: Air traffic control (ATC)

WG 3: Communications, navigation and surveillance (CNS)

WG 4: Aeronautical information services (AIS)/meteorological services for air navigation/search and rescue

In all these working groups, stakeholders from DGCA, AP1, AP2, Civil Aviation Transportation Team (CATT), ITSAP, and AsA were represented most of the time. For each group a contact person was designated, to whom members of the group were able to turn with questions, comments, etc. Each working group was led by a consultant from LFV Aviation Consulting with three dispersed working days at their disposal. At the final meeting, a tentative implementation schedule was elaborated and agreed upon, which later became the backbone of the recommended activities in the Master Plan. During the presentation of the Draft ATM Master Plan and the specific workshop concerning a performance based ATM concept on 4 May, the stakeholder participation generated considerable value for the ensuing Master Plan work.

A number of key assumptions were made in producing this ATM Master Plan:

- Recommended activities in this plan will be implemented in accordance with ICAO Annexe, documents and standards and recommended practices (SARPs).
- Indonesia will not experience a significant economic recession or other major “shock events” severe enough to have a major and lasting impact on the civil aviation sector and ATM revenues during the lifetime of the Plan.
- The charging regime based on cost-recovery principles according to the new Law no. 1 on Aviation will come into effect 2012.

1.2.1 Current system limitations

The present ATM system in Indonesia suffers from a significant lack of capacity in several sectors. According to opinions conveyed to the Team by several stakeholders, there are reasons to doubt the system’s ability to cope with expected traffic growth at a level of quality acceptable in comparison with international standards. At present there is no nation-wide ATM operational concept; this plan should hopefully initiate an elaboration of such a concept document and therefore regulations for new operational procedures and methods are not yet in place. In some cases new operations have been implemented without regulative guidance. There are limited regular audits and oversights from DGCA concerning safety standards, air traffic services (ATS) procedures, staffing regulations etc, especially for the two ACC. The quality and safety management system within the present ATM organisation falls short of an acceptable level. This is mainly due to the fact that service provision is fragmented between three providers, one of them also shouldering the role of regulator. Technical equipment is not always maintained in accordance with regulations. Indonesian ATM is also somewhat lacking in human resource management (HRM) as no strategic HRM plans for recruitment, expert and management training, staff policies etc. are available. The aeronautical information available is neither sufficient nor quality assured or easily accessible. The CNS infrastructure is not sufficient and in some instances not maintained in a safe and orderly process.

The ATM structure comprises several different systems and various generations of technology. Systems, humans and organisations are not tied to a single efficient body.

Interoperability and efficient working methods are not always in place and should therefore be developed. The following shortcomings have been identified in this project:

- Airspace management:
  - Rigid sectorisation
  - Current airspace sectorisations which have not been altered after new traffic flows and changed patterns of traffic have been introduced
  - Rigid route structure, mainly built on conventional terrestrial navigations aid
- Air Traffic Flow Management:
  - No national or regional ATFM established. There are no systems and procedures that can predict traffic overload for air traffic controllers and provide necessary mitigating actions to maintain a high level of safety.
  - ATC capacity is at limit both at some airport as well as some ACC and APP sectors. Quick actions are needed to enhance capacity and maintain a high level of safety.
  - Aircraft capabilities not used. Most newly purchased/leased aircraft by both domestic and international users are capable of fly more efficient than the present Indonesian ATM system can cater for.

A number of specific shortcomings are elaborated below.

The ATC system of Jakarta ACC is at least 15 years old and will most likely be around 20 before all necessary preparatory work is ready for it to be replaced. The system in Ujung Pandang ACC is approximately 10 years younger. In aged ATM systems like Jakarta's it is not cost-efficient to do major improvements for airspace users or the staff. In addition, when an ATM system is more than 15 years old it will become hard to find spare parts, which is the case with the Jakarta Advanced Air Traffic Control System (JAATS). This will force its operator AP 2 to put in heavy efforts for maintenance to keep the JAATS efficient and delivering the required capacity.

Figure 2: Jakarta area control centre

Photo by LFV Aviation Consulting

Very high frequency and high frequency radio are used for ground-to-air communications, with poor coverage in some areas. For the east and oceanic parts of Indonesian airspace, controller-pilot data link communications can be used for aircraft appropriately equipped. Ground-to-ground communication is to a large extent using very small aperture terminal.

The main navigational structure is based on conventional terrestrial aids, which is the main reason behind the rigid ATS route structure. It is expected that all users, in particular international airlines overflying Indonesia, will require more direct routes based on satellite navigation.

As regards surveillance, available infrastructure is under-utilised, inhibiting a more efficient separation standard which would increase the airspace capacity. Automatic dependent surveillance - broadcast (ADS-B) use in Ujung Pandang flight information region (FIR) has not yet reached an operational status and even if not all aircraft are properly equipped for this surveillance tool, many are, and could in operational use enhance the capacity of the ATC procedures. ADS-B stations are also installed in Jakarta FIR, but there are no means in the present JAATS to utilise them on an operational basis. In the field of AIS, a major shortcoming is deficient quality assurance in the processing of flight plan (FPL) data. Inefficient submission and distribution routines in the FPL process create additional workload and capacity constraints.

Many aircraft operating today have precision navigation capabilities, lateral and time, not currently used. In addition there are many aircraft capable of providing aircraft derived data (ADD) via data link. Limitations in the ground systems required to utilise this information render the airborne systems useless. The mix of aircraft capabilities is a shortcoming that could be overcome by DGCA regulatory actions. New aircraft delivered to Indonesia and the region are in most cases very modern next-generation airframes with capabilities for satellite based navigation systems, ADS-B etc. For Indonesian ATM to retain old conventional navigational aids used by a diminishing number of aircraft will be very costly for the air navigation services provider (ANSP) and therefore, in a cost-recovery charging scheme, also for the airspace users. In the meantime however, interim solutions and methods should be developed.

There is according to our information a need of additional 700 controllers in Indonesia in the near future to accommodate traffic increase and replace retirements. This shortage of staff results in inability to split ACC sectors to smaller volumes of airspace to accommodate for more traffic, which could be a constraining future factor to cope with the growing traffic demand. The total number of operational air traffic controllers in Indonesia is 934 and the declared requirement is, according to DGCA, 1634. According to DGCA, in Jakarta TWR/APP/ACC there are currently 201 air traffic controllers with a requirement of 267. In Ujung Pandang (Makassar) TWR/APP/ACC there are, according to the same source, currently 112 operational air traffic controllers with a requirement of 145.

A general activity stemming from current system limitations should be developed by DGCA and guide as an Operational Concept Document. Such document should emphasise how operational procedures and technology comply with ICAO strategic documents and form a starting point and background in the coming implementation activities proposed in this Master Plan.

A task force is presently in operation towards the objective to identify activities required to transform Indonesian ATM into a new institutional structure with a single ANS provider. Article 261 of Aviation Law no.1/2009 stipulates the structure of this Indonesian ANSP. The new ANSP will provide all air navigation services (ANS) in the country and also plan and develop ANS in all of Indonesia. A transition phase will most likely be needed until the new ANSP has reached sufficient maturity. DGCA will have the regulatory role supervising the ANSP. This will make the divided roles of regulator/provider clear for internal as well as external parties in the aviation community. A unification of ANS into one organisation will benefit future implementation of necessary changes in the Indonesian CNS/ATM, ATFM and ASM systems.

1.2.2 Implementation process

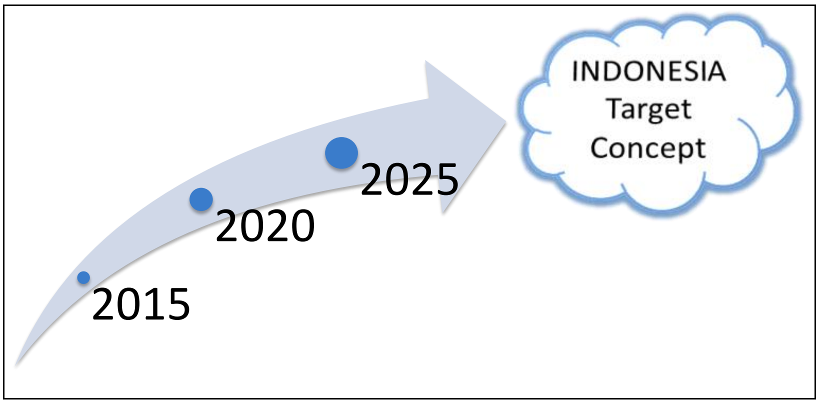
The Team proposes establishment of a cross-organisational team with a clear mandate to run dedicated projects. Participation of Indonesian operational and technical experts from both regulator and service providers plus other stakeholders such as airspace users and the military is of vital importance. If necessary, consultancy support could be added to run such specific projects in a cooperative way, including the main stakeholders. This should be seen as a necessary action caused by the forecast traffic demand. The recommended activities should be regarded as a tentative implementation plan. Implementations should be made according to recommended timelines, described for short, medium and long term periods according to stages below:

Short term: up to and including 2015

Medium term: from 2016-2020

Long term: from 2021-2025 and beyond

Figure 3: The Master Plan three timeframes



In order to have a logical approach to the different activities, ICAO GPIs have been used to coordinate the activities. The 23 initiatives are divided into seven different groups shown in the tables below.

Chapter 2 introduces the need for ATM to progress from a system approach to a performance-based approach, a paradigm shift in the ATM and aviation community. This process has been initiated by ICAO where SARPs since the mid-1990s have introduced this concept. This development will also be necessary for the Indonesian ATM community to adapt to.

Each established grouping of ICAO´s GPIs constitutes an ATM domain, where recommended activities are documented in Chapter 5 to Chapter 10 to form the core of the ATM road map (or tentative implementation schedule). Gaps between what ICAO describes in the GPI and status of current Indonesian ATM are translated into stepwise, tentative implementation plans for short, medium and long term. If recommended activities will be implemented according to the proposed timescale, there are good opportunities for Indonesian ATM to respond to future user requirements. Additional recommended activities concerning AIS transition to aeronautical information management, HRM, Contingency and quality and safety management to fulfil the roadmap are to be found in Chapter 12 to Chapter 15.

1.2.3 AOM and ATFCM

The following GPIs (from ICAO doc 9750) have been grouped into the Airspace organisation and management (AOM) and the air traffic flow and capacity management (ATFCM) domains. Recommended activities for these GPIs are found in Chapter 5 and Chapter 6.

Table 1: Airspace organisation and management GPIs

Airspace Organisation and Management (AOM)		
	Global Plan Initiative	**Description**
GPI-1	Flexible use of airspace	Fair and balanced distribution of airspace between civil and military users
GPI-2	Reduced vertical separation minima	Application of 1000 ft vertical separation.
GPI-3	Harmonisation of level systems	Adoption of the ICAO Flight Level Scheme based on feet
GPI-4	Alignment of upper airspace classifications	Application of a common ICAO ATS Airspace Class above an agreed division level
GPI-7	Dynamic and flexible ATS route management	Accommodation of user preferred flight trajectories
GPI-8	Collaborative airspace design and management	Implementation of harmonised global airspace organisation and management principles
GPI-10	Terminal area design and management	Optimisation of traffic management in the terminal area

Table 2: Air traffic flow and capacity management GPIs

ATFCM – Air Traffic Flow and Capacity Management (Demand and Capacity Balancing [DCB])		
	Global Plan Initiative	**Description**
GPI-6	Air traffic flow management	Optimisation of ATM system traffic capacity

1.2.4 Communication, navigation and surveillance

The following GPIs have been grouped into the CNS domains. Recommended activities are found in Chapter 7 to Chapter 9.

Table 3: Communication GPIs

Communication (COM)		
	Global Plan Initiative	**Description**
GPI-22	Communication infrastructure	Provision of voice and data communications capability with adequate capacity and capability to support evolving ATM requirements
GPI-23	Aeronautical radio spectrum	Protection of aviation radio frequencies

Table 4: Navigation GPIs

Navigation (NAV)		
	Global Plan Initiative	**Description**
GPI-5	Area Navigation (RNAV) and Performance-based navigation (RNP)	Use of advanced aircraft navigation capabilities
GPI-11	RNP and RNAV SIDs Standard instrument departures (SIDs) and Standard instrument arrivals (STARs)	Use of improved coordination processes to seamlessly link the enroute and terminal phases of flight
GPI-21	Navigation systems	Transition to performance-based navigation

Table 5: Surveillance GPIs

Surveillance (SUR)		
	Global Plan Initiative	**Description**
GPI-9	Situational awareness	Improved situational awareness for pilots and air traffic controllers through use of data-link based surveillance and cockpit display of traffic
GPI-12	Functional integration of ground systems with airborne systems	Provision of more fuel efficient flight trajectories through trajectory management
GPI-16	Decision support systems and alerting systems	Automated tools for detecting traffic conflicts and improving traffic flow

Surveillance (SUR)		
	Global Plan Initiative	Description
GPI-20	World Geodetic System - 1984 (WGS-84)	Implementation of WGS-84

1.2.5 Aerodrome and system-wide information management

The following GPIs have been grouped into the Aerodrome and System-Wide Information Management domains. Recommended activities are found in Chapter 10 to Chapter 11.

Table 6: Aerodrome GPIs

Aerodrome (AO)		
	Global Plan Initiative	Description
GPI-13	Aerodrome design and management	Improvement of airport movement area utilisation
GPI-14	Runway operations	Optimisation of runway capacity
GPI-15	Match instrument meteorological conditions (IMC) and visual meteorological conditions (VMC) operating capacity	Reduce effect of adverse weather conditions on airspace and airport capacity

Table 7: System-wide information management GPIs

System Wide Information Management (AIS)		
	Global Plan Initiative	Description
GPI-17	Data link applications	Increase use of data link and reduce voice transmissions
GPI-18	Aeronautical information	Management and distribution of high quality, real-time aeronautical information
GPI-19	Meteorological systems	Improved availability and quality of meteorological information

For each Global Plan Initiative, this Master Plan outlines recommendations for short-, medium- and long-term activities, constituting the core of the ATM roadmap (tentative implementation schedule). The Master Plan will mainly answer the questions ”what" needs to be done and “when” it should be done up to the year 2025 and beyond.

"How" things will be done and implemented is indicated, but must be further elaborated in design and specification documents.

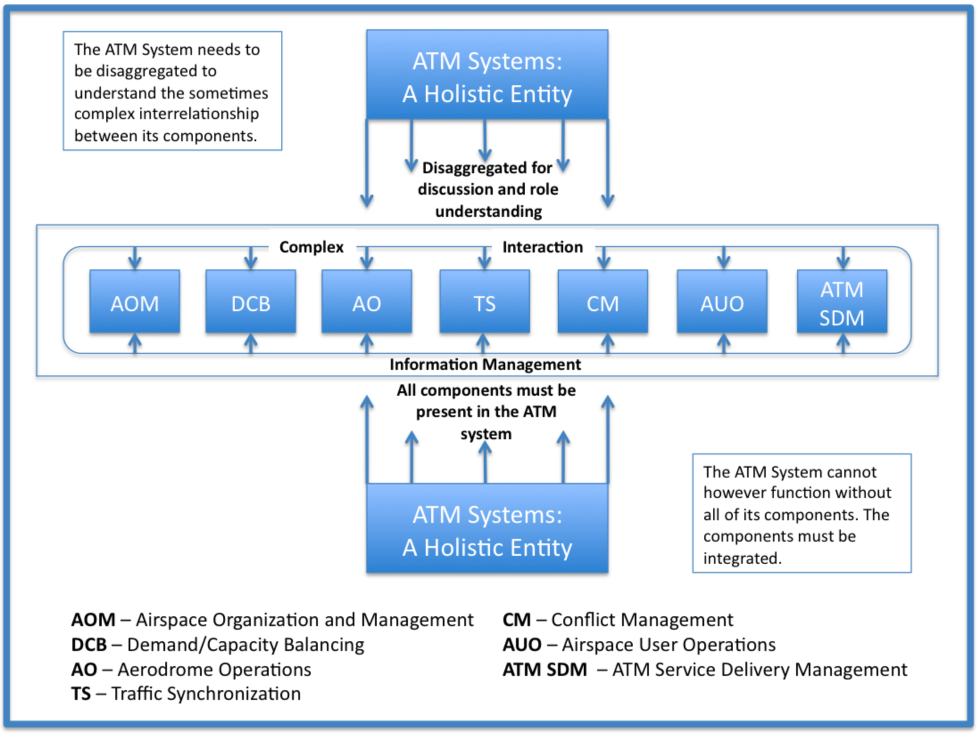
CHAPTER 2: FUTURE ATM CONCEPTS AND VISIONS

Air traffic management is the dynamic, integrated management of air traffic and airspace through the provision of facilities and seamless services in collaboration with all parties.

2.1 AIR TRAFFIC MANAGEMENT 2025 AND BEYOND

Present air traffic management (ATM) systems in most areas in the world need to be transformed in an evolutionary way in order to cope with the expected traffic growth. The International Civil Aviation Organization ICAO *Global Air Navigation Plan* (Doc 9750) describes a strategy aimed at achieving near- and medium-term ATM benefits on the basis of available and foreseen aircraft capabilities and ATM infrastructure. This Global Plan contains guidance on ATM improvements necessary to support a uniform transition to the ATM system envisioned in the *Global Air Traffic Management Operational Concept* (Doc 9854). This operational concept presents the ICAO vision of an integrated, harmonised and globally interoperable ATM system.

Figure 4: ICAO concept components



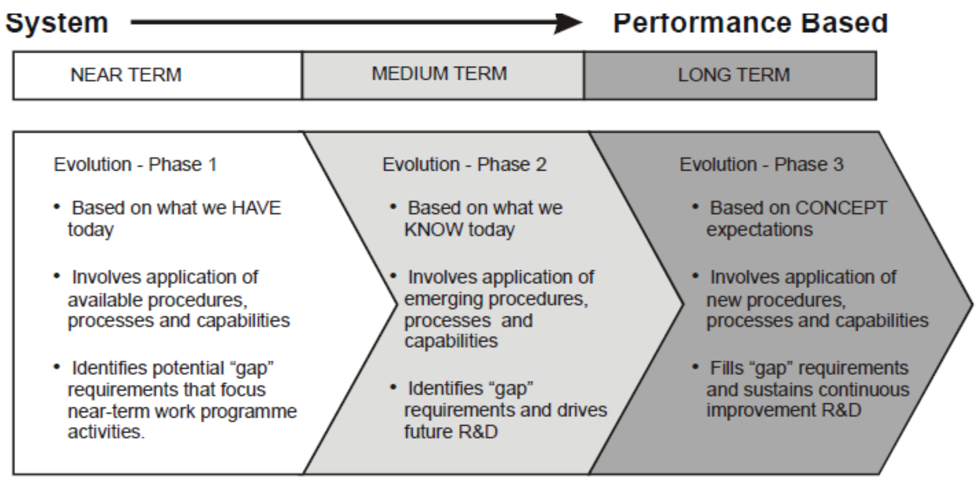
Source: ICAO Doc 9854

A truly global ATM system faces many challenges:

- Achieving interoperability and seamlessness across regions for all users during all phases of flight
- Meeting agreed levels of safety
- Providing for optimum economic operations
- Being environmentally sustainable
- Meeting national security requirements

There are many ways to present an ATM transition map, and it would be difficult to address all aspects of transition in one presentation. Therefore, the Global Plan focuses on one perspective only, *the operational and technical improvements that will bring near- and medium-term benefits to aircraft operators.* Long-term initiatives, necessary to finally achieve the global ATM system as envisioned in the operational concept, will be added to the Global Plan once they are developed and internationally accepted according to ICAO. On this basis, planning will focus on specific performance objectives, supported by a set of Global Plan Initiatives. ICAO recommends States and regions should choose initiatives that meet performance objectives, identified through an analytical process, specific to the particular needs of a State, region, homogeneous ATM area or major traffic flow. Planning tools will assist with the analysis.

Figure 5: ICAO global plan evolution



Source: ICAO doc 9750

2.2 DRIVERS FOR CHANGE

The driver for change must always be (realistic) user expectations, and the ATM Master Plan will seek to derive benefits for all members of the ATM community. This objective can be regarded from three different angles.

1) From an *airspace user* perspective, a greater equity in airspace access, easier access to timely and meaningful information for decision support and more autonomy in decision-making, including conflict management, will enable improved business and individual outcomes within an appropriate safety framework.
2) From a *service provider* perspective, including that of aerodrome operators, the ability to operate within an information-rich environment using real-time data as well as system trends and predictive data, supported by a range of automated decision-support tools, will enable optimisation of services.
3) From a *regulator* perspective, safety systems should be robust and open, allowing safety not only to be more easily measured and monitored, but also compared and integrated on a global basis, less for its own sake but as a platform for continuous improvement.

The need for change of ATM performance is driven by a number of external factors. Indonesia, as well as the rest of the global ATM community, must accommodate needed future changes by adapting a performance-based approach in the transition to the future ATM System. In Indonesia this could be a process for the long term. Operational concepts based on performance criteria are described in paragraph 2.3.

The external drivers of ATM could be summarised as follows:

- **Traffic Demand**: The main driver is the predicted substantial growth in air traffic over the next 15 years. Forecasts for Indonesia are described in Chapter 3. Traffic patterns will also most likely change significantly. ASEAN Open Sky, implemented in 2015, will most likely be an incitement for such new patterns. Under these circumstances, optimised sharing of scarce airspace resources between civil and military users will become even more important than today. Recommendations for an evolutionary implementation of flexible use of airspace (FUA) will facilitate such a sharing of airspace.
- **Aircraft fleet**: Progressive renewal will continue and we will most likely see the fleet grow in proportion with the numbers of flight. Currently there are different capabilities in the domestic fleet served by the ATM. A regulatory framework adapted to modern aircraft capabilities concerning standards for integration with ATM systems is a future necessity. Indonesian airlines, according to “National Strategy for the implementation of ASEAN Open Sky policy”, are planning to add 800 aircraft to 2014, which is three times their current fleet (2010).
- **Airports**: Investment in more capacity in order to accommodate for the forecast growing traffic is required. Future ASEAN Open Sky treaty will increase the growth with additional 5 percent from 2015. The following five airports are designated to become “ASEAN Open Sky” airports :
  - Soekarno-Hatta airport (Jakarta)
  - Juanda airport (Surabaya)
  - Ngurah Rai airport (Denpasar)
  - Medan new airport (Medan)

  - Sultan Hassanuddin airport (Makassar)

- **Safety**: With the expected increased traffic complexity and density, one could expect more accidents and incidents if no mitigation actions are taken. ATM in Indonesia is therefore expected to contribute to substantially increased safety levels, at the airports as well as in the air. It is vital that Indonesia implements fully a safety management system for the aviation community according to ICAO requirement and Chapter 14 (see also paragraph 2.3.1.).

- **Environmental performance**: Civil aviation is expected to make serious efforts to reduce fuel consumption, noxious emissions, noise and above all carbon dioxide emission. ATM is expected to contribute by optimising traffic flows “gate-to-gate”. See also paragraph 2.3.1. The airport’s contribution to environmental improvements has been acknowledged in Indonesia, where some airports have been appointed Eco-airports. Recommended activities in this Master Plan are contributing to an improved environmental performance.

- **Security**: ATM is expected to play a more active role in protecting civil aviation from security risks, by managing the security of ATM services, infrastructure, information and staff. Aviation security in Indonesia and elsewhere is of outmost importance for retaining the society’s trust and therefore willingness to use this mean of transportation.

- **Cost Efficiency**: Airlines are under increasing pressure to reduce costs to remain competitive. This translates into the need to increase their own ATM capabilities to reduce indirect ATM costs, such as delays, inefficient routing etc to the maximum extent possible, and for the air navigation services provider (ANSP) to reduce the cost of service provision. Indonesian ATM should as described in paragraph 2.3.2 be performance-driven concerning provision of a cost-efficient service for its customers.

- **New technologies**: New ATM technology is an enabler of change more than a driver. However new technology must be balanced with present infrastructure in a cost-benefit analysis. A typical issue is whether to retain old terrestrial navigation/landing aids alongside new satellite technology, which requires new aircraft fleet equipment. This Master Plan provides recommendations for new technologies in 7.1 Chapter 9.

- **Obsolete technologies**: Technical evolution renders existing equipment obsolete and sometimes no longer supported by the manufacturing industry. This is the case with, e.g., the Jakarta Advanced Air Traffic Control System (JAATS) system of Jakarta Area Control Centre (ACC). This Master Plan emphasises the urgent need for a replacement of the present JAATS system.

- **Human aspects**: these will remain central in ATM. Human resource management must be improved to meet all future necessary changes in ATM. This could also be seen as an enabler for ATM development. Currently there is a declared lack of approximately 800 air traffic controllers in Indonesia (see also Chapter 13).

- **Global context**: ATM in other parts of the world is of course changing. Indonesia cannot modernize its ATM in isolation; the nation must adhere to regional changes.

Indonesia may take a lead in the reform process through increased participation on the international ATM arena, such as ICAO and CANSO.

- **Institutional context**: The new context, where ATM service will be provided from one single provider and the Directorate General of Civil Aviation (DGCA) will transform into the regulatory authority, should facilitate future ATM changes.

Figure 6: Part of Terminal 1 at Soekarno-Hatta, Jakarta (view from ATC Tower)

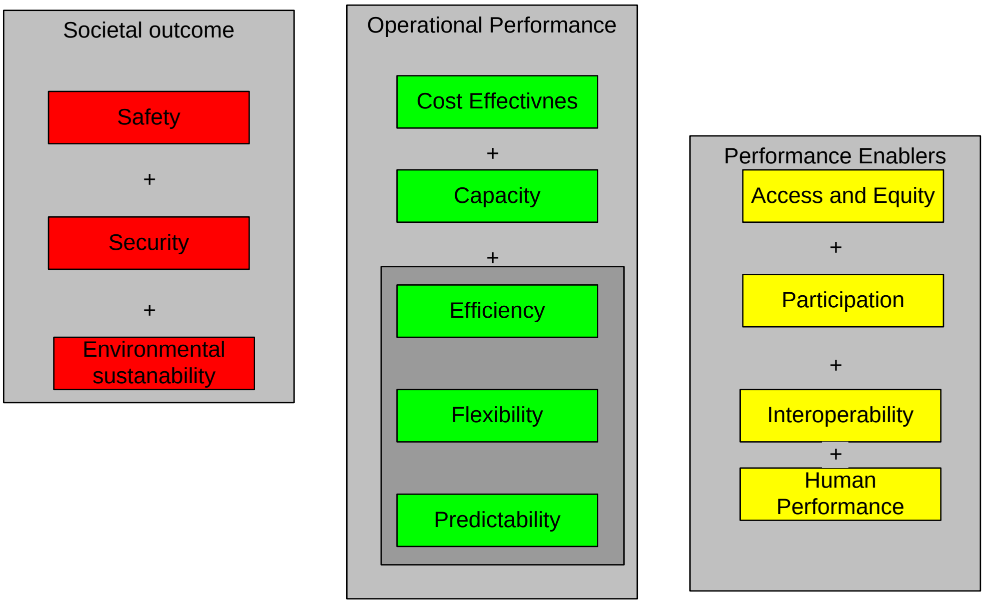
Photo by LFV Aviation Consulting

2.3 PERFORMANCE-BASED ATM CONCEPT

The future ATM operational concept must, through an evolutionary process, be developed into a performance-based system, with key performance areas (KPA) and indicators (KPI) defined according to ICAO standards and final targets set, established and monitored. This evolutionary process is recommended to start in the short term for some of the KPAs and medium term for others according to recommendations below. This evolutionary process should further be developed in the next ATM Master Plan update proposed for 2015.

A future performance-based concept should be structured around the 11 ICAO KPAs in the figure below. Human performance can be seen as a key enabler to achieve future expected targets. In the future European ATM concept, human performance plays a major role and has therefore been added as the 12th KPA. Human Performance naturally plays a vital role in ATM in Indonesia as well and therefore it is natural that this domain also is considered an important KPA.

Figure 7: ICAO 11 key performance areas plus human performance



Source: ICAO doc 9883.

Efficiency, flexibility and predictability constitute the *Quality of Service* group. In order to implement a performance-based ATM concept, including determined KPI with defined target objectives, it is a prerequisite that Indonesian ANSP has access to a central database, where all statistical data can be retrieved for a continuous monitoring of target accomplishment. The need will hopefully be discussed in cooperation between regulator and ANSP in the new organisation.

2.3.1 Societal outcome KPAs

These KPAs are the three to the left in Figure 7. For all three sectors, DGCA should in 2012 together with relevant stakeholders start to elaborate a KPI and establish a target objective.

- **Safety**: This is the highest priority in aviation, and ATM plays an important part in ensuring overall aviation safety. Uniform safety standards and risk and safety management practices should be applied systematically to the ATM system. In implementing elements of the global aviation system, safety needs to be assessed against appropriate criteria and in accordance with appropriate and globally standardised safety management processes and practices. The safety KPA addresses risk, prevention, occurrence and mitigation of air traffic accidents (see Chapter 15, Quality and Safety Management Systems).

- Performance objectives: e.g. no serious accident/incident shall occur - zero tolerance.

- **Security**: Security is protection against intentional threats (e.g. terrorism) or unintentional threats (e.g. human error, natural disaster) affecting aircraft, people or ground installations. Adequate security is a major expectation of the ATM community and of citizens. The ATM system must therefore contribute to security, and the system itself as well as ATM-related information must be protected against security threats. Security risk management should balance the needs for access to the ATM system with the need for protection. In the event of threats to aircraft or threats using aircraft, ATM shall provide responsible authorities with appropriate assistance and information. The Security KPA covers a subset of aviation security. As with safety, it addresses risk, prevention, occurrence and mitigation of unlawful interference.
    - Performance objectives will not be elaborated further but need attention in order enhance in the security risk management.
- **Environmental sustainability**: The ATM system should contribute to the protection of the environment by considering noise, emissions and other environmental issues during implementation and operation. This addresses the role of ATM in the management and control of environmental impacts. Its aims are to reduce negative environmental impacts of air traffic.
    - Performance objectives will not be elaborated further in this document, but the issue needs attention regarding enhancements of improved procedures and airspace designs.
    - DGCA shall with start 2015 together with relevant stakeholders to elaborate a KPI and establish a target objective.

2.3.2 Operational performance KPAs

These KPAs are the five in the middle of Figure 7, the three lower constituting the Quality of Service (QoS) group.

- **Cost-effectiveness**: The ATM system should be cost-effective, while balancing the varied interests of the ATM community. The additional cost of service to airspace users should always be considered when evaluating any proposal to improve ATM service quality or performance. ICAO policies and principles regarding user charges should be followed.
    - Performance objectives for cost effectiveness: the total annual cost for en route ANS should decrease in the future compared with a base year. Considering that ATM institutional arrangements are in a transitional stage based on the new Aviation Law no. 1/2009, a base year and target reduction rate cannot be set until the new ANSP is consolidated.
    - DGCA should in 2013 together with relevant stakeholders start to elaborate a KPI and establish a target objective.

- **Capacity**: The global ATM system should exploit the inherent capacity to meet airspace user demands at peak times and locations while minimising restrictions on traffic flow. To respond to future growth, capacity must increase, along with corresponding increases in efficiency, flexibility and predictability, while ensuring that there are no adverse impacts on safety and giving due consideration to the environment. The ATM system must be resilient to service disruption and the resulting temporary loss of capacity.
    - Performance objectives:
        - To elaborate an ATM target of e.g. doubling or tripling the capacity of the available airspace compared with a base year. Airspace capacity can be seen as sector capacity, i.e. how many aircraft an airspace sector can accommodate in one hour or how many aircraft an ACC, with a maximum configuration, can handle in one hour. Recommended activities in this Master Plan will increase the airspace capacity to cope with growing demand from airspace users.
        - DGCA should in 2014 together with relevant stakeholders start to elaborate a KPI and establish a target objective.
        - To elaborate a target for e.g. the five ASEAN Open Sky airports´ ATM capacities stated in movements per hour for single runway operations and parallel dependent/independent runway operations.
    - DGCA should in 2014 together with relevant stakeholders start to elaborate a KPI and establish a target objective for initially these airports.
- Regarding the QoS group, airspace users are expected to demand much higher QoS levels than ATM has been able to offer in the past. These performance areas can be seen as user expectations and it is the ANSP/Airport responsibility to accommodate these expectations. A KPI with an elaborated target should determine the lowest level of service ANSP/Airport shall deliver to the airspace users.
    - DGCA should in 2016 together with relevant stakeholders start to elaborate a KPI and establish a target objective.
- **Efficiency**: Efficiency addresses the operational and economic cost-effectiveness of gate-to-gate flight operations from a single-flight perspective. Obviously, airspace users want to depart and arrive at the times they select and fly the trajectory they determine to be the optimal one.
    - Performance objectives: Targets to elaborate could be improved departure punctuality, such as e.g. 90 percent as planned. Collaborative decision making (CDM) is necessary to avoid having too many departures with the same departure times.
- **Flexibility**: This addresses the ability of all airspace users to modify flight trajectories dynamically and adjust departure and arrival times, thereby permitting them to exploit operational opportunities as they occur. How flexible is ATM to respond to revised user requirement?

- Performance objectives: A target to elaborate could be increased accommodation of new route, level and departure time for scheduled flights.

- **Predictability**: This component refers to the ability of airspace users and ATM service providers to provide consistent and dependable levels of performance. Predictability is essential to airspace users as they develop and operate their schedules. An example is how ATM can accommodate an early controlled time of arrival.
  - Performance objectives: A target could be better arrival punctuality.

2.3.3 Performance enablers

These are the four KPAs to the right in Figure 7. DGCA should in 2017 together with relevant stakeholders start to elaborate a KPI and establish a target objective for the four KPAs below.

- **Access and equity**: The global ATM system must ensure all airspace users the right of access to the ATM resources needed to meet their specific operational requirements and that the shared use of airspace by different users can be achieved safely. ATM should also ensure equity for all users of a given airspace or service. Generally, the first aircraft ready to use the ATM resources will receive priority, except where significant overall safety or system operational efficiency would accrue or national defence considerations or interests dictate that priority be determined on a different basis. For example, overflights to/from Australia over Indonesia will have access to the ATM service delivery on the same conditions as departing/arriving traffic to Indonesia. This KPA guarantees all airspace users eligible to fly in the different airspaces access on equity basis. This is valid for visual flight rules flights, business jets, military flights, non-scheduled and scheduled flights. Recommended activities concerning FUA will improve this KPA for military and civilian users.
  - Performance objectives: An access target could be to improve the shared use of airspace and airports by different users. Where shared use is conflicting with other performance expectations (like safety and capacity) it should be ensured that alternatives will be provided to satisfy users´ requirements. An equity target could be improvement by better priority management and safeguarding that priority rules will always be applied in a transparent and correct manner.
- **Participation**: The ATM community should have a continuous involvement in the planning, implementation and operation of the system to ensure that the evolution of the global ATM system meets the expectations of the community. Stakeholders' consultation plays a vital role in ATM development.
  - Performance objectives: A target could be improvement by stakeholders during planning, development, deployment, operation and evaluation/improvement of the ATM system.

- **Interoperability**: The ATM system should be based on global standards and uniform principles to ensure the technical and operational interoperability of ATM systems and facilitate global and regional traffic flows.

    - Performance objectives: A target could be to ensure that application of standards and uniform principles together with improved technical and operational interoperability of aircraft and ATM systems promote:
        - The efficiency and flexibility of trajectories
        - Airport- and airspace related access
        - Airport- and airspace-related equity

- **Human performance**: This KPA is not included in ICAO's 11 defined KPAs. It addresses the central role of the staff in the future ATM systems including managers and decision-makers (see Chapter 13: Human Resource Management).
    - Performance objectives: Sufficient ATM staff available with the right skills, competencies and means to discharge their responsibilities and deliver the expected volume and quality of ATM service.

2.3.4 Airspace organisation and management (AOM)

Airspace management is the process by which organisation and other options in the provision of services will be selected and applied to best meet the needs of airspace users. Airspace management will be dynamic, flexible and based on demand. Its organisational boundaries, divisions and categories will be adapted to traffic patterns and changing situations and will support the efficient operation of the other ATM services described among the seven concepts. The airspace will also be organised to facilitate seamless handling of flights and the ability to conduct flights along optimum flight trajectories from gate to gate without undue restriction or delay.

Airspace planning will aim at accommodating dynamic four-dimensional flight trajectories whenever practicable. This includes a time parameter as the fourth dimension. Structured route systems will be established only in areas where the demand for dynamic trajectories cannot be accommodated. Airspace organisation will be based on the principle that all airspace is managed, meaning that the level of service to be provided will be decided by the appropriate authority.

Although there will generally be no permanent/fixed constrained airspace, certain airspace will be subject to service limitations, including access over an extended period motivated by national interests or safety issues and appropriately considered in coordination with the ATM community. There are currently areas in Indonesia where civilian aircraft have no access unless in some emergency situations. There are also some air defence identification zones (ADIZ) permanently constrained for civilian users.

Competing interests for the use of airspace will make airspace management a highly complex exercise, balancing the following interests:

- Traffic flows should not be constrained by national or facility boundaries.
- Dynamic flight trajectories and optimum system solutions must be provided.
- When conditions require, different types of traffic to be segregated by airspace.
- Organisation, size, shape and duration of that airspace will be set to minimise the impact on operations.
- Airspace use will be coordinated and monitored in order to accommodate conflicting user requirements and to minimise any constraints on operations.
- Airspace reservations will be planned in advance with changes made dynamically whenever possible. The system will also accommodate unplanned requirements.
- Structured route systems will be applied only where required to enhance capacity or to avoid areas where access has been limited or where hazardous conditions exist.
- Uniform organisation and management principles will be applicable to all regions. Global principles will be applicable at all levels of density. Complex operations may limit the degree of flexibility.
- Areas first in line for implementation are those where ATM community expectations are presently not being met.

The Team suggests the following visions for AOM:

- **Airspace organisation vision**: All airspace in the entire region is organised in a flexible and dynamic way, meaning allocation on a timely basis to different kinds of users. Restrictions will only be temporary. Dynamic, four-dimensional, user-preferred trajectories from e.g. Makassar to Jakarta will be accommodated. Fixed performance-based navigation routes will be used when the user-preferred trajectories cannot be accommodated due to military activities. Air traffic services route structure is mainly performance-based.
- **Airspace management vision**: The airspace will be managed by the new ANSP and regulated by DGCA. A special process is balancing the needs of the different airspace users. An airspace management cell in one of the ACCs, manages pre-tactical (the day before operations) airspace allocation needs while a high level body of representatives from DGCA and military authorities set the strategic framework for cooperation. Day-to-day tactical coordination is exchanged between civilian air traffic controllers and military fighter controllers. A similar management has been implemented in South-East Asia.

2.3.5 Aerodrome operations (AO)

AO describe airport functionality within the ATM system in terms of information acquisition and delivery, facility access, demand for airspace and limits on usability. AO will be considered from an en-route to en-route perspective in determining their role within the ATM system. The en-route to en-route perspective includes both airside and landside activities at the airport, as well as all the other ATM activities, while the concept gate-to-gate does not include the landside activities at the airport. Principles for smooth AO include:

- Reduced runway occupancy time
- The capability to safely manoeuvre in all weather conditions while maintaining capacity
- Any activities on the manoeuvring area or apron will be considered as having a direct influence on ATM. Normally the apron is not considered being within the air traffic control (ATC) jurisdiction, but activities there may have an indirect impact on movements on e.g. the taxiways
- Where required, runway geometry will permit runway entry and exit at any location along its length, where suitable taxiway access is provided, minimising runway occupancy time and reducing holding areas
- Surface guidance to and from a runway is available in all conditions
- The position (to an appropriate level of accuracy) and intent of all vehicles and aircraft operating on the movement area will be known and available to ATM

Figure 8: Air traffic control tower, Soekarno-Hatta, Jakarta

Photo by LFV Aviation Consulting

There will be a dependency on landside operations where improvements will be needed to optimise aerodrome capacity. Landside activities not directly related to ATM will have an impact on aerodrome operations. These activities include, inter alia, customs, security, baggage handling and fuel supply, and will be optimised through collaborative exchange of information. Environmental issues such as noise, gaseous emissions and visual intrusions will be considered in the design, development and operation of aerodromes. Restrictions on airside operations may occur due to environmental constraints and public concern. Flight parameters will be available to ATM, allowing for dynamic spacing and sequencing of departing aircraft, thereby minimising wake vortex constraints on runway capacity. The major runway capacity constraint from wake vortex is however for arriving aircraft.

- **Aerodrome operations vision**: As noted earlier, airports are not a component of ATM but airport capacity has a significant impact on ATM capacity. The five major airports Jakarta Soekarno-Hatta Airport, Medan, Makassar, Bali and Surabaya have increased runway throughput by new entry and exit locations and improved surface guidance, following special capacity studies. The airports have enhanced their surface surveillance in order to keep up capacity during low visibility conditions. At Jakarta Soekarno-Hatta Airport independent arrivals/landings to both parallel runways have been normal procedures for many years. Standardised procedures for separation between departures from one runway and landings on the other runway are in operations. A third runway is under construction. Several airports are planned to become certified as Eco-airports or Green airports. A standardised procedure for continuous descent approaches is used frequently. A departure manager position at those airports reduces the taxi times and also noise level and gaseous emissions. A recruitment and training process for aerodrome control (ADC) controllers and AFIS staff has been ongoing for many years and the vacancy level is quite low. In Jakarta, ADC staff is available to man positions for both runways.

2.3.6 Demand and capacity balancing (DCB)

The function of demand and capacity balancing (DCB) is to minimise effects of ATM system constraints. It is capable of evaluating system-wide traffic flows and capacities in order to implement necessary actions in a timely manner. DCB allows airspace users to optimise their participation in the ATM system while mitigating conflicting needs for airspace and aerodrome capacity. Collaborative usage of decision-support tools will ensure the most efficient use of airspace resources, provide equitable access, accommodate user preferences and ensure that demand on an airspace resource will not exceed its capacity. DCB will also be integrated with the ATM system and undertaken at the strategic, pre-tactical and tactical stages. DCB can also be regarded as a CDM process. DCB principles include:

- Optimising the difference between user-requested trajectories and actual trajectories
- Recognition of deficiencies and optimisation of assets to maximise capacity

- Balance operations against available assets
- Basing techniques generally on system predictability; however, systems must be able to accommodate unplanned situations
- Gate-to-gate balancing
- Techniques for resolving local demand and capacity balancing problems
- Strategic initiatives requiring tactical flexibility to provide optimal availability
- Taking into account information about current and predicted airspace conditions, projected demand and past performance; tools to strategically identify areas and times of higher density will also be available

- **Vision for demand-capacity balancing**: Air traffic flow management has been developed in the past ten years to a national centralised Flow Management Unit and is now in 2025 a part of a regional centralised Flow Management Unit. DCB is made on a strategic, pre-tactical and tactical stage for the entire South-East Asia using all airspace according to the AOM concept. All sectors have declared their capacity values including variations due to military use of airspace, weather conditions etc. All gate-to-gate movements are part in this assessment. Technical support tools have been developed for this mission so the airspace can be used equitable by all users at an optimum level. To a large extent, traffic can fly user-preferred trajectories and be offered different alternatives in a tactical and flexible way.

2.3.7 Traffic synchronisation (TS)

TS refers to the tactical establishment and maintenance of a safe, orderly and efficient flow of air traffic. TS, conflict management and DCB above are interrelated and will become fully integrated. It encompasses both the ground and airborne part of ATM and will constitute a flexible mechanism for capacity management by allowing reductions in traffic density and adjustments to capacity in response to variations in demand. TS will also make use of integrated and automated assistance to surface, departure, arrival and en route management to ensure an optimum traffic flow. The objective will be to eliminate choke points and, ultimately, to optimise traffic sequencing to achieve maximisation runway throughput.

Traffic synchronisation, together with the other ATM components, will contribute to the efficient handling of traffic from gate to gate. There will be dynamic four-dimensional trajectory control and negotiated, conflict-free trajectories. These techniques will reduce the need for traditional “path stretching” in high traffic density areas and will reduce the adverse impact this has on economy and efficiency. Synchronisation will be applicable and tailored to all airspace and aerodromes where required. Its principles include:

- The ability to tactically and collaboratively modify sequences to optimise aerodrome operations, including gate management and/or airspace user operations
- Evolution into 4-D control where a flight is given a time profile to follow
- Delegation of aircraft separation to the flight deck to reduce ground system workload
- Wake vortex will continue to be a determinant of minimum spacing but flight parameters will be available to the ATM system, allowing for dynamic spacing and sequencing of arriving and departing aircraft

- **Vision for traffic synchronisation**: TS is made on a tactical base (the day of operation). The technical support tool for managing all phases of flights will assist in finding the optimum traffic flow. The TS is fully integrated with the DCB tools as well as the support tools for the conflict management, ensuring a conflict-free trajectory for the individual flight. This support tool will accommodate smooth traffic flows and sequence the traffic based on an arrival time over a defined navigational point. The arriving traffic e.g. for Jakarta will be sequenced and spaced by issuance of very narrow timeslots being part of the dynamic trajectory. By the use of this TS tool, traffic bunching at airports, arrival/departure and en route will be mitigated. Sequencing between flights will be delegated to flight deck to optimise runway throughput, where wake vortex problems will be taken into account. TS is one of the future concepts according to ICAO Doc 9854. European and American ATM vendors are in the process of developing tools, which probably will not be in operation for Indonesia within the planning period of this ATM Master Plan.

2.3.8 Airspace user operations (AUO)

AUO refer to the ATM-related aspect of flight operations. The ATM system will accommodate diverse types of airspace user missions. These are expected to encompass inter alia air transport, military missions, business, aerial work and recreation. These missions will have different planning horizons, from those scheduled well in advance to just before flight. The ATM system will accommodate diverse types of aircraft characteristics and capabilities. Both manned and unmanned aerial vehicles will form part of the ATM system, which will accommodate the limited ability of some vehicles to dynamically change trajectory.

The evolution of ATM services will provide operational benefits and incentives commensurate with aircraft capabilities. It will have to be recognized, however, that the degree to which benefits and incentives can be realised may continue to differ between various users. Aircraft design, including avionics, and operational characteristics have an influence on ATM performance (wake vortex, environmental considerations, aerodrome requirements, etc). The interrelationship and interdependence of aircraft design and ATM performance are key considerations in aircraft and ATM system design. AUO principles include:

- Relevant ATM data will be fused into airspace user's situational awareness and conflict management.
- Airspace user operational information will be made available to the ATM system.
- Individual aircraft performance, flight conditions and available ATM resources will allow dynamically optimised 4-D trajectory management.

The following components form parts of AUO:

– **Mission planning** is performed by airspace users as a collaborative exercise with AOM, AO and DCB as appropriate, to ensure that the ATM system will be able to accommodate their missions.

– **Operational control** is a function exercised by airspace users and means the exercise of authority over the initiation, conduct and termination of a mission.

– **Operational control** is extended over the diverse types of airspace user missions and incorporates a number of elements including management of the mission, management of the individual flights, and collaboration with ATM. These concepts are not expected to be implemented within the timeframe of this Plan.

- **Vision for AUO**: Aircraft user operations will be an integrated part of the ATM system where actual real-time data on constrains, weather etc are always available. Aircraft capabilities allow user preferred 4-D trajectories, which the majority of the domestic/international fleet are able to fly. Airline companies are part of the CDM with ATM and airport.

2.3.9 Conflict management (CM)

The function of CM is to limit, to an acceptable level, the risk of collision between aircraft and hazards. A *conflict* is any situation involving aircraft and hazards in which the applicable separation minima may be compromised. *Conflict horizon* is the extent to which hazards along the future trajectory of an aircraft are considered for separation provision. Hazards from which an aircraft will be separated are other aircraft, terrain, weather, wake turbulence, incompatible airspace activity and, when on ground, surface vehicles and other obstructions. *Separation minima* are the minimum displacements between an aircraft and a hazard that maintain the risk of collision at an acceptable level of safety. *Separation mode* is an approved set of rules, procedures and conditions of application associated with separation minima. Separation provision is the tactical process of keeping aircraft away from hazards by at least the appropriate separation minima.

Separation provision, currently a major ATC task, will in most cases be transferred to flight deck. This support tool that will make the conflict management with the defined three layers possible will be integrated with the tools/procedures necessary for AOM, DCB and TS. When a flight has received an agreement, a contract (former flight plan) to fly a 4-D user-preferred trajectory, the strategic layer in the CM tool has defined the planned trajectory conflict-free and no hazards should emerge along its trajectory. The conflict management process can be applied at any point along the conflict horizon, from the flight formulation stage or schedule preparation well in advance of flight, to actual flight in real time.

Conflict management is applied in three layers, comprising:

- Strategic conflict management
- Separation provision
- Collision avoidance

Strategic conflict management is the first layer of CM and is achieved through the AOM, DCB and TS components described above. The term “strategic” is used here to mean “in advance of tactical” (ICAO Doc 9854 definition). This recognises that a continuum exists from the earliest planning of the user activity throughout the latest avoidance of the hazard. Strategic actions will normally occur prior to departure; however, they are not limited to pre-departure, particularly in the case of longer flights. Changes to the trajectory (whether at the request of the user or the service provider) will result in the selection of the best means of conflict management, which may be strategic. In general, strategic conflict management aims at reducing the need to apply the second layer - separation provision - to an appropriate level as determined by the ATM system.

Separation provision is the second layer of CM and is the tactical process of keeping aircraft away from hazards by at least the appropriate separation minima. It will be used only when the strategic conflict management above cannot be used efficiently.

Separation provision is an iterative process, applied to the conflict horizon. It consists of:

- Conflict detection, based on the current position of the aircraft involved and their predicted trajectories in relation to known hazards
- Formulation of a solution, including selection of the separation modes, to maintain separation within the appropriate conflict horizon
- Implementation of the solution by communicating the solution and initiating any required trajectory modification
- Monitoring how the solution is executed to ensure that the hazards are avoided

New trajectories should be checked to ensure that they are free from conflicts within a considered conflict horizon. In order to minimise changes to aircraft trajectories, the conflict horizon will be extended as far as procedures and information permit. It is recognised that the conflict horizon may be reduced to solve near-term conflicts when required.

Separation mode is an approved set of rules, procedures and conditions of application associated with separation minima. The separation mode will inter alia take in account the required safety level, the nature of the activity and hazard, the qualifications and roles of the actors and other conditions of application such as weather conditions and traffic density.

The *separator* is the agent responsible for separation provision for a conflict and can be either the airspace user or a service provider. The separator must be defined prior to commencement of separation provision; however, the role of separator may be delegated.

Collision avoidance is the third layer of conflict management and must activate when the separation mode has been compromised. Collision avoidance is not part of separation provision, and collision avoidance systems are not included in determining the calculated level of safety required for separation provision. Collision avoidance systems will however be considered as part of ATM safety management. The collision avoidance functions and the applicable separation mode, although independent, must be compatible.

- **Vision for conflict management**: Fully developed CM is likely to create the most dramatic change in ATM compared with current processes. The function of CM will have a negotiated trajectory approved well in advance of a flight, considering the airspace management perspective and all other air traffic with approved flight trajectories. When this trajectory is approved it should be conflict-free, meaning no further separation provision should be needed. Tactical changes may however require some separation provision, when new trajectories need approval. Airspace users´ changing needs should be adapted to in a flexible manner. Weather changes may affect the available airspace and will therefore also change the negotiated trajectory. When there is a requirement for separation provision the CM concept indicates that this will be primarily handled by the airspace users. For this objective to be realised in Indonesia, considerable and fundamental; change is required in international (ICAO) procedures. Such changes are not expected to have impact on Indonesian ATM within the timeframe of this Plan.

2.3.10 ATM service delivery management (SDM)

The ATM SDM function will balance and consolidate the decisions of the various other processes/services, as well as the time horizon and the conditions under which these decisions are made. Services to be delivered will be established on an on-request basis subject to ATM system design, which in turn will be determined by collaborative decision-making and system-wide safety and business cases.

When there is a request for ATM services, the process will build an agreement on the flight trajectory based on user wishes, constraints and opportunities related to other services and information available on the operational situation. The agreement will then be the subject of monitoring. A significant deviation from the agreement, as observed or inferred, will trigger a revision to the agreement or a warning drawing attention to the need to revert to the agreement. SDM will manage the distribution of service responsibilities and their seamless performance, including the designation of a predetermined separation provider. This function will be important to ensure that the SDM will, through collaborative decision-making, balance and optimise user-requested trajectories to achieve the ATM community's expectations. To maintain situational awareness, ATM service delivery management will monitor a wide range of non-flight-specific infrastructure and traffic demand information. Principles include:

- Trajectory, profile, and aircraft intent
- Management by trajectory
- Clearance

The future ATM system, based on *trajectory, profile and aircraft intent*, will rely on explicit and unambiguous information and on wide information exchange within the system. Key information relates to the future position of aircraft, and to the meaning and status of that information. System-delivered trajectories will take into account aircraft performance characteristics. The notification of intent will be a means for airspace users to specify their request for services and the nominal capabilities available during the flight. It will also satisfy the gate-to-gate, collaborative decision-making and network management requirements.

Management by trajectory will involve development of an agreement extending throughout all phases of flight. The trajectory will never be allowed to have an open-ended vector, which means that every manoeuvre will be reflected as an update to the agreement. Management by trajectory does not require every aspect of a flight to be predetermined and captured in detail at the time of departure. The agreement and its management will have the detail required by the traffic management phases that the flight is subject to at the time when the initial agreement and subsequent updates are made.

Clearances will allow the incremental delivery of the trajectory by the ATM system based on the assignment of traffic. Therefore, although the flight deck and the ATM system will have entered into a "gate-to-gate" agreement; that agreement will be actively affirmed by the delivery of each portion of the trajectory as a clearance.

- **Vision for service delivery management**: SDM will be adapted to the global new concept according to the description above. However, considering the entailing dramatic change of the current situation and what this concept anticipates in the future, it will most likely not be developed within the nearest 15 years. For this concept to reach an operational status, all the other six ICAO concepts need to be implemented into the Indonesian system as well as the regional ATM systems. The future role of ATC with this visionary outlook will move from a managerial role to a more monitoring one, where airspace users will assume an increased ATM role. For this objective to be realised in Indonesia, considerable and fundamental change is required in international (ICAO) procedures. Such changes are not expected to have an impact on Indonesian ATM within the timeframe of this Plan.

2.4 INFORMATION SERVICES

Information services deal with the exchange and management of information used by the different processes and services. It will ensure the cohesion and linkage between the seven concepts components described above. Information management provides accredited, quality-assured and timely information used to support ATM operations. It will also monitor and control the quality of the shared information and provide information-sharing mechanisms supporting the ATM community.

Information management will assemble the best possible integrated picture of the historical, real-time and future state of the ATM situation. It will provide the basis for improved decision-making by all ATM community members. Key to the concept will be the management of an information-rich environment. Its more direct contribution to improvements in the ATM system will be in the quality of the information that in turn will provide significant additional benefits. In particular, the wide availability of high-quality, relevant aeronautical data presented to all airspace users in a usable format will contribute to increased aviation safety. The ATM community will depend on information management, shared on a system-wide basis, to make informed collaborative decisions for best business and operational outcomes. Within the ATM system, based on this operational concept, it will be the information itself that will be of significance and not the technology that supports it. For the ATM system to operate at its full potential, pertinent information will be available when and where required.

ATM data has temporality and will change over time, but to varying degrees in terms of frequency or magnitude, varying from almost static to very dynamic. Information management will recognise and accommodate this temporality of data. This will impact the organisation and issuance of data. Information may be personalised, filtered and accessed as needed. The initial quality of the information will be the responsibility of the originator; subsequent handling will not compromise its quality. The information management function will allow all participants to adjust information sharing to mitigate any proprietary concerns. Sensitivity with regard to some data will continue to exist and will be managed within the information management function. Once an ATM community member agrees to release information, the data will be available to the extent required and will be made accessible to specified parties. Information management will achieve a seamless transfer of relevant information between parties in a flexible, adaptable and scalable information environment. It will use globally harmonized information attributes.

2.5 AERONAUTICAL INFORMATION

The scope of information management includes all types of information, in particular aeronautical. Since the architecture and organization of information services are implementation issues, this operational concept will be the vision for Indonesian transition from aeronautical information services to aeronautical information management. Nevertheless, in addition to the intrinsic characteristics of information management, servicing information will incorporate the following basic concepts:

2.5.1 Temporality and issuance

The temporality of the information depends on its nature. Some data can be prepared in advance and are valid for a rather long period; other data change in real time and are obsolete immediately. As a principle, all valid and relevant information will be made available as soon as it becomes available. In order to satisfy the requirements of all information users and to avoid waste of resources and the risk of information overload, information management will use a variety of information issuance concepts in relation to the application using it and the media used to carry it. Typically, the information relevant to a flight will be tailored and filtered, and accessible dynamically as the flight is planned and then progresses. Intelligent information management will be used to realise virtually “unlimited” access to information with “limited” bandwidth, and optimise the transfer of information.

The reference medium for aeronautical data will be a fully electronic and networked environment, with printouts used only as needed for reference, temporary memorisation and visualisation support to human operators. Information will use a variety of channels on the ground (and space-based segments). The best information routing will be selected for use on the basis of quality of service and economic criteria, possibly in real time.

2.5.2 Meteorological information

The provision of meteorological information will be an integrated function of the ATM system. Content, format and timeliness of information will be tailored to meet ATM requirements. The main benefits of the meteorological information for the ATM system will be related to the following:

- Improved accuracy and timeliness of meteorological information will be used to optimise flight trajectory planning and prediction, thus improving ATM safety and efficiency.
- Increased availability of shared meteorological information on-board the aircraft will allow the preferred trajectory to be refined in real time.
- Better identification, prediction and presentation of adverse weather will allow the management of its effects more efficiently. Safety and flexibility, for example, will be improved by accurate and timely information on the need for diversion or re-routing.
- Improved aerodrome reports and forecasts will facilitate optimum use of aerodrome capacity.
- Increased availability of meteorological information (air reports) from on-board meteorological sensors will improve meteorological forecasting and the display of real time information.
- Meteorological information will contribute to minimising the environmental impact of air traffic.

Performance management will be an important part of the quality assurance of meteorological information.

2.5.3 Other essential services

There are other essential activities that the ATM system will provide information to, or may receive information from. These include the following:

- Air defence and military control systems will need timely and accurate information on flights and ATM system intents. They will be involved in airspace reservations and notification of air activities and in enforcing measures related to security.
- Search and rescue organisations will need timely and accurate information on aircraft in distress and on accidents. Such information plays an important role in the quality of the search function.
- Aviation accident/incident investigation authorities will need to exploit recordings of flight trajectory data and ATM actions.
- Law enforcement (including customs and police authorities) will need flight identification and flight trajectory data, as well as information about traffic at aerodromes.
- Regulatory authorities will need to implement the regulatory framework within the legal powers given to them and to monitor the safety status of the ATM system.

These entities have a defined relationship with the ATM system, and all will impose requirements on the system.

2.6 ENVIRONMENTAL ATM AND LEVEL OF SYSTEM MATURITY

Like the global community, the global aviation industry is currently highly aware of the major concern of global climate change issues. In media around the world, the aviation industry is often given more blame for the negative environmental impact it causes than maybe is the reality. It is however a cause for environmental concern. Research in developing more environmentally adapted bio-fuel is progressing and quieter and less fuel consuming aircraft engines are being developed. Airports are concerned not only for the emissions from aircraft movements on ground and in the vicinity of the airport, but also for the required infrastructure for ground transportation. From an ATM point of view, an airspace organisation and management more adapted to environmental concerns are necessary to provide more flight efficient routes.

Level of maturity can be perceived in multiple ways. Technical maturity has an obvious impact on what can be achieved from a system level. Operational maturity is closely linked to human factors and addresses acceptability and usability of operational functions and pertaining procedures. Finally a political or organisational maturity is required for some conceptual elements (e.g. flexible use of airspace, FUA) that require a consensus among various stakeholders.

The transition from current Indonesian operations towards the ATM target concept is illustrated in Figure 4. Important functions and enablers for a new and efficient system are presented in terms of expected availability in time. To actually use and benefit from new functions will require development of methods, training and also safety considerations. In some areas cooperation with external stakeholders is also required, e.g. to establish a concept using FUA needs coordination and agreements with the military. Functions may also gradually be used as knowledge and understanding increases and suitable methods are introduced.

CHAPTER 3: FUTURE ATM CONCEPT FOR OPERATIONS

The variety of different recommended air traffic management (ATM) activities in the following chapters will - if implemented - bring Indonesian ATM forward during the three different time periods; short, medium and long term where the concepts of operation below are anticipated.

3.1 SHORT-TERM CONCEPT

By the end of 2015, Indonesia ATM is divided into one regulator, Directorate General of Civil Aviation (DGCA) and one provider (air navigation services provider [ANSP]) of air navigation services. Airport affairs are no longer part of the Indonesian ANSP organisation.

- **Airspace organisation and management**: Flexible use of airspace has been introduced, where a high level military-civilian agreement is negotiated and some high-priority Conditional routes are established to the benefit of civil aviation. An airspace management cell (AMC) is established in one of the air control centres (ACCs) to allocate airspace on a pre-tactical basis, optimising the use of the airspace between the civil and military traffic. The airspace classification is reviewed and class B airspace is most likely changed to C. The division of airspace at FL245 between class A and G is reviewed and could be lowered, in order to provide a more controlled ATM environment when domestic traffic is undergoing a substantial growth. The Flight Service Sectors have been reorganised to a more functional number. Some prioritised new performance-based navigation (PBN) routes are established and more one-way route structures are implemented in order to increase necessary sector capacity. Segregated standard instrument departures (SIDs)/standard instrument arrivals (STARs) in the terminal control areas (TMAs) are implemented and some of these could be based on required navigation performance RNP 1 –criteria to cater for continuous descent approaches.
- **Air traffic flow and capacity management (ATFM)**: ATFM has been introduced and sector capacities are calculated for the ACC and Approach Control (APP) sectors. Each ACC has established a flow management position, where pre-tactical ATFM is performed.
- **Communication, navigation and surveillance**:
  - *Communication*: The VHF coverage in eastern Indonesia has been improved. The use of standard Doc 4444-messages for exchange of coordination is formally adopted and improved. The Aeronautical message handling system (AMHS) is developed to cater for required capacity. Use of controller-pilot data link communications (CPDLC) in remote areas and over ocean area is increased.

- *Navigation* will mainly be guided by conventional ground-based aids. There are some highly prioritised PBN routes established as well as some precision SID/STARs. Adequate regulations are in force. DGCA has presented a plan and alternative for aviation dependent on ground based navigation.
- *Surveillance* will still use conventional radar as its main tool. A strategic plan for surveillance infrastructure is established, where the use of automatic dependent surveilance-broadcast (ADS-B) initially in Ujung Pandang ACC will be implemented and used operationally in parallel with conventional radar. The use of automatic dependent surveillance -contract (ADS-C)/CPDLC has expanded in the western part of Indonesia, when the new Jakarta Advanced Air Traffic Control System (JAATS) has this capability integrated. Multilateration (MLAT) as a bridge to ADS-B is being considered. A new JAATS system is in operation in Jakarta ACC. As a risk reduction a backup system should be implemented. System coordination with Ujung Pandang ACC is fully operational using inter-facility data communications. Both systems are now equipped with the safety nets short term conflict alert (STCA), minimum safe altitude warning and area proximity warning, as well as the monitoring aids CLAM and RAM. The medium term conflict detection function is operational in both ACCs. Paper strips are no longer used in any of the ACCs. Both Makassar Advanced Air Traffic Control System (MAATS) and JAATS have a system upgrade in order to integrate the new International Civil Aviation Organisation (ICAO) flight plan (FPL)-format. DGCA are planning for an upgrade for 2012.

- **Aerodromes**: Collaborative decision-making (CDM) has been established and capacity enhancing activities have started in order to increase airport airside capacity. Aerodrome taxiway and runway design is being adapted as such an activity.
- **System-wide information management** (including aeronautical information services [AIS]/meteorological services for air navigation [MET] to aeronautical information management [AIM]): AIS has started the transition to AIM and the FPL process has been improved with the help of an improved training process. A quality management is established in the AIS organisation. Submission time for a FPL is three hours.
- **Human resource management**: Indonesian ANSPs have developed staffing plans for all categories of ATM staff, including recruitment and training, which should has reduced the vacancies specifically for air traffic controllers. The working conditions are regulated and improved, when more staff is available.
- **Contingency**: Plans are established both for Jakarta and Ujung Pandang ACC including both short term and long term situations. Also major APP/aerodrome control (ADC) sectors have developed contingency plans.
- **Safety and quality management**: A safety (SMS) and quality management system has been introduced. Both the regulator and the ANSP have established a flight safety policy as a base for the SMS. The safety culture is being developed in the organisations, where the reactive, proactive and predictive safety work is being improved and safety audits are carried out.

3.2 MEDIUM-TERM CONCEPT

By the end of 2020, the ATM system has been consolidated in a mature and regulative DGCA and one ANSP. The ANSP is responsible for all planning of future development necessary to accommodate future user requirements.

- **Airspace organisation and management**: Flexible use of airspace has been further developed. The high level military - civilian agreement has been expanded and is a natural part of the improved relation. Additional conditional routes are established. The AMC is also a natural part of daily operations. PBN routes are established according to ICAO Regional PBN Plan for the short term both for the en route and the terminal airspace, improving the required navigational performance. The use of CPDLC has increased and thereby improved the tactical CDM.
- **Air traffic flow and capacity management**: ATFM is working well and the ACCs can predict sector loads. A centralised ATFM unit is established and co-located with the AMC.
- **Communication, navigation and surveillance**:
    - A *communication* network based on internet protocol sub-network technology has been established. The use of AIDC has been implemented between internal ACC sectors and between ACC sectors and local ADC/APP sectors.
    - *Navigation* will mainly be performed via PBN routes. Non-directional beacons will not be phased out and VHF Omni-directional range/distance measuring equipment will remain as a complement to PBN. Ground-based augmentation system (GBAS) regulations are in force and RNP-AR approaches are available at some airports with high landing minima based on conventional landing aids.
    - Conventional radar is still used as the main means of *surveillance*. Wide area multi-lateration is deployed for en route and TMA airspace. Airport MLAT is further deployed to increase surveillance at the airports. Use of ADS-B is increasing. The JAATS and the MAATS systems are fully integrated. A specification for a new replacement of MAATS is ongoing. Arrival manager (AMAN) for Surabaya is considered. For major APP-units, also safety nets like STCA have been incorporated. Regulations for introduction of new technology are established.
- **Aerodrome**: Airport CDM has been established and developed. Capacity-enhancing activities are part of a continued process including review of taxiway and runway design.
- **System-wide information management** (including AIS/MET to AIM) and the transition from AIS to AIM are ongoing activities. Web-based information of Aeronautical Information Publication (AIP), Notice to Airmen, AIC and AIP Supplement are implemented.
- **Human resource management, contingency and quality and safety management:** The ATM system with the developed staffing plans and training activities has further reduced staff vacancies. Contingency plans are established and further developed. The quality management system is enhanced based on ICAO AIM

quality manual and the new ANSP is certified according to ISO standard for QMS. The safety culture is further developed in the organisation and the safety level is considered high.

3.3 LONG-TERM CONCEPT

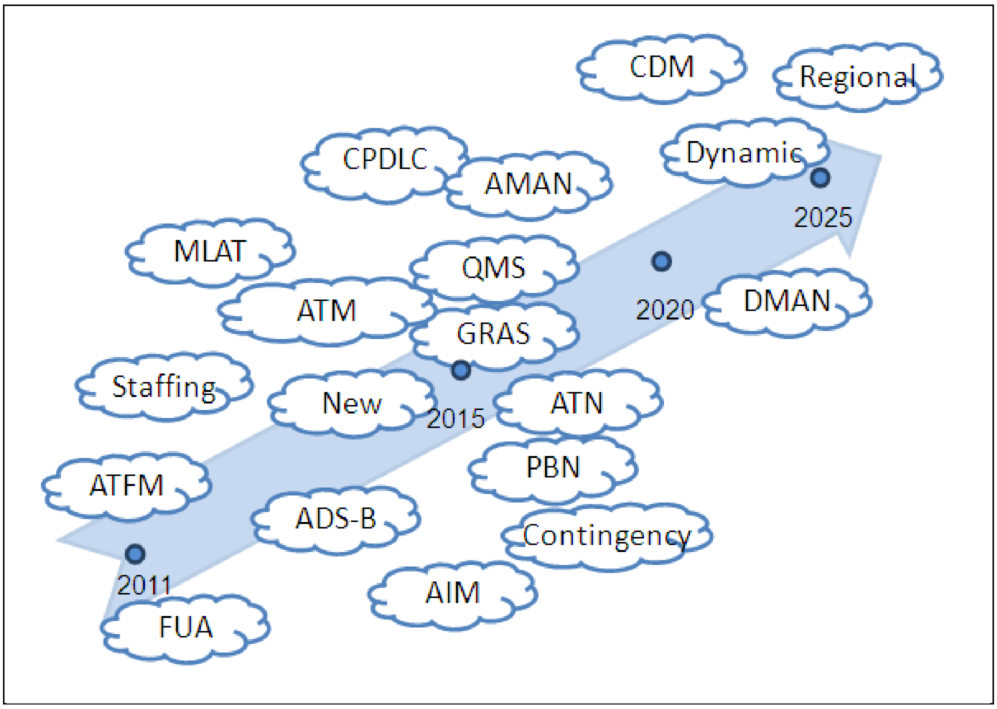
The ATM system has been consolidated in a mature and regulative DGCA and one ANSP. ANSP has moved to a performance based approach where targets for elaborated key performance indicators (KPIs) in each key performance area described in paragraph 2.3, are set, established, monitored and acted upon.

- **Airspace organisation and management**: All Indonesian and neighbouring airspace is organised in a flexible and dynamic way, meaning that the airspace will be allocated on a timely basis to different kinds of users. Any airspace restriction will only be temporary. Airspace will be able to accommodate dynamic 4-D user preferred trajectories from Jayapura to Jakarta. Fixed PBN (Area navigation/RNP) routes will be published to be used when the user preferred trajectories cannot be accommodated due to military traffic or other airspace constrains. Route structures are no longer based on conventional ground based navigation.
- **Air traffic flow and capacity management**: Indonesian ATFM has been developed in the past 10 years, now being a part of a centralised Flow Management Unit. Demand and capacity balancing is made on a strategic, pre-tactical and tactical stage for the whole South-East Asia using all airspace according to the airspace organisation and management concept. All sectors have declared their capacity values, which may vary due to military traffic, weather conditions etc. All traffic movements from gate-to-gate are part in this assessment concerning available capacity versus the demand. Technical support tools have been developed for this mission so the airspace can be used equitable for all users at an optimum level. To a large extent, traffic can fly their user-preferred trajectories and be provided different alternative routes in a tactical and flexible way.
- **Communication, navigation and surveillance**:
    - *Communication*: A fully deployed Aeronautical Telecommunication Network (ATN) is established and used for many applications like AMHS. Commercial off-the-shelf products are the solutions for data transport.
    - *Navigation* will mainly be performance-based. NDB operations are no longer protected. GBAS regulations are in force and RNP-AR approaches are available at more airports with high landing minima based on conventional landing aids.
    - Conventional radar will be phased out with the exception of independent *surveillance* in busy TMAs and ADS-B will be used as the major surveillance technology. For major APP-units safety nets like STCA are incorporated.
- **Aerodrome**: Jakarta Soekarno-Hatta Airport, Medan, Makassar, Denpasar and Surabaya have increased runway throughput through additional entry and exit locations and improved surface guidance. The airports have increased their surface

surveillance in order to keep up capacity during bad weather conditions. At Jakarta Soekarno-Hatta Airport independent arrivals/landings to both the parallel runways have been normal procedures for many years. Standardised procedures for separation between departures on one runway and arrivals on the other are in operation. Five major airports in Indonesia are categorised as Eco- or Green airports and more are in the pipeline. A standardised procedure for continuous descent approaches is used frequently in daily operations. The departure manager at those airports reduces the taxi times and therefore also noise level and gaseous emissions.

- **System-wide information management**: The transition from AIS to AIM is an ongoing activity according to the ICAO Roadmap.
- **Human resource management, contingency and quality & safety management**: Sufficient ATM staff is available with the right skills, competencies and means to discharge their responsibilities and deliver the expected volume and quality of ATM service. A KPI is established, monitored and acted upon. Contingency plans are established and further developed. KPI for safety are established, monitored and acted upon.

Figure 9: Indonesia ATM visions



CHAPTER 4: FUTURE TRAFFIC DEMAND

Several forecasts have been performed for the future growth of Indonesian civil aviation during the last couple of years. LFV Aviation Consulting developed an air traffic forecast for Indonesia in August 2010, however this did not account for increased demand as a result of the implementation of Open Sky agreements. As part of the on-going Open Sky project a forecast was developed by Mott MacDonald in April 2011 that accounts for Open Skies effects. The results from these studies are used as the basis for many of the activities in this Master Plan. The forecasts indicates an annual passenger volume of 320 million (LFV) and 358 million (Mott) respectively in 2025 in an unconstrained environment. The difference can be justified by the fact that 2010 traffic data was fully available in the later forecast. With Open Skies effects, the total passenger volume is expected to be 16 million more in 2025. Earlier forecasts developed by Swedavia and JICA in 2006 and 2008 have been reviewed but found to be too pessimistic given the last years strong growth. The JICA study in 2008 indicated around 240 million passengers in 2025 at the most.

4.1 LFV AVIATION CONSULTING TRAFFIC ANALYSIS

The strong growth in Indonesian economy can be seen in the high demand for air travel. In an effort to understand traffic growth up to the year 2025, a forecast based on the relationship between gross domestic product (GDP) and passenger volume has been developed using traffic data and economic indicators for the period 2002-2009. Two main forecasts on a nationwide level, one for international and one for domestic passengers, were developed. A forecast on future aircraft movements was developed using the passenger forecast and estimates on future average seating capacity and load factor on typical domestic and international flights. To narrow down the scope of work, it was agreed to focus the study on twelve main airports and the routes between these and the country's main hub at Jakarta. Individual airport forecasts for passengers and movements were developed using the average growth ratios for the nation as a whole derived from the nationwide forecasts. In addition overflying traffic, mainly to and from Australia, has been analysed and forecasted.

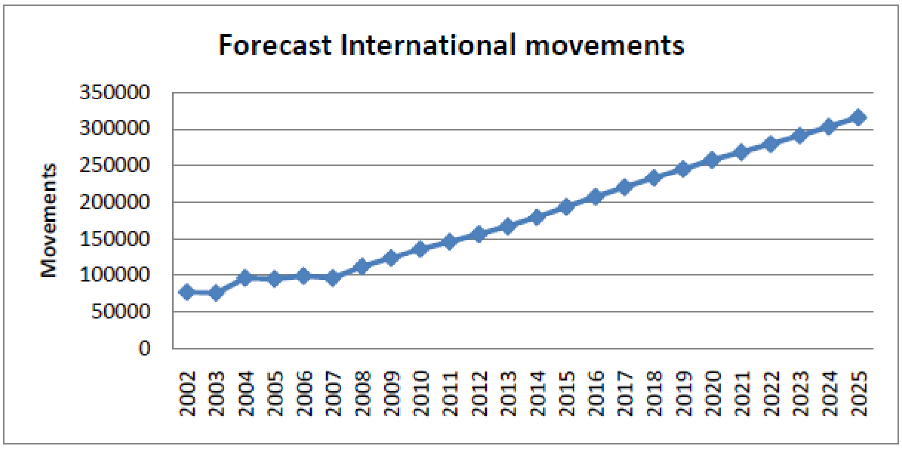
It is evident that Indonesia will face a dramatic increase in air travel over the next 15 years. The traffic forecast indicates that domestic passenger numbers may grow from 82 million in 2009 to 280 million in 2025. International passengers may grow from 16 million in 2009 to over 40 million. This is slightly more than previous forecasts but can be justified by the very high growth in the last years and changes in the aviation market with low cost carriers gaining market shares over traditional legacy carriers. Implementation of Open Sky agreements may boost international traffic by an additional 25 percent according to demand forecasts developed by Mott MacDonald. Of course, there are also many factors that could be negative as well, like higher fuel prices, implementation of taxes on aviation fuel, capacity constraints at airports and in the airspace etc. Having this in mind, the forecast traffic volumes in this report should be taken as estimates only, generally with a possibility of a minus 10 percent to a +5 percent deviation from the main forecast due to the factors mentioned above.

The output of the analysis shows that Indonesia's main gateway at Jakarta Soekarno-Hatta airport could have more than 100 million passengers and 500,000 to 600,000 movements per year in the end of the forecasting period given that the airport can continue to expand unrestricted. The high-density route between Jakarta and Surabaya could be the world's densest route by 2025. Meanwhile over-flying traffic will continue to grow, although at a slower pace more in line with the region as whole. Given the International Air Transport Association(IATA) and the International Civil Aviation Organization's(ICAO) traffic forecasts for the region the number of flights over flying Indonesia could double.

At airport level, the results are very disparate, from capacity problems visible already in the short term - like Jakarta airport mentioned above - to more easily handled growth at Tarakan and Jayapura. Certainly, at Jakarta, a third and fourth runway or a second airport may be needed to accommodate unconstrained growth.

Concerning forecast for air traffic movements, figures 7-9, below give a clear indication of expected future traffic growth that will have a substantial impact on requirement for air traffic management (ATM) development in Indonesia.

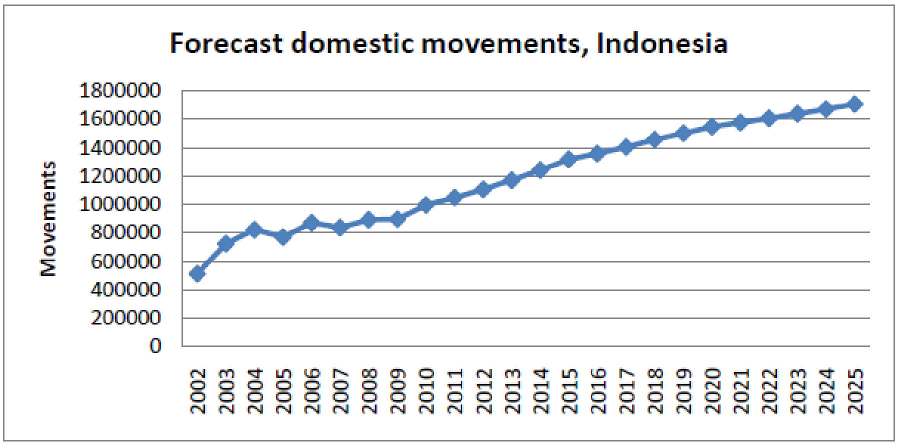
Figure 10: Forecast international movements



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting August 2010

The LFV forecast indicates almost 200,000 international movements by 2015, more than 250,000 international movements by 2020 and by 2025 Indonesia will have more than 300,000 international movements.

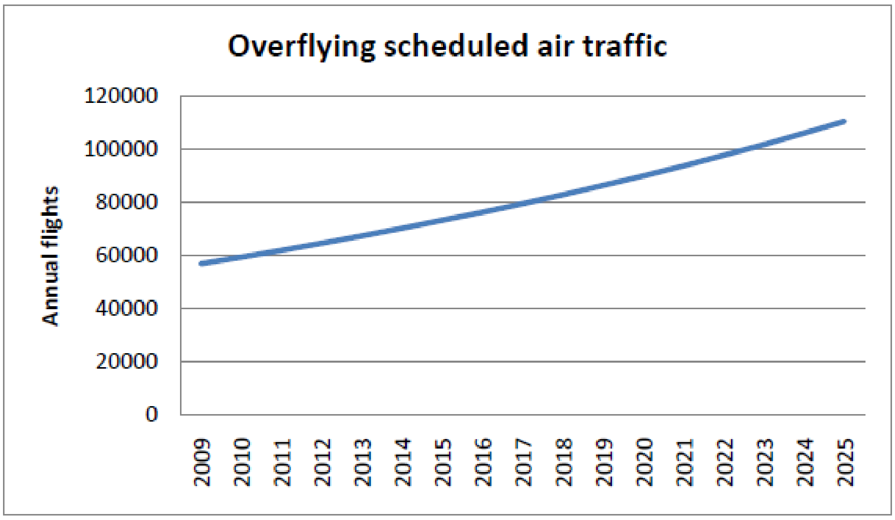
Figure 11: Forecast domestic movements



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting August 2010

The LFV forecast indicates more than 1.3 million domestic movements by 2015, almost 1.6 million domestic movements by 2020 and by 2025 Indonesia will have more than 1.7 million domestic movements.

Figure 12: Forecast overflying scheduled traffic



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting August 2010

The traffic growth of the overflying scheduled traffic over Indonesia indicates an annual traffic growth of approximately 60,000 movements during 2010 rising to approximately 115,000 movements in 2025.

Possible capacity constraints appearing before 2025 are likely to be well known and required action to meet the expected traffic growth can be determined fairly easily. In contrast, this is not the case at route level. The airspace situation is scrutinised at length in the ATM report (deliverable 2) where it became clear that huge investments are required for other reasons than the sheer traffic growth. Required actions concerning airspace, given limited funds, are more complicated to pinpoint and expected traffic growth is far from the only determinant.

4.2 FINDINGS FROM ASEAN OPEN SKY STUDY

The status of Indonesia in relation to the ASEAN Open Sky Policy is, according to the report *National Strategy for the implementation of ASEAN Open Sky policy*, currently as follows:

So far Indonesia has yet to ratify the two agreed ASEAN multilateral agreements, i.e. the multilateral agreement on the full liberalisation of air freight services and the multilateral agreement on air services. The latter will bring a gradual relaxation of traffic rights ahead of the full liberalisation of passenger services. The multilateral agreement on the full liberalisation of passenger services has been agreed upon and will commence during 2015. The agreement will mean the liberalisation of third[1], fourth[2] and fifth[3] freedom traffic rights between international airports within the ASEAN region.

Indonesia has the largest population and GDP in the ASEAN region. The nation has 42 percent of ASEAN land area, 39 percent of the population, 37 percent of the GDP and 94 percent of the average GDP/capita (the average is about 2500 USD). Indonesia has a 24 percent share of the ASEAN aircraft fleet and 21 percent of the available seat capacity, indicating Indonesian airlines use smaller aircraft than those operating in Thailand, Singapore and Malaysia. Jakarta Soekarno-Hatta Airport was the third largest airport in 2009 in the region as regards passengers and is expected to overtake Singapore in 2010.

According to Ministerial Decree there are four airport classifications. 29 airports fall in the international category and five of these are designated as “Utama” or major airports. They are also designated international in the Open Sky concept (see below).

[1] The right or privilege, in respect of scheduled international air services, granted by one State to another State to put down, in the territory of the first State, traffic coming from the home State of the carrier.

[2] The right or privilege, in respect of scheduled international air services, granted by one State to another State to take on, in the territory of the first State, traffic destined for the home State of the carrier.

[3] The right or privilege, in respect of scheduled international air services, granted by one State to another State to put down and to take on, in the territory of the first State, traffic coming from or destined to a third State.

- Jakarta Soekarno-Hatta Airport, ranked by ACI as the 23rd largest airport in the world. In 2009 it had 273,000 aircraft movements, an increase of 9.1 percent compared with 2008. Reported passenger load was 269 percent of capacity in 2009
- Bali - Ngurah Rai reported 122 percent passenger overload
- Surabaya – Juanda reported 194 percent passenger overload
- Medan - Polonia reported 551 percent passenger overload
- Makassar - Sultan Hassanuddin reported 82 percent passenger overload

The MoT website lists a total of 201 airports in Indonesia.

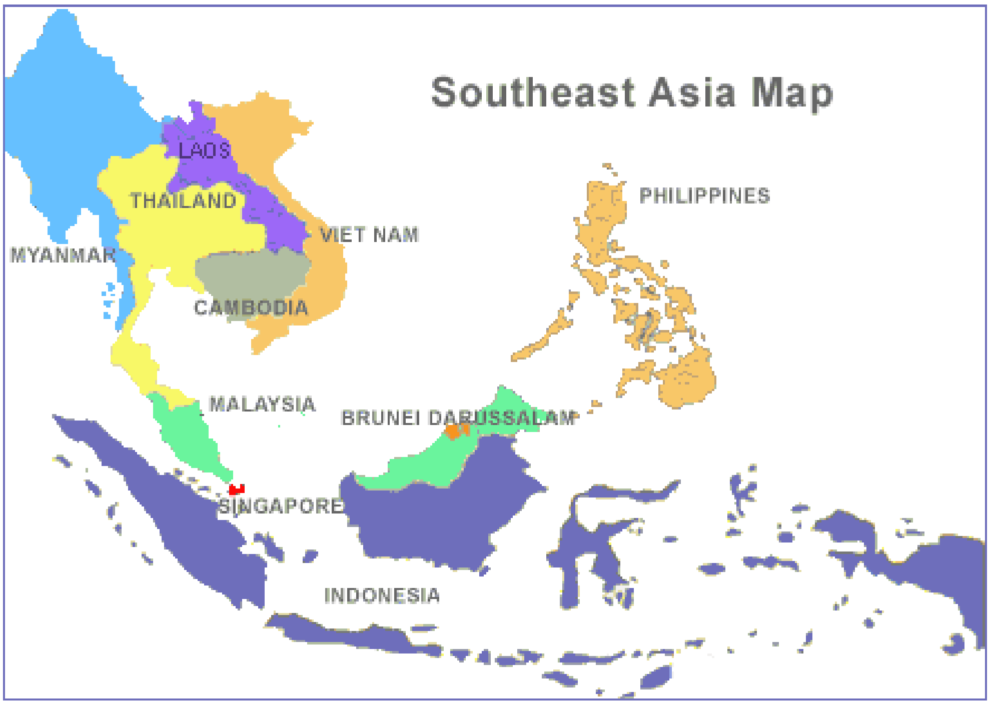
- PT Angkasa Pura 1 manages 13 airports and PT Angkasa Pura 2 manages 12 airports
- 23 airports are managed by State-owned enterprises
- 164 airports are managed by the UPT, a technical implementation unit under the management of the Directorate General of Civil Aviation (DGCA)

In relation to Open Sky requirements, the Indonesian ATM is not meeting international standards. Ground-based surveillance coverage over oceanic areas is not sufficient due to natural reasons and automatic dependent surveillance-broadcast (ADS-B) surveillance implementation is not ready. One reason is that aircraft fleet equipage is not ready and another reason is lack of regulations and an operational concept stating the future separation standards required to accommodate at least 800 additional aircraft, which are planned to be added to Indonesian airlines within a five-year period. In addition, should the ASEAN Open Sky be implemented by 2015, a number of additional flights from adjacent ASEAN states will be eligible to fly in the Indonesian airspace.

Where Open Sky treaties have been implemented in other parts of the world, experiences show accelerated market growth. In particular, states like Indonesia with a large domestic market and large local aircraft fleet provide the best basis for a positive approach to an Open Sky regime. Therefore it is the opinion of LFV Aviation Consulting that this regime will be implemented in this region, including Indonesia. As a preliminary step toward ASEAN open skies by 2015, it is expected (according to the Centre for Asia Pacific Aviation [CAPA]) that airlines from the ten member countries will be permitted to operate unlimited frequencies between capital cities in this grouping.

Between 2005 and 2009, annual aircraft movements in Indonesia increased from around 865,000 to 1017 million, a growth of almost 18 percent. Annual growth rate was 6.8 percent for international traffic and 3.8 percent for domestic. By 2009 the share of domestic aircraft movements was 88 percent. Open Sky will lead to requirements for more flights crossing Indonesian airspace, demand for more direct and flight-efficient air traffic services (ATS) routes and significant investment in the Indonesian ATM infrastructure.

Figure 13: Map of ASEAN member states

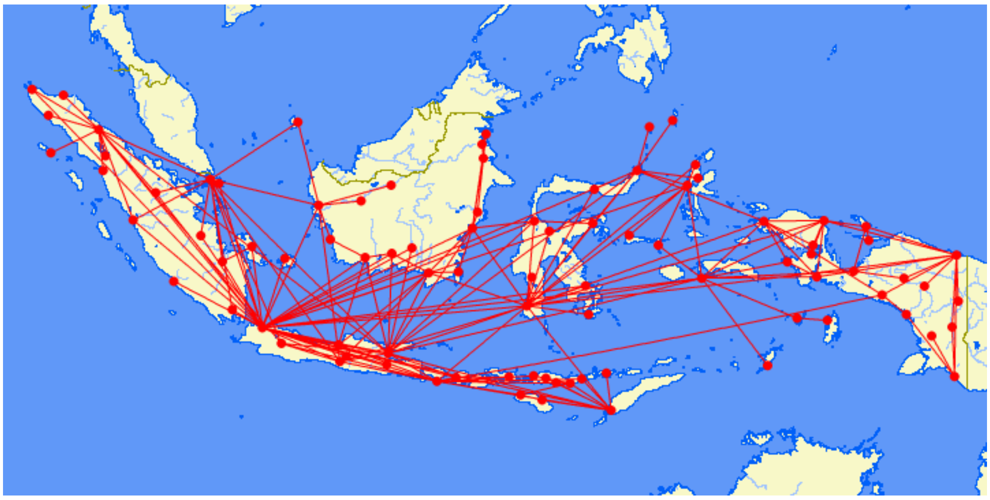


Source: ASEAN Open Sky report

4.3 ROUTE LOAD

A challenge for ATM is that the traffic distribution in terms of movements is heavily skewed towards a small number of routes like Jakarta - Surabaya and Jakarta - Bali in domestic traffic and Jakarta - Singapore/Kuala Lumpur in international traffic.

Figure 14: Scheduled air traffic route network as of December, 2010



Source: DGCA. Map: www.gcmap.com.

The expected aircraft movements on 10 selected city-pairs in 2010 and 2025 are illustrated below. Those forecasts shows that peak hour traffic at Jakarta will most likely exceed available capacity when the Open Skies concept is implemented during 2015. The traffic movements at peak hours in Bali (Denpasar) are expected to increase from 25 movements per hour to 45 movements per hour 2010-2025.

Traffic forecast for city-pair Jakarta-Surabaya will increase from currently 25,000 annual movements to approximately 47,000 movements. Currently the ATS Routes between this city-pair is considered very busy. Additional traffic growth impacted by the implementation of the Asean Open Skies regulations are in the LFV Aviation Consulting forecast set to approximately 5 percent.

Figure 15: Annual aircraft movements between selected city-pairs in 2010

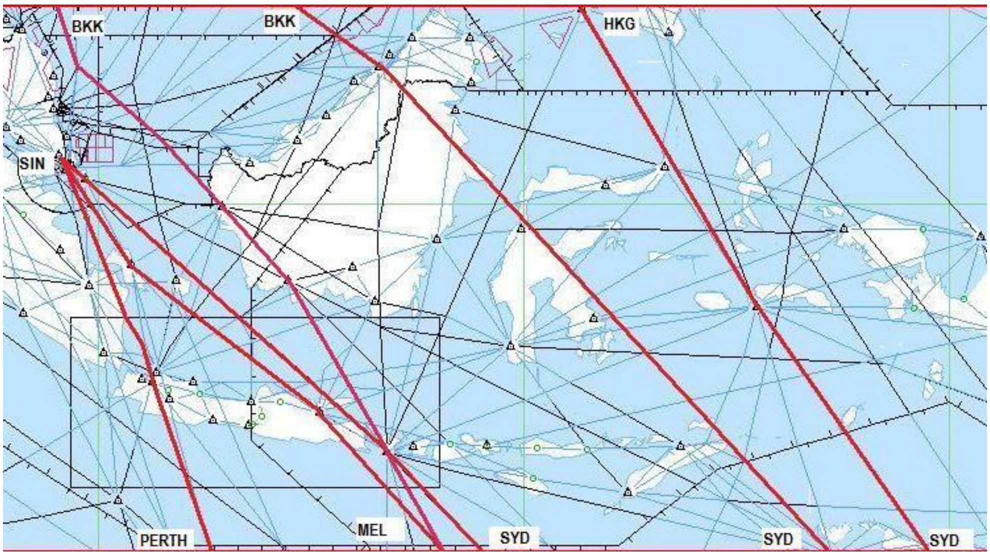
Source: Consultant report

Figure 16: Forecast aircraft movements between selected city-pairs in 2025

Source: Consultant report

Overflying air traffic is dominated by scheduled air services to/from Australia with typical routings as shown in figure below. Overflying traffic has been forecast to grow in line with ICAO’s general growth forecast for the Asia Pacific region. This will mean almost a doubling of scheduled overflying traffic in 2025 compared to today.

Figure 17: Typical routing of overflying traffic between major city-pairs



Source: Consultant report

A challenge for ATM is that the traffic distribution in terms of movements is heavily skewed towards a small number of routes like Jakarta-Surabaya and Jakarta-Bali in domestic traffic and Jakarta-Singapore/Kuala Lumpur in international traffic.

4.4 REGIONAL ATM STATUS AND DEVELOPMENT.

ICAO's regional office in Bangkok for the Asian-Pacific Area has been proactive in promoting and encouraging participating states to develop future ATM/communications, navigation and surveillance concepts in a feasible and practical way. Singapore and Australian ATM communities, generating a lot of the traffic into/from Indonesia, can be regarded as the forerunners in implementing new ATM technology in the area. The South East Area ADS-B Working group (ICAO sub-group) developed in 2010 a draft roadmap for implementation of ADS-B in the South China Sea area. The project involves ADS-B data and VHF communications sharing among the air navigation services providers of Indonesia, Singapore and Vietnam. Participating States have been urged to expedite approval of the project.

A cost-benefit study conducted by IATA and others for the initial phase of ADS-B implementation over the South China Sea area indicates a strong business case for the project and identifies annual economic saving of over US$ 4 million. It would also provide for environmental savings of about 10 million pounds of CO_2 emissions arising from reductions in airborne and ground delays.

ICAO states that although more than 70 percent of all aircraft are equipped to fly in an ADS-B airspace, it is unlikely that all aircraft will have homogeneous avionics. This situation will persist during the coming transition period. Ground systems must therefore be capable of coping with a heterogeneous set of aircraft capabilities, local system sophistication, etc., while still providing the required quality of service. In some airspace, priority may be given to more suitably equipped aircraft. This will provide economic benefits to operators of certified aircraft and in turn encourage airlines to modernise their fleets more quickly in order to reap the benefits afforded by ADS-B. There are common regulatory issues, such as flight standards and certification, and each state will have to resolve these issues to ensure regional/global harmonisation.

In addition, Australia and Indonesia have established an ADS-B data sharing programme to improve safety and efficiency at the boundaries between Brisbane and Ujung Pandang FIRs. Australia is providing data from two ground stations and Indonesia Merauke and Saumlaki. The objective of the projects was to share ADS-B data to provide situational awareness and support improved aviation safety. Brisbane has implemented operational procedures for this ADS-B implementation, while Indonesia is preparing necessary regulations, before operations can start. These projects are all excellent examples of regional collaboration in the deployment and use of this promising new technology.

ADS-B has - according to ICAO - well demonstrated its capabilities and unparalleled characteristics compared with existing surveillance technologies. Implementation of ADS-B data-sharing between states to enhance flight safety is encouraging but will require regional collaboration and further cooperation and coordination between stakeholders. The role of ADS-B in achieving ICAO's envisioned Global ATM System should not be under-estimated.

Performance-based navigation implementation in the region is planned by an Asia Pacific (APAC) regional Implementation plan that will enhance the airspace organisation and management in the whole region. In the Philippines, a major enhancement in modernizing the ATM system has started. Manufacturer Thales will deploy its latest generation Eurocat ATM system nationwide, together with an integrated digital voice control system, aeronautical information services, automated message handling system, aeronautical telecommunication network router, global navigation satellite system monitoring and meteorological systems. Malaysia, with its two flight information regions Kuala Lumpur and Kota Kinabalu, has almost full radar coverage of the area and provides mostly radar service. Provision of ATS in some airspace blocks has been delegated to Singapore. The Malaysian Aeronautical Information Publication published on the Internet. Required navigation performance 10 airspace exists in the oceanic areas over the South China Sea and over the Bay of Bengal.

CHAPTER 5: AIRSPACE ORGANISATION AND MANAGEMENT

Airspace organisation and management (AOM) comprises the following seven components and associated Global Plan Initiatives:

- Flexible use of airspace (FUA) GPI-1
- Reduced vertical separation minimum (RVSM) GPI-2
- Harmonisation of level systems GPI-3
- Alignment of upper airspace classifications GPI-4
- Dynamic and flexible air traffic services (ATS) route management GPI-7
- Collaborative airspace design and management GPI-8
- Terminal area design and management GPI-10

These Global Plan Initiatives (GPIs) are global to its nature, and for Indonesia they apply to a huge airspace, divided into Jakarta Area Control Centre (ACC) in the west and Ujung Pandang ACC in the east.

Figure 18: Indonesian airspace

Source: Aeronautical Information Publication (AIP) of Indonesia.

5.1 GPI-1 FLEXIBLE USE OF AIRSPACE

The scope of GPI-1 is optimisation and equitable balance in the use of airspace between civil and military users, facilitated through both strategic coordination and dynamic interaction. Related operational concept components are AOM and airspace user operations (AUO). GPI-1 can be achieved through the following strategies:

5.1.1 FUA strategies

Airspace use could be optimised through the dynamic interaction of civil and military ATS including real-time civil/military controller-to-controller coordination. This requires systems support, operational procedures and adequate information on civilian traffic position and intentions.

FUA is based on the principle that airspace should not be designated purely as civil or military, but rather as a continuum in which all user requirements are accommodated to the greatest possible extent. FUA should result in the removal of large areas of permanent or temporary restricted airspace or special use airspace. Where there are continued requirements to accommodate specific airspace uses, blocking airspace of certain dimensions, this should be accommodated on a transient basis. Airspace should be released immediately after the operation requiring the restriction has been completed. As reserved airspace is often established along critical flight paths at national boundaries, greater benefits associated with implementation of FUA will be obtained through inter-state cooperation which may entail regional and sub-regional agreements.

The application of the FUA concept leads to:

- Improved flight economics offered through a reduction in distance, time and fuel burn
- Establishment of enhanced ATS route network and associated sectorisation
- Increased air traffic control (ATC) capacity
- Reduction of emissions
- More efficient ways to separate operational and general air traffic
- Enhanced real-time civil/military co-ordination
- Reduction of ATC workload by simplified airspace structure
- Reduction in airspace segregation needs
- Definition and use of Temporary Segregated Areas (TSA) that are more closely in line with military operational requirements and more generally fulfil specific military requirements in tactical phase

ICAO Doc 4444 Chapter 3 recommends implementation of FUA as one possibility to increase sector capacity in ACC sectors. A legal ground for introduction of FUA is catered for in article 7 in the Aviation Law #1/2009 as well as the elucidation of this article. The implementation of FUA could be done in a number of steps such as implementation of some conditional routes and temporary segregated areas, see proposed short-, medium- and long term activities. The air traffic management (ATM) system should support presentation on the "Air Situation Display" of aircraft and active areas with a pre-notification time, and the voice communication system must permit direct and reliable access between the operational coordination partners, civil and military. Effective application of the FUA concept requires the establishment of three levels of airspace management in Indonesia:

1) **Strategic Level**: A national high-level airspace policy body. This body should be tasked with the reassessment of national airspace, the progressive establishment of new flexible airspace structures and the introduction of procedures for the allocation of these airspace structures on a day-by-day basis. It is also of vital importance to establish adequate real-time civil/military coordination facilities and procedures so as to fully exploit the FUA Concept.
2) **Pre-tactical Level**: The practical application of the FUA Concept relies on a National Airspace Management Cell (AMC) for the daily allocation and promulgation of flexible airspace structures. The dissemination to aircraft operators of the daily availability of non-permanent ATS routes could be a task for a Regional Airspace Data Function or a Regional Flow Management Unit if and when established in the future.
3) **Tactical Level**: The real-time use of airspace allowing a safe separation between civil and military aircraft and activities handled by the operational sectors.

Civil/military cooperation will also:

- Benefit military operations by a greater level of mission completion and increased operational flexibility through increased ATM integration
- Enable efficient use of training areas and improved ability to conduct military exercises
- Improve security coordination
- Improve safety for civil/military aviation
- Reduce environmental impact

Summing up, it will increase flexibility for civil and military aviation use whilst maintaining control for the military.

5.1.2 Airspace structure and procedures

Flexible airspace configuration will be designed to support changes in ATM services according to traffic flows, airspace restrictions and runway configuration at major airports. The FUA concept uses airspace structures that are particularly suited for temporary allocation and/or utilisation. The different airspace structures to be implemented in the short term are designated:

- Conditional routes (CDR)

- Temporary reserved areas (TRA)
- Temporary segregated areas (TSA)

TRA or TSA are established to accommodate civil, military, R&D, training, test flights or activities of a temporary nature which, due to the nature of their activities, need segregation to protect themselves and non-participating traffic. TRA or TSA are established in accordance with national policy and allocated by AMC for specific activities.

A CDR is a non-permanent ATS route or a portion thereof which can be flight planned and used only under certain specified conditions. CDRs permit the definition of more direct and alternative routes by complementing and linking to the existing permanent ATS route network. CDRs are non-permanent parts of the ATS route network published in Aeronautical Information Publication (AIP) and can be divided into different categories according to their estimated availability and flight planning possibilities. The authorities in Indonesia could in a collaborative decision evaluate whether one or more categories of CDR should be implemented in Jakarta and/or Ujung Pandang area of responsibility (AoR) and state the conditions and rules for use:

- CDR 1: Available for flight planning
- CDR 2: Closed during military exercise hours but can be available for flight planning even during mil time. Information is available at 1400 UTC on the day before the flight.
- CDR 3: Not available for flight planning during military exercise hours. Can be used tactically by ATC

Two different types of airspace reservation can be established, considering the activity that would take place associated with the transit possibility:

- TRA is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily reserved, by common agreement, for the specific use by another aviation authority allowing other traffic to transit.
- TSA is a defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily segregated, by common agreement, for the exclusive use by another aviation authority and through which other traffic will not be allowed to transit.

5.1.3 FUA short-term activities

1) AOM-1: Implement a high level body of Directorate General of Civil Aviation (DGCA) and military counterparts.

It is recommended that DGCA take the initiative together with Indonesian Armed Forces to form this body and to establish a project team including the air navigation services provider (ANSP) and other main stakeholders. A legal ground for introduction of FUA is catered for in article 7 of the Aviation Law #1 2009 as well as the elucidation of this article. This high level body should determine the ToR and give sufficient mandate and responsibilities to project teams for the FUA implementation.

2) AOM-2: Implement a first step of the FUA concept.

The project team (civil/military working group) could in a collaborative decision evaluate if one or more categories of CDR should be implemented in Jakarta and/or Ujung Pandang AoR and state the conditions and rules for their use. A first step should contain implementation of few high priority CDRs as described above. Implementation of a few TRA and TSA should also be considered. A number of CDRs should then be published and used whenever the military activity permits.

3) AOM-3: Introduce an AMC function for pre-tactical airspace allocations.

In order to use the airspace in an efficient way by civil and military users, enabled through the implementation of a FUA concept, there should be an AMC. It should be a function within Jakarta or Ujung Pandang ACC and manned by the selected centre´s operational supervisor or flow management position controller in cooperation with a military partner in the first and limited implementation step. Manning of a separate working position should be planned for the next step. This function will act as a focal FUA-point and ensure there is a more effective sharing of airspace through joint civil/military strategic planning and pre-tactical airspace allocation. AMC should have both civil and military competence and mandate.

4) AOM-4: Establish direct speech facilities between the respective ACC and military counterparts for tactical co ordinations.

Tactical level refers to real-time use of airspace allowing a safe separation between civil and military aircraft and activities and handled by the operational sectors. It is very important to grant reliable and fast speech facilities direct between the workstations concerned. This could be dedicated lines or PSTN depending on the access time.

5.1.4 Medium-term activities

5) AOM-5: Establish required CDR, TRA and TSA.

DGCA should in a dialogue with the military authority and ASNP initiate the work to develop and establish required CDRs and if found necessary TRAs and TSAs. When more CDRs, TRAs and TSAs are established and utilised, one or several of the following benefits accrue:

- Better traffic distribution
- Increase in overall ATC capacity
- Improved flight economics
- Reduced emissions

This is considered to be a prerequisite to accommodate increased demand in an Open Sky scenario.

6) AOM-6: Further develop the FUA concept by establishment of new airspace structures including new TRAs and TSAs.

DGCA should initiate work together with military authority and ANSP to further develop and create enhanced capacity if deemed needed in the Open Sky scenario and consider additional TRA or TSAs allocated by AMC for specific activities.

5.1.5 Long-term activities

7) AOM-7: Additional steps of FUA implementation could be taken pending earlier development.

The different airspace structures to be considered for long-term implementation are called:

- Cross-border areas (CBAs)
- Prior coordination airspace
- Reduced coordination airspace
- Free route airspace

Cross border operations can be seen as a visionary goal. A CBA is an airspace reservation (TSA or TRA) established for specific operational requirements over *international* boundaries. Political and military agreements between the states concerned are required prior to the establishment of a CBA. Formal agreements for the establishment and use of CBA have to address issues of sovereignty, defence, legality, operations, the environment and search and rescue.

CBA will also provide airspace users the possibility to flight plan a user-preferred routing in a free route airspace scenario, i.e. is a part of the key performance area environmental sustainability.

5.2 GPI-2 REDUCED VERTICAL SEPARATION

The scope of reduced vertical separation minima, RVSM, is the optimisation of airspace utilisation and enhancement of aircraft altimetry systems. Related operational concept components are AOM and conflict management (CM).

5.2.1 RVSM strategies

RVSM reduces vertical separation to 1000 ft above Flight Level (FL) 290 up to FL 410 from the current 2000 ft, thereby providing six additional levels. The manual on implementation of 1000 ft RVSM, International Civil Aviation Organisation (ICAO) Doc 9574, provides specific guidance. A great deal of experience has been gained with RVSM, and all necessary standards and recommended practices material are available to support implementation.

5.2.2 Short- and medium-term activities

Suggested short-term activities are as follows:

8) AOM-08: Update AIP to include RVSM status

The present AIP supplement from 2003 is not updated and should be updated by DGCA.

9) AOM-09: Presentation of RVSM status in ATC system

The replacement of Jakarta Advanced Air Traffic Control System (JAATS) Indonesian ANSP should have the possibility to show, in label, the RVSM status of the aircraft. This feature should also include the Makassar Advanced Air Traffic Control System.

There is only one medium term recommendation:

10) AOM-10: Reduce the use of repetitive flight plans (RPLs)

Indonesian ATM should consider a gradual change of the use of RPLs. One of the reasons is to enhance the Australian Airspace Monitoring Agency's capability to identify non-RVSM approved operators and to facilitate the height-keeping performance monitoring service. Another reason is that there is most likely some inertia in initiating necessary updates of an RPL, like e.g. aircraft change and therefore the actual flight plan becomes at fault. Responsible for this implementation is DGCA.

No long-term actions are deemed necessary.

5.3 GPI-3 HARMONISATION OF LEVEL SYSTEMS

The scope of this harmonisation is the adoption by all states of the ICAO FL scheme based on feet as contained in Appendix 3 to Annexe 2 in ICAO Rules of the Air. Related operational concept components are AOM, CM and AUO. As Indonesia as well as adjacent centres are fully compliant with the ICAO Flight Level scheme, no activities are deemed necessary.

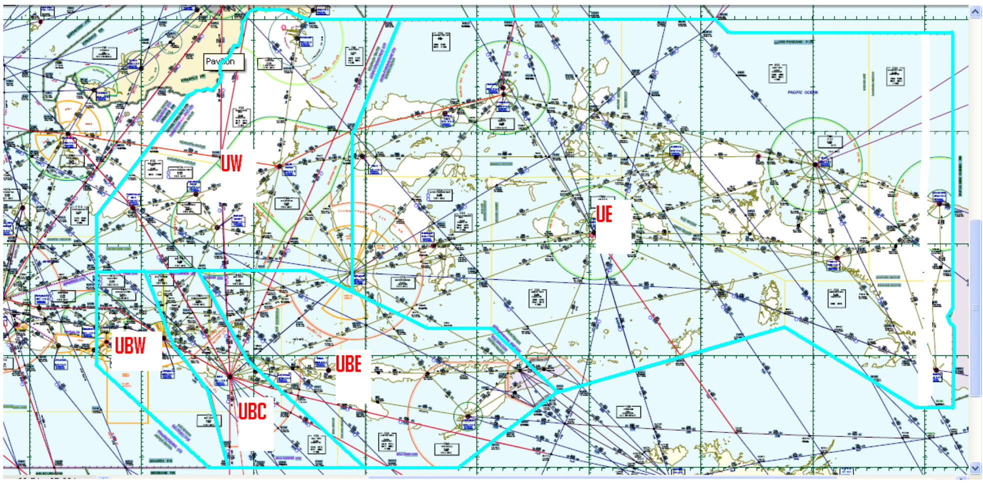
5.4 GPI-4 ALIGNMENT OF UPPER AIRSPACE CLASSIFICATIONS

The scope of this GPI is harmonisation of upper airspace and associated traffic handling through application of a common ICAO ATS airspace class above an agreed division level. Related operational concept components are AOM, CM and AUO.

5.4.1 Alignment strategies

To the extent possible, airspace should be structured as a continuum, free from operational discontinuities, inconsistencies and differing rules and procedures. Alignment of airspace classifications can help to achieve this goal. It would also facilitate the introduction and better utilisation of data link communications, improved flight plan processing systems, and advanced airspace management (ASM) coordination tools and message exchange capabilities, leading to progressively more flexible and dynamic management of airspace. Airspace classifications should be harmonised intra-regional and, where possible, across several regions.

Figure 19: Upper ACC sectors in Ujung Pandang FIR



Source: AP 1

Air transport and most business aircraft operations should be contained within airspace where positive ATC services are provided to all aircrafts, i.e. Class A to D. ATM provided in various airspace volumes should be based on the ICAO airspace classification system from A to G as defined in Annexe 11 Air Traffic Services. These classifications should be implemented on the basis of a safety assessment, taking into account the volume and nature of air traffic.

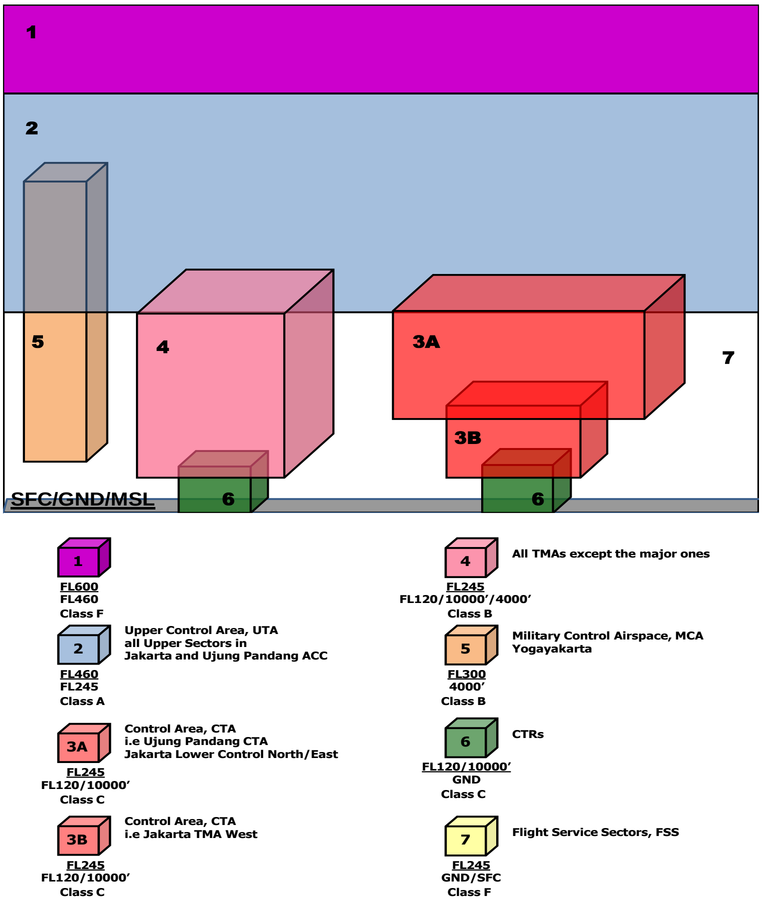
Indonesian airspace is designated in accordance with ICAO airspace classification as follows:

- Class A: Controlled airspace between FL245 and FL460 and designated as a CTA and Upper Control Area

- Class B: Controlled airspace within the limits of all control zones (CTRs)
- Class C: Controlled airspace within all terminal control areas (TMAs) and TZs where aerodrome control service is provided; VFR speed limitation is 250 KIAS below 10,000 feet
- Class F: Uncontrolled airspace from ground to unlimited designated FIR, Upper Flight Information Region (UIR) and Flight Information Service Sector; in addition, the class F applies to airspace above an aerodrome where AFIS is provided and unattended aerodromes; IFR and VFR speed limitation is 250 KIAS below 10,000 feet
- Class G: Uncontrolled temporary airspace designated for special purposes; IFR and VFR speed limitation is 250 KIAS below 10,000 feet

Class B: Airspace within most ANSPs is primarily reserved for very high density aerodromes serving medium to heavy jet traffic. A separation requirement between all aircraft creates a higher workload for ATC. For some airports in Indonesia, Class C airspace could be quite sufficient.

Figure 20: Airspace classification



Source: compiled from DGCA maps.

5.4.2 Short-term activities

11) AOM-11: Review airspace classes with regard to forecasted traffic growth

Will the present airspace classification be optimal for the forecast for traffic growth? DGCA should at an early stage review the airspace classification, considering future traffic scenarios and involving consultation with stakeholders like aerodrome operators, airlines, military operators, the ANSP concerned and other users.

12) AOM-12: Review the actual need for airspace class B at some airports

Currently class B airspace applies at some Indonesian aerodromes (Indonesian AIP). This airspace calls for separation between all aircraft which creates a higher ATC work load than perhaps required if e.g. class C airspace had been sufficient. DGCA should analyse this airspace classification to identify possible safety effects following a change to class C and also measure ATC workload improvement, which means additional ATC capacity. Note: This recommendation concerns lower airspace classification and has intentionally been placed here.

13) AOM-13: Review, by means of traffic modelling, whether the present division of FL 245 between class A and F airspace will be sufficient for forecast growth

DGCA should review, in a consultation with stakeholders, whether present division of airspace between upper controlled area and lower uncontrolled area will provide sufficient safety if the forecast major domestic air traffic growth materialises. This analysis should be based on a traffic modelling scenario where future traffic growth is included.

14) AOM-14: Review and adapt the number of Flight Service Sectors to an appropriate number for optimum capacity

Any change should be based on the outcome from AOM-12. See also earlier recommendations from JICA report 2008 to reduce the 10 sectors to 4 in Ujung Pandang FIR. A review based on an analysis of current flight service sector (FSS) organisation and work load for operators in all of Indonesian airspace should be carried out under DGCA auspices. A re-sectorisation of lower airspace, ATZ, CTR,TMA and inclusively FSS within Ujung Pandang FIR became effective on 7 April 2011.

15) AOM-15: Review and adapt ACC/Approach Control sector design reflecting future traffic growth and user requirements

Indonesian ANSP should make an analysis of how the airspace sectorisation should be designed for optimal accommodation of forecast traffic growth. The analysis should be based on traffic modelling for different traffic growth scenarios.

5.4.3 Medium-term activities

16) AOM-16: Review the airspace classification, based on user needs

The air traffic in Indonesia is expected to grow substantially in the medium-term horizon. DGCA should, based on user needs, perform a renewed analysis of possible drivers for change. This professional review should be conducted by DGCA airspace experts with due consideration to AOM-12 and 13, providing a result based on the future airspace users requirement.

There are no long-term recommendations in this field.

5.5 GPI-7 DYNAMIC AND FLEXIBLE ATS ROUTE MANAGEMENT

The scope of GPI-7 is the establishment of a more flexible and dynamic route system based on navigation performance capability and aiming at accommodating preferred flight trajectories. Related operational concept components are AOM and AUO.

5.5.1 Strategies

The implementation of an ATS route structure preventing aircraft congestion points and implementation of an ATS routing environment enabling airspace users to operate along preferred and dynamic flight trajectories will increase capacity and aircraft operating efficiency. Area navigation (RNAV) routes are not restricted to the location of ground-based aids and provide benefits to aircraft operators and the ATM system. All modern aircraft are RNAV capable, and efforts should be made to design and implement RNAV routes. However all Indonesian aircraft fleet is not yet RNAV capable, even if the new acquisitions are, which put some time constraints on full RNAV implementation.

Dynamic route management involves the aircraft in the planning process. Typical scenarios include the generation of change-of-routing requests by the dispatch functions of the aircraft operators, the processing and approval of these requests by ATS providers and transmission of the change-of-routing approval to the aircraft. Advanced scenarios foresee the aircraft making requests directly to ATS providers who would process and modify the request if necessary and then forward the approved route to the aircraft and affected service providers.

Random routing, strategic or pre-tactical, can be flight-planned in certain defined areas within which fixed routes can be suspended on a temporal basis and where aircraft can determine an appropriate track from an entry point to an exit point. In some European states upper ATS routes have been permanently suspended for the benefit of user preferred routing. User-preferred routes utilise the capability of aircraft operators to determine optimum tracks, based on a range of flight parameters. In accordance with this concept, ATS routes or tracks would not be fixed to pre-determined routes or waypoints, except where required for control purposes, however, trajectories would be available to ATM staff. Routing requests are generated by the airspace user or their dispatch functions and submitted to the ATS provider for approval or renegotiation if a conflict arises. Advanced scenarios would have the aircraft making requests directly to ATS providers who would process and modify the request if necessary and then forward the approved route to aircraft.

5.5.2 Short-term activities

17) AOM-18: Establish a Change Manual for airspace processes

There is currently no manual describing how to create or amend airspace and ATS routes. Such instructions are essential, in particular when new staff is undertaking these tasks. DGCA should involve stakeholders in developing such a manual.

18) AOM-19: Establish a process to review the need for future routes and withdrawal of unused routes

DGCA together with Indonesian ANSP and airspace users should establish an airspace forum as part of a process where requirements for new routes are on the agenda and where unused or low-use routes can be withdrawn.

19) AOM-20: Review current airspace design and develop an airspace plan

A review of present design should take into consideration forecast traffic growth, including possible effects of the ASEAN open skies regime. The plan should include transformation of conventional route structures to performance-based navigation (PBN)-based structures, where required navigation performance should be taken into account. The national airspace plan should also consider the future needs for one-way route structures as well as any other route concept. DGCA should in this review include participation from ANSP and Airspace User.

20) AOM-21: Establish prioritised PBN routes according to user requirements as a complement to conventional ATS routes

As a frontrunner to a total transformation of ATS routes to be based on higher precision required navigation performance (RNP) than the conventional ATS routes can provide, some highly prioritised PBN routes should be established by DGCA.

21) AOM-22: Implement a one-way route structure

Dependent on the outcome from AOM-20, one-way routes should be implemented by DGCa to increase overall ATC capacity where complexity is high with opposite descending and climbing traffic, and also when there is a significant interaction between different aircraft categories, e.g. jets and non-jets. One-way routes improve safety and offer environmental benefits when facilitating for continuous climb and descent. Routes joining TMAs should join feeder-fixes instead of terminating at the airports.

22) AOM-23: Select ATS route designators according to ICAO Annexe 11 Appendix 1

Route designators and names of significant points (way-points) shall be selected after consultation with ICAO Regional office by DGCA.

5.5.3 Medium-term activities

23) AOM-24: Implement PBN according to ICAO Asia Pacific (APAC) short term PBN schedule

The table below shows ICAO short term APAC Regional recommended PBN implementation plan for the Asia Pacific region. The implementation schedule is not feasible for Indonesia in the short term, which is why it appears under medium-term activities. Indonesian ASM will initially need to focus on an operational concept based on mainly conventional navigational aids the years ahead in order to accommodate for the annual growth of traffic. Consultation with ANSP and all Airspace Users is a prerequisite for a successful implementation.

Table 8 ICAO APAC short-term implementation plan (2008-12)

Airspace	Preferred Nav. Specifications	Acceptable Nav. Specifications
Route – Oceanic	RNP 4	RNAV 10
Route – Remote continental	RNP 4	RNAV 10
Route – Continental en-route	RNAV 2, RNAV 5	

Source: ICAO APAC Regional PBN implementation plan

24) AOM-25: Develop a concept for user preferred routes

This concept consists of flexible flight routings based on user requirements. The airspace organisation and management should include a larger part of free route airspace, where the airspace users are eligible to plan direct tracks above a certain flight level. During stakeholders participation in Working Groups described in section 1.2, it was agreed upon that this concept should be initiated in the medium term. Consultation with ANSP and airspace users is a prerequisite for a successful implementation.

5.5.4 Long-term activities

25) AOM-26: Establish a task force reviewing delegation of ATS to other states in accordance with Aviation Law No 1.

Cooperation within Indonesian authorities as well as Singapore and Australia is needed in order to develop an efficient solution. Political issues regarding delegation of ATS need to be solved prior to any change.

26) AOM-27: Implement PBN according to ICAO APAC medium term PBN schedule

This table below shows ICAO APAC Regional recommended PBN implementation plan in the medium term in Asia Pacific region. The implementation schedule is not feasible for Indonesia in the medium term. Indonesian ASM will during the long term implement the ICAO APAC Regional PBN Plan intended for implementation in the medium term. Consultation with ANSP and Airspace Users is a prerequisite for a successful implementation.

Table 9 ICAO APAC medium-term implementation plan (2013-16)

Airspace	Preferred Nav. Specification	Acceptable Nav. Specification
Route – Oceanic	RNP 2**, RNP 4	RNAV 10
Route – Remote continental	RNP 2	RNAV 2, RNP 4, RNAV 10
Route – Continental en-route	RNAV 1, RNP 2	RNAV 2, RNAV 5

Source: ICAO APAC Regional PBN implementation plan

** **Note 2:** Related CNS requirements and operational procedures for RNP 2 application in Oceanic Airspace are yet to be determined.

5.6 GPI-8 COLLABORATIVE AIRSPACE DESIGN AND MANAGEMENT

The scope of uniform airspace organisation and management principles on a global basis is a more flexible airspace design able to accommodate traffic flows dynamically. Related operational concept components are AOM and AUO.

5.6.1 Strategies

Collaborative airspace design and management aim at organising airspace in a cooperative manner involving all users aged to accommodate their preferred trajectories. States and regions should take advantage of aircraft capabilities when designing airspace. In the design and implementation of airspace changes, the fleet capabilities must be taken into account. Furthermore, collaboration with airspace users will identify procedures and/or solutions that make use of available aircraft capabilities.

Other emerging developments such as collaborative decision-making (CDM), the “required time of arrival” function in the aircraft’s flight management system (FMS), the endorsement of the global ATM operational concept and the implementation of data link applications will also allow improved airspace design and management. During an evolutionary period, dynamic airspace management should be applied where significant benefits would be gained. Dynamic ASM comprises integrated decision making and demand-based capacity. Integrated decision making is an extension of the FUA principles to include airspace users in decision-making with respect to tactical assessments and requirements for transit times of special use airspace.

Some aircraft FMS can provide information on estimated time en route for proposed route changes. In addition, data link communication through controller-pilot data link communications (CPDLC), up- and down linking flight planning information, can support deployment of integrated decision making, where aircraft and ground stations are suitably equipped.

5.6.2 Short-term activities

27) AOM-28: Regulation of aircraft capabilities to be PBN- and automatic dependent surveillance-broadcast (ADS-B)-approved using specific airspace

See activities in GPI-7, where participation of airspace users in airspace planning is essential to utilize fleet capabilities. In order to do necessary PBN implementations, DGCA needs to regulate aircraft navigation capabilities from a specific date. This could be sometime during the medium term. Regulations concerning requirement for ADS-B equipment for utilising specific airspace must also be elaborated. The regulations should be in force sometime during end medium term-beginning of long term.

28) AOM-29: Improve CDM concerning airspace where possibility could be to increase the use of CPDLC in ocean and remote airspace

The objectives of CDM are to develop common situational awareness between partners of flight progress in the air and on the ground and to make air traffic more predictable due to timely and accurate shared information. CDM is based on data sharing and also an improvement of the quality of the data exchanged between the users is required. The use of CPDLC is recommended over the ocean and in regions outside of VHF coverage. The replacement of the JAATS system must cater for CPDLC capabilities. CPDLC deployment is the primary means of communication in oceanic and remote airspace where the quality of voice communications is often poor. Established working group 3, concerned with communications, navigation and surveillance issues agreed upon CPDLC as an enabler for communications in ocean and remote areas, which already is a reality in Ujung Pandang AoR. Indonesian ANSP should be responsible for implementation.

5.6.3 Medium- and long-term activities

29) AOM-30: Improve CDM concerning airspace by increasing the use of CPDLC in en route and terminal airspace

CPDLC should be gradually introduced to busier en route and terminal airspace in order to relieve voice communications. See also COM-8. Concerning CDM in general see recommended activity AO-2.

Technical development will widen the options in the long term:

30) AOM-31: Introduce dynamic airspace management, where an integrated decision making in flight is possible

In a future dynamic airspace scenario, the aircraft capability should enable in-flight decisions on how to use available airspace on a tactical basis, thus making the FUA concept even more flexible on a very tactical basis.

5.7 GPI-10 TERMINAL AREA DESIGN AND MANAGEMENT

The scope of this GPI is optimisation of the TMA through improved design and management techniques. Related operational concept components are AOM, aerodrome operations, traffic synchronisation, CM and AUO.

5.7.1 Strategies

There are many ways by which a well-designed and managed TMA can improve safety, capacity and efficiency. TMA design should be implemented uniformly across all TMAs within a state or region to provide benefits while reducing pilot/controller communications and pilot and controller workload. TMA arrival acceptance rates should be based tactically on a CDM process involving tower, TMA and en-route sectors, while strategically involving airspace users, to ensure optimum traffic handling.

The enhancement of TMA management includes:

- Complete implementation of World Geodetic System- 1984
- Design and implementation of optimised RNAV and RNP arrival and departure procedures (see also RNAV and RNP-based navigation GPI-5)
- Design and implementation of RNP-based approach procedures
- Enhanced traffic and capacity management

The implementation of dynamic TMA management procedures may comprise several elements such as dynamic wake vortex detection and mitigation and collaborative capacity management. At locations where a business case supports implementation, decision support tools should be developed and implemented to provide a more structured and efficient management of arrival and departure traffic flows and more efficient use of the runway(s), more fuel-efficient trajectories and reduced noise exposure. In complex terminal areas like Jakarta and Surabaya TMA and some others, separated departure and arrival routes should be established. At crossing points, level windows should be defined to allow aircraft to fly as close as possible to an optimal profile. Guidance is found in the Asia/Pacific Regional Performance-Based Navigation Implementation Plan.

In this sense and as called for under Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) Conclusion 18/53, Indonesia as well as other states shall develop their own national plans for the implementation of PBN in sovereign TMAs. Such national plans should be based on the Asia/Pacific Regional PBN Implementation Plan, seek the harmonisation of the application of PBN and avoid the need for multiple operational approvals for intra- and inter-regional operations. Applicable aircraft separation criteria should also be considered.

5.7.2 Short-term activities

31) AOM-32: Review standard instrument departure (SID)/standard instrument arrival (STAR) requirements for major airports and make necessary new procedures based on PBN as a complement able to cater for continuous descent approaches

As part of this redesign by DGCA, a number of waypoints should be created at an appropriate distance (e.g. 50 NM) to act as feeder-fixes, where one-way route structure should be designed to join at these feeder-fixes. Consultation with ANSP and airspace users is a prerequisite for a successful implementation.

5.7.3 Medium-term activities

32) AOM-33: Implement RNP-AR approaches

This should be done at airports where terrain obstacles lead to high minima for conventional approaches and be carried out on operational test trials.

33) AOM-34 Implement PBN in TMA/APP according to ICAO APAC PBN Implementation Plan (short term)

The table below shows ICAO short term APAC Regional recommended PBN implementation plan for the Asia Pacific region. The implementation schedule is not feasible for Indonesia in the short term, which is why it appears under medium-term activities. Indonesian ASM will initially need to focus on an operational concept based on mainly conventional navigational aids in order to accommodate the growth of traffic. Consultation with ANSP and airspace users is a prerequisite for a successful implementation.

Table 10 ICAO APAC regional short-term PBN implementation plan (2008-12)

TMA – Arrival	RNAV 1 in radar environment and with adequate navigation infrastructure. Basic-RNP 1 in non-radar environment	
TMA – Departure	RNAV 1 in radar environment and with adequate navigation infrastructure. Basic-RNP 1 in non-radar environment	
Approach	RNP APCH with Baro-VNAV in most possible airports RNP AR APCH in airport where there are obvious operational benefits.	

Source: ICAO APAC Regional PBN implementation plan (short term 2008-12)

5.7.4 Long-term activities

34) AOM-35: Continue to develop PBN in TMA/APP according to ICAO PBN Implementation Plan (medium term)

The table below shows ICAO APAC Regional recommended PBN implementation plan in the medium term in Asia Pacific region. The implementation schedule is not feasible for Indonesia in the medium term. Indonesian ASM will during the long term implement the ICAO APAC Regional PBN Plan intended for implementation in the medium term. Consultation with ANSP and airspace users is a prerequisite for a successful implementation.

Table 11 ICAO APAC regional short-term PBN implementation plan

TMA – Arrival	Expand RNAV 1 or RNP 1 application Mandate RNAV 1 or RNP 1 approval for aircraft operating in higher air traffic density TMAs	
TMA – Departure	Expand RNAV 1 or RNP 1 application Mandate RNAV 1 or RNP 1 approval for aircraft operating in higher air traffic density TMAs	
Approach	Expansion of RNP APCH (with Baro-VNAV) and APV Expansion of RNP AR APCH where there are operational benefits Introduction of landing capability using GNSS and its augmentations	

Source: ICAO APAC Regional PBN implementation plan (medium term 2013-2016)

5.8 SUMMARY TIMETABLE

The table below provides an overview of all recommendations within Chapter 5: Airspace organisation and management.

Table 12: Airspace organisation and management activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
Airspace Organisation and Management (AOM)										
1	Implement a high-level body of DGCA and Military Counterparts									
2	Implement a first step of the FUA concept									
3	Introduce an AMC function for Indonesia for pre-tactical airspace									
4	Direct speech between ACC and Mil counterparts									
5	Establish required CDRs, TRA and TSA									
6	Further develop the FUA concept									
7	Additional steps of FUA implementation									
8	Update AIP to include RVSM status									
9	Presentation of RVSM status in ATC system									
10	Reduce the use of RPLs									

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
11	Review airspace classes with regard to forecast traffic growth									
12	Review the requirement for airspace class B categorisation									
13	Review the division of FL 245 between class A and G airspace									
14	Review and adapt number of FSS									
15	Review and adapt ACC/APP sector design									
16	Review the airspace classification based on user needs									
17	Establish a Change Manual for airspace process									
18	Establish a process to review the requirement of future routes									
19	Review current airspace design and develop an airspace plan									
20	Establish prioritized PBN routes according to user requirements									
21	Implement one-way Route structure									
22	Select ATS Route Designators according to ICAO									
23	Implement PBN according to ICAO APAC Regional Plan									

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
24	Develop concept for user preferred routes									
25	Review delegation of ATS to be compliant with Aviation LAW 1									
26	Implement PBN according to ICAO APAC Regional Plan									
27	Regulation of Aircraft capabilities to be PBN and ADS-B approved									
28	Improve CDM concerning airspace									
29	Improve CDM concerning airspace									
30	Introduce dynamic airspace management									
31	Review SID/STAR requirements for major airports									
32	Implement RNP-AR approaches									
33	Implement PBN in TMA/APP according to ICAO APAC PBN									
34	Implement PBN in TMA/APP according to ICAO APAC PBN									

CHAPTER 6: AIR TRAFFIC FLOW AND CAPACITY MANAGEMENT

The scope of Global Plan Initiative 6 is the implementation of strategic, tactical and pre-tactical measures aimed at organizing and handling traffic flows in such a way that the totality of the traffic is compatible with the capacity of the air traffic management (ATM) system. Related operational concepts are airspace organisation and management, aerodrome operations, demand and capacity balancing (DCB), traffic synchronisation, conflict management and airspace user operations.

6.1 STRATEGIES

The implementation of demand/capacity measures, on a regional basis where needed, will enhance airspace capacity and improve operating efficiency and safety. In the event that actual or forecast traffic demand regularly exceeds capacity, with frequent traffic delays, the appropriate ATM units should consider implementing steps aimed at improving the use of existing system capacity and developing plans for future increases. Any such planning to increase capacity should be undertaken in a structured and collaborative manner.

Indonesia should evolve to a collaborative-based approach to capacity management. The Global ATM Operational Concept should envisage a more strategic approach to ATM overall, and through collaborative decision-making less reliance on tactical flow management. It is inevitable that tactical flow intervention will continue to be required; however closer coordination between airspace users and ATM service providers can reduce the need for routine tactical intervention which is often disruptive to aircraft operations.

6.2 CURRENT SHORTCOMINGS

There is no air traffic flow management (ATFM) in operation in Indonesia today, i.e. there is no or limited protection against system overload as well as air traffic controller overload. This fact has a major impact on safety within the ATM domain. Air traffic flow and capacity management (ATFCM) will enable flight predictability, punctuality and efficiency with the emphasis on managing the balance between traffic demand and capacity. It will also maximise the use of available resources and co-ordinate adequate actions in order to increase the level of safety and to maximise performance of the ATM System. Jakarta and Ujung Pandang air control centres (ACC) should therefore develop flow management positions (FMP) and combine the services with the civil part of the airspace management cell (AMC) when flexible use of airspace (FUA) is implemented in order to communicate with adjacent centres and military counterparts to the extent such entities are implemented.

When ATFM measures are needed, Jakarta and Ujung Pandang FMP should respectively be responsible for their assessment, coordination and promulgation. The overall objective is to optimise the traffic and to avoid congestions jeopardising safety. The predicted sector demand compared with the decided sector capacity should indicate when traffic regulation is needed in order to avoid overload for air traffic control (ATC), including airside traffic to and from congested airports. Statistical data from ACCs in Indonesia shows that currently hourly sector loads during peak hours are very high. Some ACC sectors reports 54 flights/hour (based on traffic data for May 2010 from PT Angkasa Pura 2). This can by international standards be considered as a high traffic load.

ATFM should be carried out in three phases as explained in International Civil Aviation Organization (ICAO) Doc 4444 Chapter 3:

- Strategic planning phase: Strategic activities (research, planning and coordination) normally carried out more than two days before day of operation. ATFM planning is carried out in conjunction with air traffic services (ATS) units and military authorities.
- Pre-tactical planning phase: Planning and coordination activities carried out during the two days before the day of operation. Pre-tactical planning involves examining the updated demand, comparing it with the ATC capacity expected to be available and where necessary either adjusting the strategic plan or deciding tactical measures to overcome cases of excess demand. In exceptional cases there could be a need to regulate the demand.
- Tactical operation phase: ATFM activities carried out on the day of operations. No matter how well strategic and pre-tactical planning is carried out, the actual ATC and traffic situations are likely to differ from the forecast. Tactical ATFM activities are directed towards ensuring that:
    - Adequate measures are in place to resolve demand/capacity problems
    - Measures imposed are the minimum required and unnecessary restrictions are lifted
    - ATC resources are deployed to take account of the actual demand situation and make maximum use of available capacity
    - Unavoidable delays are distributed as equally as possible

6.3 SHORT-TERM ACTIVITIES

35) DCB-1: Determine sector capacity values

As a matter of urgency, sector capacity values for all ACC sectors should be determined by Indonesian ANSP followed by capacity values for some main APP sectors selected by the Directorate General of Civil Aviation (DGCA) or air navigation services provider (ANSP). Capacities for merged sectors should also be determined. Capacity values for the sectors should at this stage be based on experience and capacity assessments stated in ICAO Doc 4444 Chapter 3, ATS System Capacity and Air Traffic Flow management.

36) DCB-2: Develop a Flow Management Position handbook

Indonesian ANSP should develop and approve FMP handbooks for Jakarta and Ujung Pandang ACC/FMP based on ICAO Doc 4444 and the ATFM Communication handbook for the Asia Pacific Region.

37) DCB-3: Implement Flow Management Positions as an interim solution

A taskforce on ATFM should promptly be established by Indonesian ANSP and start by implementing FMP at Jakarta and Ujung Pandang ACC with responsibilities stated in the FMP handbook. The responsibility of Jakarta and Ujung Pandang FMP should include airspace and airports geographically located inside each area of responsibility. Introduction of ATFM measures should start as soon as possible in a first phase using “manual” working methods and computer assistance by standard office equipment.

38) DCB-4: Plan for a permanent solution for FMP/AMC positions

In the new Jakarta Advanced Air Traffic Control System (JAATS) and the update of Ujung Pandang ACC, Indonesian ASNP should plan for an FMP/AMC work station. The tasks for the FMP could be extended further from the interim solution proposed above. DGCA should take the initiative to regulate and appoint one of the units to take a national coordinating role in ATFM measures for Indonesia. The FMP/AMC could also be involved in alleviating capacity problems experienced by other ACCs in the region.

39) DCB-5 Sector demand presentations of ACC and main APP sectors

A new or updated ATM system should support the presentation of expected sector demand derived from flight plan information and/or other sources and be used as a monitoring tool in order to prevent system and staff overload in an increased traffic demand and complexity situation.

40) DCB-6: Survey and develop activities of future ACC sectorisation

Bearing in mind the implementation of the new JAATS, the ANSP should perform a survey of future sectorisation and where possible/desirable make a re-sectorisation prior the planned commissioning in 2013. In conjunction with the update of Ujung Pandang ACC a similar survey should take place. In order to receive documentation and objective results of different solutions including horizontal division of the airspace, a fast time simulation is recommended. Additional objective for simulation could be to investigate different possibilities to merge sectors temporarily in order to gain staff efficiency.

6.4 MEDIUM-TERM ACTIVITIES

41) DCB-7: Develop sector and capacity definition criteria

This is a continuation activity of DCB-1 above. The future ATM capacity should be planned to accommodate the normal traffic demand but available capacity will vary due to several factors including uncontrollable events such as technical shortcomings and weather. In order to determine the number of sectors needed in an objective way, different criteria must be developed. These criteria can be used as far as practicable in the production of revised sectorisations during the planned period. The criteria should be based on experience gained from previous sectorisation work. ATM tools, such as medium term conflict detection and inter-facility data communications, could also have a positive impact when creating or modifying sectors and determining capacity values.

A combination of inputs based on these different criteria could be used in a survey or planning for a revised sectorisation together with the experience from existing sectorisation were applicable, and/or results from a fast time simulation. Another important criteria from an efficiency point of view is that merging, splitting and reopening of sectors shall be facilitated and cause a minimum of extra workload. System-capability for such actions has to be considered including user-friendly air-ground and ground-ground communication facilities. Closing/opening of sectors should not affect adjacent units. A number of merged sectors are also assumed to be used in the event of a contingency situation, and should therefore be an integrated part of normal operations outside peak hours.

It can be anticipated that after a period of operational experience from the benefits of using new equipment and silent co-ordination methods, revised and more flexible criteria for sector and capacity definition can be expected.

42) DCB-8: Develop methods for sector load prediction

The future system should be able to present predicted sector loads based on flight plan information and possibly other parameters. Ideally the system support should be able to reflect not only volumes of traffic but also expected complexity. Complexity factors could be expected conflicts, military activity or weather. The function would support planning of sectorisation and staffing of ATC centres and deliver benefits in efficiency and safety.

43) DCB-9: Establish a centralised ATFM unit

Establish a common ATFM unit for Indonesia located at Jakarta or Ujung Pandang including AMC for Indonesia with the task to coordinate efficient use of airspace (developed FUA) together with military counterparts. This task could be co-located (organised) together with other nation-wide ATM services if established.

6.5 LONG-TERM ACTIVITIES

44) DCB-10 : Implement a regional Central Flow Management Unit (CFMU)

Indonesia should support or implement a regional CFMU for the region if and when such an entity is feasible.

6.6 SUMMARY TIMETABLE

The table below summarises all activities in this chapter.

Table 1: Air traffic flow and capacity management activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
ATFCM - Air Traffic Flow and Capacity Management (DCB)										
35	Determination of sector capacity values									
36	Development of an FMP Handbook									
37	Implement FMP, interim solution									
38	Plan for a permanent solution of FMP/AMC positions									
39	Sector demand presentations of ACC and main APP sectors									
40	Survey and development activities of future ACC sectorisations									
41	Sector and capacity definition criteria									
42	Sector load prediction									
43	Indonesian centralised future ATFM unit									
44	Regional CFMU									

CHAPTER 7: COMMUNICATION

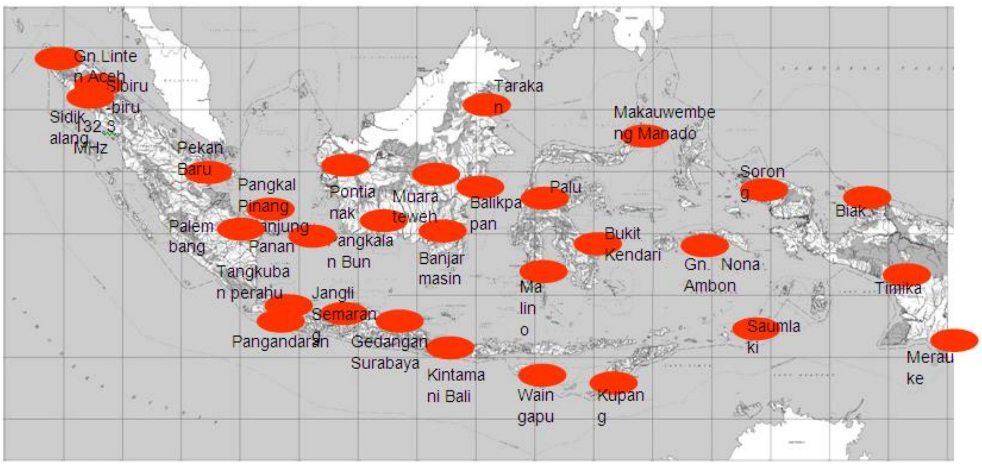
Communication comprises the following two components and associated Global Plan Initiatives (GPIs):

- Communication infrastructure GPI 22
- Aeronautical radio spectrum GPI 23

7.1 GPI-22 COMMUNICATION INFRASTRUCTURE

The scope of communication infrastructure is to evolve the aeronautical mobile and fixed communication equipment, supporting both voice and data communications, accommodating new functions as well as providing the adequate capacity and quality of service to support air traffic management (ATM) requirements. Related operational concepts are aerodrome operations (AO), traffic synchronisation (TS), conflict management (CM) and airspace user operations (AUO).

Figure 21: VHF-ER stations



Source: DGCA

The coverage of VHF is dependent on several factors and increases with aircraft altitude. In the upper airspace, above flight level 245, 30 VHF ER ground stations cover the Indonesian land areas and most of the surrounding seas.

Figure 22: VHF-ER coverage in upper airspace

Source: PBN Implementation and CNS Infrastructure by DGCA, 2010. Circle radius is 250 NM (463 km).

7.1.1 Strategy

ATM depends extensively and increasingly on the availability of real-time or near real-time, relevant, accurate, accredited and quality-assured information to make informed decisions. The timely availability of communication capabilities to accommodate ATM requirements and to fulfil the capacity and quality of service requirements is essential. Communication network infrastructure should accommodate the growing need for information collection and exchange within a transparent network in which all stakeholders can participate.

Gradual introduction of performance-based standards and recommended practices and system-level and functional requirements will allow increased use of commercially available voice and data telecommunication technologies and services. In the framework of this strategy, states should to the maximum extent possible take advantage of appropriate technologies, services and products offered by the telecommunication industry. Considering the fundamental role of communications for aviation, the common objective is to seek the most efficient communication network service providing the desired services with the required performance and interoperability for aviation safety levels at minimum cost.

On all areas in the ATM business where using common public solutions (e.g. on the transmission level) there is a general move towards the use of commercial off-the-shelf (COTS) local or wide area network (LAN/WAN) products for data transport. This is also the case for telephony where the trend is towards a voice over internet protocol (VoIP) solution. However there is still a need to handle present technology which, for at least 5-10 years, leads to a need for compatibility with analogue circuits, digital circuits like ISDN or equivalent and VoIP access. At the other end of the ATM business, operating business-specific solutions like double-side amplitude modulation VHF radio, Mode 3/C monopulse secondary surveillance radar etc, there is definitely a slower transition to common public solutions. There are of course COTS solutions for the ATM business but the evolvement is driven by international standardisation which means that changes take a long time as backward compatibility must be maintained.

The target for evolvement of the communication service should be to provide:

- Increased flexibility in data sharing
- Support for flexible use of airspace requirements of increased coordination
- Support for new requirements, e.g. retransmission
- During a medium term transition period, support existing systems until they can use IP-based communication
- Possibility to replace obsolete technology in a safe, economical and timely fashion
- Sound balance between capacity and operating costs
- Availability of service on a functional level
- Geographical coverage, e.g. possibility to have air navigation services (ANS) Aeronautical Telecommunications Network (ATN) access in dispersed locations
- Support for ANS contingency and service continuity planning
- Information security for operational voice and data used in air traffic services (ATS), meteorological services for air navigation (MET), aeronautical information services (AIS) and communications, navigation and surveillance (CNS) services and air traffic flow management systems

Improved communications is one of the most important strategies to establish a reliable and redundant ATS communication network. The network also needs to be sufficiently monitored and managed. A flexible, modern voice communication system is a prerequisite for a user-friendly work situation where reliable communication is essential not only for safety but also for the efficiency and flexibility of ATS manning. The voice communication system (VCS) must be able to support air-ground and ground-ground communication and ground-to-air and ground-to-ground digital and analogue communication in the VHF and UHF bands. High frequency (HF) possibilities should be maintained for oceanic areas including redundancy for controller-pilot data link communications (CPDLC).

It is vital that a VCS is fully redundant and consists of features that will facilitate redundancy. The VCS should support functions such as short-term recording and playback. All information should be well integrated into the controller working positions and tailored with quick access for the most critical commands. The VCS functions and layout should support the controller in stressful situations by minimising the operation time and workload.

7.1.2 Short-term activities

45) COM-1: Establish a communication operational concept

For all systems it is important that the operational requirements are properly established. The operational use of the systems needs to be established and properly documented by Indonesian air navigation services provider (ANSP). Safety assessment must be an integrated part and shall be done during all steps from specification, operational use and maintenance (see Chapter 15, QSMS, of this document).

46) COM-2: Establish a communication maintenance plan

Indonesian ANSP should define responsibility of communication infrastructure together with a plan covering strategies for ongoing support, maintenance and replacement of equipment.

47) COM-3: Improvements of VHF coverage in the eastern part of Indonesia

There are specific requirements for communication at the more remote airports and for air operations in eastern Indonesia. The Directorate General of Civil Aviation (DGCA) should document requirements and create a task force to investigate and establish acceptable communication facilities. Cooperation with e.g. Indonesian military unit should be investigated in order to find acceptable solutions.

48) COM-4: Investigate benefits of DOC 4444 messages

Indonesian ANSP should investigate whether exchange of coordination information may be improved by the use of standard DOC 4444 messages.

49) COM-5: Establish a reliable and redundant ATN network

A reliable and redundant communication ATM network for ATM, based on IP sub-network technology, is a key enabler of a modern CNS/ATM infrastructure. It will support ANS ATS, MET, AIS and CNS services. In the first phase a backbone network should be implemented. This should then be further expanded in coming phases. The first application should be aeronautical message handling system (AMHS). Indonesian ANSP should be responsible for the implementation.

50) COM-6: Establish a communication monitoring function

More and more information is transported within different networks. To enhance the situational awareness of communication network status, a centralised function for monitoring of all networks used in ATM should be established by Indonesian ANSP.

51) COM-7: Implement AMHS status

Status of AMHS should be established by Indonesian ANSP and any remaining actions identified for operational use should be finished. The need for two aeronautical fixed telecommunication network (AFTN) centres with sub-centres should be further investigated and a strategy should be established before AMHS is further implemented. AMHS (AFTN) capacities need to accommodate increasing numbers of messages such as flight plan and exchange of inter-facility data communications (AIDC) messages.

52) COM-8: Continue implementation of CPDLC

Continue the implementation for use of CPDLC/automatic dependent surveillance-contract for coverage in remote areas of Indonesia area of responsibility. The impact on equipage and costs for airspace users should be carefully considered.

7.1.3 Medium-term activities

53) COM-9: Implement second phase of ATN network

In this phase major sites not covered by the backbone network should be connected.

7.1.4 Long-term activities

54) COM-10: Implement VoIP

The COTS-based solution VoIP should be implemented where practicable and infrastructure is available.

55) COM-11: Phase out HF

HF as a means of communication should not be maintained. Existing equipment should be used but not replaced.

56) COM-12: Implement third phase of ATN network

In this phase remote sites should be connected.

7.1.5 Short- and medium-term AIDC activities

The AIDC standard (International Civil Aviation Organization [ICAO] ATS Inter-facility Data Communication) defines message exchange between different units for flight plan data information. For sector-to-sector co-ordination, the entry and exit conditions for flights should be exchanged and late changes could trigger an update or dialogue about entry/exit conditions. For Area Control Centre (ACC) to Approach Control (APP) co-ordination, entry and exit conditions together with expected departure time could be exchanged in order to reduce verbal communication.

57) COM-13: Implement AIDC

An automatic coordination support should be implemented and approved by Indonesian ANSP between Ujang Pandang ACC and Brisbane ACC; possibly also Melbourne ACC.

58) COM-14: Indonesian ANSP shall implement automatic co-ordination support between Jakarta and Ujung Pandang ACC as well as with adjacent ACC

In the medium term, internal AIDC should be implemented.

59) COM-15: Implement automatic co-ordination support between ACCs and ADC/APPs located in the ACC premises

7.2 GPI-23 AERONAUTICAL SPECTRUM

The scope of this GPI is the timely and continuous availability of adequate radio spectrum, on a global basis, to provide viable communication, navigation and surveillance. Related operational concepts are AO, TS, CM, AUO and ATM service delivery management.

7.2.1 Strategy

ICAO States need to address all regulatory aspects on the agendas of the International Telecommunication Network (ITU) recurrent World Radio Communication Conferences (WRC). Particular attention is drawn to the need to safeguard the current spectrum allocations to aeronautical services. The radio spectrum is a scarce natural resource with finite capacity for which demand from all users (aeronautical and non-aeronautical) is constantly increasing. Thus the ICAO strategy on aeronautical radio spectrum aims at long-term protection of the aeronautical spectrum for all radio communication, surveillance and radio navigation systems. The process of international coordination in the ITU obliges all spectrum users, aeronautical and non-aeronautical, to continually defend and justify spectrum requirements. Civil aviation operations are expanding globally, creating pressure on the already stressed and limited available aeronautical spectrum.

The framework of this initiative involves support and dissemination of the ICAO quantified and qualified policy statements regarding aeronautical radio frequency spectrum agendas for WRC. This is necessary to retain current spectrum allocations for aeronautical services, ensure its continuing availability and ultimately guarantee the viability of air navigation services globally. In Indonesia, the Ministry of Transport (MoT) and information technology departments are responsible for the radio frequency spectrum. DGAC should closely follow ICAO recommendations. Together with MoT and information technology departments DGCA should continue to attend the ITU WRC to secure that Indonesia's needs are addressed. There are no further recommendations in this field.

7.3 SUMMARY TIMETABLE

The table below summarises all activities in the Communications chapter.

Table 1: Communication activities time schedule

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	Communication (COM)									
45	Communication operational concept									
46	Communication maintenance plan									
47	Improved VHF coverage in eastern Indonesia									
48	Use of DOC 4444 messages									
49	ATN network 1									
50	Communication monitoring									
51	AMHS implementation									
52	Use of CPDLC									
53	ATN network 2									
54	Use of VoIP									
55	Phase out of HF									
56	ATN network 3									
57	Implement AIDC									
58	Use of AIDC for ACC									
59	Use of AIDC for Indonesia									

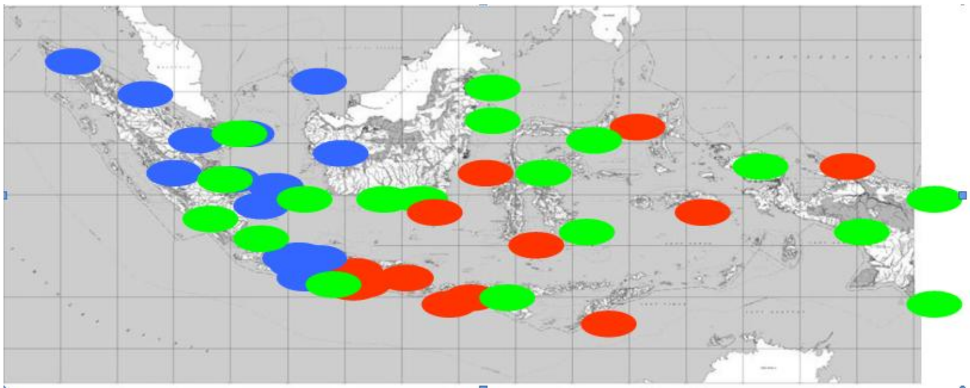
CHAPTER 8: NAVIGATION

Navigation comprises the following three components and associated Global Plan Initiatives (GPIs):

- Area navigation (RNAV) and required navigation performance (RNP) including performance-based navigation (PBN) GPI-5
- RNP and RNAV standard instrument departures (SIDs) and standard instrument arrivals (STARs) GPI-11
- Navigation systems GPI-21.

Present navigation infrastructure consists of 75 VHF Omni-directional Radio Range (VOR) beacons, a system certified by the International Civil Aviation Organisation (ICAO) in 1949, and its modernised version Doppler VOR (DVOR) plus a number of non-directional beacons (NDB). VORs and DVORs are in most cases co-located with a distance measuring equipment (DME), giving the distance to the beacon.

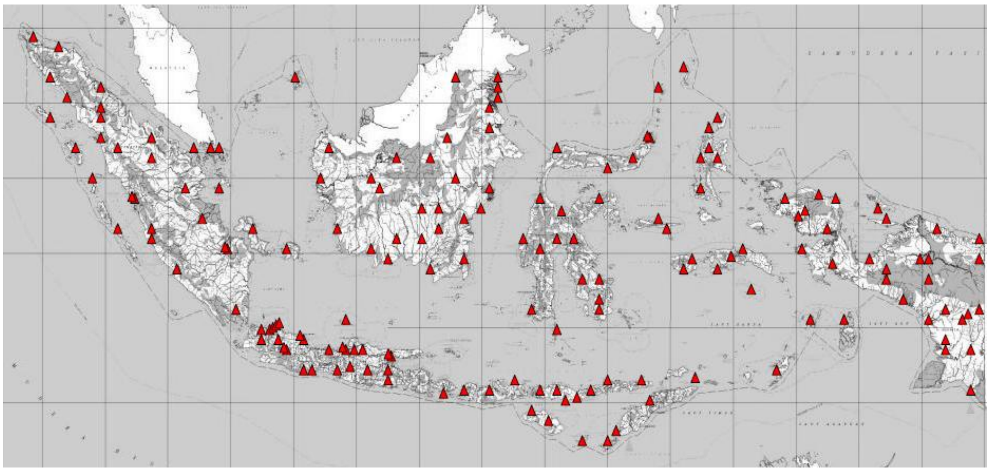
Figure 23: VOR locations



Source: PBN Implementation and CNS Infrastructure by DGCA. *APT 1* *APT 2* *UPT Ditjen Hubud*

A huge number – around 175 - of NDB remain.

Figure 24: Non-directional beacons



Source: PBN Implementation and CNS Infrastructure by DGCA.

8.1 GPI-5 RNAV AND RNP WITH PBN

The scope of this GPI is to incorporate advanced aircraft navigation capabilities into the air navigation system infrastructure. Related operational concepts are airspace organisation and management (AOM), aerodrome operations (AO), traffic synchronisation (TS), conflict management (CM) and airspace user operations (AUO).

8.1.1 Strategy

The implementation of PBN will lead to increased capacity and enhanced efficiency through reductions in separation minima, bringing benefits to airlines using equipment meeting performance requirements. PBN will also improve safety, particularly on approach, through a reduction of controlled flight into terrain.

A significant number of aircraft are capable of RNAV and RNP. Where warranted, these capabilities should be further exploited to develop more efficient routes and aircraft trajectories that are not directly tied to ground-based navigation aids. Certain RNAV-equipped aircraft also have a significantly enhanced capability to achieve sequencing requirements to runways, particularly through the use of the “required time of arrival” function of the on-board flight management system. The performance-based navigation concept, which comprises RNAV and RNP operations, recognises that a clear distinction must be made in the designation of operations between those aircraft operations that require on-board self-contained performance monitoring and alerting and those that do not.

In accordance with the PBN concept, all phases of flight are addressed including en-route oceanic/remote and continental, terminal and approach. The concept, its implementation processes, navigation applications and associated operational approval and aircraft qualification requirements, is described in the ICAO PBN manual (Doc 9613). The PBN concept specifies RNAV and RNP system performance requirements in terms of accuracy, integrity, availability, continuity and functionality needed for the proposed operations in the context of a particular airspace concept. In that context, the PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications which include the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonisation by providing specific implementation guidance for ICAO States and operators.

Practical examples of tangible benefits from PBN are also found in the ICAO document:

- Increased airspace safety through the implementation of continuous and stabilised descent procedures using vertical guidance
- Provision of runway-aligned final approach path which may not be possible from conventional navigation
- Reduced aircraft flight time due to the implementation of optimal flight paths
- Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements
- Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and foster smoother traffic flows
- Reduced delays in high-density airspaces and airports through the implementation of additional parallel routes and additional arrival and departure points in terminal areas
- Reduction of lateral and longitudinal separation between aircraft to accommodate more traffic
- Decreased air traffic control (ATC) and pilot workload by utilising RNAV/RNP procedures and airborne capability and reduce the needs for ATC-pilot communications and radar vectoring.
- Increased predictability of the flight path
- Reduction of maintenance and flight inspection costs for conventional navigation aids

8.1.2 Short-term activities

60) NAV-1: Maintain conventional navigation structure

Not all of today aircraft have Global Navigation Satellite System (GNSS) navigation capabilities. It is therefore important to review the existing terrestrial infrastructure and develop a needs-based retention/reduction strategy to allow conventional navigation in parallel to the development of RNAV/RNP.

61) NAV-2: Implement augmentation

Air navigation services provider should investigate the most cost effective means of providing augmentation.

There are no medium or long term activities in this GPI although some may come out necessary as a result of activities listed in GPI 21.

8.2 GPI-11 RNP AND RNAV SIDS AND STARS

The scope of this GPI is optimisation of the terminal control area (TMA) through implementation of improved air traffic services (ATS) route structures based on RNP and RNAV, connecting the en-route phase of flight with the final approach, based on improved coordination processes. Related operational concepts are AOM, AO, TS, CM and AUO.

8.2.1 Strategy

The implementation of optimised and integrated standard instrument departures (SID), standard instrument arrivals (STAR), instrument flight and associated procedures, taking advantage of aircraft navigation capabilities like RNP and RNAV as well as air traffic management (ATM) decision support systems, will substantially improve capacity and efficiency. The development of SIDs and STARS should be done in a manner where the 3D flight paths are integrated to ensure the TMA workload is reduced and safety is ensured. The way to achieve this is to “integrate” the approaches and departures. The use of SlDs and STARs will maximise system capacity and predictability while reducing fuel consumption and ATS coordination. Indonesia should take advantage of the available performance characteristics to design such route structures. Near-term benefits can be achieved by applying RNP 1 and RNAV 2 and 1 criteria to SID/STAR design, allowing optimum spacing between the routes leading to greater capacity and efficiency benefits.

SlDs and STARs allow efficient transit of aircraft from the runway to en-route flight and vice versa, separation of departing traffic from arriving traffic to provide safe aircraft spacing, maintaining of obstacle clearance requirements, meeting environmental requirements and the provision of a predictable flight trajectory compatible with aircraft RNAV systems.

8.2.2 Short-term activities

62) NAV-3: Extend implementation of standardised in-and outbound procedures

In order to increase capacity before new technology is being introduced, more standardised procedures and working methods should be implemented.

63) NAV-4: Develop regulation for the use of augmented GNSS

Regulation for augmented GNSS for precision approach category I/II should be established.

64) NAV-5: Implement augmented GNSS for precision approach category I/II at the busiest airports

8.2.3 Medium-term activities

65) NAV-6: Continue with implementation of augmented GNSS for precision approach category-I/II at suitable airports

There are no long-term recommendations in this GPI.

8.3 GPI-21 NAVIGATION SYSTEMS

The scope of the Navigation Systems GPI is to enable the introduction and evolution of PBN supported by a robust navigation infrastructure providing an accurate, reliable and seamless global positioning capability. Related operational concepts are AO, TS, CM and AUO.

8.3.1 Strategy

Airspace users need a globally interoperable navigational infrastructure that delivers benefits in safety, efficiency and capacity. Aircraft navigation should be straightforward and conducted to the highest level of accuracy supported by the infrastructure. To meet those needs, the progressive introduction of PBN must be supported by an infrastructure comprising a combination of GNSS navigation, self-contained navigation systems (nowadays inertial navigation/reference systems) and conventional ground-based navigation aids.

GNSS provides standardised positioning information to the aircraft systems to support precise navigation globally. A global navigation system will support a standardisation of procedures and cockpit displays coupled with a minimum set of avionics, maintenance and training requirements. Thus, the ultimate goal is a transition to GNSS that would reduce the requirement for ground-based aids, although the vulnerability of GNSS to interference may require the retention of some ground aids in specific areas.

GNSS-centred PBN enables a seamless, harmonised and cost-effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity. GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. Near-term applications of GNSS are intended to enable the early introduction of satellite-based area navigation without any infrastructure investments, using the core satellite constellations and integrated multi-sensor airborne systems. The use of these systems already allows for increased reliability of non-precision approach operations at some airports. Medium/longer-term applications will make use of existing and future satellite navigation systems with some type of augmentation or combination of augmentations required for operation in a particular phase of flight.

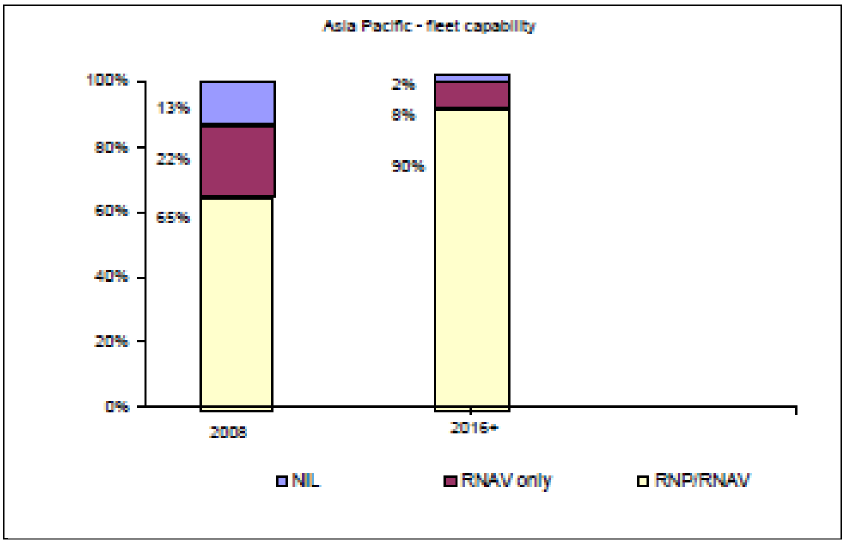
GNSS is a system utilising satellite signals, such as global positioning system, for providing accurate and reliable position, navigation, and time services to airspace users. In 1996, ICAO endorsed the development and use of GNSS as a primary source of future navigation for civil aviation. ICAO noted the increased flight safety, route flexibility and operational efficiencies that could be realised from the move to space-based navigation.

GNSS supports both RNAV and RNP operations. Through the use of GNSS augmentations, GNSS navigation provides sufficient accuracy, integrity, availability and continuity to support en route, terminal area, and approach operations. Approval of RNP operations with certified avionics provides on-board performance monitoring and alerting capability enhancing the integrity of aircraft navigation.

GNSS augmentations include Aircraft-Based Augmentation System, Satellite-Based Augmentation System (SBAS), Ground-Based Augmentation System (GBAS), and Ground-based Regional Augmentation System.

All major commercial aircraft manufacturers since the 1980s have included RNAV capabilities and commercial aircraft currently produced incorporate an RNP capability. An analysis in March 2008 based on fleet numbers from Ascend Online Fleets database and RNAV/RNP classification by the International Air Transport Association (IATA) shows the following status and forecast for 2016:

Figure 25: Asia Pacific RNAV/RNP fleet capacity



Source: ICAO APAC 2009

The traditional navigation infrastructure with VOR/DME and non-directional beacons (NDB) will change to new GNSS support capabilities, including GBAS and SBAS. It is expected that some limited SBAS benefits could be derived from the MSAS geostationary satellites in the short term but in order to utilise the full benefit of those systems, a ground-monitoring infrastructure would be needed.

Care must be taken to not dismantle the current VOR/DME and NDB infrastructure until the PBN concept has been fully evaluated and properly implemented in Indonesia. Consideration must also be taken to whether or not the equipment standard of aircraft operating in remote areas is at an acceptable level.

8.4 GPI-20 WGS-84

The scope here is simply to implement the World Geodetic System 84 (WGS-84) by all ICAO States. Related operational concepts are AO, CM and AUO.

Geographical coordinates used around the world to determine the position of runways, obstacles, aerodromes, navigation aids and ATS routes are based on a wide variety of local geodetic reference systems. With the introduction of RNAV, this problem is more evident and has clearly shown the need for a universal geodetic reference system. ICAO, to address this issue, adopted in 1994 the WGS-84 as a common horizontal geodetic reference system for air navigation effective from 1 January, 1998.

Fundamental to the implementation of GNSS is the use of a common geographical reference system. ICAO adopted the WGS-84 geodetic reference system as that datum, and many ICAO States have implemented the system. Failure to implement, or a decision to use an alternative reference system, will create a seam in ATM service and will delay the full realisation of GNSS benefits. Complete implementation of WGS-84 is a prerequisite for a number of ATM enhancements, including GNSS. In this respect, Indonesia is considered to be on its way. However, present quality of data is highly uncertain and on most airports, data still need to be verified, while coordinates for terminal areas and en route navigation are quality-assured.

8.4.1 Short-term activities

66) NAV-7: Review and secure current use of conventional ground based navigation aids

A review of the current use of ground based navigation equipment should be conducted by the Directorate General of Civil Aviation (DGCA). DGCA should also publish a number of alternative routes available for RNAV-equipped aircraft only.

67) NAV-8 Establish a navigation operational concept

For all systems it is important that the operational requirements are properly established. Special attention should be given to Papua due to its challenging topography. The operational use of the systems must be established and properly documented. Safety assessment must be an integrated part and shall be done during all steps from specification, operational use and maintenance. See Chapter 15 of this document.

68) NAV-9: Establish a navigation maintenance plan

The responsibility for procurement of navigation infrastructure shall be defined together with a plan that covers strategies for maintenance and replacement of equipment.

69) NAV–10: Establish a calibration procedures plan

DGCA should establish and update a plan for calibration of ground based navigational equipment.

70) NAV-10a: Complete WGS-84 validation, publication and amendments of coordinates

DGCA will be responsible for continued verification of all published coordinates as well as publication of new coordinates. The process should follow a quality management system for aeronautical data meeting ISO 9001 and following QSMS procedures as proposed in Chapter 15 (SAFETY AND QUALITY MANAGEMENT SYSTEM).

DGCA should require aerodrome operators or contractors to issue revised data such as runway threshold-location whenever changes take place. DGCA should also either force aerodrome operators to make surveys to be used for updated aerodrome obstacle charts on all airports with commercial air traffic, or make these surveys itself. Furthermore, it is recommended that DGCA within this activity includes:

- Developing a certification system for companies/ professionals approved to do aeronautical surveys
- Adopting a quality assurance perspective when receiving data from various sources
- Establishing a procedure for collection and implementing aeronautical data in a central database, like the European Aeronautical Information Database (see Chapter 12).

71) NAV-11: Phase out NDB equipment

NDB as means of navigation should not be maintained. Existing equipment should be used but not replaced. In the long run, alternatives must be presented.

8.4.2 Medium-and long-term activities

72) NAV-13: DGCA must in due time present a plan and alternatives for aviation using NDB equipment, especially in remote areas
73) NAV-15: Maintain VOR/DME operations

In the very long term VOR could be phased out but DME should still remain as a backup to GNSS-based navigation

8.5 SUMMARY TIMETABLE

The table below summarises all activities in the navigation field.

Table 1: Navigation activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
Navigation (NAV)										
60	Conventional navigation structure									
61	Implement augmentation									
62	Implement standardised in-									

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	and outbound procedures									
63	Develop regulation for the use of augmented GNSS									
64	Implement augmented GNSS step 1									
65	Implement augmented GNSS step 2									
66	Review use of conventional ground navigation aids									
67	Navigation operational concept									
68	Navigation maintenance plan									
69	Calibration procedures plan									
70	WGS-84 validation, publication and amendments									
71	Start of NDB phase-out									
72	Plan alternatives for NDB-dependent navigation									
73	VOR/DME operation retained									

CHAPTER 9: SURVEILLANCE

Surveillance comprises the following three topics and associated Global Plan Initiatives (GPIs):

• Situational awareness	GPI 9
• Functional integration of ground and airborne systems	GPI 12
• Decision support systems and alerting systems	GPI-16
• World Geodetic System - 1984	GPI 20.

The need for surveillance applies to a huge number of overflying routes and routes to Indonesia.

Figure 26: Main ATS routes around Indonesia

Source: JICA 2008 report

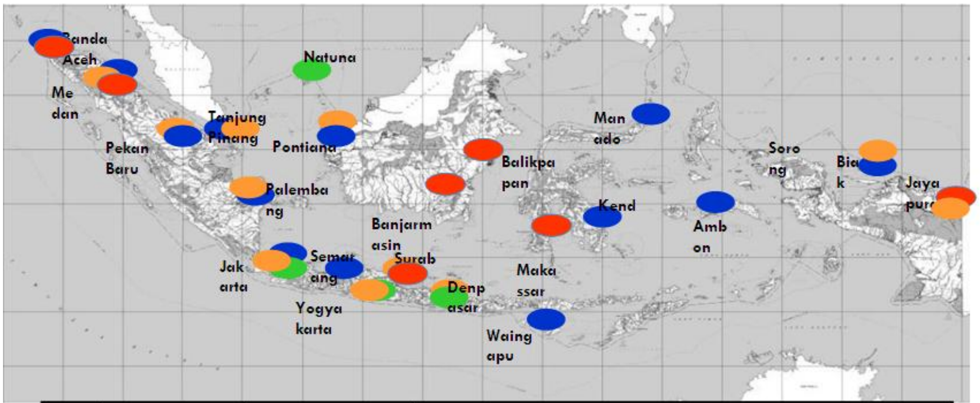
9.1 GPI-9 SITUATIONAL AWARENESS

The scope of GPI-9 is operational implementation of surveillance based on data-link, allowing traffic information to be displayed in the aircraft. This will support conflict prediction and collaboration between flight crew and the air traffic management (ATM) system and improve situational awareness in the cockpit. Related operational concepts are aerodrome operations (AO), traffic synchronisation (TS), conflict management (CM) and airspace user operations (AUO).

9.1.1 Description of strategy

Continued implementation of enhanced surveillance techniques (automatic dependent surveillance- broadcast or contract [ADS-B or ADS-C]) will allow reductions in separation minima and improved safety, increased capacity and improved flight efficiency, all on a cost-effective basis. These benefits are achieved by bringing surveillance to areas where there is no radar, whenever warranted by cost-benefit analysis. In airspace where radar is used, enhanced surveillance can bring further reductions in aircraft separation minima and in high density areas improve the quality of surveillance information both on the ground and in the air, thereby increasing safety levels. The implementation of quality-assured electronic terrain and obstacle data necessary to support the ground proximity warning systems with forward-looking terrain avoidance function as well as a minimum safe altitude warning (MSAW) system will benefit safety substantially.

Figure 27: Radar stations



	Type of Equipment	Total until 2009	Location
	PSR	11	Medan, Palembang, Pekanbaru, Tanjung Pinang, Cengkareng, Pontianak, Yogyakarta, Surabaya, Denpasar, Sentani, dan Biak
	SSR	12	Medan, Palembang, Pekanbaru, Tanjung Pinang, Cengkareng, Semarang, Waingapu, Pontianak, Kendari, Manado, Ambon dan Biak
	MSSR	4	Natuna, Cengkareng, Yogyakarta dan Denpasar
	MSSR MODE-S	7	Banda Aceh, Medan, Makassar, Banjarmasin, Balikpapan, Surabaya dan Jayapura

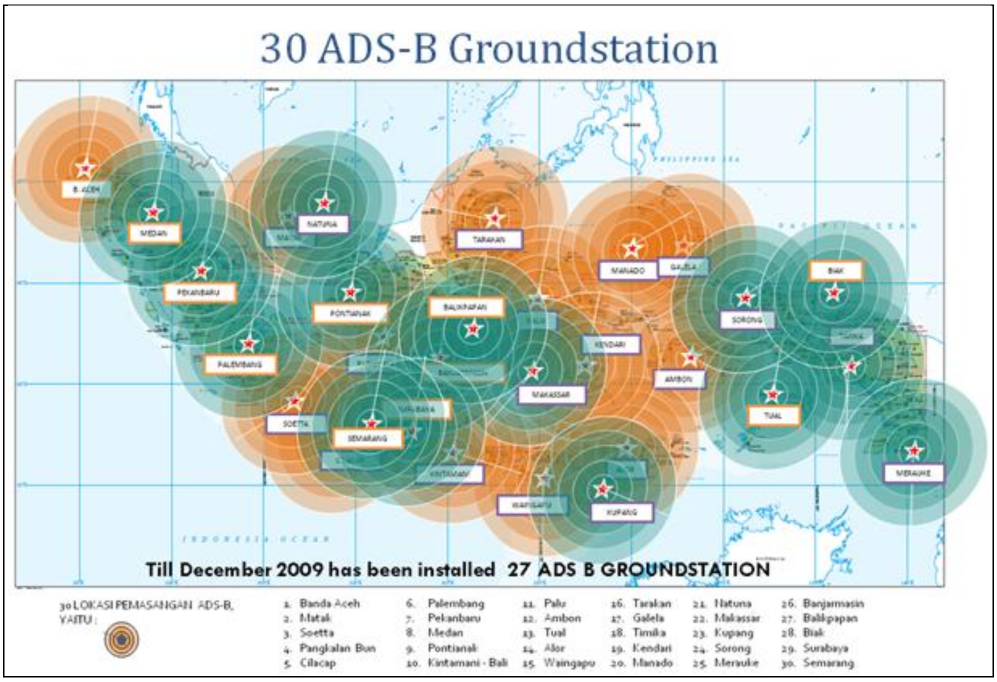
Source: PBN Implementation and CNS Infrastructure by DGCA, 2010.

Existing radar stations are show in the figure above. Implementation of surveillance systems for surface movement at aerodromes where weather conditions and capacity warrant will also enhance safety and efficiency while implementation of cockpit display of traffic information and associated procedures will enable pilot participation in the ATM system and improve safety through greater situational awareness.

ADS-B can be used to enhance traffic surveillance in domestic and oceanic airspace. In remote and oceanic airspace where ADS-C is used, Future Air Navigation Services capabilities exist on many airliners and could be added to business aircraft at reasonable costs provided that dashboard space, equipment bays and wiring looms permit, which is not always the case. In this respect, it should be noted that the 1090 Extended Squitter (ES) is available and should be accepted as the choice for ADS-B data link in Indonesia. Multilateration (MLAT) provides a surveillance service at a potentially lower cost, higher levels of accuracy and greater reliability than conventional secondary surveillance radar (SSR). The technique requires no additional avionics equipment, as it uses replies from Mode A and C transponder carried by all aircraft. Also replies from Mode S and ADS-B transponders are used if received and ADS-B data can be displayed to the controllers.

Implementation of new systems must be based on user requirements while respecting legal requirements and providing both cost-efficiency and operational improvements with the same or higher safety and availability. The equipment requirement and operational methods must enable the use of radar, multilateration, ADS-B and ADS-C for separation in controlled airspace. The tentative development of free route airspace and "direct routing" also imply an increased demand for comprehensive air situation presentation.

Figure 28: ADS-B stations



Source: PBN Implementation and CNS Infrastructure by DGCA, 2010.

Tactical information is directly relevant for executing safe management of traffic. Equally important is the access to strategically supporting information sources. Digital maps and charts are examples of information that should be easily accessible for the operators. Search functionality will support quick access to relevant data enabled by an integrated information system. This is further elaborated under GPI 18 in the system-wide information management chapter and in the aeronautical information services/meteorological services for air navigation (Chapter 12).

9.1.2 Short-term activities

74) SUR-1: Establish a surveillance operational concept

For all systems it is important that the operational requirements are properly established. Indonesian ANSP should establish an operational use of the systems. Safety assessment must be an integrated part during all steps from specification to operational use and maintenance. See Chapter 15: QSMS of this document.

75) SUR-2: Establish an operational manual

Indonesian air navigation services provider (ANSP) should in an operational manual document local operational procedures, methods and use of surveillance systems.

76) SUR-3: Prepare a surveillance maintenance plan

Indonesian ANSP should define the objectives to be met by communication infrastructure together with a plan covering strategies for ongoing support, maintenance and replacement of equipment.

77) SUR-4: Implement sharing of surveillance information

Sharing of surveillance data between Indonesian area control centres (ACCs), the military and adjacent states should be studied by Indonesian ANSP.

78) SUR-5: Declare an objective for surveillance coverage

One important part of the operational concept proposed in SUR-1 above is to declare objectives for surveillance coverage. The following topics should be covered as a minimum:

- Areas and vertical limits where minimum redundant surveillance coverage is needed
- Areas where single coverage is acceptable
- Minimum coverage requirement over oceanic areas
- Areas where lack of surveillance coverage may be acceptable

79) SUR-6: Declare operational separation criteria.

Realistic surveillance separation minima should be declared by Indonesian ANSP for different parts or regions in Indonesia, including congested as well as less congested terminal control areas (TMAs). The available surveillance coverage like primary surveillance radar, SSR, MLAT, ADS-B and ADS-C should be a base for the criteria used.

80) SUR-7: Install surveillance fallback systems

With high traffic loads and where air traffic control (ATC) does not use paper strips, the issue of fall-back levels becomes critical. The paper strips represent flight information that remains even if serious break-downs occur. A fall-back system with air situation display presentations should therefore be installed by Indonesian ANSP in both ACCs. The fallback level should allow for the safe management of flights during system problems or failure.

81) SUR-8: Replacement of Jakarta Advanced Air Traffic Control System (JAATS)

The current JAATS system is old and difficult to maintain. A program should be established to ensure that requirements are fully defined for a replacement. Many of the recommended activities in this Master Plan include requirements for the new system. Requirements for backup, contingency and simulators should also be included.

82) SUR-9: Investigate feasibility of WAM for en route and TMA airspace

Wide area multilateration (WAM) may be suitable for en-route and TMA airspace as an alternative replacement until ADS-B can be fully used. The current infrastructure of ADS-B should be used as far as possible.

9.1.3 Medium-term activities

83) SUR–10: Enable sharing of ATM data

The new ATM system in Jakarta and the upgraded system at Ujung Pandang should enable future automatic coordination and sharing of flight plan and surveillance data between ACCs and other ATS units in Indonesia.

84) SUR-11: Investigate feasibility of MLAT to support surveillance

Airport MLAT is a feature of almost all advanced surface movement guidance and control systems may be an option to support surveillance at major airports.

9.1.4 Long-term activities

85) SUR-12: Phase out conventional radar

The operational concept will drive the requirements for different types of surveillance. In the long term, SSR and SSR mode S (cooperative surveillance) will be phased out as the main surveillance source. WAM (cooperative surveillance) would remain as a complement even in the long term. Dependent surveillance (e.g. ADS-B) will be the main type of surveillance in the long term. Non-cooperative independent surveillance (e.g. primary radar) could still be used in high density terminal areas even in the long term.

9.2 GPI-12 FUNCTIONAL INTEGRATION OF GROUND AND AIRBORNE SYSTEMS

The scope of this integration is optimising the terminal control area to provide for more fuel-efficient aircraft operations through arrival procedures based on flight management systems (FMS). Related operational concepts are airspace organisation and management, AO, TS, CM and AUO.

9.2.1 Strategy

In recent years there have been several efforts to develop flight procedures providing the most efficient approach trajectory to the destination aerodrome. These procedures allow an uninterrupted flight trajectory from top of descent until the aircraft is stabilised for landing. For the purposes of design work, it may be necessary to implement these procedures in a staged manner.

The design of en-route and arrival air routes and associated procedures should facilitate the routine use of continuous descent procedures. Similarly, the design of departure procedures should facilitate the routine use of unrestricted climb procedures. To maximise efficiency in TMA airspace, it is critical to take advantage of improved TMA design and make the best use of automation. Therefore, in addition to continuous descent capabilities, aircraft will increasingly be equipped with time-of-arrival computation. This capability will integrate with ground automation to deliver time of arrival over fixes to assist in the sequencing process allowing aircraft to remain closer to their 4-D preferred trajectory.

9.2.2 Short-term activities

86) SUR-13: Develop integrated standard instrument departure (SID)/standard instrument arrival (STAR) trajectories to cater for continuous descent approaches and continuous climb departures

See the activity for GPI-11.

There are no medium-term activities in this field and only two in the long term.

9.2.3 Long-term activities

87) SUR-14: Integrate a Required Time of Arrival function in FMS

See introduction text to this GPI above. Required time of arrival (RTA) is a future concept for issuing ATC arrival slots with a very narrow window, e.g. plus/minus two minutes. Predictability will be increase which will lead to an increased runway capacity.

88) SUR-15: Consider using intent data

A future expansion step to consider is using a data link infrastructure so efficient use of 4D-trajectory, i.e. intent, information can be achieved. With 4D-trajectory information, the controller and the ground system would get access to information calculated by the aircraft's FMS. This information enables advanced flow management and increased predictability while reducing the dependency of trajectory prediction calculations. With the introduction of ADS-B and on-board systems such as cockpit display of traffic information and electronic flight bag, it is important for the controller to understand the aircraft capabilities.

9.3 GPI-16 DECISIONS SUPPORT AND ALERT SYSTEMS

The scope of these systems is the implementation of decision support tools to assist air traffic controllers and pilots in detecting and resolving air traffic conflicts and in improving traffic flow. Several tools are available to support safety, like MSAW, short-term conflict alert (STCA) and runway incursion alerting systems. Tools to improve efficiency could be automated flight data processing systems, medium term conflict detection (MTCD), sequencing tools (arrival manager [AMAN]/departure manager [DMAN]) and online data exchange systems (inter-facility data communications). Related operational concepts are demand and capacity balancing, TS, CM and AUO.

9.3.1 Strategy

Decision support systems facilitate early resolution of potential conflicts, provide basic levels of explorative probing to optimise strategies and reduce the need for tactical action. The executive role of controllers is thereby enhanced, giving scope for management of more traffic within acceptable workload limits.

Conflict prediction tools span several sectors and permit improved sectorial planning, thereby providing the advantage of more expeditious traffic flows and fewer potential conflicts within established arrival schedules. This will allow sector teams to operate more effectively and result in more efficient arrival flows. Automation of coordination tasks between adjacent sectors improves the quality of information on traffic transiting between sectors and makes it more predictable, thereby allowing reduced separation minima, decreased workload, increased capacity and more efficient flight operations.

An automated flight data processing system is normally a basic prerequisite to get access to many of the support and alerting systems mentioned above.

Conflict management (CM) consists of three layers:

- Strategic
- Separation provision

- Collision avoidance

The strategic CM consists of organising and managing airspace to reduce conflicts in traffic flows to the extent possible. ATM system capacity should be organised to meet the expected traffic demand. In the rare instances when this is not possible, restrictions should be published, to avoid overload of the ATM system. TS, a component of CM, aims at organising and optimising traffic to avoid bunching. The overall aim of the strategic conflict management is to reduce tactical conflicts and indirectly reduce controller workload.

The second layer of CM, separation provision, is used to detect deficiencies in the strategic planning where the evolving tactical events indicate conflicts. There are four possible stages of a separation provision:

- Conflict detection
- Solution selection[4]
- Implementation
- Monitoring

The ATM system should include support for these stages. MTCD provides a means for system identified conflicts and additional support to the planning function in its detection and analysis of conflicts. This function is highly dependent on data accuracy, trajectory predictions and conflict parameters. Experience from past implementations indicates an acceptable degree of usability during stable flight conditions. In dynamic environments, e.g. TMA operations, the function is expected to improve its usability in the future. MTCD should also check for segregated airspace and provide an improved means to tactical flight planning and for re-routing.

The aim of MTCD is to facilitate transition from the current, largely reactive form of air traffic control, to a more pro-active control, thereby balancing more evenly the workload of tactical and planning tasks, enhancing sector team efficiency as well as safety and service. By maximising the opportunity of pro-active problem solving during sector planning, MTCD may reduce tactical workload. MTCD should be considered as a prerequisite planning tool for the introduction of ACC operations without paper strips.

The third layer of CM is collision avoidance. The ground system should have a STCA to inform the controller of imminent separation infringement. An STCA is a safety net to warn the controller of any situation where the minimum separation distances is violated, or is predicted to be so within a short time (usually two minutes). By providing a visual alert on the air situation display, STCA allows the controller to retrieve the alerts in a timely manner to resolve potentially hazardous situations. The system may also support audible alerting. STCA is mandatory in Europe, and EUROCONTROL has

[4] The controller will not necessarily select and implement a measure for all conflicts. It is also possible just to monitor the situation and if it does not deteriorate, action may not be necessary.

recommended the following principles to be placed at the centre of policy making for use of STCA:

- STCA is a safety net; its sole purpose is to enhance safety and its presence is ignored when calculating sector capacity.
- STCA is designed, configured and used to make a significant positive contribution to the effectiveness of separation provision and collision avoidance.
- STCA should not be used as a separation tool - an important issue for training.

Monitoring is an important part of the controller's tasks and a modern system can support the controller in this area:

- Route adherence monitoring (RAM) provides support in detecting that an aircraft is no longer following the trajectory as expected by the system
- Clearance adherence monitoring (CAM) provides support in detecting that an aircraft is not following the assigned clearance issued by ATC
- Area proximity warning (APW) provides support in detecting that the aircraft is about to enter a segregated area
- Minimum safe altitude warning (MSAW) provides support in detecting that the aircraft is too low in altitude
- Presentations of FMS data; pilot operations

9.3.2 Short-term activities

89) SUR-16: Safety nets should be implemented and approved for operational use as soon as possible in Jakarta ACC

Indonesian ANSP should in the new Jakarta ACC system provide for safety nets like STCA, RAM, CLAM, APW and MSAW above. The safety nets should be approved for operational use, and staff to be trained accordingly as soon as practicable.

90) SUR-17: Safety nets should be approved and implemented in Ujung Pandang ACC

The Makassar Advanced Air Traffic Control System EUROCAT X system supports the safety tools mentioned above but Indonesian ANSP should make sure they are approved for operational use.

91) SUR-18: Implement planning tool MTCD

MTCD in Ujung Pandang should be developed and approved by Indonesian ANSP for operational use and staff to be trained accordingly as soon as practicable. It should be implemented in conjunction with the commissioning of the new Jakarta ACC system.

92) SUR-19: Introduce a sequencing tool

Indonesian ASNP should, in order to synchronise major traffic flows, introduce a sequencing tool to enable increased ATC capacity as well as for airspace users to fly optimum trajectories.

The information from the arrival management tool (AMAN) should be integrated with the normal display system to provide efficient advisories for the controllers in ACC and approach control (APP) sectors to major airports. With the traffic growth expected for several airports in Indonesia, a special task force should use cost-benefit analysis to determine where it is most appropriate to integrate this tool.

9.3.3 Medium-term activities

93) SUR–20: Introduce monitoring safety net systems in APP units

Safety nets should be considered for implementation in major approach units in conjunction with the next equipment generation.

94) SUR-21: AMAN should be considered also for airports in inter alia Jakarta, Surabaya, Bali, Medan and Makassar

There are no long-term activities in this field.

9.4 SUMMARY TIMETABLE

Table 1: Surveillance activities time schedule

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	Surveillance (SUR)									
74	Surveillance operational concept									
75	Operational Manual									
76	Surveillance maintenance plan									
77	Sharing of surveillance information									
78	Objective for surveillance coverage									

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
79	Declare operational separation criteria									
80	Radar fall-back									
81	Replacement of JAATS									
82	Wide area MLAT for en route and TMA									
83	Sharing of ATM data									
84	Airport MLAT to support surveillance function									
85	Phase out of conventional radar									
86	Develop integrated SID/STAR trajectories									
87	Integration of RTA function in FMS									
88	Use of intent data									
89	Safety net Jakarta ACC									
90	Safety nets Ujung Pandang ACC									
91	Planning tool MTCD									
92	Sequencing tool									
93	Introduce monitoring safety net systems in APP units									
94	Integration of additional sequencing tools									

CHAPTER 10: AERODROME

Aerodrome comprises the following three components and Global Plan Initiatives (GPIs):

- Aerodrome design and management GPI 13
- Runway operations GPI 14
- Matching instrument meteorological conditions (IMC) and visual meteorological conditions (VMC) operating capacity GPI 15.

10.1 GPI-13 AERODROME DESIGN AND MANAGEMENT

The scope of this GPI is implementation of management and design strategies to improve movement area utilisation. Related operational concepts are aerodrome operations (AO), conflict management (CM) and airspace user operations (AUO). Focus in this chapter is on airport capacity; the aerodrome infrastructure itself is not an air traffic management (ATM) component.

10.1.1 Strategy

Improved aerodrome design and management activities, including coordination and collaboration between ATM providers, vehicle operators and aircraft operators, can have an important impact on safety and capacity. Local collaborative decision-making processes should lead to sharing of key flight scheduling data that would enable all participants (aerodrome, air traffic control (ATC), air traffic flow management (ATFM), aircraft operators and ground handling) to improve their awareness of aircraft status throughout the “turn around” process. This will allow minimal and precise ATFM measures to be applied and higher predictability of schedules to be achieved. Benefits would include more efficient use of aerodrome resources and ground handling, reduction in delays and greater predictability of schedules.

As an integral part of the air navigation system, the aerodrome will provide the ground infrastructure - lighting, taxiways, runway and runway exits, and precise surface guidance to improve safety and maximise aerodrome capacity in all weather conditions. The ATM system should enable the efficient use of airside infrastructure capacity:

- Runway occupancy time should be reduced where capacity and efficiency benefits can be gained
- The ability to safely manoeuvre in all weather conditions while maintaining capacity should be sought

- Where warranted, precise surface guidance will improve capacity and efficiency
- The position (to an appropriate level of accuracy) and intent of all vehicles and aircraft operating on the manoeuvring and movement areas should be known to the ATM community members at those aerodromes where cost-benefit analysis indicates substantial capacity and efficiency gains

10.1.2 Short-term activities

95) AO-1: Review aerodrome design and identify lack of airside capacity, including forecast shortcomings

In order for airside infrastructure not to be bottlenecks in the gate-to-gate process, it is essential that studies are carried out by the Directorate General of Civil Aviation to identify such bottlenecks now and in the future. Such studies should be carried out in conjunction with airport operators.

96) AO-2: Establish a formalised collaborative decision-making forum with airport, ATM and airspace users

A common understanding of the ATM process requires that all stakeholders share a collaborative approach to decision making both on a strategically and tactical level.

97) AO-3: Establish a road map for capacity enhancements at identified aerodromes

Based on the result of the review recommended in 95), it is necessary that in a collaborative decision-making (CDM) context establish a roadmap for capacity enhancement activities.

98) AO-4: Implement capacity enhancing activities chartered in 97)

Implementation activities should be followed according to the roadmap above and acknowledged investment plans. *This activity should continue into the medium- and long-term horizons.*

10.1.3 Medium-term activities

The activities in the elaborated road map above normally take a long time to carry out. The road map is following an improvement process, which goes on indefinitely.

99) AO-6: Make an updated road map according to 97) above

To promote flexibility in accommodating changing priorities, an updated road map should be established.

100) AO-7: Refine the CDM process

There are no long-term activities apart from the continued updating of the roadmap.

10.2 GPI-14 RUNWAY OPERATIONS

The scope here is to maximise runway capacity. Related operational concepts are AO, traffic synchronisation (TS), CM and AUO.

10.2.1 Strategy

Enhancing the performance of runway operations begins with the establishment of runway capacity benchmarks, usually defined as the maximum number of flights an aerodrome can routinely handle in an hour for weather minima above Category I. These benchmarks are estimates that vary with runway configurations and the mix of aircraft types. Where warranted, it should be an objective to utilise aircraft capabilities and available runways in the most appropriate manner to move the all-weather throughput as close to the levels of visual throughput as possible.

Achieving the optimum capacity for each runway is a complex task involving many factors, both tactical and strategic. It is essential to measure the effects of operational changes and to monitor performance of airspace users and ATM providers. The latter case will be applicable to the analysis of pilot and controller performance and must recognise the requirement to maintain the confidence of the users and to work within the existing culture of safety. A system of performance indicators forming the basis of measurements and analyses should be devised. Tactical factors affecting runway occupancy include flight operations and ATM factors. The flight operations aspects include operator performance, effects of airline procedures, use of the airfield infrastructure and aircraft performance issues.

Runway capacity constraints are defined by, inter alia, procedures, physical characteristics, aircraft performance capabilities, surveillance capabilities, aircraft spacing, weather limitations, environmental restrictions and surrounding land use management. Improved procedures for minimising spacing such as reduced runway separation, precision runway monitoring and required navigation performance +-approaches for closely-spaced parallel runways will optimise spacing capability.

Aerodrome operations describe the functionality within the ATM system in terms of such factors as information acquisition and delivery, facility access, demand on airspace, and limits on usability. There will be a dependency on landside operations where improvements will be needed to optimise aerodrome capacity (especially relevant if mixed-mode operations are applied). Aerodrome operations will be considered from an en-route to en-route perspective in determining their role within the ATM system.

The principal challenge to aerodrome operators will be to provide sufficient aerodrome capacity, while the challenge to the ATM system will be to ensure that all available capacity is fully and efficiently utilized in a timely manner. Aerodrome operation principles include the following:

- Runway occupancy time will be reduced
- The capability will exist to safely manoeuvre in all weather conditions while maintaining capacity
- Any activity on the manoeuvring area or apron will be considered as having a direct influence on ATM

Where required, runway geometry will permit entry and exit at any location along its length, where appropriate taxiways are provided, minimising runway occupancy time and reducing holding areas. Precise surface guidance to and from a runway is preferred in all conditions. The position of all vehicles and aircraft operating on the movement area will be known and available to the ATM community.

Landside activities not directly related to the ATM system will have an impact on aerodrome operations. These activities include, inter alia, customs, security, baggage handling and fuel supply and will be optimised through the collaborative exchange of information. Environmental issues such as noise, gaseous emissions and visual intrusions will be considered in the design, development and operation of aerodromes. Restrictions on airside operations may occur due to environmental constraints and public concern. Flight parameters will be available to the ATM system, allowing for dynamic spacing and sequencing of departing aircraft, thereby minimising wake vortex constraints on runway capacity.

In order to achieve a smooth flow of traffic and to optimise capacity and safety in an efficient and environmentally acceptable manner, it is recommended to work in a collaborative way involving air navigation services provider (ANSP) and airport operators (authorities). The objective should be to link TS activities together with AO activities.

10.2.2 Short-term activities

101) AO-9: Model runway throughput at certain airports

In order to identify bottlenecks in runway and taxiway systems, modelling of throughput capacity is recommended for aerodromes expected to reach saturation within the short or medium term. DGCA should in conjunction with stakeholders identify such airports. Previous AO-2 recommendation should generate such a forum for a collaborative decision-making process. Necessary actions must be taken for identified airports with airside capacity constraints.

102) AO-10: Review runway and taxiway architecture

For the same reason as above, additions/changes based on a cost-benefit analysis to avoid saturation may be necessary: Jakarta Soekarno-Hatta Airport, with a specific runway dedicated for international traffic due to its proximity to the international terminal, is lacking one taxiway between the two parallel runways. This situation is currently a safety issue, when standardised procedures are not followed. Surabaya airport has its high-speed taxiways located where only heavy aircraft can expedite vacating the runway. Medium-weight aircraft stop much earlier, and the runway occupancy time should be lowered if high-speed turn-offs were adjusted to this aircraft category.

103) AO-11: Review aerodrome control procedures

At saturated aerodromes, procedures need to be reviewed and when necessary revised in order to create more runway capacity. As an example, procedures for more efficient use of the parallel runway system at Jakarta Soekarno-Hatta Airport should be established.

10.2.3 Medium- and long-term activities

104) AO-12: Additional runway capacity should be provided at saturated airports.

In order for Jakarta Soekarno-Hatta Airport to cater for forecast traffic growth, additional runway capacity will be needed. Other major airports may need additional runway capacity as well. This is also a long-term activity - a continuous review of required additional runway capacity is recommended.

10.3 GPI-15 MATCH IMC AND VMC OPERATING CAPACITY

The scope of this matching is to improve the ability of aircraft to manoeuvre on the aerodrome surface in adverse weather conditions. Related operational concepts are AO, CM and AUO.

10.3.1 Strategy

It should be an objective of the ATM system to utilise all airborne and service provision capabilities to maintain as much as possible of the visual meteorological conditions (VMC) capacity during instrument meteorological conditions (IMC). More use should be made of the capability of modern aircraft systems and ground systems towards this objective. Taxiway design and guidance capability may then be matched to those conditions.

Implementation of an advanced surface movement guidance and control system (A-SMGCS), decision support tools and associated procedures offer the best solution for aircraft to operate in IMC. At those locations where cost-benefit cost analysis indicates a positive value, the improved guidance and control of taxiing aircraft and moving vehicles on the movement area as well as impending conflict alert may be fully automated.

Synthetic vision, based on a detailed aerodrome map, can enhance situational awareness under adverse weather conditions where runway/taxiway markings may be obscured. Head-up display and guidance systems that can synthesise enhanced vision sensor data and synthetic vision images can offer an integrated solution to enhance situational awareness. Enhanced conflict detection and alerting technologies and procedures will improve the aerodrome surface movement throughput while meeting established levels of safety. Controllers should also have access to systems to help develop and maintain situational awareness of all traffic on the movement area in all weather conditions.

10.3.2 Short-term activities

105) AO-14: Establish dedicated ATC ground positions

Dedicated ground positions should be made available and manned to increase overall airport ATC capacity at airports with ATC capacity constraints. These positions should be established by Indonesian ANSP in cooperation with the airport authorities.

106) AO-15: Provide proper safety training

All users of the airport areas should have proper safety training on regulations for entry to vital airport areas (see section 15.2 concerning safety management system).

107) AO-16: Provide sufficient security

Airport authorities should ensure that security is sufficient to prevent unauthorised trespassing. In this Master Plan, the security issue has only bearing on ATM facilities and staff (Ref International Civil Aviation Organisation Doc 8966 and 8973).

10.3.3 Medium- and long-term activities

108) AO-17: Increase surveillance capability

E.g. install A-SMGCS, where multilateration could be a cost-beneficial alternative to enhance safety and capacity at selected airports. ATM should be the initiating part.

109) AO-18: Analyse the need for a departure manager function

In order to reduce taxiing time for departing traffic, implementation of a departure manager (DMAN) function is recommended. This will provide for more environmentally adapted air traffic handling at and in the vicinity of the airports. A cost-benefit analysis, including environmental effects, must be undertaken in order to identify airports with this need. A DMAN also increases overall ATC capacity for the aerodrome control unit, when fewer aircraft are taxiing to a holding point simultaneously. Hence the long-term recommendation is to implement DMAN.

110) AO-19 : Implement a DMAN functionality

The airport authority should be responsible with ATM as the initiating part.

10.4 SUMMARY TIMETABLE

The table below summarises all activities concerning aerodromes.

Table 1: Aerodrome activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	Aerodrome (AO)									
95	Review aerodrome design for Indonesian airports									
96	Establish forum with airport, ATM and airspace users									
97	Establish a road map for capacity enhancement									
98	Implement capacity enhancing activities									
99	Updated road map for capacity enhancing activities									
100	Refine the CDM process									
101	Runway throughput modelling									
102	Runway/taxiway architecture									
103	ADC Procedures									
104	Additional runway capacity at saturated airports									

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
105	Dedicated ATC Ground positions									
106	Proper safety training									
107	Sufficient Security									
108	Increase surveillance capability									
109	Analyse need for a DMAN function									
110	Implement a DMAN functionality									

CHAPTER 11: SYSTEM-WIDE INFORMATION MANAGEMENT

System Wide Information Management (SWIM) comprises the following three components and associated Global Plan Initiatives (GPIs):

• Data link applications	GPI 17
• Aeronautical Information	GPI 18
• Meteorological systems	GPI 19

11.1 GPI-17 DATA LINK APPLICATIONS

The scope is to increase the use of data link applications. Related operational concepts are demand and capacity building (DCB), aerodrome operations (AO), traffic synchronisation (TS), conflict management (CM), airspace user operations (AUO) and ATM service delivery management (ATMSDM).

11.1.1 Strategy

The implementation of less complex data link services like pre-departure clearance, oceanic clearance, digital-automatic terminal information service (D-ATIS) and automatic position reporting can bring immediate efficiency benefits to the provision of air traffic services (ATS). Transition to data link communications for more complex safety-related uses taking advantage of a wide variety of controller-pilot data link communications (CPDLC) messages, including air traffic control (ATC) clearances, is already being successfully implemented. Use of CPDLC and implementation of other data link applications can bring significant advantages over voice communication for both pilots and controllers in terms of workload and safety. In particular, they can provide efficient linkages between ground and airborne systems, improved handling and transfer of data, reduced channel congestion, reduced communication errors and interoperable communication media. The reduction of workload per flight translates into capacity increases and enhanced safety.

Communication and surveillance data link technologies and applications should be selected and harmonised for seamless and interoperable global operations. Automatic dependent surveillance-contract, automatic dependent surveillance-broadcast and CPDLC are in service in various regions of the world but lack global harmonisation. Current regional initiatives, including utilising unique message subsets and CPDLC procedures, hinder efficient development and acceptance for global aircraft operations. Existing and emerging technologies should be implemented in a harmonised global manner in the near term to support long-term goals. Harmonisation will define global equipage requirements and therefore minimise user investment.

Future air navigation services (FANS)-1IA and aeronautical telecommunication network applications support similar functionality, but with different avionics requirements. Many internationally-operated aircraft are equipped with FANS-1IA avionics initially to take advantage of data link services offered in certain oceanic and remote regions. FANS-1IA equipage on international business aviation aircraft is underway and is expected to increase.

One of the foundations of future air traffic management (ATM) is information sharing. To reach this objective aeronautical information shall be made available digitally. Barriers between static and dynamic data should be removed and data fusion from multiple sources should be possible. This requires standardised data exchange formats and interfaces, ready to be used by the next intended user (system). Digital aeronautical information management (AIM) aims to establish an overall environment for sharing the required information.

11.1.2 Medium- and long-term activities

There are only medium- and long-term activities in this field.

111) AIS-1: Introduce pre-departure clearance

The use of CDPLC should be increased by introducing pre-departure clearance at major airports. This is one use of CDPLC and other applications will be implemented with different time frames.

112) AIS-2: Introduce digital AIM

This will improve information management in the AIS domain.

11.2 GPI-18 AERONAUTICAL INFORMATION

The scope is to make available real-time, quality-assured electronic information - aeronautical, terrain and obstacle. Related operational concepts are AOM, DCB, AO, TS, CM, AUO and ATMSDM.

11.2.1 Strategy

Area navigation, required navigation performance, computer-based navigation systems and ATM requirements introduced a need for new corresponding aeronautical information services (AIS) requirements for quality and timeliness of information. To manage the provision of information and satisfy these new requirements, the traditional role of aeronautical information service should change into a system-wide information management service with changing duties and responsibilities.

To facilitate coordination, improve efficiency and safety and ensure that the ATM community shares the same information when collaborating on decisions, it is essential that quality-assured electronic information is available in real-time. Electronic information will enhance pilots' situational awareness by loading on-board equipment with geo-referenced data sets containing en-route, terminal and aerodrome information. The same information can be made available at different ATC positions and pre-flight planning units as well as for access by airlines' flight planning departments and general aviation users. The electronic information can be tailored and formatted so that it satisfies ATM user requirements and applications. Standardised data formats will be used in creating the information databases.

As today, close coordination shall be established between the Meteorological Watch Office (MWO) in Indonesia and the corresponding ATS unit. This is a requirement set by ICAO Doc 9377, 8896 and standards and recommended practices (SARPs) AN3 and 11. Also the Asia/Pacific Regional SIGMET Guide add requirements. The controllers require access to current weather information in order to have a clear information source to make tactical or strategic decisions. There should be access to the weather information (e.g. SIGMET) sources available in neighbouring states in order to present high-quality information to the controller. It is vital that the controller can transmit, without delay, special air-reports received through voice communication to the associated MWO.

11.3 CURRENT SITUATION, SHORTCOMINGS AND MITIGATION ACTIVITIES

The ongoing reorganisation of the Directorate General of Civil Aviation (DGCA) and air navigation services providers (ANSP) is also affecting the AIS/meteorological services for air navigation (MET) domains. AIS (Aeronautical Information Publication (AIP)/MAP Service) and Notice to Airmen NOTAM Office (NOF) are today organised as a part of DGCA. Aerodrome AIS Units/Briefing Office combined with ATS Reporting Office are currently organised by the airport authority. NOF will initially be delegated to the new planned single ANSP, while the AIP/MAP services will be delegated in the medium to long term to the ANSP. The activities proposed in the Master Plan are however valid independent of the organisational outcome.

The transition from AIS to AIM will be an important part of future activities for Indonesia and are proposed to follow the International Civil Aviation Organisation (ICAO) Road Map. In the new ATM environment, when the bulk of commercial aircraft flying in or over Indonesia is equipped with GPS and equipment reliant on a database for navigation, it is essential to have accurate and reliable data created and supplied by AIS.

Currently the AIS of Indonesia is conducted under the ICAO SARPs but there have been deficiencies in products leading to complaints from airlines, pilots and the chart industry. Revised regulations and development of guidelines are necessary for AIS and data resources/suppliers. Quality assurance programs must therefore continue in order to restore and maintain confidence. Indonesia is promulgating AIP, including amendments and supplements, according to AIRAC circles and currently the updated information is available on the DGCA website. The International NOF is located at DGCA headquarter and open H24. Aerodrome AIS units/briefing offices are found at almost all instrument airports in Indonesia.

The future aeronautical information management, safeguarding that the ATM community shares the same real-time information for decision-making, will be addressed in recommended activities. Short term activities listed below are identified from studies like the JICA report, the working group AIS/MET/search and rescue associated with the Master Plan work, stakeholders' expectations and ICAO identified issues in the AIS to AIM Road Map.

11.3.1 Short-term activities

113) AIS-3: Establish a task force for transition from AIS to AIM

DGCA should establish a task force to plan for the transition from AIS to AIM based on the ICAO Road Map. The purpose of the plan should be to provide guidance on the development of processes, structures and staffing, data management and technology in harmony with national requirement and international obligations.

114) AIS-4: Improve the submission and distribution of flight plans

DGCA should, as a matter of urgency, establish a task force with the aim to clarify why several flight plans are lost at operational units in Indonesia. This situation is valid for both domestic and international flights and is not acceptable.

After a survey of reasons for these shortcomings, remedies must be implemented. Special attention must be paid to small airports without briefing offices and aeronautical fixed telecommunication network line and different solutions investigated such as e-mail, phone, short messaging service application and web-based applications.

115) AIS–5: Increase flight plan (FPL) prior submission time

DGCA as the regulator should investigate and propose effective solutions. A proposal from the WG activities is to require an earlier submission time for IFR-flight plans. This is strongly recommended to be three hours before estimated off-block time. One reason for this early submission is to enable ATM units to have prepared data at the time of departure and another is to allow air traffic flow management (ATFM) monitoring of expected traffic demand.

116) AIS-6: Provide FPL process training

DGCA as the regulator should require that all staff entering flight plans into the ATM system must be given training and adhere to the correct FPL process as stated in ICAO Doc 4444. The current process of raising, distributing and modifying FPL must be reviewed to improve timeliness, accuracy and consistency.

117) AIS-7: Implement ICAO New Flight Plan 2012

DGCA should establish an ICAO Flight Plan Implementation team to manage and coordinate the introduction of the new ICAO Flight Plan and necessary upgrading of associated systems, initiated 2012. An updated training activity for all staff concerned should be arranged.

118) AIS-8: Improve AIS/ATC communication with associated MWO.

ANSP should formalise and provide for telephone connection with associated MWOs. It is important that ATM units and MWO can exchange information of reported or expected significant weather conditions and also transit essential weather messages between MWO and pilot

119) AIS–10: Implement web-based information of AIP, NOTAM, AIC and AIP Supplement including digital NOTAM

DGCA should investigate possibilities and plan for future development in the AIS/AIM domain using new technology. Australia and Singapore could be used as examples.

11.3.2 Medium- and long-term activities

120) AIS-9: Review and evaluate repetitive flight plan (RPL) system

DGCA should investigate and propose mitigation actions in order to minimise the use of RPL. Future national flight data processing system will benefit from increased use of FPL also in relation to monitoring activities for instance in the reduced vertical separation minimum project.

The only long-term activity in this field is to continue development.

121) AIS–11: Continue AIS/AIM development

11.4 GPI-19 METEOROLOGICAL SYSTEMS

The scope is to improve availability of meteorological information in support of a seamless global ATM system. Related operational concepts are AOM, DCB, AO and AUO.

11.4.1 Strategy

Immediate access to real-time, global operational meteorological (OPMET) information is required to assist ATM in tactical decision-making for aircraft surveillance, air traffic flow management and flexible/dynamic aircraft routing. Such stringent requirements imply that most meteorological systems should be automated and meteorological service be provided in an integrated and comprehensive manner through global systems like the world area forecast system (WAFS), the international airways volcano watch (IAVW) and the ICAO tropical cyclone warning system. Enhancements to WAFS, IAVW and the ICAO tropical cyclone warning system to improve the accuracy, timeliness and usefulness of the forecasts will be required.

Increasing use of data-link to downlink and uplink meteorological information (through such systems as D-ATIS and digital meteorological information for aircraft in flight [D-VOLMET]) will assist in the automatic sequencing of aircraft on approach and will contribute to the maximisation of capacity. The development of automated ground-based meteorological systems in support of operations in the terminal area will provide OPMET information (such as automated low-level wind shear alerts) and automated runway wake vortex reports. OPMET information from the automated systems will also assist in the timely provision of forecasts and warnings of hazardous weather phenomena. These forecasts and warnings, together with automated OPMET information, will contribute to maximising runway capacity.

At present there is a corporate agreement between the Ministry of Transport and the Meteorology, Climatology and Geophysics Agency, regarding service information of aviation meteorology. ATC receives METAR information every 30 minutes for the main airports in Indonesia, similar to the procedures valid in other countries. MET and airport information for some of the main airports are automatically transmitted via ATIS to the pilot. Specific data from weather radars are not presented on the existing ATC radar presentation systems.

Exchange of reported significant weather conditions between controller and MET office seems to be limited and not formalised. This shortcoming may be overcome at low or no coast to the benefit of safety. This is especially valuable in this tropical area and has an impact on both en-route and airport operations.

11.4.2 Short-term activities

122) AIS-12: Improve communication between Area Control Centre (ACC)/TWR with associated MWO

DGCA should initiate a process to ensure communication possibilities between ACC/TWR and associated MWO, including regulation and telephone communication facilities. It is important to exchange information of reported or expected significant weather conditions and also when needed transit essential weather messages between MWO and pilot.

11.4.3 Medium-term activities

123) AIS-14: Consider future weather information system

DGCA should consider implementation of new technology for weather information including satellite weather information to be accessible for air traffic controllers in ACC. Forecast severe weather or other significant weather information advised by the forecaster should be presented. Bad weather such as cyclones and typhoons or significant information such as thunderstorm and jet stream as well as the existence of ash clouds could be a hazard for aviation.

11.4.4 Long-term activities

In the long term, information requested by the aircraft could be uploaded and weather data from aircraft downloaded using data link.

124) AIS-15: Review long-term weather information system

11.5 SUMMARY TIMETABLE

The table below summarises all activities in the AIS field.

Table 1: System-wide information management activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
System Wide Information Management (AIS)										
111	Pre-departure clearance									
112	Digital AIM									
113	Transition from AIS to AIM									
114	Improved submission and distribution of FPL									
115	FPL prior submission time									
116	FPL Training process									

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
117	ICAO New Flight Plan Implementation 2012									
118	AIS/ATC communication with associated MWO									
119	Web-based AIP, NOTAM, AIC and AIP Supplement									
120	Review and evaluate RPL system									
121	Continuing development									
122	Jakarta & UP ACC communication with associated MWO									
123	Future weather information system									
124	Long-term weather information system									

CHAPTER 12: AIS/MET TRANSITION INTO AIM

The vision for aeronautical information services AIS is to use information management to provide accredited, quality-assured and timely information supporting air traffic management (ATM) operations. Information management will also monitor and control the quality of the shared information and provide information-sharing mechanisms supporting the ATM community.

12.1 STRATEGY

Information management will assemble the best possible integrated picture of the historical, real-time and planned or foreseen future state of the ATM situation. It will also provide the basis for improved decision-making by all ATM community members. Key to the concept will be the management of an information-rich environment. AIS will ensure the cohesion and linkage between the seven concept components in International Civil Aviation Organisation (ICAO) Doc 9854 and will use globally harmonised information attributes. Direct improvements of the ATM system will be:

- The quality of the information that, in turn, provides significant additional benefits
- That pertinent information will be available when and where required
- That the system will recognise and accommodate temporality of data
- That information can be personalised, filtered and accessed as needed
- That the system will allow all participants to adjust information sharing to mitigate any proprietary concerns
- Achieving a seamless transfer of information between parties in a flexible, adaptable and scalable information environment

The provision of meteorological information will be an integrated function of the ATM system. Information will be tailored to meet ATM requirements in terms of content, format and timeliness. The main benefits for the ATM system will be related to the following:

- Improved accuracy and timeliness of meteorological information
- Increased availability of shared meteorological information on-board the aircraft
- Better identification, prediction and presentation of adverse weather
- Improved aerodrome reports and forecasts
- Increased availability of meteorological information (air-reports) from on-board meteorological sensors
- Meteorological information will contribute to reducing the environmental impact of air traffic

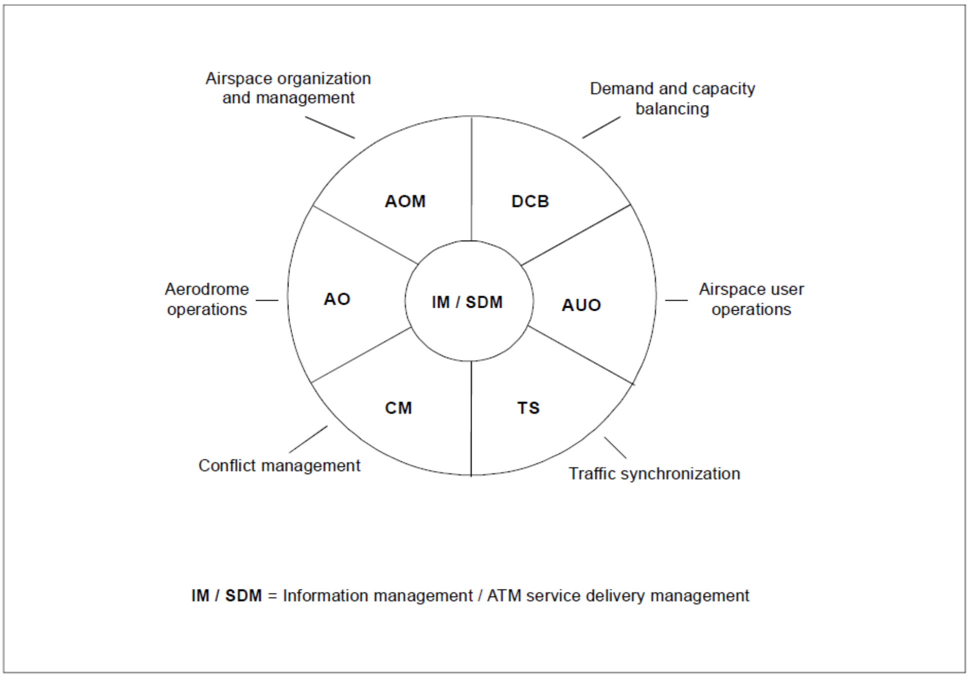
Regarding alerting services for Search and Rescue (SAR) organisations, a follow-up methodology will assure that all aircraft in distress and all accidents are detected without delay and that alerting of SAR (Indonesian Search and Rescue Agency [BASARNAS]) will be initiated immediately. The information to BASARNAS will be based on timely and accurate SAR information on aircraft in distress and on accidents. A dedicated position (e.g. supervisor or flight data operator) should be able to monitor if flight plans are not terminated. This may indicate either a failure to register a landing or in a worse scenario a possible accident. The aim is to grant flight following and secure the alarming function to the responsible Air Rescue Coordination Centre (ARCC).

Currently there is a corporate agreement between the Ministry of Transportation and the National SAR Agency regarding SAR for aviation. In case of a possible accident, the operator should be able to view both passive and active recordings. With an active recording the solution enables the operator to replay an event and actively make inputs, such as changing parameter settings etc, during the replay.

12.2 COMING GLOBAL CHANGES

Globally, the provision of aeronautical information today is mainly focused on the requirements of pre-flight briefing. The global provision tomorrow will address the requirements of all components of the ATM system for all phases of flight.

Figure 29: Information management in the future ATM operational concept



Source: ICAO Roadmap for the Transition to AIM

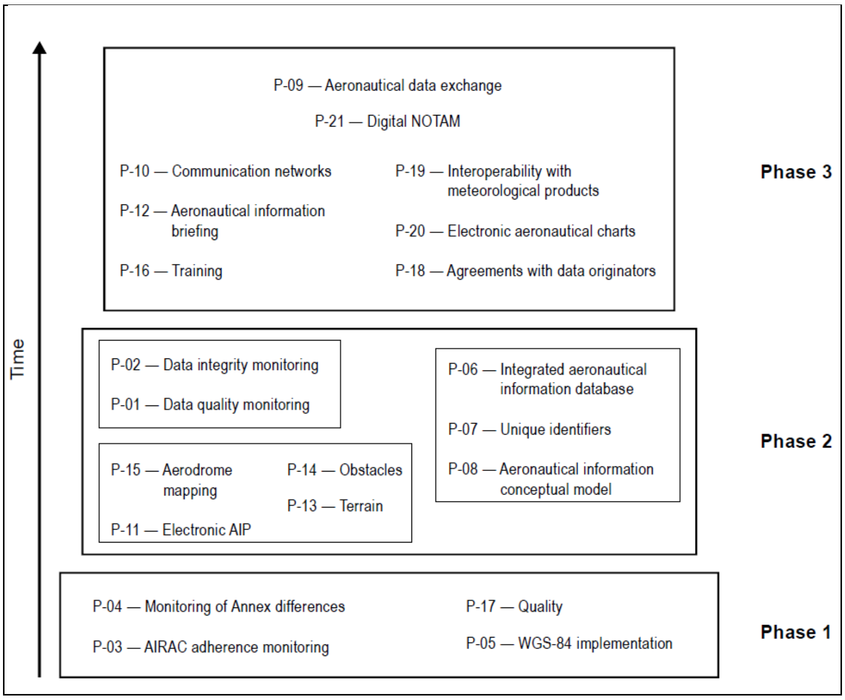
The ICAO roadmap provides the strategic direction and major principles for the transition to aeronautical information management (AIM). The three phases introduced in Part I need not be followed in a waterfall approach; for example, steps may be taken to introduce the digital elements even though the consolidation steps have not all been finalised. Similarly, it is not necessary that all steps for going digital are achieved before introducing new measures related to information management. The phases, however, give an indication of how to address the transition.

A minimum list of major steps to achieve the transition to AIM is provided in Part II of the ICAO road map document. A broad positioning of the steps in relation to the three phases is also provided in Figure 30. The transition to AIM will be effective at the global level when these steps have been achieved. Most steps in Phases 2 and 3 of the transition require new standards and recommended practices to be adopted at the global level; an indication of the time required for these new texts to be available is provided in Part III of the road map document.

The steps listed in Part II constitute a minimum list of areas of activities for ICAO States to coordinate the transition to AIM between themselves and with ICAO. These steps are to be taken as a checklist of high-level actions. Failure to take action on any of these steps would increase the duration of the transition and negatively affect the enabling role of AIM in the future ATM concept of operation.

The list may evolve during the transition, especially when closer to Phase 3. This road map will be updated with the further evolution of the overall ATM concepts and system requirements.

Figure 30: Positioning of the 21 road map steps in the three phases



Source: ICAO Roadmap for the Transition to AIM

12.2.1 Short-term activities

125) AIM-1: Introduce procedures or systems to grant flight monitoring from a SAR perspective

A flight data operator or supervisor should be able to monitor whether flight plans are terminated. To assure that all aircraft in distress and all accidents are detected without delay and that alerting of BASARNAS is initiated immediately, a SAR procedure must be established.

126) AIM-2: Implement a dedicated work-station to support ARCC with information

The operator should be able to view both passive and active recordings. The work station could be placed at both Area Control Centres (ACCs) in conjunction with the new Jakarta ACC and the update of Ujung Pandang or at a national entity if so decided in the re-organisational project.

127) AIM-3: Safeguard quality of AIS data

The top priority is to explore practical ways of assuring quality of AIS data. With modern air navigation, the quality of AIS data has a direct impact on flight safety. Airlines, suppliers of aeronautical charts, performance data and navigational data bases are all relying on accurate data. AIM-4 to AIM-9 below include elements of a proposed quality assurance methodology.

128) AIM-4: Adopt a quality assurance process for received data

It is essential that there is a process for quality assurance of data received and evaluated from different sources.

129) AIM-5: Train staff regarding data quality and integrity

All staff involved in the process of receiving, establishing, submitting, and publishing data need proper training.

130) AIM-6: Introduce a certification system for aeronautical surveys

Companies and professionals contracted for aeronautical surveys should be certified by the regulator.

131) AIM-7: Undertake obstacle surveys and produce Aerodrome Obstacle Charts (Type A) for all airports with commercial air traffic

Currently there are many airports without this kind of charts. This is a safety issue requiring immediate attention. The Directorate General of Civil Aviation (DGCA) can require the airports to undertake this under current regulations.

132) AIM-8: Establish a reporting process for aerodrome changes

For events like construction works at an aerodrome, changing essential data like threshold location, a process should be established where aerodrome operators or contractors are required to issue revised data.

133) AIM-9: Negotiate agreements with data originators to assure quality and availability of received data

In order to have constant access to quality-assured data, it is necessary to have an agreement with the data producer.

134) AIM-11: Improvement of existing AIS training manual

The existing AIS training manual should be improved and all staff should attend AIS training to increase their knowledge and competence. To facilitate the development of the manual, a team comprising AIS staff and experts from an international independent organisation should be engaged.

135) AIM-12: Develop a plan for integrating FPL between ACC and approach control

136) AIM-13: Establish a quality management system for AIS/AIM in accordance with ISO 9001

The quality management system should be based on guidance provided in ICAO Doc 9906 (Quality Assurance Manual for Flight Procedure Design), Doc 9674 (WGS-84 Manual), Doc 8126 (AIS Manual) and AIS Quality System Manual (SI175-05). Quality and Safety Management in general is described in Chapter 15:

137) AIM-14: Establish a quality management function into the organisation

See also Chapter 15:

138) AIM-15: Provide training in Quality Management

AIM staff involved in the handling of AIS data needs quality management training.

139) AIM-16: Establish a Quality Management Manual

The existing draft quality management manual (DGCA Staff Instruction 175-05) should be improved and finalised.

12.2.2 Medium-term activities

140) AIM-17: Establish a central database and procedures for collection, implementing and storing of aeronautical data in this database

It is essential that there is one database where all quality assured AIS data can be retrieved. Compare with the European Aeronautical Information Database.

141) AIM-18: Establish a data quality monitoring system

It is essential that the quality of all data entered into the database is monitored.

12.2.3 Long-term activities

142) AIM-19: Follow the ICAO Road Map Transition from AIS to AIM

The long- term recommendation is the obvious goals derived from ICAO Road map transition from AIS to AIM. The work group sessions fully supported these and confirmed their validity for Indonesia.

12.3 SUMMARY TIMETABLE

The table below summarises all activities in the field of transition from AIS to AIM.

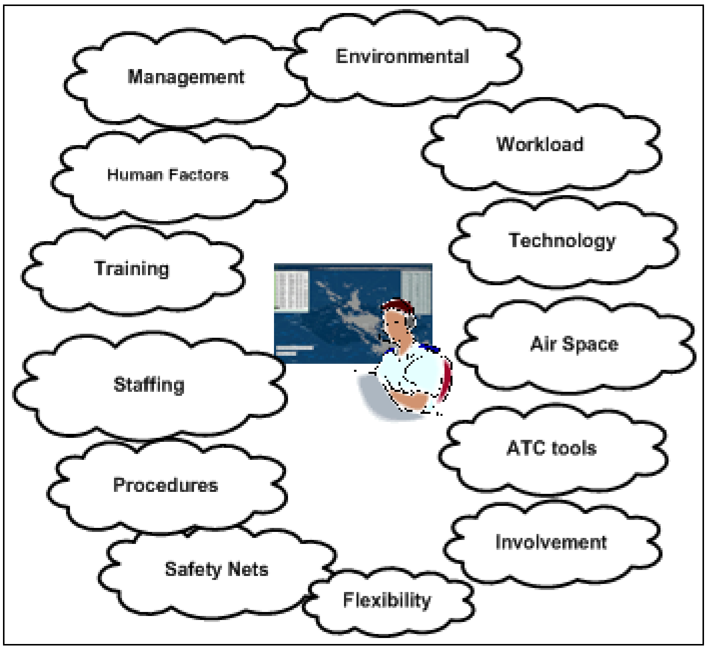
Table 1: AIS/MET transition activities time schedule

	Horizon	Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	AIS/MET Transition to AIM (AIM)									
125	Procedures/system to grant flight in a SAR perspective									
126	Implement a dedicated work-station									
127	Assuring quality of AIS data									
128	Adopt a quality assurance process for received data									
129	Staff training regarding data quality and integrity									
130	Certification system for aeronautical surveys									
131	Undertake obstacle surveys and produce charts									
132	Establish a change process for aerodrome changes									
133	Assure quality and availability of received data									
134	Establish an AIS Training Manual									
135	Develop plan for integrating FPL (single point of entry)									
136	Establish a Quality Management System									
137	Establish a quality function into the organization									
138	Provide training in Quality Management									
139	Establish a Quality Management Manual									
140	Establish aeronautical data in central database									
141	Establish a data quality monitoring system									
142	Follow the ICAO Road Map Transition from AIS to AIM									

CHAPTER 13: HUMAN RESOURCE MANAGEMENT

Human performance is dependent on methods, systems and organisational support to introduce "best practices" in terms of efficiency and safety. A human-machine interface (HMI) behaviour and style guide is an example of best practice in an area important for efficiency and for user acceptance. This section describes human resource management (HRM), the human aspects that should be considered when implementing a new concept of operations.

Figure 31: The Team's impression of human resource management



The subject of human factors (HF) in the air traffic management (ATM) world is one important issue and there is a need for air traffic controllers and other operational ATM staff to have "knowledge of human performance and limitations". Historically, HF belonged to the scientific world but things have changed especially with regard to automation, although controllers, pilots and technicians still function in the same roles as before. Human factors in air traffic control have migrated from the academic to the operational world. A major result has been a new appreciation for the importance of HF issues by air navigation services providers (ANSP). HF is only one part of HRM, which covers all aspects of the management of all employees of an organisation. This chapter will provide information on some of those aspects.

13.1 HUMANS AND AUTOMATION

Humans and their skills will constitute the core part of the future ATM system. Humans make things work, using their competence and flexibility - important properties for the foreseeable future in the aviation sector. However, in order to accommodate future traffic increase and to improve efficiency, a level of automation has to be introduced. Humans should be in the centre of this development. Systems should respect human qualities and human deficiencies. Ideally, systems will strengthen human skills and support where humans have weaknesses. ATM staff will in general benefit from automation.

Automation should be designed to improve safety, capacity and efficiency through supporting humans in their operational tasks. Automation may not only support humans, it also places the human in a more vulnerable situation, when automation fails or unexpected situations occur. It is therefore necessary to validate and monitor how operators perform in an evolving system environment. Humans need to be able to maintain situation awareness and to act in a relevant and efficient manner when tasks demand the human to take action.

All ATM systems comprise humans and technology. The human is needed because of his/her strength in managing systems rationally and flexibly, especially when confronted with unforeseen events. A problem could be that because we are human, we will make mistakes leading us to believe that we are the cause rather than the cure, and by removing us we improve safety since we reduce the risk for human error. Humans become frustrated when being blamed for “errors” while receiving no recognition for making things work. We need to recognise the strengths and limitations of humans and as well the strengths and limitations of automation.

Indonesian ATM Community should agree that the human is the central element in aviation systems, and as such, is entitled to all available resources promoting and facilitating the understanding of philosophies in system design, and understanding concepts such as situational awareness and error management. Humans shall remain the managers of automation and not its servants. This means that the human chooses what is to be done, delegates execution to automation and is able to intervene if required; this is a core principle that should be applied for new ATM Systems. It is important that controllers and other ATM staff are involved in the modernisation process not only in automation but also in implementation of new equipment and working methods.

13.2 TRANSITION OF WORKING METHODS

The Directorate General of Civil Aviation (DGCA) and PT Angkasa Pura 1 have experience from commissioning of the new area control centre in Ujung Pandang including use of new technology. The new Indonesian ANSP should prioritise human-machine interface HMI features of new equipment and applications of new procedures, in today’s environment. Focus must be shifted from eliminating error to preventing and managing error.

The bonus will be a new ATM system supporting Indonesian user, removing non-essential tasks, reducing workload and improving performance and efficiency. In order to continue to embrace automation to move forward, the support must be developed and implemented in a way that fosters trust and confidence in the automation. The user confidence in the system is vital when making a transition from today's operation into tomorrow's.

There are challenges, but a first essential step is commitment to an evolutionary process ensuring that the strengths of humans and automation are maximised while their weaknesses are minimised. The Indonesian authorities and ANSP must also be attuned to system error - not just "human error" but deficiencies involving humans and/or automation. It is important that humans are not held responsible for automation that is not within the human's capacity to monitor and manage or within his/her ability to influence. The foreseen changes in the human role within ATM will have a major effect on staffing and training and therefore those who will "operate" the automation must be involved throughout the design, simulation, implementation and review of automated systems.

13.3 WORKING ENVIRONMENT AND CONDITIONS

The Indonesian ATM community must also be aware of other "human necessities" in work places such as adequate catering facilities, proper rest areas particularly when night work is involved, and the control room/tower environment. Environmental conditions are not only affecting the system components but have also a great impact on the humans using the system.

Room temperature, humidity and lighting contribute greatly to the well-being of workers and reduce the risk for fatigue etc. Historically, area control and approach centres (ACC/APP) required rooms without any windows since the daylight was reflected on the radar displays with a negative impact on the controller's ability to monitor the traffic. This resulted in windowless environments having a negative impact on human performance. In a modern ACC/APP rooms the displays can tolerate a much greater amount of daylight without causing nuisance for the controller and it is strongly recommended to enable some daylight to enter the ACC/APP rooms when renovating or rebuilding ATM premises.

The design of new operational work-stations is important for the long-term performance and well-being of the operators. Ergonomics are becoming important in an information- and input-intensive environment. Since operators in a modern ATM-system are making selections of data and frequent inputs, the associated ergonomics and input device become critical.

Safety- and HF-related issues such as hours of work, consecutive working days and mandatory overtime can in their own subtle way contribute to the fatigue factor. The ANSP must together with the different categories of ATM staff develop good working conditions taking into account not only working hours/week but also minimum breaks, holiday and extra duty conditions.

13.3.1 Motivation and training of ATM staff

The motivation factor is based on commitments from the employer to the employee. It covers staff–management but also management to management. Motivated employees have a higher level of productivity than unmotivated employees. Factors influencing the motivation factor are (among others):

- Working conditions (salary, rosters, etc)
- Work culture (relation to others colleagues/bosses)
- Work load and variety of tasks
- Support from management

The ATM Community has currently an agreement with a qualified training institute. The training requirement, in terms of content, skill and number of trainees/year should be determined. All training must be based on International Civil Aviation Organization recommendations and contain different training domains such as:

- Basic controller training, non-radar and radar services ACC, APP, aerodrome control and flight information staff training
- English language training
- Specific training for staff working in automated environment
- ATM management training for operational and technical supervisors, flight management position (FMP) managers and proficiency check controllers
- FMP controllers, briefing officers, flight plan specialists and engineers

The ANSP should also develop a training plan and organise “refresher training” including training in procedural control, the use of “fall back” system and emergency situations. The latter should focus on local conditions and procedures etc.

13.3.2 Human factors training

The ANSP should take positive steps to provide the required training programs for all staff in the area of HF. Training programmes featuring gradual and systematic introduction of HF knowledge to new and experienced employees alike is a necessity. The key to longevity is to direct our efforts on converting practical expertise into written procedures, rules and regulations in a culture that focuses on the human, and as such these programmes should include HF specialists and operational training specialists as they are the most appropriate source for information on user preferences, knowledge of issues, procedures, and practices. Service providers must invest in their most valuable resource - their staff. A motivated and dedicated workforce will thrive well into the future.

HF knowledge should be placed high on the list of priorities. Indonesia's goal should be not only to implement or maintain safe systems, but also to improve aviation safety through education. It must be emphasised that to limit HF issues to individual operators in a complex system such as aviation, whether they are controllers, pilots or other vital participants, is undesirable. Operators must be familiar with the logic behind the HMI and share the same basic understanding of how a system or component is designed, how it works and its limitations. Since the man-machine interface is so important in aviation, it is imperative that the systems fit the human and not the other way around. It is somewhat appalling that in this day and age there are many occasions where new or updated equipment goes into service with little or no direct input from the people who will use it.

A key element is education and training in HF and the development of a formal education plan will also ensure that HF considerations are fully incorporated when procuring and commissioning a new ATM system. Team resource management as a concept should be considered in the continuation training of air traffic controllers (ATCOs).

13.3.3 Recruitment and staffing

Recruitment and staffing are of paramount importance for the successful management of the ATM system. The evolving complex generation of ATM systems requires careful considerations in order to improve efficiency and safety. The well-being of humans is also an important factor for transition to new environment. In the strategic HR planning, it is essential to have the right amount of professionals well qualified for the current work but also for new tasks being developed by new technical equipment and new procedures. Staffing plans with regular updates should contain expected increases of staff due to increasing traffic and retirement replacements. The composition of a staffing plan for a specific unit should also consider the age and gender of the existing staff in order to get as broad a mix of qualifications and experiences as possible. Human resource situation concerning ATCOs see 1.2.1.

13.3.4 Short-term activities

143) HRM-1: Create a task force for working conditions

Indonesian ANSP should create a task force with the objective to handle working condition issues for staff in the new organisation. The work should take into account use of "best practices" and the information described in this chapter.

144) HRM–2: Create a task force for training of ATM staff

Indonesian ANSP should establish a task force with the objective to formulate the requirements and competences of future ATM staff categories (see below). Due to the need for a high number of staff, especially air traffic controllers to manage the forecast demand, the possibilities to engage external agency or international training institutes should be a part of this activity. The minimum experience and qualifications should be proposed by the ANSP and approved by DGCA. Details are found in section 13.3.1.

145) HRM-3: Develop staffing plans for controllers, aeronautical information services staff, flight data operators and engineers

Indonesian ANSP should develop staffing plans and update plans at least annually. Technical/operational specialists must be available for the ANSP to maintain and up-date data set and other system development issues. The following objectives apply to all staffing plans:

- To overcome existing lack of operational staff and determine required numbers
- To recruit a sufficient number to operate the additional sectors and units or extended hours of operation required due to forecast increase of traffic in ACC, APP and ADC. Determine required numbers
- To recruit in order to meet expected retirements and other reasons for leave; determine future required numbers including the need of 700 additional air traffic controllers in the near future
- Assess the capability of current infrastructure to accommodate training requirements
- If found necessary, make arrangement with foreign agency training in the short and medium term

To recruit in order to meet expected retirements and other reasons for leave; determine future planned.

13.3.5 Medium- and long-term activities

146) HRM–7: Continued training

Recruitment and continuation of training should be planned and developed by Indonesian ANSP based on experience from developing staffing plans (HRM-3).

13.4 SUMMARY TIMETABLE

The table below summarises all activities in the HRM field.

Table 1: Human resource management activities time schedule

Horizon		Short term					Med.		Long	
Project description (abbreviated)		2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
Human Resource Management (HRM)										
143	Working conditions									
144	Training of ATM staff									
145	ATCO, AIS, FDO and engineers staffing plans									
146	Continued training									

CHAPTER 14: CONTINGENCY

Contingency arrangements shall serve the provision of air traffic services in the event of a disruption. The “contingency plan” should form part of the business continuity arrangements and allow for the servicing of civil and military traffic in a safe and cost-effective manner all the while maximising business continuity to the extent possible.

14.1 TERMS USED IN THIS CHAPTER

Aiding unit: An air traffic services (ATS) unit handling air traffic through an adjacent area of responsibility (AoR) in a critical situation. Methods are agreed in a letter of agreement (LoA) or via temporary agreement between operational supervisors. Agreed capacity will be imposed via flight management position (FMP), preferably based on cFLAS below.

Conflict-free flight level allocation scheme (cFLAS): Agreed coordinated flight levels without any level conflicts, enabling transit flights through an adjacent area on predetermined conditions.

Contingency system: A full or limited capacity substitute for the main air traffic management (ATM) system including its fall-back systems, residing in a separate facility and capable of taking over delegated defined tasks in case of a “total failure” of the main system in the Area Control Centre (ACC)/Approach Control (APP) building or in case of the entire building being declared unserviceable due to a fire or other causes.

Contingency sector: A sector established at another unit or in other premises manned by rated staff from failing centre (ACC or APP). Decided and limited capacities are imposed via FMP.

Fallback system: A system component of the main ATM system and residing in the ACC/APP building. The system component will take over when one system component of the main system experiences a “total failure”. An example is the voice communication system (VCS) system which should have a fallback in the emergency VCS. The emergency system, when activated, is used for a controlled “clear the sky” activity.

Outage: An exceptional circumstance, foreseen or unforeseen affecting one or more elements of the system (people, procedures and equipment) that, in the absence of adequate fallback arrangements, may lead to service disruption.

14.2 STRATEGY

Reasons for, and causes of failures/outages are so variable that it may not always be possible to provide an exhaustive list of mitigating actions to be taken. Under these circumstances, air traffic controllers are expected to exercise their best judgment to ensure the safety and efficiency of air traffic. It is recommended that the new air navigation services provider (ANSP) organisation and its associated equipment should have built-in redundancy(s) and fall back systems for both operational and technical considerations as well as for sites, methods, instructions, checklists and emergency training.

The operational supervisor in cooperation with the FMP controller should be the focal point in contingency situations, particularly as they pertain to slot allocations and information to users during all phases of any contingency. Letters of agreement should authorise supervisors of ATS units to introduce temporary modifications and deviations, for specified periods of time as required. Such procedures should be described in Annexes to the LoAs.

A valuable resource to assist the Directorate General of Civil Aviation (DGCA) and Indonesian ASNP in its contingency planning is the International Civil Aviation Organisation (ICAO) Annexe 11 Attachment D “Acceptable level of safety” and DOC 9426. In addition, information is available in the EUROCONTROL Document “Guidelines for Application of ATS Contingency Planning”.

If and when operational contingency methods require, an alternate, temporary air traffic control (ATC) centre location should be prepared. The following tentative list of site alternatives to be planned should be considered:

- Transfer and merging of sectors in ACC
- Transfer into remote facilities such as simulators when available
- Mutual contingency arrangements between Jakarta and Ujung Pandang ACCs
- Mutual contingency arrangements between the respective ACC and ADC/APP when feasible
- Use of defence sites
- Other centres in adjacent countries for parts of the AoR, including the possibility to temporary delegate the provision of ATS within defined limited portions of the airspace, for specific time periods

14.3 CONTINGENCY PHASES

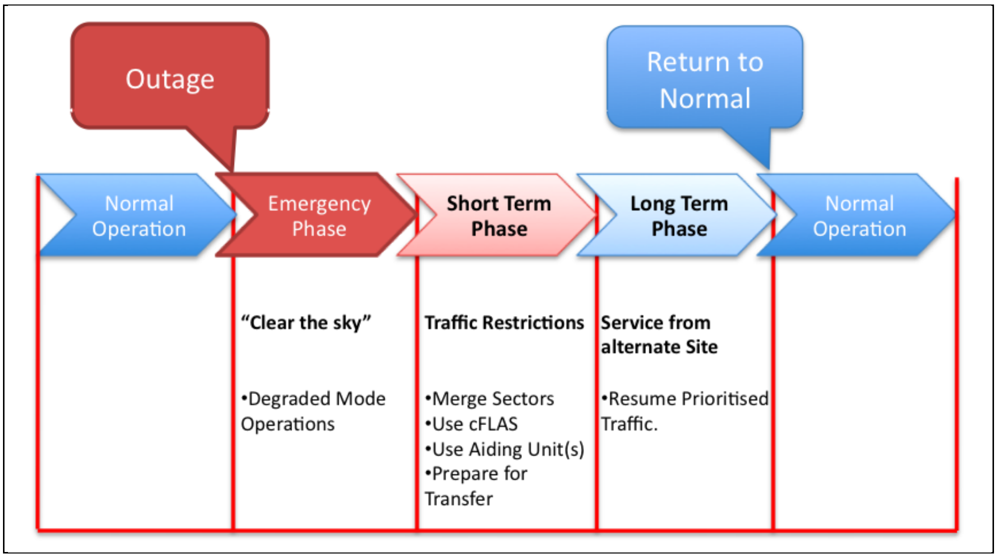
The emergency phase constitutes the time period from the occurrence of a severe technical outage or disruption, until such time as the operational staff has control over the situation, and the traffic volume is reduced to a reasonable level considering the existing staffing and equipment situation ("clear the sky"). Action plans and checklists for staff concerned should be available at short notice.

The short- term phase constitutes the time period from when control was established up to the time that the emergency phase ended. This could be up to approximately 48 hours after the disruption. As soon as ACC has the situation under control, work should start to accommodate the prioritised traffic demand (see below) to the best of its capability, in addition to resuming limited traffic flow assisted by FMP. Flight safety must be maintained by introducing traffic restrictions in order to reduce sector capacity and by means of "aiding unit functions" and the use of cFLAS. Preparations for transfer of service and staff to alternate operational facilities (contingency system site) should be made as soon as available.

The long-term phase is defined as a disruption occurring more than 48 hours after an emergency phase. As soon as it is assumed that the disruption of service is likely to last for more than 48 hours, a part of the Central Coordinating Committee with representatives from DGCA, ANSP and Indonesian Air Force should convene as soon as possible to facilitate a move of operations in order to provide service from the alternative site.

In the long-term phase, contingency measures set out in the plan are applicable in cases of foreseeable events. These may be caused by unexpected interruptions in ATM from natural occurrences or other circumstances, which may impair or totally disrupt the provision of ATM and/or of the related support.

Figure 32: Contingency phases



Source: based on Eurocontrol Guidelines for Contingency

The following arrangements have been put in place to ensure that the management of the contingency plan provides for international flights to proceed in a safe and orderly fashion through the upper airspace of the Jakarta flight information region (FIR) but should also be activated in other contingency situations.

14.3.1 Central Coordinating Committee

As soon as practicable in advance of, or after a contingency event has occurred, the Director General of DGCA should convene the Central Coordinating Committee (CCC) comprised of representatives from:

- DGCA
- PT Angkasa Pura I as ATS provider for the Ujung Pandang FIR and operator of major airports in the eastern region (the single ANSP when established)
- PT Angkasa Pura II as ATS provider for the Jakarta FIR and operator of major airports in the western region (the single ANSP when established)
- Indonesian Air Force
- Ministry of Defence
- Representative from the airlines committee
- Meteorological and Geophysical Agency
- Other participants as required

The CCC shall oversee the conduct of the contingency plan and in case Jakarta or Ujung Pandang ACC premises are out of service for an extended period, make arrangements for and facilitate the temporary relocation of the ACC. The objective is to restore ATS services. The terms of reference for the CCC will be determined by the DGCA.

14.3.2 ATM Operational Contingency Group

The ATM Operational Contingency Group (AOCG) will be convened by the CCC with a primary responsibility to oversee the day-to-day operations under the contingency arrangements, and coordinate operational ATS activities, 24 hours a day, throughout the contingency period. The terms of reference of the AOCG will be determined by the CCC. The AOCG will include specialised personnel from the following ATS disciplines:

- Aeronautical telecommunication (COM)
- Aeronautical meteorology (MET)
- Aeronautical information services (AIS)
- ATS equipment maintenance service provider

The mission of the AOCG shall include:

- Review and update of the contingency plan as required
- Keep up to date at all times of the contingency situation
- Organise contingency teams in each of the specialised areas

- Keep in contact with the ICAO Asia and Pacific Regional Office, operators and the International Air Transport Association Regional Office
- Exchange information with the adjacent ATS authorities concerned to coordinate contingency activities
- Notify the designated organisations in Indonesia of the contingency situation sufficiently in advance and/or as soon as possible thereafter
- Take the necessary action for issuing Notices to Airmen (NOTAMs) according to the contingency situation, this plan or as otherwise needed. If the situation is foreseeable sufficiently in advance, a NOTAM will be issued 48 hours in advance

14.4 CONTINGENCY ROUTE STRUCTURE

In the event of disruption of ATC services provided by Jakarta ACC, contingency routes will be introduced to ensure safety of flight and to facilitate limited flight operations possible under the prevailing conditions. Existing ATS routes form the basis of the contingency routes and a flight level assignment scheme will minimise potential points of conflict and limit the number of aircraft operating simultaneously in the system under reduced ATS. The contingency route structure for international flights should be published.

Additional contingency routes will be introduced as and when circumstances require, such as in the case of volcanic ash forming clouds. For domestic operations, if circumstances dictate, all flights shall be temporarily suspended until a full assessment of the prevailing conditions has been completed and sufficient air traffic services restored. A decision to curtail or restart domestic operations must be made by the CCC.

Aircraft on long-haul international flights and special operations (e.g. search and rescue [SAR], state aircraft, humanitarian flights, etc), shall be afforded priority in accordance with this plan. International operators affected by the suspension of all operations from Indonesian airports will be notified by the relevant airport authority when operations may be resumed, and flight planning information will be made available pertaining to that airport. International flights receiving such approval may be required to flight plan via domestic routes to join international contingency routes.

International operators may elect to avoid the Indonesian airspace and route to the west around Jakarta FIR via Melbourne and Colombo FIRs to Chennai and Kuala Lumpur FIRs and vice versa. The contingency routes to be used in this scenario will be provided by the ATS authorities concerned.

14.5 OBJECTIVES FOR ATM AND CONTINGENCY

The overall objective is to find solutions that gradually increase the air traffic to 50 percent of the normal “peak hour” number. The priority order is to find solutions to handle the following traffic:

1) HOSP and SAR
2) Quick reaction alert aircraft
3) International civil high sea traffic
4) International civil transit flights
5) International civil flights
6) Domestic flights
7) Military operations are subject to negotiations with military authorities
8) Other traffic

The list is based on ICAO Annexe 11 and EUROCONTROL Guidelines for Application of ATS Contingency Planning.

ANSP should also develop methods and procedures using cFLAS and aiding unit functions. Such procedures can be negotiated and included in the existing LoA and may be implemented before the commissioning of the new Jakarta ATM system.

As a “last resource” in an unlikely extreme catastrophic situation such as earthquake and terrorist attack, discussions with military authorities should take place in order to prepare for the tentative establishment of a limited collaborative ATM service for high priority operations.

14.5.1 Short-term activities

Note: The work with the activities below should take into account international guidelines and use of “best practices” together with information described in this chapter.

147) CON-1: Develop contingency plan for Jakarta ACC/APP/aerodrome control (ADC) and Ujung Pandang ACC

DGCA together with ANSP should establish a task force to develop and promulgate contingency plans for Jakarta ACC/APP/ADC and Ujung Pandang ACC according to ICAO requirements in Annexe 11 and Doc 9426. Supporting information is found in Eurocontrol Guidelines for Application of ATS Contingency Planning.

148) CON-3: Develop contingency plans for major APP/ADC in Indonesia

DGCA together with ANSP should establish a task force to develop and promulgate contingency plans for major APP/ADC units according to ICAO requirements in Annexe 11 and Doc 9426.

149) CON-4: Planning of future contingency facilities in Jakarta and Ujung Pandang AoR

DGCA as the regulator should, together with Indonesian ASNP in the planning process for the new Jakarta ACC and tentative new training facilities, take as far as practicable actions to include a contingency location for a number of merged sectors for ACC and APP. For Ujung Pandang AoR, contingency possibilities should be coordinated with the planning of the new Jakarta centre.

150) CON-5: Define sector capacity in contingency situations

Indonesian ASNP should define sector capacity in contingency situation, based on normal capacity. During situations when technical systems fail and are not in full-mode operation, a pre-planned alternative sector capacity should be developed.

151) CON-6: Investigate interim Jakarta Advanced Air Traffic Control System (JAATS) life extension

AS a proactive contingency activity, a possible interim life extension for JAATS should be investigated to cover a situation with major technical problems until a replacement is installed and operational (could be seen as a temporary maintenance and lack of spare parts issue leading to a contingency situation).

14.5.2 Medium-term activities

152) CON-7: Continue development

Further development of the short term activities above must be ensured in order to accommodate more traffic in a contingency situation.

14.6 SUMMARY TIMETABLE

The table below summarises all activities in the contingency field.

Table 1: Contingency time activities schedule

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	Contingency (CON)									
147	Contingency plan for Jakarta and UP ACC/APP/ADC									
148	Contingency plans for major APP/ADC									
149	Plan contingency facilities in Jakarta and UP AoR									
150	Define sector capacity in contingency situations									
151	Interim life extension for JAATS									
152	Further development to increase contingency capacity									

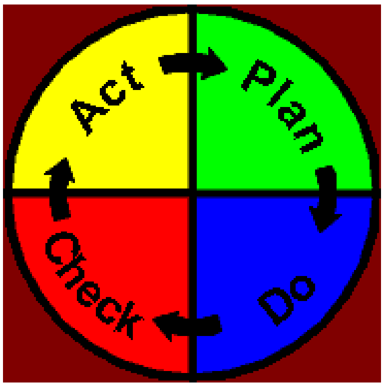
CHAPTER 15: SAFETY AND QUALITY MANAGEMENT SYSTEM

There is an International Civil Aviation Organisation (ICAO) requirement to implement a safety management system (SMS) within all air traffic management (ATM) services. There is also an ICAO requirement to implement quality management (QM) within aeronautical information services (AIS). The joint abbreviation is QSMS.

15.1 QM STRATEGY

A quality management system can be described as a systematic approach to achieve the selected goals and meet commitments based on customers' expectations. Customer orientation means an ongoing dialogue with our customers. We should always consider the possibility of satisfying customers' needs and preferences in relation to the cost. The Plan Do Check Act (PDCA) or "Improvement wheel" serves as a basic quality philosophy that will permeate work in an organisation with a developed QSMS.

Figure 33: PDCA wheel



Source: LFV Aviation Consulting

Plan: Identify objectives and processes necessary to deliver results in line with customer requirements and the organisation's policies and resources. There are also risk assessments.

Do: The phase where you implement what you have planned. Check that necessary regulation is in place and that you comply with this.

Check: Monitor and measure what you have implemented. "Was it really what we had planned?"

Act: Take action to continuously improve the performance of the different ATM processes, and start the planning process all over again.

Auditing is a way to improve operations. Audits verify that we maintain and improve our level of operations. An internal operation audit is intended to control whether the quality management system (QMS) of the ATM organisation is working and that the organisation is following what is described in manuals. If the organisation is certified according to an ISO standard, i.e. ISO 9001:2000, compliance will be assessed. With a revision involved, at least two auditors should attend to ensure objectivity. During the audit, the auditors discuss with the unit's management and as many employees as possible. The individual dialogues will be completely anonymous. Deviations from the previous audit are also followed up. Differences found are compiled in a report and discrepancies are followed up after an agreed time.

Once deviations are identified, they must be attended to. There are several types of deviations but the general definition is “everything that is not right or something you want to improve” and may occur for several reasons:

- Someone performs a task without due authority
- Someone does not follow a process/routine or other governing documents
- The absence of a process/routine
- Documents are not updated or do not match

An improvement is not based on anything that has gone wrong, but is a suggestion for things that work in the current situation but could work even better after some kind of change:

- Are we working with something that can be simplified/improved/removed?
- Are we working with something that can be simplified with a method/routine?

In addition to audits carried out, follow-ups in different ways within the organisation are normally carried out:

- How do we handle the operational work?
- Administration – how do we file documents? How is the document management system working? Are all filed documents traceable?
- The economy – do we follow rules and directives concerning budget issues?
- Environment – do our actions comply with rules and regulations?

In order for Indonesian ATM to provide future cost-efficient and safe service for all users concerned, it is vital that a QMS is implemented. This QMS could be based on ISO standardisation and when the single air navigation services provider (ANSP) is being established, it is recommended that it will be “quality” certified at an early stage.

15.1.1 Short-term activities

153) QMS-1: Implement customer orientation

Indonesian ASNP should, in order to understand customers´ requirements and expectations, organise regular groups where representatives for ANSP and customer can meet.

154) QMS-2: Implement a structured working method in the organisation

In order to work in a structured effective way, the Directorate General of Civil Aviation (DGCA) and Indonesian ASNP shall implement the philosophy of the PDCA wheel (see above) and create necessary manuals for all types of activities in the organisation. These manuals must be reviewed and updated to maintain a high quality output.

155) QMS-3: DGCA and Indonesian ANSP shall implement a structured system for deviation reports and improvements suggestions

156) QMS-4: DGCA and Indonesian ANSP shall implement a structured way for follow ups and audits

157) QMS-5: DGCA and Indonesian ANSP shall certify the QMS

The ANSP should be certified according to an ISO standard for QMS

A QMS must be reviewed and updated regularly. This is a medium- and long-term mission.

158) QMS-6: DGCA and Indonesian ANSP shall enhance the QMS

15.2 SAFETY MANAGEMENT SYSTEM

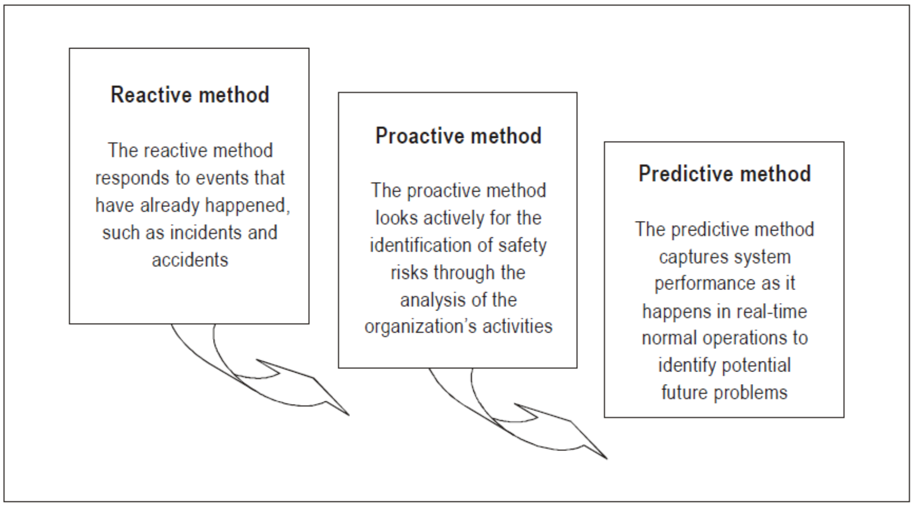
ICAO requires States to implement a State Safety Programme (SSP) in accordance with ICAO Annexe 11. The requirement for States to establish SSP aims at achieving an acceptable level of safety in civil aviation. An SSP is a management system for the management of safety by the State.

A clear understanding of the relationship between an SSP and an SMS is essential for concerted safety management action. This relationship can be expressed in the simplest terms as follows: Indonesian DGCA is responsible for developing and establishing an SSP while the Indonesian ANSP is responsible for developing and establishing an SMS. This is a very important point: States are not expected to develop an SMS; rather the SSP fulfils the equivalent role. Nevertheless, States are responsible, as part of the activities of their SSP, to accept and oversee the development, implementation and operational performance of the service provider's SMS.

Organisation and safety culture: The accountable manager has the overall responsibility for safety within the organisation but all employees have a responsibility to ensure that all activities are conducted according to the safety policy. It is every manager's responsibility that employees are encompassed by a high level of safety culture; that enough human resources with adequate competence for safe work are available and that lessons learned are shared and the safety level is always monitored.

Reactive, proactive and predictive safety data capture systems provide safety data for equivalent reactive, proactive and predictive safety management strategies, which in turn inform specific reactive, proactive and predictive mitigation methods. A summary of safety management strategies is presented in the table below.

Table 1: Safety management strategies



Source: ICAO Doc 9859 AN/474

In the ICAO Doc 9859 SMM, 2nd edition 2009, eight basic and generic building blocks underlie the process of managing safety. Surveillance has been added as the 9th.

a) **Senior management's commitment to the management of safety**. Managing safety, just like any other management activity, requires allocation of resources. This allocation of resources is, in all organisations, a function of senior management, hence the need for senior management's commitment to the management of safety. In plain language: no money, no safety.

b) **Effective safety reporting**. It is a known aphorism that "one cannot manage what one cannot measure". In order to manage safety, organisations need to acquire safety data on hazards that allow for measurement to take place. Most of such data will be acquired through voluntary and self-reporting by operational personnel. It is essential therefore for organisations to develop working environments where effective safety reporting by operational personnel takes place.

c) **Continuous monitoring** through systems that collect safety data on hazards during normal operations. Safety data collection is just the first step. Beyond collection, organisations must analyse and extract safety information and safety intelligence from data, because data that are collected and relegated to a drawer are as good as no data at all. Furthermore, it is essential to share the safety information and intelligence gleaned with those who operate the system daily for they are the ones who are in constant contact with the hazards, the consequences of which effective safety reporting aims to mitigate.

d) **Investigation of safety occurrences** with the objective of identifying systemic safety deficiencies rather than assigning blame. It is not as important to identify “who did it” as it is to learn “why it happened”. System resilience can be much more effectively reinforced by removing systemic deficiencies than by removing supposedly “unfit” individuals.

e) **Sharing safety lessons learned and best practices** through the active exchange of safety information. Another well-known aphorism eloquently illustrates the need for data sharing and exchange of safety information: “learn from the mistakes of others, you are not going to live long enough to make them all yourself”. The aviation industry’s excellent tradition of sharing safety data must be maintained and, if at all possible, reinforced.

f) **Integration of safety training for operational personnel**. Seldom do training curricula for operational personnel include dedicated safety training. There is an assumption that since “safety is everybody’s responsibility”, operational personnel are safety experts in their own right. The fallacy of this line of reasoning is evident and is discussed in Chapter 7. There is an urgent need to include dedicated training addressing the basics of safety management at all levels of operational personnel training.
Effective implementation of standard operating procedures (SOPs), including the use of checklists and briefings. SOPs, checklists and briefings, whether on a flight deck, in an air traffic control room, in a maintenance shop or an aerodrome apron, are amongst the most effective safety devices operational personnel have to discharge their daily responsibilities. They are a powerful mandate from the organisation regarding how senior management wants operations to be conducted. The safety value of realistic, properly written and constantly adhered to SOPs, checklists and briefings should never be underestimated.

g) **Continuous improvement of the overall level of safety**. Managing safety is not a one-day affair. It is an ongoing activity that can be successful only through continuous improvement.

h) **Surveillance**. Safety audits and regular follow-ups are conducted to monitor the safety level in order to identify possible risks and take action before the risk develops into a problem.

ICAO makes audits within the programme of ICAO USOAP - Universal Safety Oversight Audit Programme, Specifically, the USOAP audits focus on the State's capability for providing safety oversight by assessing whether the critical elements of a safety oversight system have been implemented effectively. The audit teams also determine the State's level of implementation of safety-relevant ICAO Standards and Recommended Practices, associated procedures, guidance material and practices. For an ANSP to introduce SMS, ICAO Doc 9859 provides guidance. This document is found in Appendix 2 to Chapter 7 – Guidance on the development of an SMS GAP analysis for Service Providers.

The implementation of an SMS requires a service provider to conduct an analysis of its system to determine which components and elements of an SMS are currently in place and which must be added or modified to meet the implementation requirements. This analysis is known as gap analysis, and it involves comparing the SMS requirements to the existing resources of the service provider.

The gap analysis provides, in checklist format, information to assist in the evaluation of the components and elements comprising the ICAO SMS framework and to identify the components and elements that will need to be developed. Once the gap analysis is completed and documented, it will form a basis of the SMS implementation plan.

Some of the recommended activities may already have been implemented, but the discussions in the four different stakeholder working groups did not indicate any such case. The above-mentioned GAP analysis however will indicate whether these following activities need to be implemented.

15.2.1 Short- term activities

159) QMS-8: Establish a Safety Policy for the new single ANSP and DGCA

It is one of the prerequisites for an organisation introducing an SMS to establish a safety policy. Responsibility should rest on the Indonesian ANSP.

160) QMS-9: Develop a safety culture in each organisation

A safety culture must be created. This can only be established if the management at all levels of Indonesian ANSP is involved in the safety issues as a prioritised issue for all aspects of operational activities.

161) QMS-10: Provide each organisation with sufficient manpower to handle safety management issues

Indonesian ANSP and DGCA are responsible for having staff with dedicated tasks related to safety management. An organisational structure to comply with this should to be established.

162) QMS-11: Provide SMS training for experts/specialist concerned with changes for safety related issues

SMS training should be provided by Indonesia ANSP for all of its staff in order to guarantee quality assurance in their hazard assessments, analysis of deviation reports etc.

163) QMS-12: Provide documented safety assessments prior to implementation of new equipment, new procedures, etc.

All changes in the ATM system affecting operational activity should, as part of the SMS, be safety assessed by Indonesian ANSP, and the change shall not be implemented if defined hazards cannot be mitigated or reduced to an acceptable level.

164) QMS-13: Create a non-punitive reporting culture and encourage staff to report malfunctions of systems, deviations of procedures, etc.

In order to have a reporting culture where all ATM system deviations are reported, it is of outmost importance that the reporting staff will not in any way be penalised if the deviation was caused by a human factor. For more information concerning, hazards, risk management etc see ICAO Doc 9859 SMM 2009 2nd edition.

165) QMS-14: Provide for a Report Analysis Unit at ANSP organisation

In order to improve safety in the ATM system, it is vital that all deviation reports are thoroughly analysed and that proper recommendations are given in order to improve the safety level. Responsibility for implementation should rest on the Indonesian ANSP.

166) QMS-15: Provide Lessons Learned information to concerned units/staff

Instances where the human factor is involved in situations where safety is at stake, or could have been, should always be reported. Those reports, including analyses and recommendations, should be provided to concerned staff to avoid a repetition of the same or similar occurrence.

167) QMS-16: DGCA should provide oversights of the ANSPs concerning SMS regulations

As a regulator, the DGCA should have trained SMS experts in order to conduct regular oversights of the SMS in the ANSP and its sub units.

15.2.2 Medium- and long-term activities

168) QMS-17: Develop the SMS further according to activities in short term

In the long term, development turns into refinement:

169) QMS-18: Refine the SMS

15.3 SUMMARY TIMETABLE

The table below summarises all activities in the QMS field.

Table 2: Quality and safety management activities time schedule

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
	Quality and Safety Management System (QMS)									
153	Implement customer orientation									
154	Implement a structured working method in the organisation									
155	System for deviation reports and improvements suggestions									
156	Implement a structured way for follow ups and audits									
157	Certify QMS									
158	Enhance the QMS									
159	Establish a flight safety policy for single ANSP and DGCA									
160	Develop a safety culture in each organisation									
161	Provide organisation with manpower for Safety Management									
162	Provide SMS training									
163	Provide safety assessments prior to implementation									
164	Create a non-punitive reporting culture									
165	Provide for a Report Analysis Unit at ANSP organisation									
166	Provide lessons learned information to concerned units/staff									
167	DGCA to provide oversights of ANSPs concerning SMS regulations									

Horizon		Short term					Med.		Long	
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	2021-2025	Beyond
168	Develop the SMS further according to activities in short term									
169	Refine the SMS									

CHAPTER 16: CURRENT ATM SITUATION AND PLANS

This Annexe briefly describes the current air traffic management (ATM) situation and includes figures and pictures derived from different Directorate General of Civil Aviation (DGCA) sources and contain present information on:

- Indonesian and adjacent flight information regions (FIRs)
- Sectorisations
- Location of non-directional beacons (NDB), VHF Omni-directional range (VOR)/distance measuring equipment (DME) stations
- Instrument landing system (ILS) stations
- Radar and automatic dependent surveillance-broadcast (ADS-B) stations and coverage
- VHF stations and coverage
- Organisation Ministry of Transport
- Organisation DGCA
- Organisation PT Angkasa Pura 1 (AP1) and PT Angkasa Pura 2 (AP2).

Air navigation service (ANS) in Indonesia is currently provided by three different organisations: DGCA, which also provides regulatory oversight; and two state owned enterprises, AP1 and AP2. En route services are provided primarily by AP1 and AP2, as are services at Indonesia's 27 largest airports. Terminal and airport services at more than 100 smaller airports are provided by DGCA.

16.1 CURRENT AIRSPACE ORGANISATION

Indonesian airspace is divided into two FIR and area control centres (ACC); Jakarta (AP2) and Ujung Pandang (AP1), flight service sectors (FSS), approach units (APP) and aerodrome control towers (ADC). At small airports there are also aerodrome flight information service units. Alerting service is provided by all units. ATM is supported by the International NOTAM office (NOF) located at DGCA, aeronautical information services units/offices at many airports and aeronautical fixed telecommunication centres. All Indonesian airspace is designated in accordance with ICAO airspace classification.

Figure 34: Indonesian FIRs, Jakarta/Ujung Pandang

Source: DGCA

Each of the two ACCs in Indonesia has subdivided their area of responsibility (AoR) into several airspace volumes. Such an airspace volume is referred to as an *ACC sector*. Normally two air traffic controllers share responsibility for such a sector. Radar coverage is limited in this huge area, especially over oceanic areas. In the east part of Indonesia (Ujung Pandang) automatic dependent surveillance-contract (ADS-C) is operationally available together with controller-pilot data link communications (CPDLC). In the west part (Jakarta) ADS-C is not yet available. Automatic dependent surveillance-broadcast ADS-B is not in operational use yet in Indonesia. One reason is that regulations on how to operationally implement and utilise this surveillance tool are not in place.

At Jakarta ACC one sector is a so-called Low Density Oceanic Sector. The Indian Ocean Sector (IOS) shows great similarities to other oceanic sectors like e.g. Bodö Oceanic Sector in the North Atlantic Ocean. The IOS can only use VHF communication for the eastern part of this huge oceanic airspace and radar surveillance is also limited to the eastern portion. Communication outside VHF coverage is performed with HF and the separation criteria west of the radar coverage area are based on time. Traffic density in the IOS is, compared to other international Oceanic Sectors, rather low.

During May 2010, only 549 flights were registered, 213 of these being overflights. Maximum traffic for one day in May was 34 while one day had no flights at all. In October 2010 there were totally 841 flights registered. The Jakarta Advanced Air Traffic Control System (JAATS) is manually updated with the aircraft's position presented as a flight plan track on a specific screen. In the future JAATS both communication and surveillance capability will be substantially enhanced by the use of CPDLC and ADS-B/C.

Figure 35: Indian Ocean Sector (IOS) working position

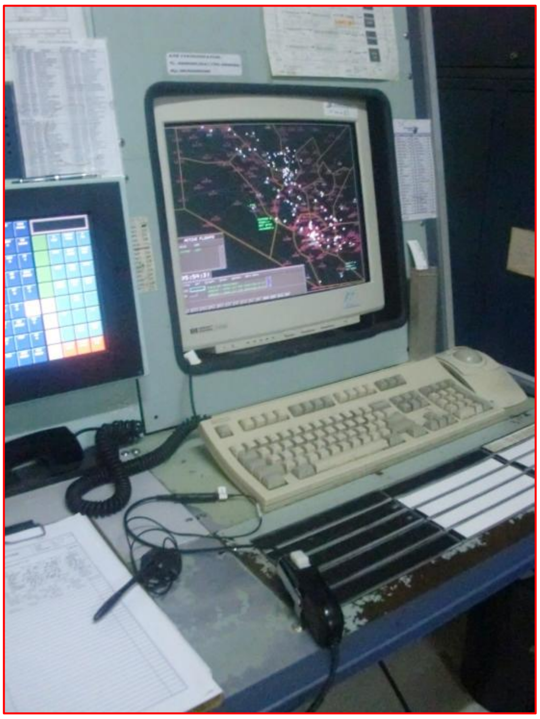


Photo by LFV Aviation Consulting

Awaiting the arrival of the single air navigation services provider (ANSP) established by the new Aviation Law, the responsibility for ANS provision is split between DGCA, AP 1 and AP 2 as follows:

Table 3: Division of air traffic control

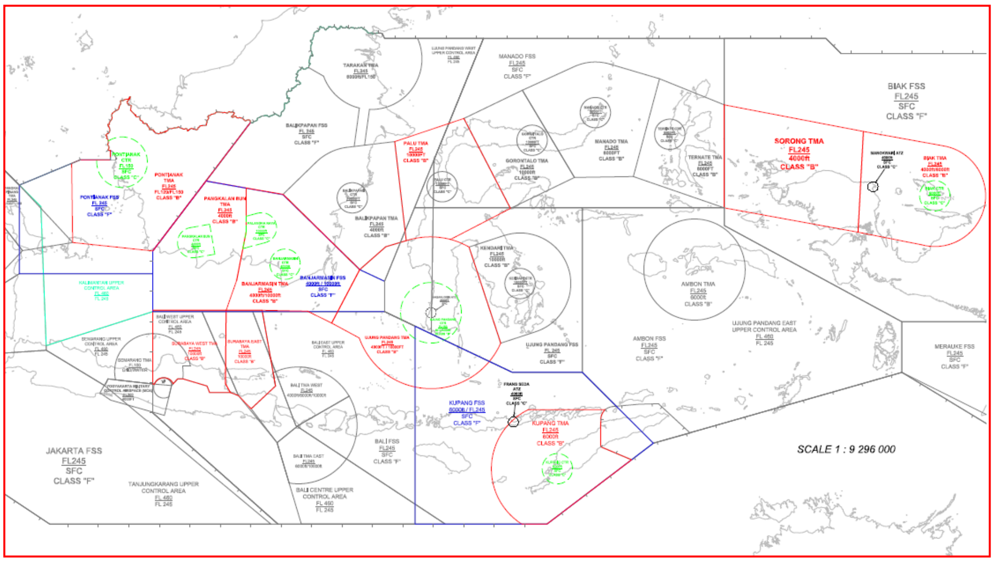
Institution	Airports	Air Navigation Services (ANS)		
		Aerodrome Control (ADC)	Approach Control (APP)	En-route Control (ACC)
PT. AP-I	Owns and Operates 13 significant airports in Eastern Indonesia	✓	✓	✓ (East Indonesia)
PT. AP-II	Owns and Operates 12 significant airports in Western Indonesia	✓	✓	✓ (West Indonesia)
DGCA	Owns and Operates 162 relatively small airports	✓	✓	-

Note 1:Above 164 DGCA airports include Batam Airport that is owned by Batam Airport Authority (BAA).
Note 2:Besides the above, one airport at Timika is owned and operated by a private mining company.

Source: JICA 2011 report

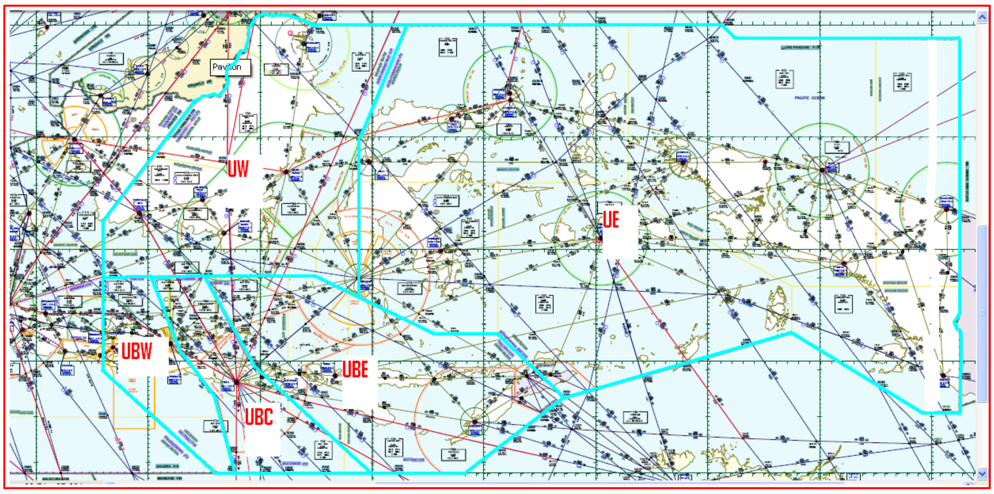
As shown in the table, the DGCA exerts control service only on and around its own airports and not in the rest of the airspace. Control services in the non-DGCA are split between AP 1 and AP 2 as follows:

Figure 36: Lower airspace sectorisation AP1



Source: DGCA

Figure 37: Upper airspace sectorisation AP1



Source: AP 1

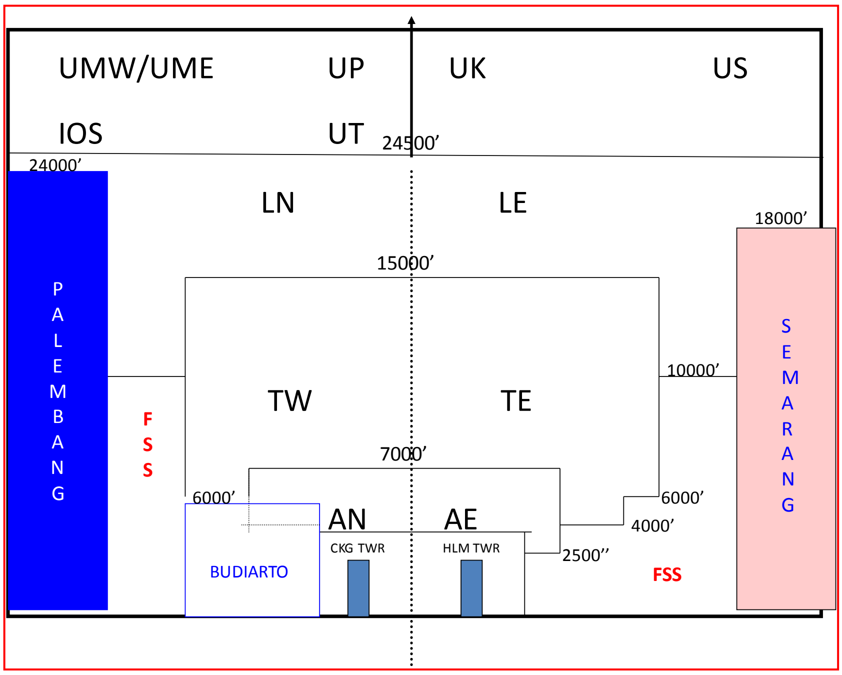
Figure 38: Lower airspace sectorisation AP 2

Source: AP 2

Figure 39: Upper airspace sectorisation AP 2

Source: AP 2

Figure 40: Upper and lower vertical airspace sectorisation, Jakarta FIR



Source: AP 2. Regarding airspace classification, see Figure 20: Airspace Classification on page 20.

16.2 ATS ROUTES

Currently, approximately 15 area navigation (RNAV) routes are used for international traffic and one for domestic. However, there is a staff shortage of airworthiness inspectors that can certify aircraft avionics for RNAV. This could, without proper actions, lead to a bottleneck issue, when performance- based navigation (PBN) is introduced on a large scale.

The tables below show the RNAV/required navigation performance (RNP)10 ATS routes in Jakarta FIR implemented according to DGCA. The first shows international RNAV Routes from parts of SE Asia to Australia and the second routes established mainly as route segments to connect to other RNAV routes.

Table 4: RNAV routes SE Asia - Australia

Routes	Significant Point	Direction	To facilitate traffic between
L511	PKP-SBY-TARUN	One-way southbound	Singapore-Australia
L644	KIKOR - DKI		Japan/S Korea- Jakarta
L895	PKP-SAPDA		SE Asia -Australia
L764	PKP-LAMOB		Singapore-Melbourne
N752	ATMAL-PLB		SE Asia- Australia
N646	ATMAL-PKU		Malaysia-Australia

Source: DGCA

Table 5: Two-way RNAV routes

Routes	Significant Point	Direction	To facilitate traffic between
P570	PKU-BIRAS-KAGAS-DOLEM-MABIX-NIXUL	Two-way	Jakarta – Middle East
M300	SALAX-PEKDO-OKABU-BULVA-TOPIN		Singapore- Middle East
N563	SALAX-AMVIL-MDN-MEMAK		Singapore- Middle East
P574	PUGER-ANSAX		Malaysia- Middle East
L896	SAPDA-NISOK		Malaysia- Middle East
M772	OSUKA-ANIPU		SE-NE/Asia-Bali
L897	XMX-KETIV		Middle East- Australia

Source: DGCA

Many conventional routes in the upper airspace have superimposed RNAV routes, meaning that the route waypoints based on terrestrial navigational aids are also described as lat/long waypoints based on the World Geodetic System - 1984. These routes have two designators, one as a conventional route and one as a RNAV route (L, M or N). They are not additional routes in Indonesia, but this change can be seen as a first step in implementing PBN. The next step is to create more routes according to user requirements, where there are no ground-based navigational aids to guide the route trajectory. Data supplied by DGCA refer to 2009.

Table 6: Combined conventional/RNAV routes 2009

ATS Routes Transformation		FIR
Conventional/Existing	RNAV	
B344	L774	WIIF
B584	M522	WAAF
A464	M774	WIIF, WAAF
G462	M766	WIIF, WAAF
B583	M768	WAAF
A214	N628	WIIF
B335	N633	WIIF
A327	P627	WIIF
B592	P648	WIIF
R456	P756	WIIF

Source: DGCA

16.3 TMA/APPROACH AND MILITARY AIRSPACE

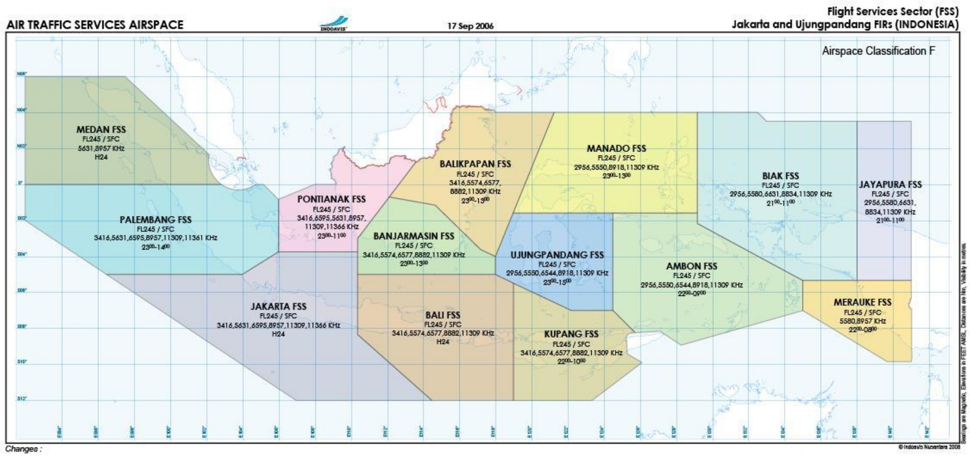
Design of major terminal areas in Indonesia is not optimal with regard to present and future traffic demand. Capacity to handle the departing/arriving traffic will be increased by proper airspace design for the TMAs. In and outbound traffic to/from an airport should be laterally separated when possible, to reduce workload for air traffic control (ATC), thereby increasing overall capacity. Standard instrument departures (SIDs)/Standard instrument arrivals (STARs) based on RNP and RNAV or even precision area navigation criteria (i.e., RNP5 and RNP1) require the aircraft fleet using the airport to be properly equipped. The higher navigational precision provides possibilities to reduce the lateral separation between the SID and STAR, saving valuable distance for the airspace users. Using SID/STAR also reduces the radio communication between ATC and cockpit.

The military training areas are mostly located where there are no ATS routes. Normally, these areas are blocked for civilian use while utilised by the military. There is a great need for civil/military coordination. There are also Prohibited Areas (P), Restricted Areas (R) and Danger Areas (D). There may be future desiderata for an expansion of areas mainly dedicated for military use, requiring increased flexibility of airspace use in order to cope with growing civil aviation.

16.4 LOWER AIRSPACE

In the lower airspace outside TMAs, the airspace is divided into flight service sectors (FSS) where Flight information services are provided with the use of high frequency-communication. In these sectors, no surveillance is presently available. There are presently four FSS in Jakarta FIR and 10 in Ujung-Pandang FIR.

Figure 40: Flight service sectors



Source: DGCA

Flight statistics and forecasts for the 14 FSS are found in section 19.7.

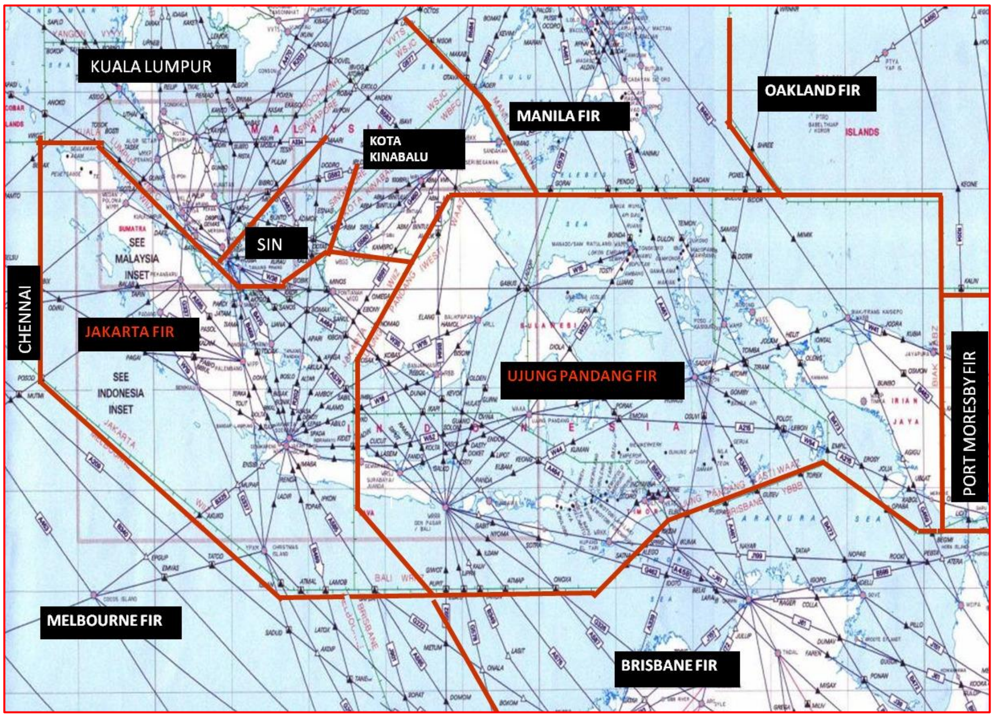
16.5 ADJACENT ACC UNITS AND CROSS-BORDER ROUTES

In border areas, the ACC's have to coordinate traffic with adjacent ACC units. These procedures are described in a Letter of agreements (LoA). Separation of air traffic is mainly based on time (10 minutes). There are nine adjacent ACC units:

- Kuala Lumpur
- Singapore
- Kota Kinabalu

- Manila
- Oakland
- Port Moresby
- Brisbane
- Melbourne
- Chennai

Figure 41: Surrounding FIRs



Source: DGCA

Currently, approximately 15 RNAV routes are used for international traffic. Many domestic conventional routes and pioneer routes have been established during the last five-year planning cycle in order to connect more airports in the country. These pioneer routes are available only for visual flight rules operations.

16.6 TRAFFIC DEMAND AND CURRENT CAPACITY

Air traffic controllers, from both ACCs, have reported situations where they have experienced overloads. Baseline capacity values (i.e. number of aircraft/60min) for ACC sectors have not been thoroughly assessed and are not reported by the ACCs.

16.6.1 Traffic demand at ACC units

The two tables below show the current traffic demand for each ACC in Indonesia. The first table shows the monthly traffic movements during the last three months of 2010 and the first three months of 2011 in different ACC sectors and the Approach sector for Makassar TMA. Detailed statistics and forecasts for the upper airspace sectors are found in Chapter 19.

Table 7: Monthly traffic movements in Ujung Pandang FIR

Month	SECTOR						
	UE	UW	UBE	UBC	UBW	LWR	APP
October 2010	5571	9488	5864	11,533	12,779	6629	6169
November 2010	5655	9374	5523	11,040	11,841	6185	5713
December 2010	5686	9314	5460	11,327	12,425	6327	5860
January 2011	5764	9269	5407	11,667	12,685	6502	6050
February 2011	5330	8505	4859	10,481	11,436	5833	5421
March 2011	5992	9524	5335	11,483	12,870	6496	6042

Source : Angkasa Pura 1

The table below shows the monthly number of movements in different approach and ACC sectors as well as the number of flights for Jakarta ADC during 2010. Total movements for Jakarta ADC almost reached 310,000.

Table 8: Monthly traffic in Jakarta FIR during 2010

MONTH	UNITS									
	ADC	APP / TMA	ARR	ACC1		ACC2	ACC3	UM	IOS	FIC
				UP	UT	UK	US			
JAN	24,636	25,461	12,278	11,465	11,348	8481	9880	6786	409	863
FEB	22,388	23,192	11,150	10,381	10,343	7841	8744	6223	391	1026
MAR	25,657	26,683	12,801	11,802	11,740	8675	9656	7174	577	1139
APR	25,130	26,275	12,538	11,595	11,535	8760	9751	7048	540	1047
MAY	26,167	27,215	13,039	12,030	11,980	8838	10,182	7735	549	1116
JUN	26,152	27,188	13,057	12,110	13,772	8782	10,165	7478	542	1464

MONTH	UNITS									
	ADC	APP / TMA	ARR	ACC1		ACC2	ACC3	UM	IOS	FIC
				UP	UT	UK	US			
JUL	27,149	28,359	13,565	12,809	12,685	9423	10,385	7660	608	1273
AUG	24,756	25,770	12,368	11,678	11,566	9045	9456	7009	580	1297
SEP	26,924	27,995	13,410	12,568	12,376	9112	10,610	7636	522	1021
OCT	27,562	28,652	13,751	12,980	12,670	9731	10,908	8118	841	1046
NOV	25,509	26,634	12,720	11,989	11,683	10,722	8300	7831	700	963
DEC	27,497	28,571	13,714	13,331	13,049	9585	10,412	8564	832	1463
2010	**309,527**	**321,995**	**154,391**	**144,738**	**144,747**	**108,995**	**118,449**	**89,262**	**7,091**	**13,718**

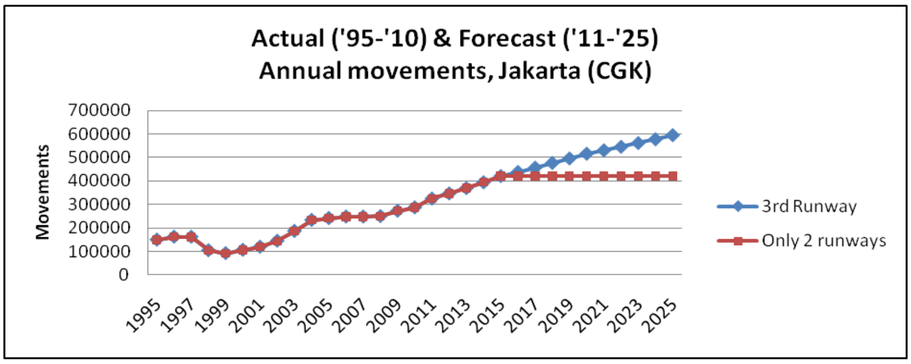
Source: Angkasa Pura 2

16.6.2 Traffic demand at key airports

In 2010, LFV Aviation Consulting made a forecast for a number of Indonesian airports until 2025. Results for the top five are shown below:

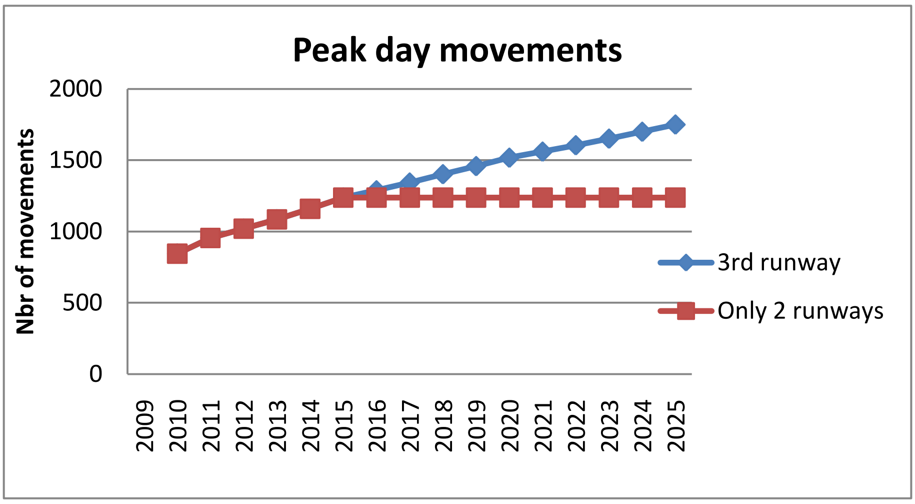
1) Jakarta Soekarno-Hatta
2) Surabaya Juanda
3) Bali Ngurah Rai
4) Makassar Sultan Hasanuddin
5) Medan Polonia (soon to be replaced with Medan Kuala Namu)

Figure 42: Actual and forecast annual movements, Jakarta (CGK)



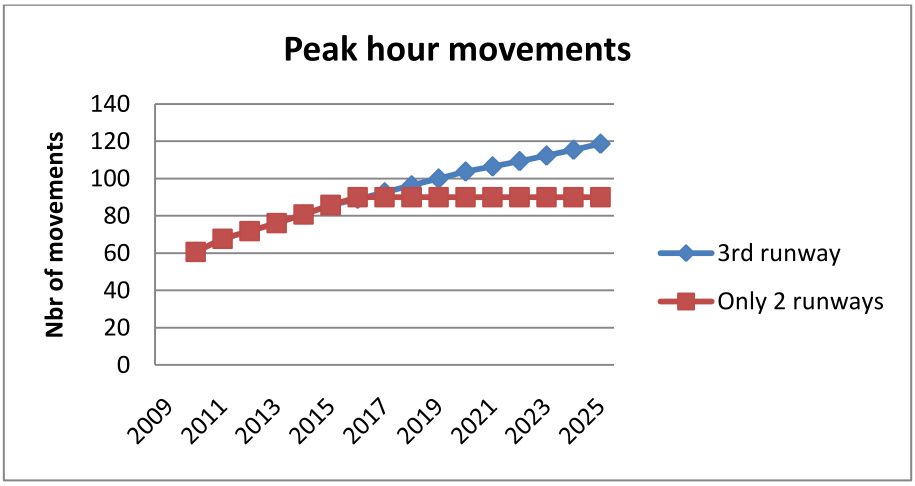
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 43: Actual and forecast peak day movements, Jakarta (CGK)



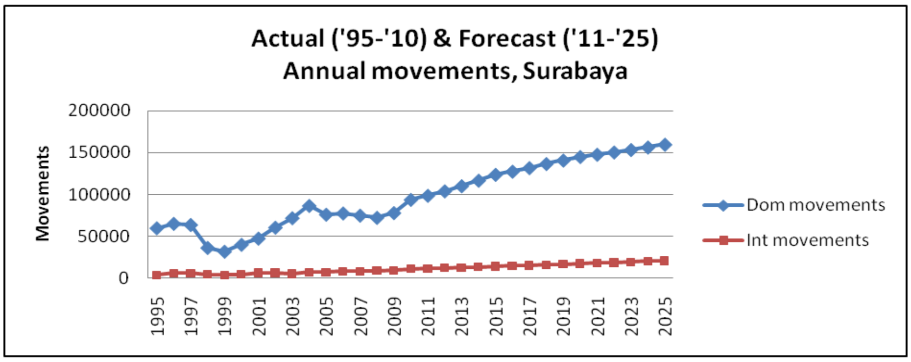
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 44: Actual and forecast peak hour movements, Jakarta (CGK)



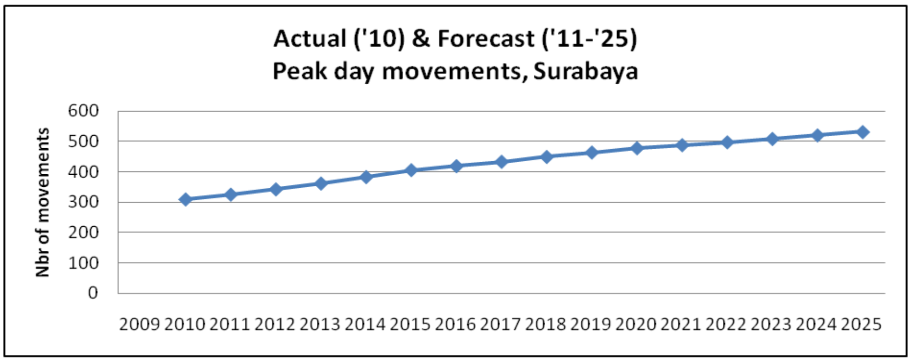
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 45: Actual and forecast annual movements, Surabaya



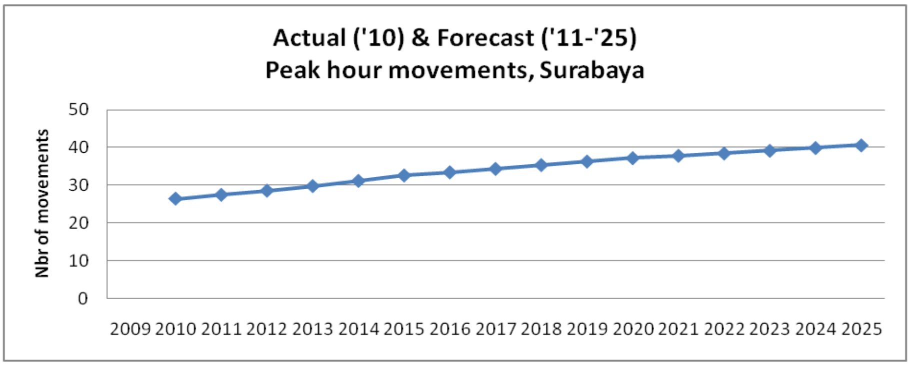
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 46: Actual and forecast peak day movements, Surabaya



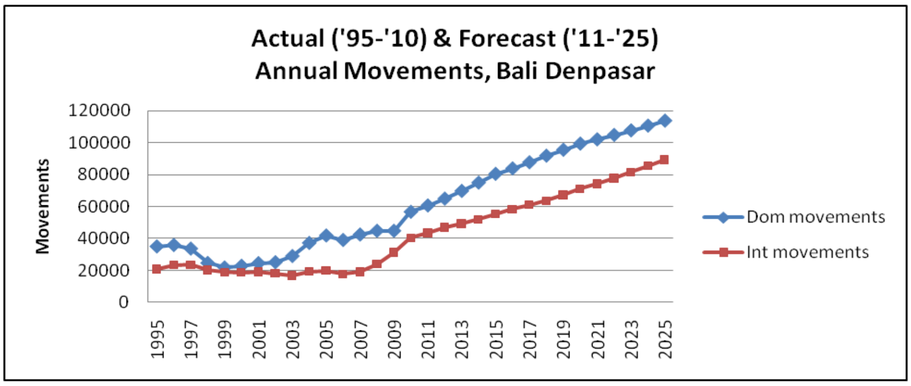
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 47: Actual and forecast peak hour movements, Surabaya



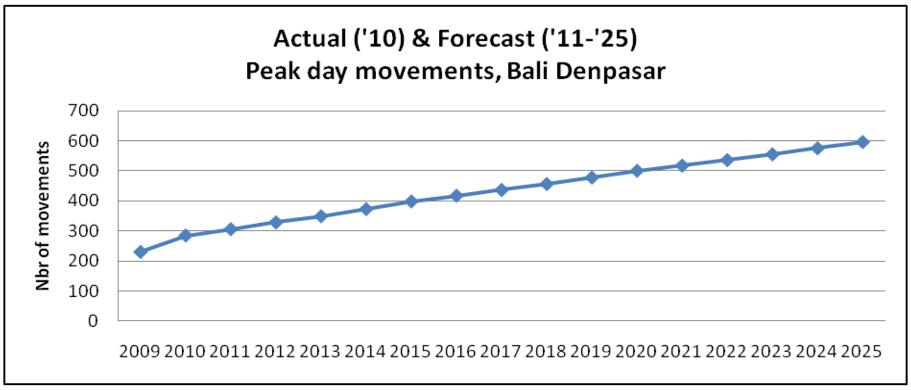
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 48**: Actual and forecast annual movements, Bali Denpasar**



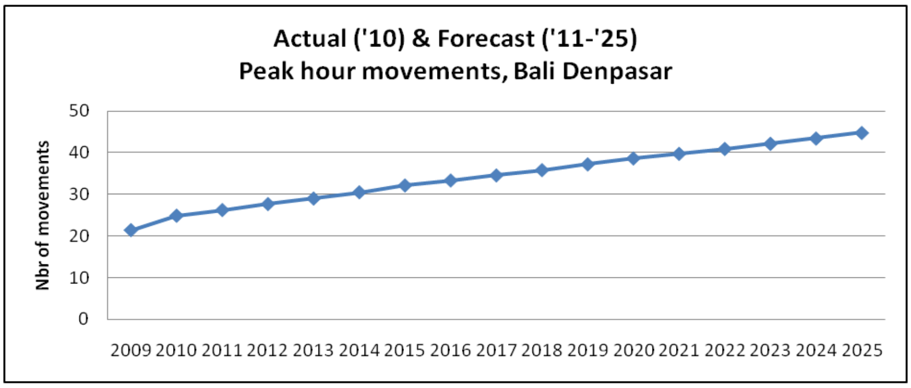
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting August 2010

Figure 49: Actual and forecast peak day movements, Bali Denpasar



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 50: Actual and forecast peak hour movements, Bali Denpasar

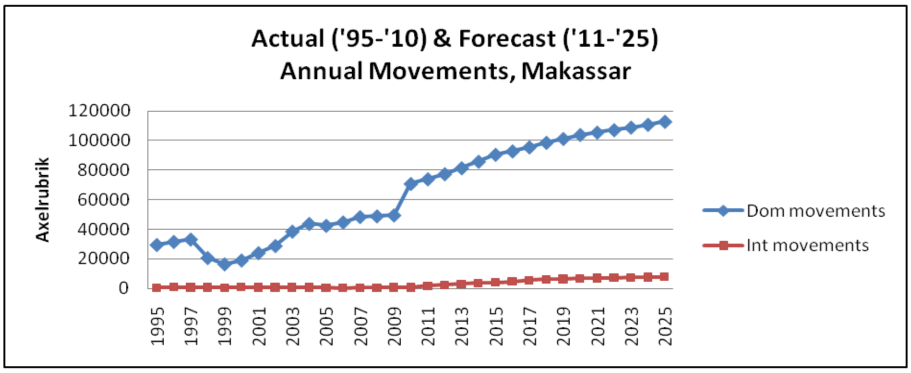


Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

The Bali Denpasar forecast, like all others in this section, is the result of a top-down approach where expected traffic growth rate on national level was applied to the individual airports. The result of this method when applied to Bali has been called in question by LFV Aviation Consulting in a subsequent report where the drivers of air traffic to Bali were analysed in further detail. The conclusion was that Bali Island cannot cope with the number of tourists associated with the growth in movements shown in

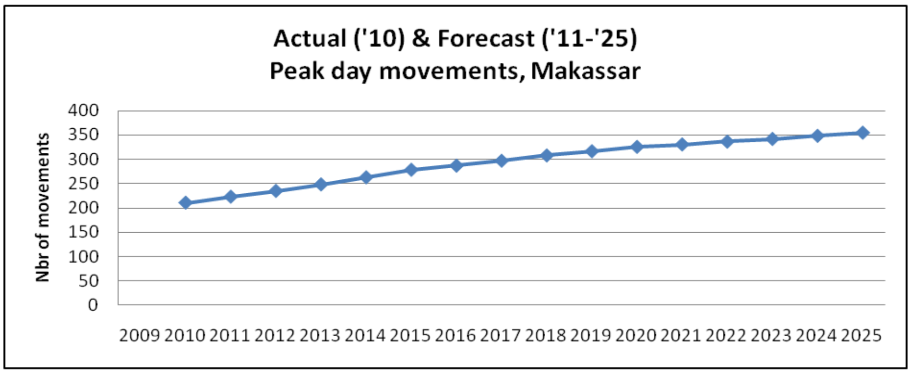
Figure **48**[5]. It was also found that the air traffic service capacity, with a few minor improvements, will be able to cope with the lower traffic growth following from the revised forecast.

Figure 51: Actual and forecast annual movements, Makassar



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

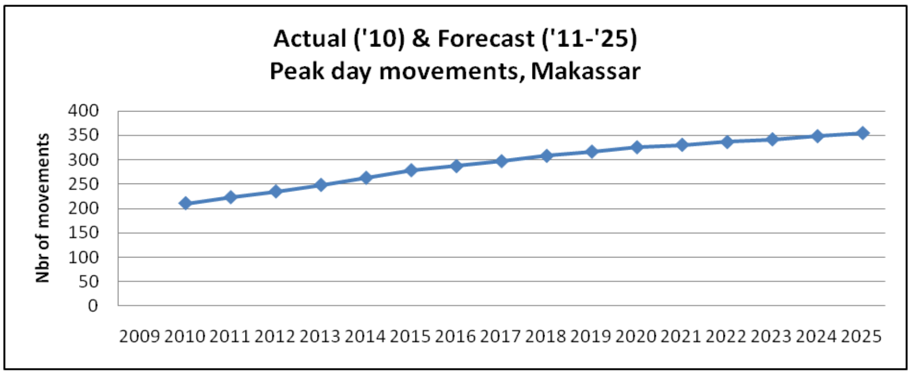
Figure 52: Actual and forecast peak day movements, Makassar



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

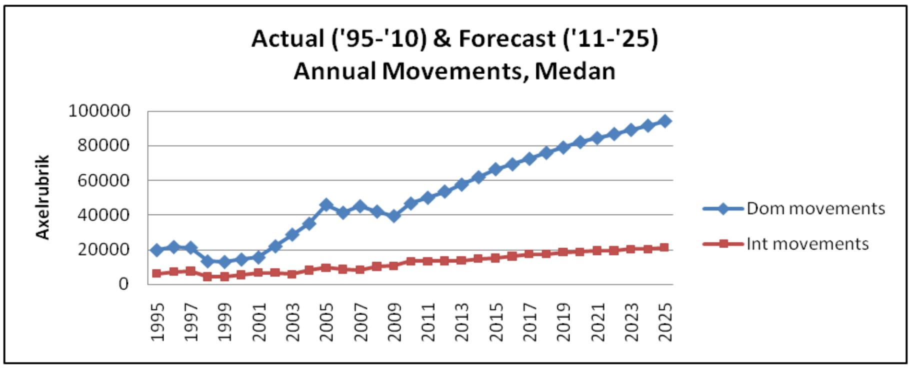
[5] Bali Airport Development Project, Deliverable 2, 2011.

Figure 53: Actual and forecast peak hour movements, Makassar



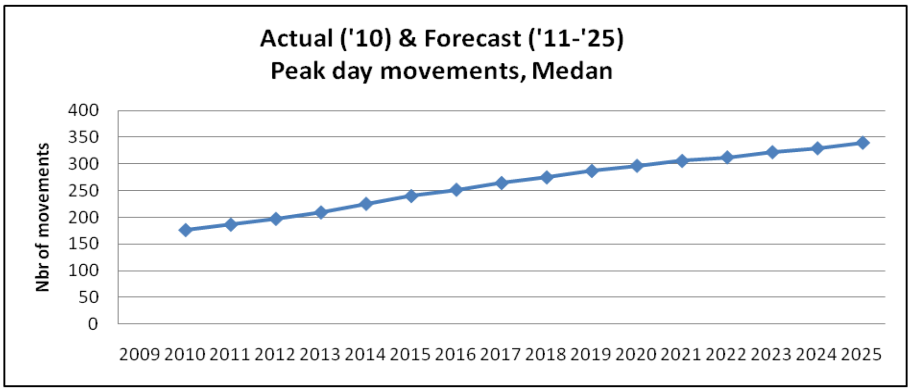
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 54: Actual and forecast annual movements, Medan



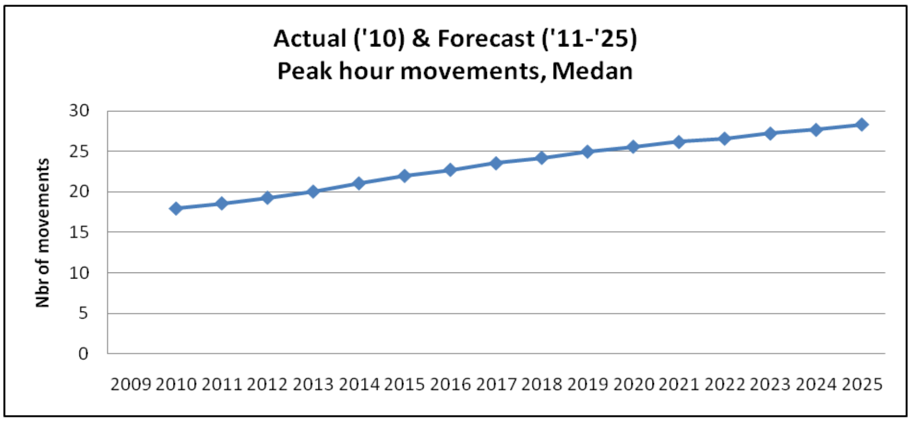
Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 55: Actual and forecast peak day movements, Medan



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

Figure 56: Actual and forecast peak hour movements, Medan



Source: Air Traffic Management Analysis and Forecasts – LFV Aviation Consulting, August 2010

16.7 DELAY SITUATION AND ATM SYSTEMS

No data concerning delays have been presented. DGCA reports however that Jakarta and Surabaya airports suffer from delay situations in the morning and afternoon peaks during weekends and Mondays.

The ATM system for Jakarta FIR (JAATS) has been operational from 1997 and it is now quite difficult to find spare parts. Ujung Pandang FIR ATM (Makassar Advanced Air Traffic Control System) system is newer and has been operational from 2005. It is a Thales product named Eurocat X.

Figure 57: JAATS, air traffic controllers working position at Jakarta ACC

Photo by LFV Aviation Consulting

16.7.1 Communication, navigation and surveillance

Installation of 30 ADS-B ground stations will be finalised this year and the plan is to have them operational in Ujung Pandang FIR as soon as possible. This will provide a good coverage for Indonesia. The ATM system in Ujung Pandang has been updated to receive ADS-C/CPDLC (future air navigation services-1/A protocols) messages. This concept was implemented in September 2010. For Jakarta ACC the plan is to introduce ADS-C/CPDLC in a minor back-up system available for some of the sectors. This will allow for some ADS-C/CPDLC functionality until the entire ATM system will be replaced.

Radar coverage over oceanic and remote areas including Papua is not sufficient today, due to natural reasons, and ADS-B surveillance is not yet approved for operational use. One of the reasons is that the display of ADS-B information in Jakarta ACC is not possible today but it is planned to be included in the new JAATS. There is also a need for additional regulations and an operational concept stating the future required separation standards. However, these shortcomings must be solved before 2015 and the investments in ADS-B must be used together with CPDLC for the benefit of increased capacity.

In the short run, the capacity improvements offered by the technologies above may be somewhat restricted by insufficient aircraft equipage, see Figure 25: Asia Pacific RNAV/RNP fleet capacity. It is quite possible, and often feasible, to restrict the use of some controlled airspace to sufficiently equipped aircraft, but the equipage level should be a bit higher than present before such a step is taken.

16.7.2 Current ATM initiatives and investments

According to a DGCA presentation in April 2010, Indonesia is ready to implement PBN gradually and conduct route planning and flight procedures design. The plan is valid 2009-2016 and beyond and includes en route, oceanic, remote continental, TMA arrival/departure and approach domains. PBN implementation will support enhanced capacity and an early implementation is fully supported by the International Air Transport Association.

A specification process for procurement of the new JAATS is reported to have been finalised, but this has not been confirmed. Whether calls for tenders are disseminated is not clear. DGCA reports that a new building to host the new JAATS system (ACC) is being built during 2011. The premises for TWR and APP will remain in the present buildings.

ILS is used at most Indonesian instrument airports for guiding aircraft on approach. It is not included in this review as it is an airport component rather than a part of the ATM system. However it does have an important role in allowing the ATM system to operate efficiently.

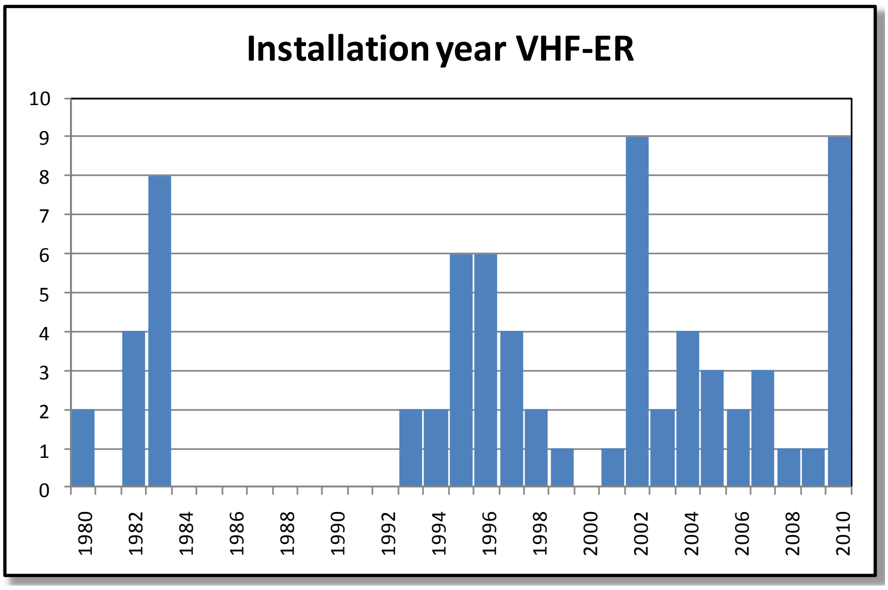
16.8 EQUIPMENT VINTAGES

Data on installation year for all communications, navigation and surveillance equipment currently in use have been collected from DGCA. It may be the case that these data do not contain the latest investments. Figures pertain to equipment currently in use.

16.8.1 Communication and radar equipment

The radio communication stations (VHF Extended Range) shown in Figure 22 are mainly of post-1995 origin although some stations from the early 1980s remain. The 1992-1998 investment bulge with 21 units will soon lead to a corresponding surge in replacement requirements.

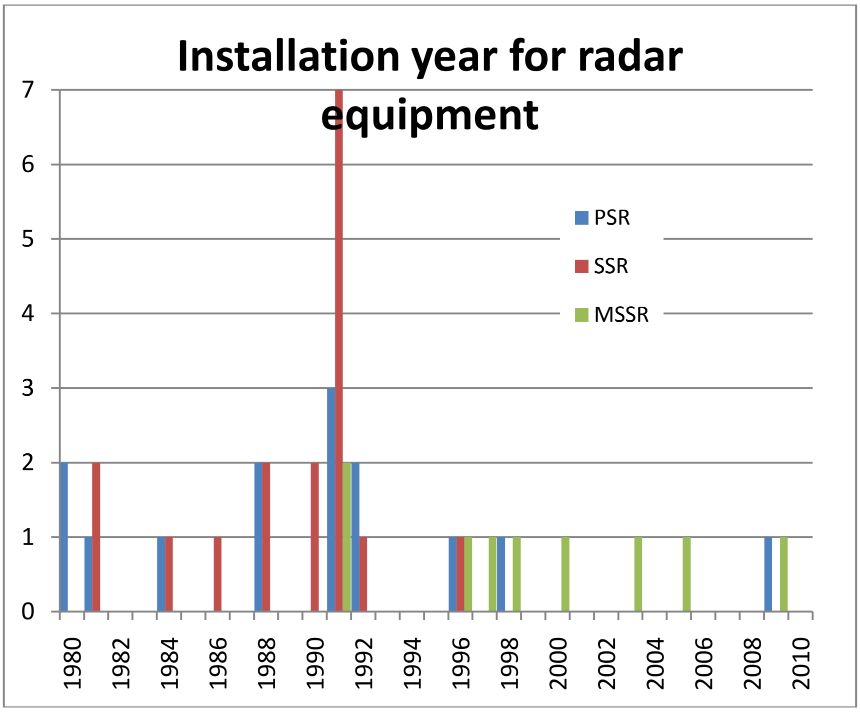
Figure 58: Installation years for 72 VHF-ER stations



Source: compiled from DGCA data.

Primary surveillance radar installations range from the late 1970s to 2009 with a peak in the 1990s, although one station was installed in 2009. *All secondary surveillance radar installations are at least 15 years old, with a peak in the early 1990s.* As can be expected, the SSR was abandoned in favour of the more modern monopulse secondary surveillance radar. All in all there are 14 primary, 17 secondary and nine monopulse radar stations in use; however the statistics provided by DGCA appear not to be quite up to date. There may be post-2009 installations not covered in the data.

Figure 59: Installation years for 40 radar stations



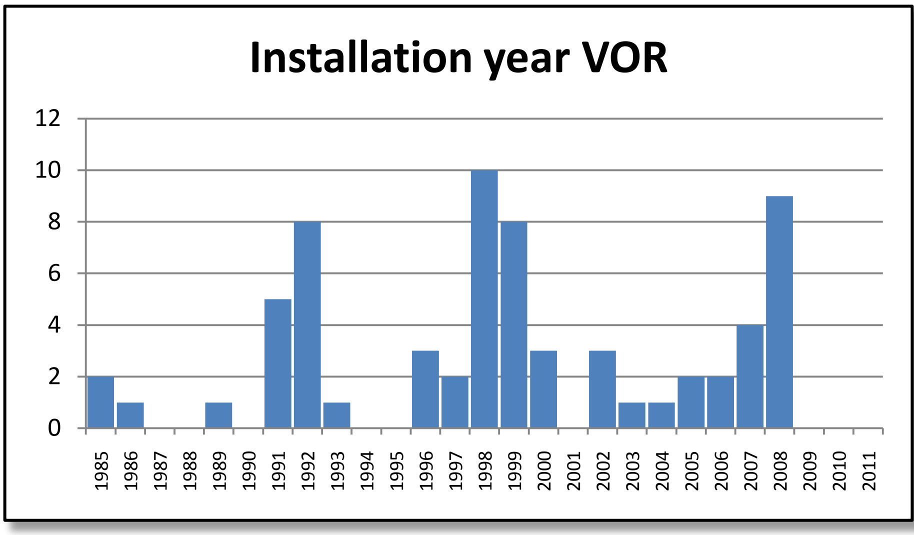
Source: Compiled from DGCA data.

Radar history shows a huge peak in the 1990-1992 period with 17 units, setting the stage for a massive replacement need in the coming decade. The use of multilateration may reduce the cost and should be thoroughly investigated.

16.8.2 Navigation equipment

The VHF Omni-directional radio range (VOR) installations (see Figure 23) are spread from the mid-1980s to recent years:

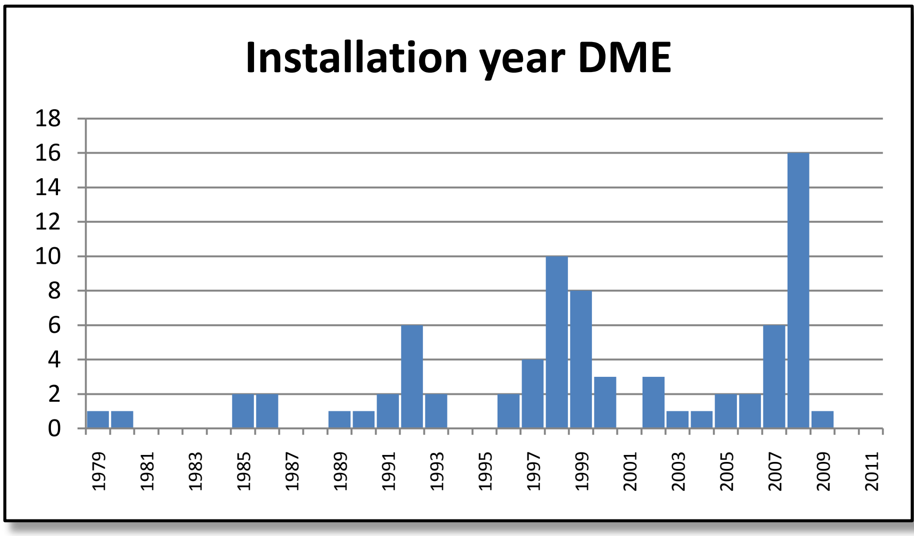
Figure 60: Installation years for 66 VOR stations



Source: compiled from DGCA data

DME stations show basically the same age pattern as VOR, mainly due to the fact that DME for en route navigation is normally co-located with a VOR:

Figure 61: Installation years for 77 DME stations

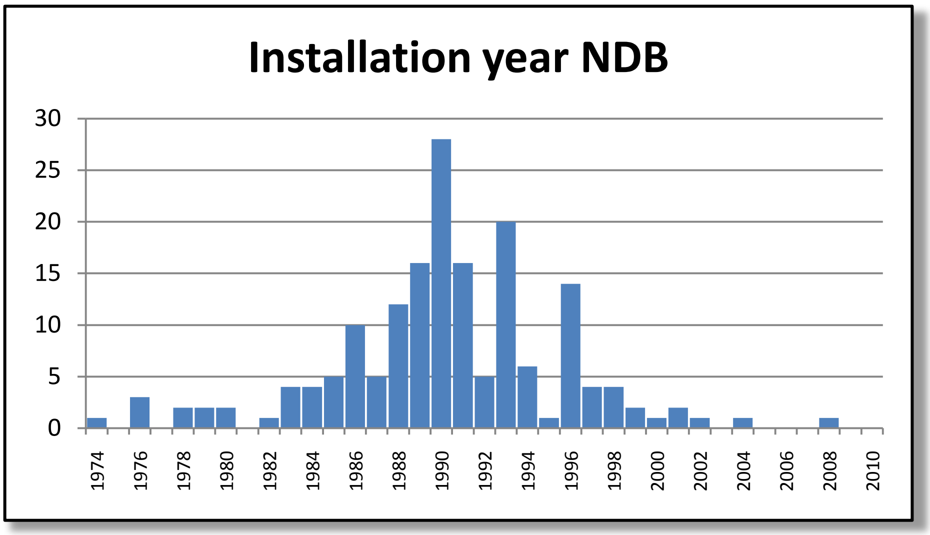


Source: compiled from DGCA data

Consequently, a huge investment bill looms around the corner when the combined VOR and DME replacements needs surface in the coming years.

The outmoded NDB system installations range from the mid-1970s to present day with a clear peak around 1990:

Figure 62: Installation years for 173 NDB stations



Source: compiled from DGCA data

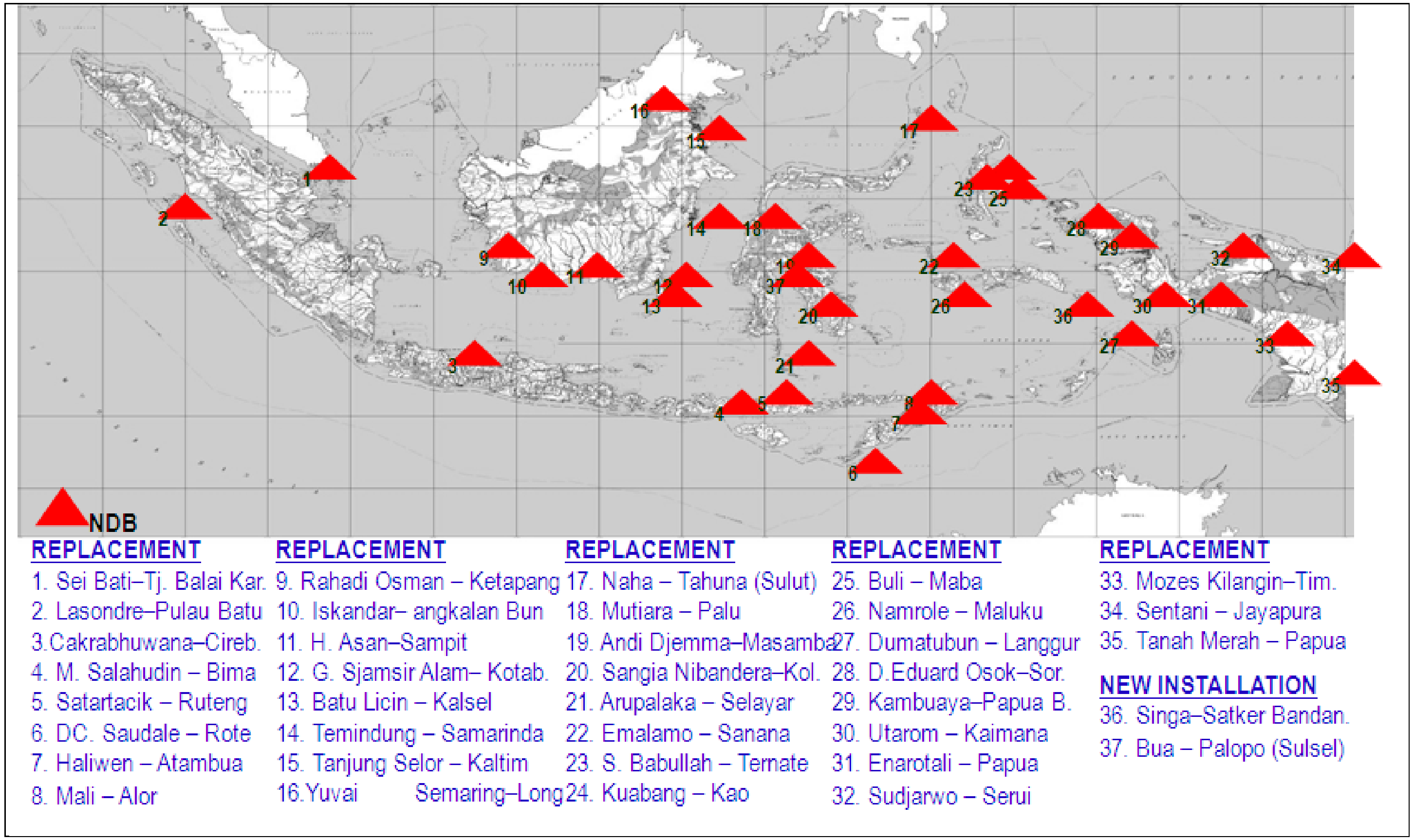
16.9 NAVIGATION AND SURVEILLANCE INVESTMENT PLANS

Equipment vintages shown in the previous section indicate a need for massive replacement and there is also a need for new investment. The Team has surveyed all existing plans as of early 2011. All plans cover the years 2012-2014. To the extent post-2014 plans exist, these have not been provided by DGCA.

16.9.1 NDB beacons

There is an ambitious plan to replace a number of NDB stations, in spite of the system's obsolescence, and the plan also includes setting up two new stations at Singa - Satker Bandan and Bua - Palopo. Present NDB locations are shown in Figure 24 on page 83. In the Team's opinion, no new investment should be made in NDB technology and decommissioning should be considered as an alternative to heavy repair costs.

Figure 64: Planned replacement for NDB stations 2012-2014

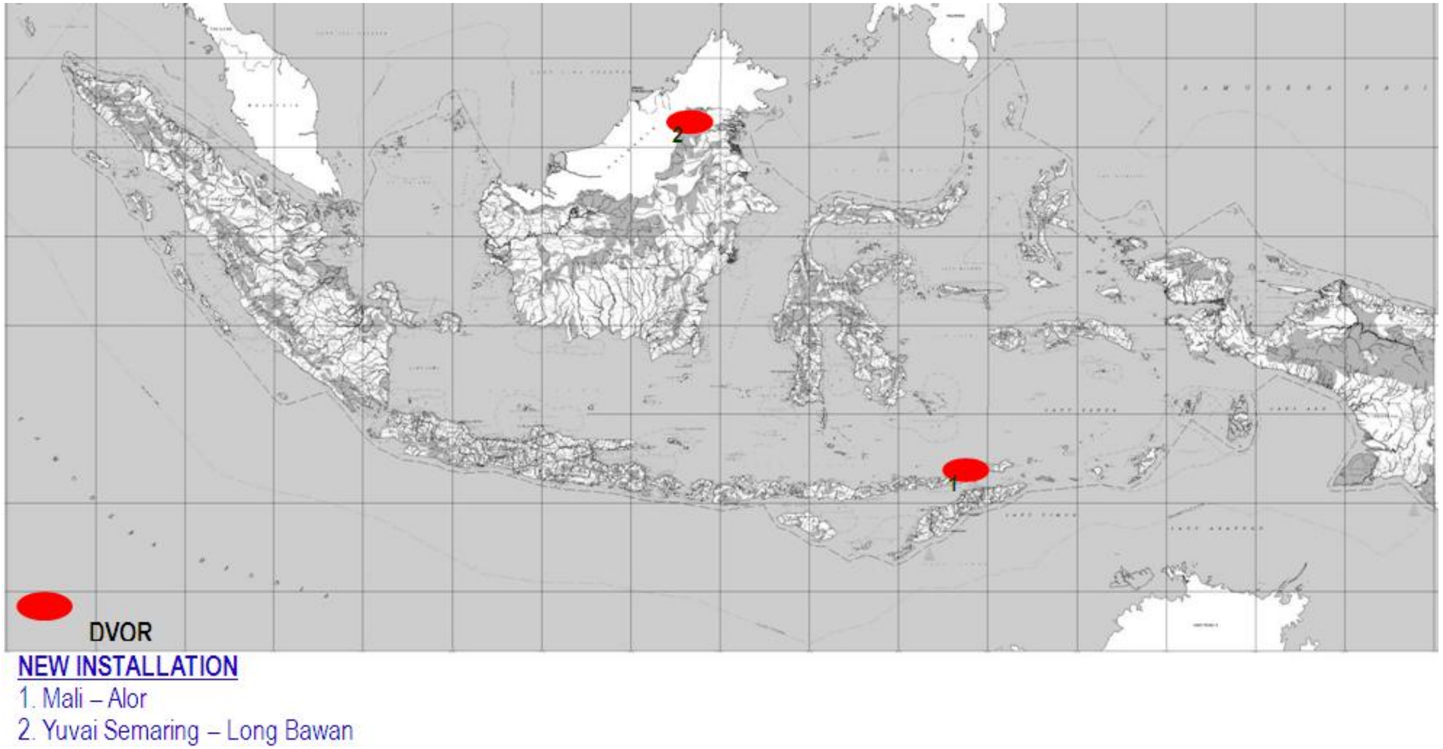


Source: DGCA. For existing NDBs see Figure 24.

16.9.2 VOR/DVOR and DME

The current location of these navigational aids is shown in Figure 23 on page 87. New installations of “stand alone” VOR are planned only for Mali – Alor (1) and Yuwai Semaring – Long Bawan, in both cases Doppler-VOR.

Figure 65: Planned new installations of VOR for 2012-2014



Source: DGCA

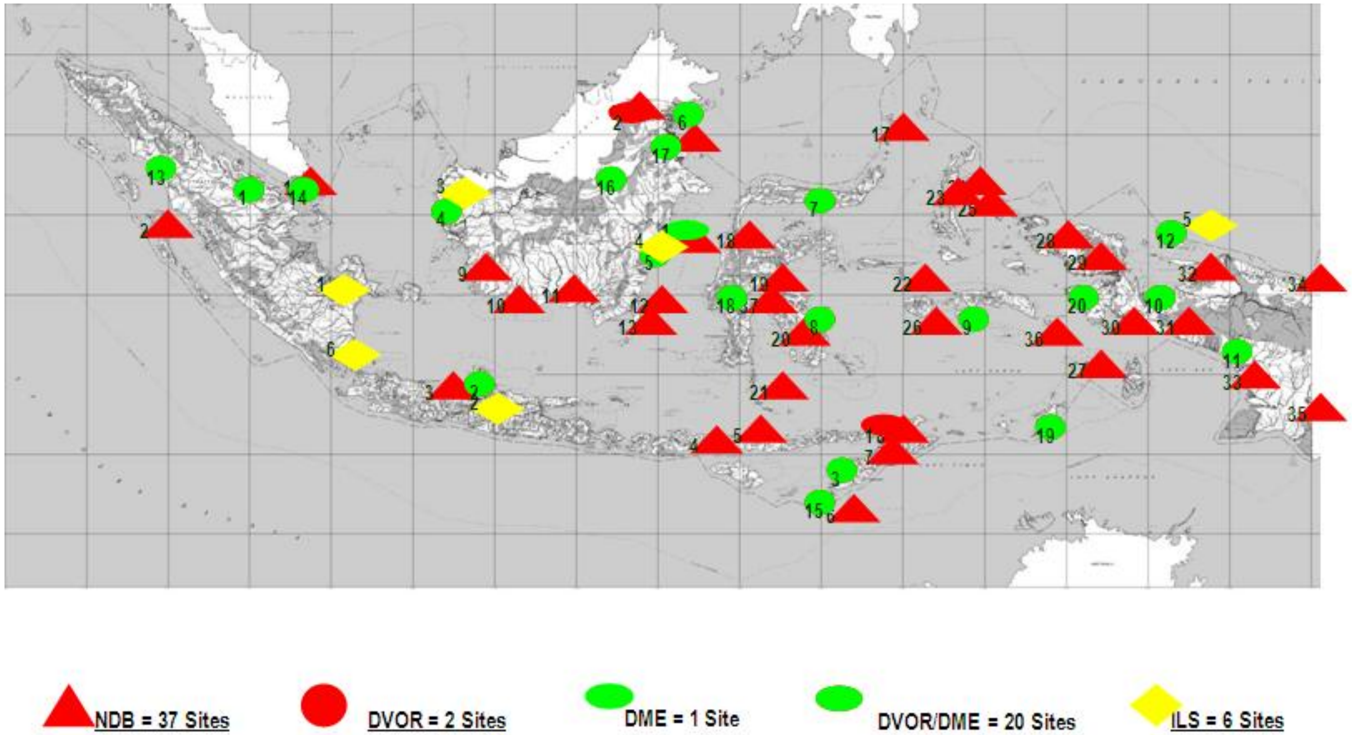
In contrast, co-located VOR/DME will be replaced at 12 locations and new equipment installed at another eight. A single stand-alone DME will be installed at Termindung-Samarinda, not shown on the map but located slightly north of Sepinggan-Balikpapan on the east Kalimantan coast.

Figure 66: Planned new installations of VOR/DME for 2012-2014

Source: DGCA

A summary map of all navigation equipment investments, including six ILS stations not being an ATM component, is shown below.

Figure 67: Planned navigation installations for 2012-2014



Source: DGCA

16.9.3 Radar stations

Regarding radar stations, the only information provided is an obsolete map of installations planned up to and including 2009. It is not clear to what extent these 34 projects have been completed. Present radar locations and coverage are shown in Figure 27 on page95.

Figure 68: Radar MSSR Mode S projects

	Type of Equipment	Replacement and New Installation Radar MSSR Mode S until year 2011	Location
	MSSR MODE-S	4	Denpasar, Waingapu (Replacement), Tarakan, Timika (New Installation)

Source: DGCA

CHAPTER 17: OVERFLYING TRAFFIC

This chapter is excerpted from a separate background report provided by MJG Aviation in April, 2011. It has been slightly edited to match the main text.

17.1 PRESENT SITUATION

The air route structure in the upper airspace over Indonesia is currently based on the historic pattern using terrestrial navigation aids. This pattern is evolving to one based on satellite navigation and therefore enabling more direct tracking. Airspace users are increasingly seeking access to “random tracking” for more fuel- and time-efficient operations. The random tracking requirements include access to four dimensional (4D) trajectories.

The pattern of traffic overflying Indonesia in the past was based on routes between Australasian ports and ports in Asia such as Singapore, Kuala Lumpur, Bangkok and Hong Kong. This was a result of both demand factors and aircraft range. The pattern is now evolving to add routes to the Middle East (Abu Dhabi, Dubai, Doha and others).

The major implications for the Plan of the two evolving changes noted above are:

- A need for flexible airspace structures and airspace management procedures
- Increased involvement for the Jakarta en route centre leading to a need for increased functionality and capability for the system and increased numbers and training for human resources

17.2 CONFLICT POTENTIAL BETWEEN DOMESTIC AND OVERFLIGHT TRAFFIC

Given the distances involved and aircraft types flying the domestic routes, there is potential for the traffic operating on domestic routes to be in the same airspace volumes as the overflight traffic. If this were to occur at the same time in large numbers, stress would be placed on both the ATM system and the airspace structure. This issue, should it occur, would be increased in potential for stress on the system by the different alignments of the major route structures: east/west for domestic and north/south for the overflights.

Analysis of the schedules for the major routes and city pairs shows that the domestic traffic occurs generally between 0600 and 2030 local time. Due to curfew requirements and connections with traffic to and from Europe, the majority of overflight traffic operates at times which would place it in Indonesian airspace during periods when there is little or no domestic traffic in the airspace. These timings mean that there is very little conflict between the domestic and overflight traffic; however, because of the temporal distribution of traffic there is effectively no lull or period of reduced activity for the en route air traffic management (ATM) system.

17.3 IMPLICATIONS

The implication for the ATM Plan is:

- A need for sufficient numbers and training of human resources to ensure the en route system can operate 24 hours a day

17.3.1 Airspace capacity

The following data and analysis has been quoted verbatim from the LFV report "Air Traffic Management Analysis and Forecast" dated August 2010:

Statistics on movement at selected airways in Area Control Centre (ACC) Ujung Pandang in eastern Indonesia has been collected from PT Angkasa Pura 1 (AP1). Using the average annual growth ratio for movements in Indonesia determined in section 4.7, the future number of movements at the selected airways can be estimated. Of course this approach will not be completely correct since the characteristics of the traffic will vary over time. New routes, changes in aircraft size and frequencies as well as changes in airspace structure and management will affect how traffic is distributed. The figures below will therefore serve only as a rough estimate of annual movements. "DCT" in the legend to the figures corresponds to the number of flights given a "direct to" clearance, hence not following the airway structure. In UTA East the percentage of DCT flights has been large for a couple of years, however it is beyond the scope of this report to forecast the future share of DCT flights since it is directly related to the progress of the ATM Masterplan implementation.

A majority of flights flying over the Indonesian airspace consists of traffic to/from the Australian continent. Aviation statistics have been collected from the Australian Bureau of Infrastructure, Transport and Regional Economics, to get a picture of the current volume of flights. According to statistics from 2009, the number of scheduled international flights between Australia and Southeast Asia was 35,873 (Indonesia not included) whereas the number of flights to and from Northeast Asia was 20,199. Additionally, 130 flights were operated between India and Australia, where at least a part of those flights would have been routed through the Indonesian airspace.

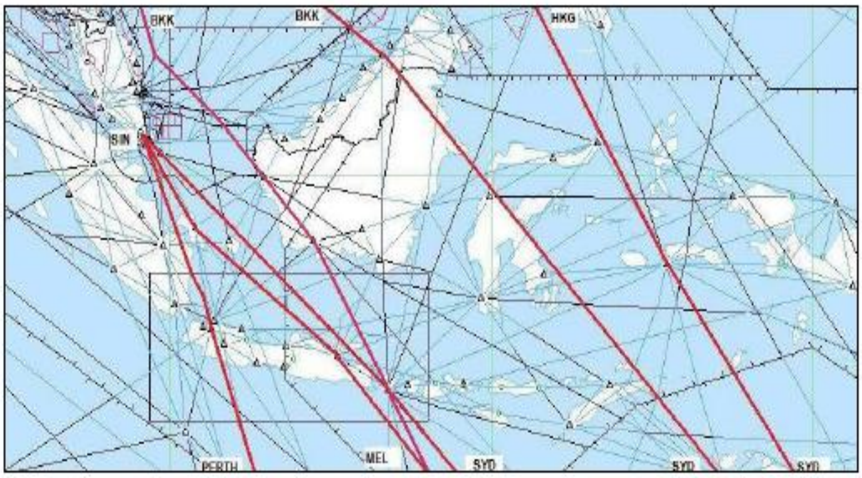
Table 9: Statistics on overflying traffic 2009

Region	Destination countries	Flights	Passengers	Passengers per flight
Southeast Asia	Brunei, Malaysia, Philippines, Singapore, Thailand, Vietnam	35,873	8,260,105	230
Northeast Asia	China, Hong Kong, Japan, Korea, Taiwan	20,997	4,558,797	217
India	India	130	25,432	195
Total		57,000	12,844,244	225

Source: LFV Report "Air traffic Management Analysis and Forecast", 2010

This indicates about 160 daily commercial flights flying over the Indonesian airspace, assuming that traffic is distributed evenly throughout the year. In addition there were some commercial flights to/from New Zealand as well as non-commercial and military flights. According to ICAO statistics, from a sample week in July 2008 the Bangkok-Sydney route had 88 flights, Bangkok-Melbourne had 32 flights and Hong Kong-Sydney had 76 flights. Average annual growth rate in 2002-2008 had been 9.5 percent between Bangkok and Sydney but only 0.4 percent between Hong Kong and Sydney, indicating that the latter route has reached its mature stage.

Figure 63: Major routes for overflying traffic



Source: LFV Report 2010. Although not complete, the picture above illustrates the routing through Indonesian airspace of flights between common city-pairs.

17.3.2 Traffic growth

ICAO's forecasts for aircraft movements in the Asia/Pacific region provide a good estimate on future development of overflying air traffic. The following table is extracted from International Civil Aviation Organization (ICAO) Doc 9961:

Table 10: ICAO aircraft movement forecast

Years	Low	Most likely	High
2009-2020	4.7	5.6	6.6
2020-2030	3.8	4.5	5.3
2009-2030	4.2	5.1	6.0

Average annual percentage growth rate. Source: ICAO Doc. 9961.

Applying these figures to the movement data used in the LFV discussion above show that the number of flights overflying Indonesia can be expected to almost double during the planning period. This expectation may be reduced slightly by the increased number of A380 aircraft introduced into service by some of the airlines flying these routes.

The fixed route structure diagram (above) shows five possible routes. Assuming the traffic is concentrated in a 12-hour period (worst case) and two separated levels are available on each route, there is adequate capacity in the fixed route structure throughout the planning period. However it is expected that more random tracking will be in use as the planning period progresses. These considerations add a buffer to the capacity which means it will be adequate throughout the planning period.

17.3.3 Conclusion

Although the capacity of the airspace is adequate in both the fixed and flexible route environments, there is still am implication for the ATM Plan:

- *Both the en route centres will need suitable facilities, capability and manning to handle traffic on fixed and random routes on a continuous 24 hours a day basis.*

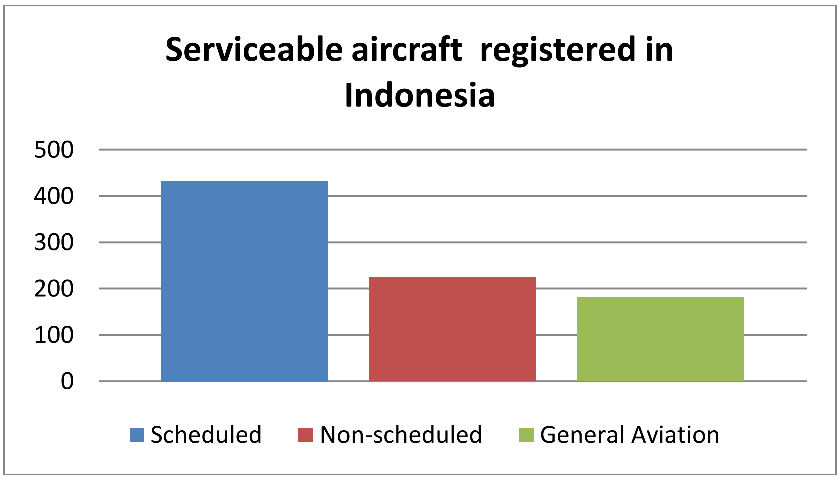
CHAPTER 18: NON-SCHEDULED, MILITARY AND GA TRAFFIC

This chapter analyses some data from the Indonesian aircraft registry and other sources in order to clarify whether non-scheduled, military and general aviation traffic must be taken into account as a dimensioning factor in the Air Traffic Management (ATM) Master Plan. In general, the answer is no - due to the small volumes involved and the low need for air traffic services.

18.1 OPERATORS AND AIRCRAFT TYPES

Out of the 839 aircraft in Indonesia with a current certificate of airworthiness, about half are operated by scheduled airlines. Two hundred and twenty-five aircraft are engaged in non-scheduled commercial operations such as air charters, VIP flights, medical evacuation, offshore operations, seismic and geologic flights etc. One hundred and eighty-two aircraft are registered in the general aviation sector, including private aircraft, non-profitable humanitarian relief operators, flying schools, agricultural flight operations etc. There are 24 scheduled operators in Indonesia, 32 non-scheduled and 31 general aviation operators.

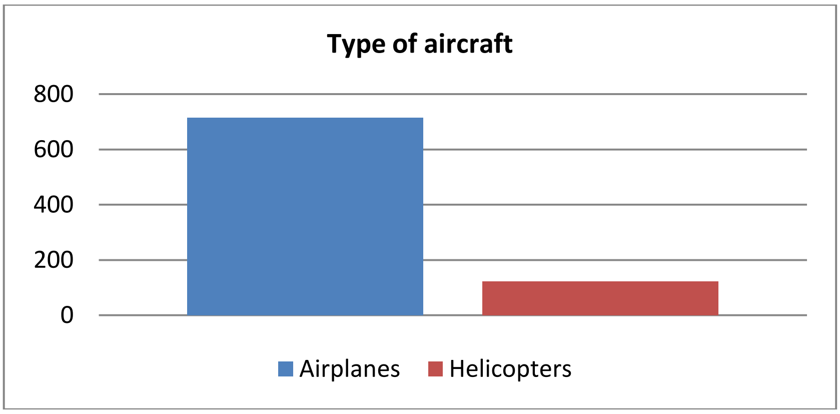
Figure 64: Registered aircraft



Source: compiled from DGCA data

As expected, airplanes (sometimes referred to as "fixed-wing" aircraft) vastly outnumber helicopters:

Figure 65: Airplanes and helicopters



Source: compiled from DGCA data

18.2 MILITARY AND NON-SCHEDULED TRAFFIC

Reviewing statistics on movements in upper airspace sectors, it can be concluded that the number of military IFR movements in civil-use airspace is very low compared to civil traffic. Hence, military traffic will have no major impact on the proposed priorities in the ATM Master Plan.

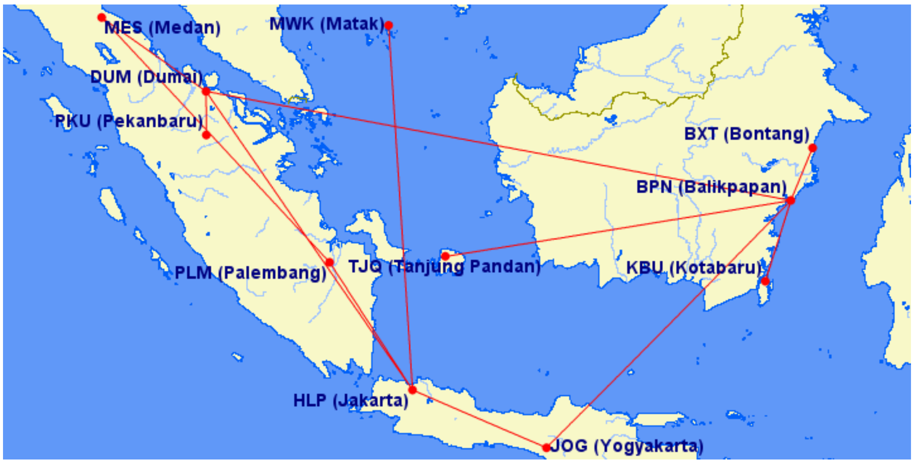
Non-scheduled commercial traffic in Indonesia consists mainly of pioneer flights, support flights for the oil, gas and mining industry, medical evacuation (medevac) flights and air charters.

18.2.1 Support flights for the natural resource industry

One of the major non-scheduled air operators is Pelita Air Service, having 60 percent of its business from providing support flights for the oil, gas and mining industry. They operate a variety of aircraft including helicopters. Clients include regional governments in need of on-demand air transport services. Out of its base at Halim airport, Jakarta, Pelita operates regular transport flights to foremost Balikpapan with offshore workers. At Balikpapan airport, helicopters continue the transport to different offshore platforms in the Java Sea as well as land locations in Kalimantan. Most companies in the Indonesian extraction industries have established contracts with operators for transportation of staff and equipment to remote locations. In most cases these flights have to be carried out by helicopters and the demand for helicopter services is growing. On the other hand, airplane contracts are decreasing due to the increased competition from low-fare scheduled airlines. Many customers, like ExxonMobil, nowadays prefer to put their staff on a Garuda or Lion Air flight to the regional intermediate destinations for onward travel on helicopters to the working site.

The main constraint to further growth in this sector is claimed to be a shortage of qualified helicopter pilots in the country. Offshore or mining helicopter flights are very challenging and require experienced pilots; hence an increase in the number of graduated helicopter pilots alone will not solve this problem in the short term. Examples of recent and present non-scheduled city-pairs for Pelita Air Service are shown in the figure below. The extraction industry is concentrated in Sumatera, Kalimantan, eastern Java and western Papua.

Figure 66: Scheduled airplane network of Pelita Air Services



Source: Pelita Air Services

The non-scheduled support flights share of the total IFR movements in Indonesia is very low, hence these activities will not have a major impact on the ATM system and its future development.

18.2.2 Pioneer flights and general aviation

Pioneer flights to small, remote airstrips are common all over the country but the most extensive networks can be found in the eastern Indonesian regions of Sulawesi, Kalimantan and Papua. One of the largest pioneer flight operators is Merpati Nusantara. These flights are performed with small turboprop aircraft such as the Twin Otter or the Cessna Caravan and provide a well-needed air bridge for people living in remote areas to provincial capitals and district centres. It is mainly the lower airspace that is affected by this traffic. The majority of aircraft used are not pressurised and the flights are normally performed below 10,000 ft. Not uncommonly, these flights are performed mostly in uncontrolled airspace. Given this, and the fact that pioneer flights only accounted for a small percentage of the total movements in Indonesian airspace, approximately 14,500 movements in 2010, it can be concluded that this traffic will not have any impact on the ATM Master Plan.

Table 11: Pioneer flights in 2010 per province

Province	Freq.	Pax	Pax/freq.
Aceh	1217	14,041	
Sumatera Utara	777	4952	
Kalimantan Timur	1075	13,203	
Kalimantan Tengah	370	2355	
Nusa Tenggara Timur	352	5086	
Sulawesi Selatan	1778	19,055	
Sulawesi Barat	377	2317	
Sulawesi Tengah	292	2742	
Maluku	490	4377	
Maluku Utara	994	8528	
Nabire Area	1319	10,698	
Jayapura Area	575	4772	
Wamena	780	6358	
Merauke	647	6757	
Timika	2898	24,989	
Manokwari Area	394	4307	
Sorong Area	218	1345	
Total	**14,553**	**135,882**	**9**

Source: compiled from DGCA data.

General aviation in Indonesia is very limited. There are about nine flight schools registered in the country and all in all only two Aero Clubs. The number of privately owned and operated jet or turboprop aircraft is also relatively small, given the large population and huge number of corporations in the country.

18.2.3 Flight schools

The strong growth in the demand for air travel means increased business for the flight schools. The state-owned flight school STPI, the country's largest, expects around 100 students to graduate during 2011 which is twice the number of 2009. The school is currently in the phase of expanding further to meet a demand for 200 graduates annually in 2013. The growth at other flight schools is expected to be strong as well. Since a majority of the flight schools are located at Jakarta, near already congested airspace, this will increase the number of movements in lower airspace. The designated training area at Budiarto is no longer sufficient for all the training flights and STPI is in the process of setting up satellite training facilities at other airports in Java and Sumatera where airspace is less congested.

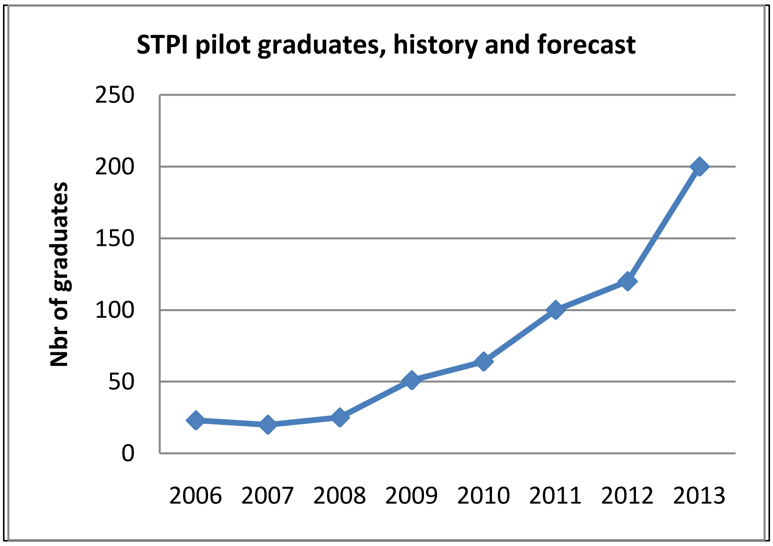
Table 12: Flying schools in Indonesia

Name	Base	Aircraft
Aero Flyer Institute	Budiarto Curug	8
Alfa Flying School	Jakarta-Halim	9
Bali Widya Dirgantara	Bali	12
Deraya Flying School	Jakarta-Halim	11
Merpati Pilot School	Jakarta	2
National Aviation Management	Jakarta	2
Nusa Flying International	Jakarta	6
Sekolah Tinggi Pernerbangan Indonesia (STPI)	Budiarto Curug	41
Wings Flying School	Jakarta	3
Total		94

Source: compiled from DGCA data.

STPI foresees a rapidly growing number of commercial pilot license (CPL) graduates in the coming years:

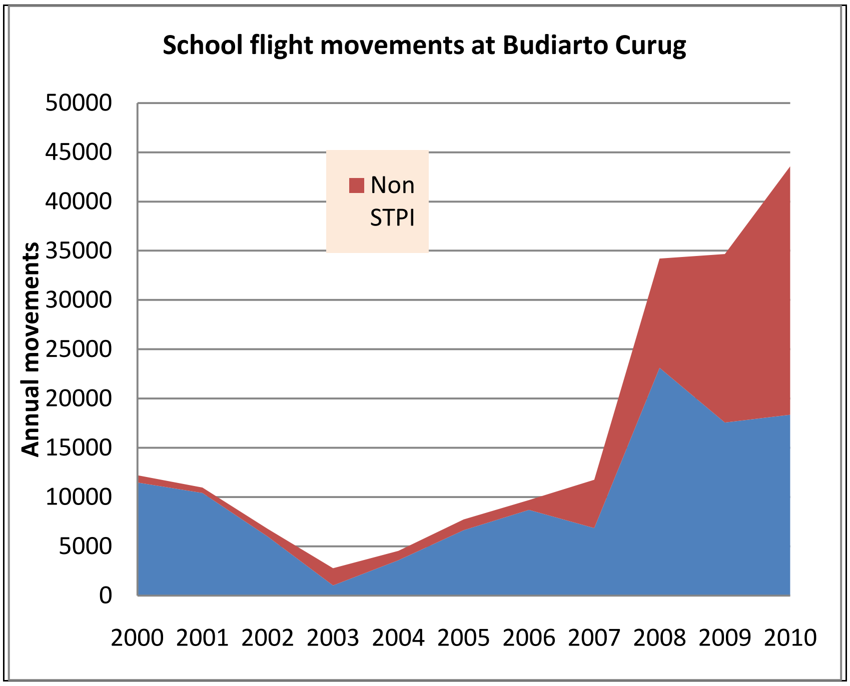
Figure 67: STPI forecast of CPL graduates



Source: STPI.

The forecast in Figure 67 is underestimating the future strain on ATM to be expected from commercial pilot training. While STPI actually more than doubled its movements at Budiarto Curug airport from 2006 to 2010, its share of school flights plummeted from almost 90 percent to below 40 percent:

Figure 68: School flights at Budiarto Curug airport 2000-2010



Source: compiled from DGCA data

Initial commercial pilot training is under visual flight rules (VFR) outside controlled airspace and poses little or no strain on the air traffic services. The ensuing more advanced training segments for instrument, multi-engine and multi-crew ratings will mostly be IFR in controlled airspace. Final type rating on airliners is probably not offered by the present flight schools but is 100 percent IFR.

Consequently, in a few years' time flight training may contribute significantly to the work load for Jakarta area control centre. Given the country's vast airspace and huge number of instrument airports, the problem can be solved by relocating IFR training to other airports. DGCA should initiate a dialogue with the flying schools on this subject.

18.2.4 Private flying

Due to the extremely few registered private light aircraft in the country, private flying will not impose any challenges for the ATM Master Plan. It is not likely that this fleet will grow significantly in the mid or long term, due to the high costs associated with owning and operating a private airplane. The characteristics of this traffic are low frequency, low altitude, low speed and predominantly VFR operations which is why the impact on the ATM system will be negligible.

Table 13: Registered flying clubs in Indonesia

Name	Nbr of aircraft
Alfa Flying Club	4
FASI Swayasa	5

Source: compiled from DGCA data.

18.2.5 Relief flights and corporate aviation

Humanitarian organizations such as Mission Aviation Fellowship (MAF) have a notable presence in the country, especially in Kalimantan and Papua. They operate large fleets of single-engine piston aircraft such as the Cessna 172/182 but also larger turboprops like the Cessna Caravan and Twin Otter. This traffic is also conducted from small provincial airports to strips in remote, often mountainous areas. Most flights are operated VFR in uncontrolled airspace and the impact on the ATM system is negligible. According to MAF's webpage (May, 2011) two bases are established in Indonesia - one in Kalimantan and one in Papua operating a total of 20 airplanes.

Table 14: MAF's operation in Indonesia

	Kalimantan	Papua
Nbr of aircraft	7	13
Nbr of flights last 12 mths	5681	10,028
Carried passengers	17,169	36,882
Cargo carried	516,562 lbs	4,600,000 lbs

Source: compiled from www.maf.org .

On the other side of the general aviation sector, there are larger corporate jets operated by the flight departments of major companies. However, according to the civil aircraft register, it can be concluded that the number of corporate jets in the country still is very low. Only 10 to 15 airplanes are registered as active in May 2011. Even if this part of aviation is growing, it is growing from very small numbers and will not need any special consideration in the ATM Master Plan. Most of today's business jets have the same equipment level and navigation capabilities as modern airliners.

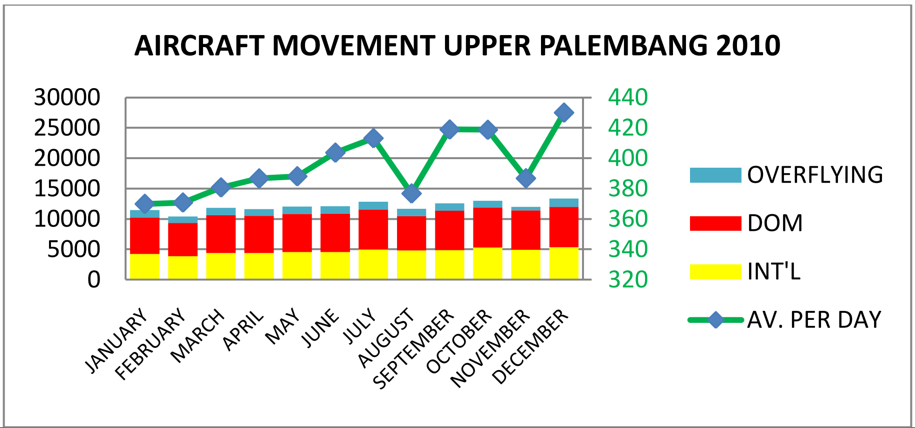
To summarise, low end traffic growth is mostly occurring in the flight training sector and among on-demand helicopter services. This is low altitude, low speed traffic that will not have a major effect on the ATM Master Plan. New training areas for school flights may have to be set up from time to time near airports used as bases for flying schools. This may require adjustments of arrival and departure routes to/from nearby airports. When considering equipment levels, the vast majority of even small and light aircraft produced today comes with modern avionics including at least area navigation
5 capability.

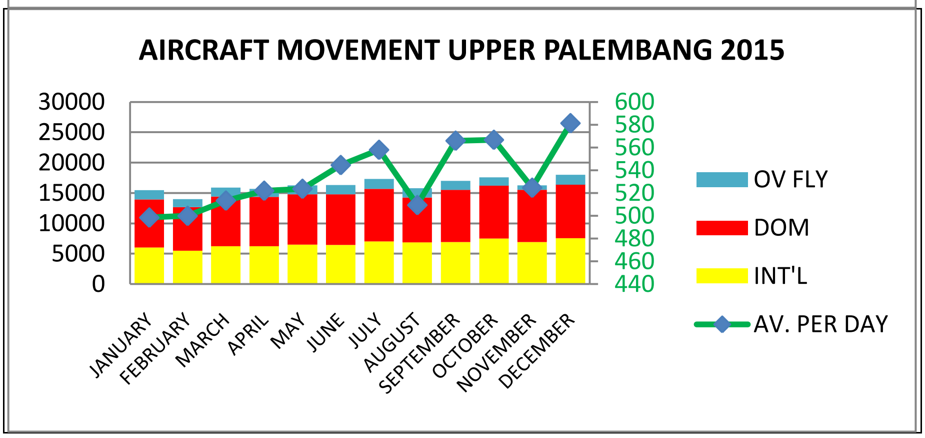
CHAPTER 19: MOVEMENT STATISTICS AND FORECASTS

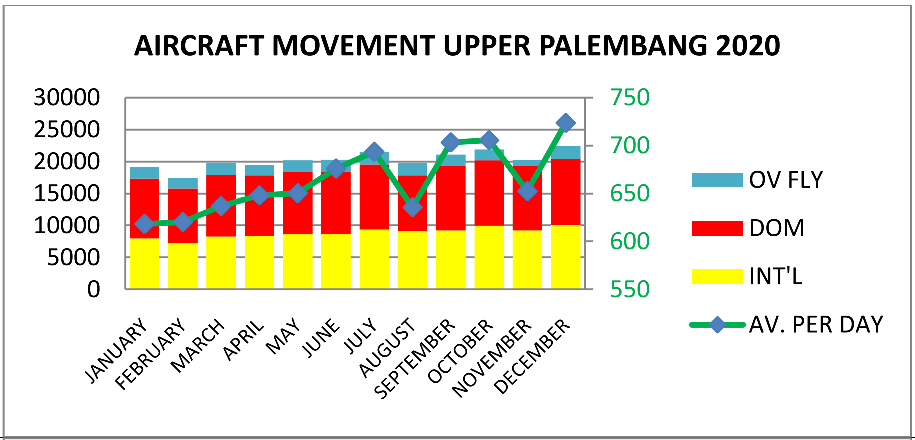
Statistics on aircraft movements by the categories scheduled and non-scheduled is not available. Neither PT. Angkasa Pura 1(AP 1), PT Angkasa Pura 2 (AP 2) or DGCA has this data. Movement data by domestic, international, military and overflight categories are available and presented below. Forecasts are bases on actual data for 2010 increased by the average annual growth rates for international, domestic and overflying air traffic as forecast by LFV Aviation Consulting in August 2010. Barring a few exceptions, military traffic is not included in the upper area sectors, due to its negligible share of total movements. It is expected that military traffic volume will remain approximately the same over the foreseeable future.

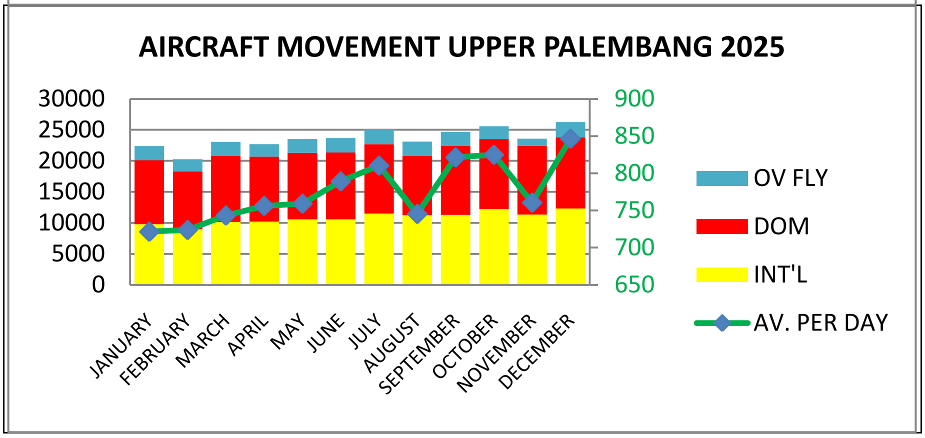
The left axis - number of movements per month - retains the same scale for each sector during the 2010-2025 period to make growth more visible. Average movements per day, being a more obvious indicator of growth, are shown against the right axis.

19.1 UPPER PALEMBANG SECTOR

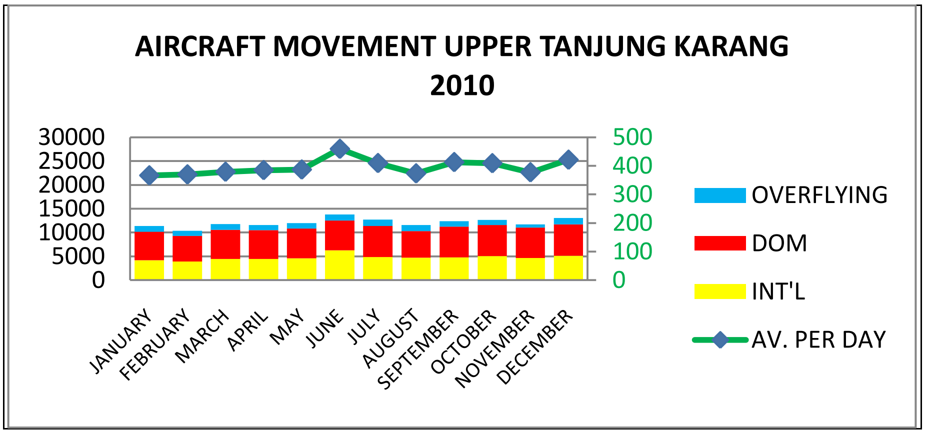


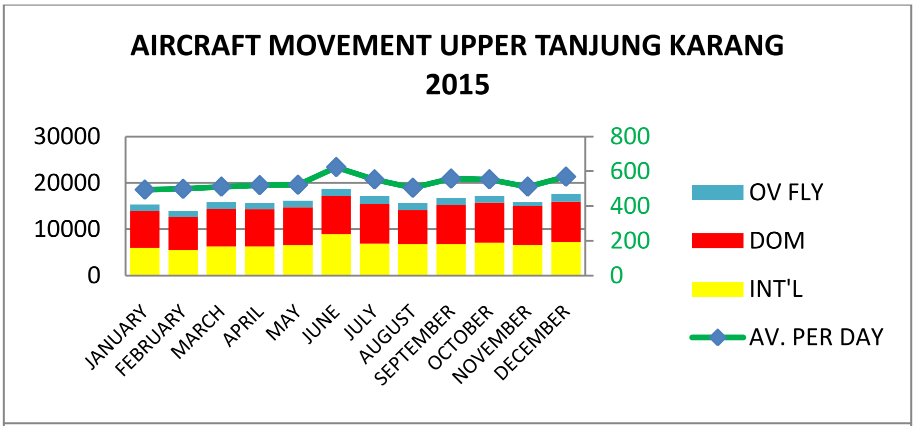






19.2 UPPER TANJUNG KARANG SECTOR

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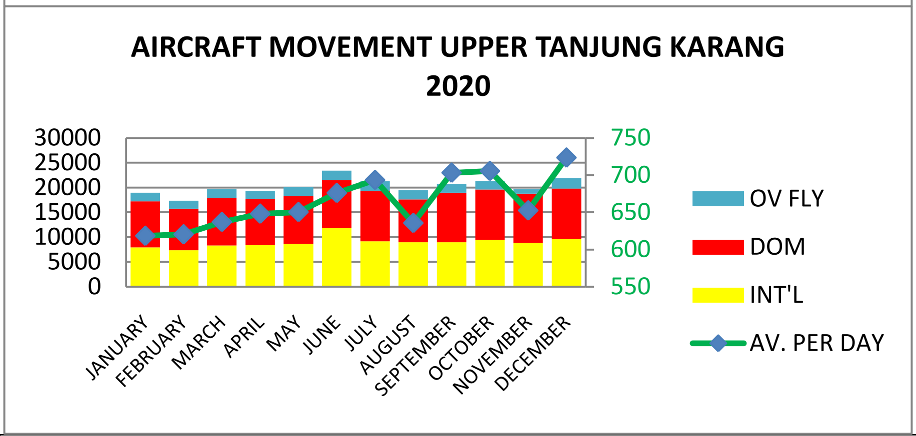
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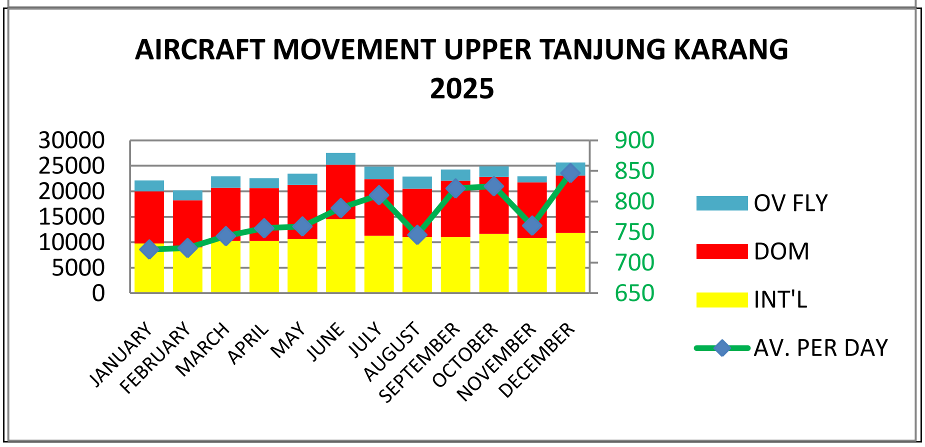
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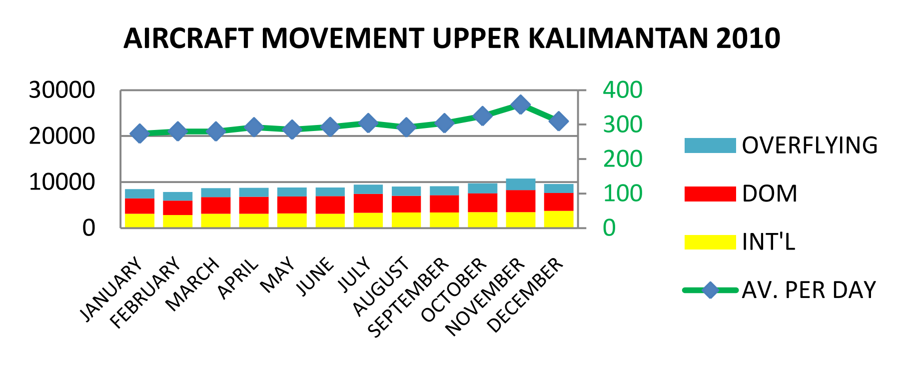
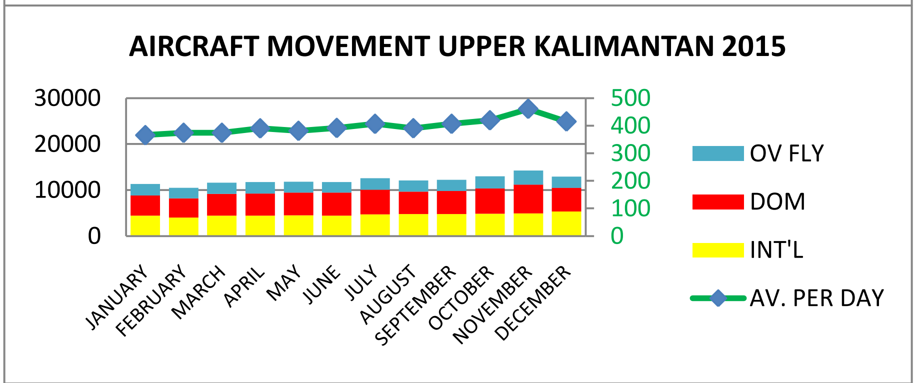
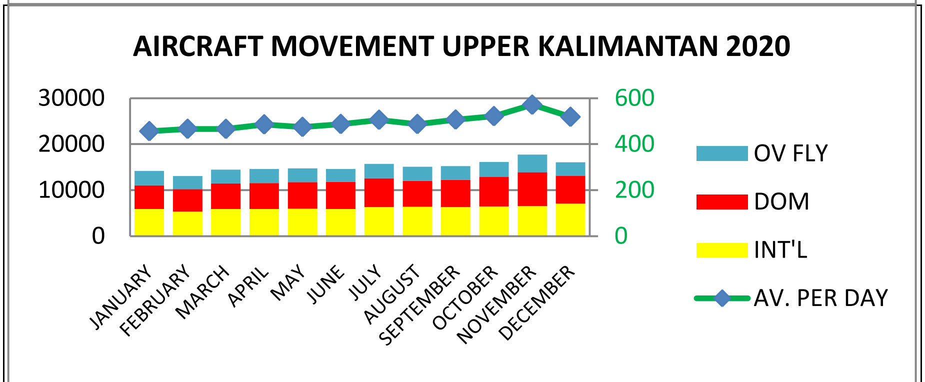
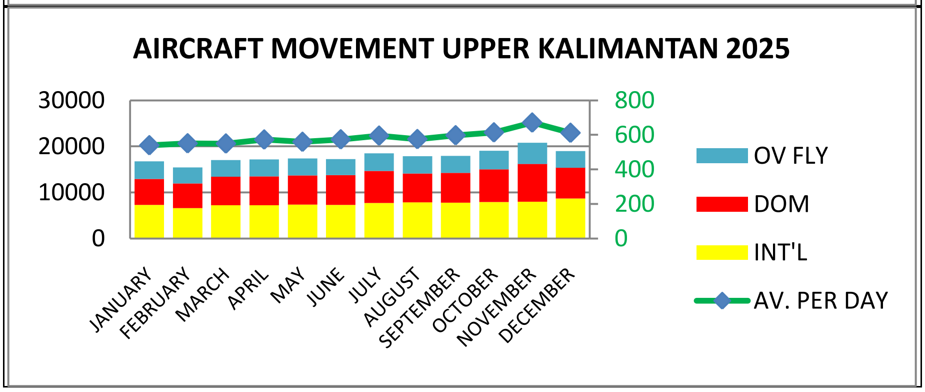
19.3 UPPER KALIMANTAN SECTOR

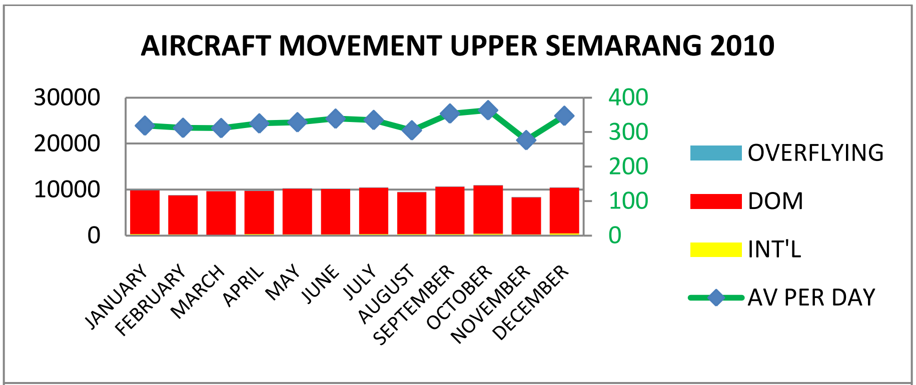


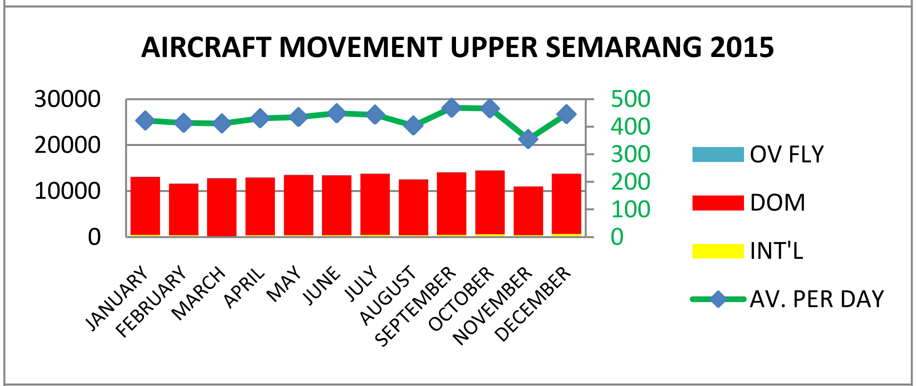


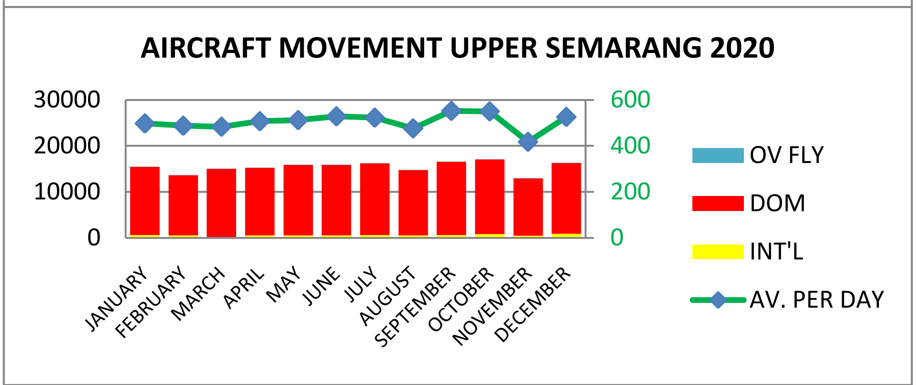


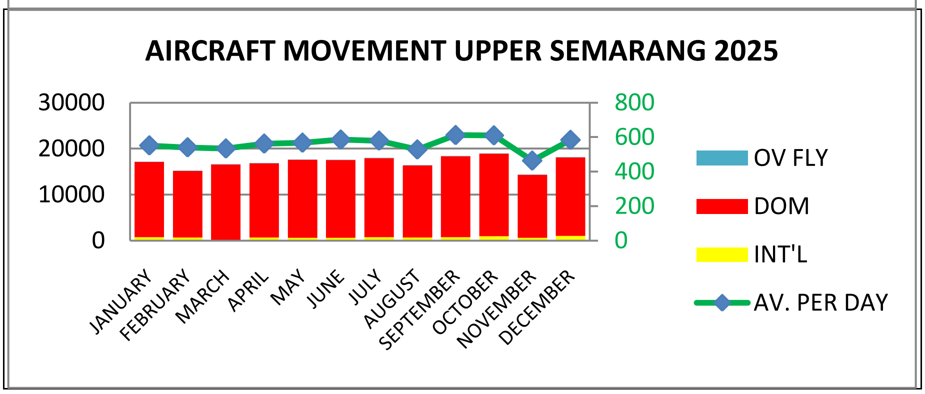


19.4 UPPER SEMARANG SECTOR



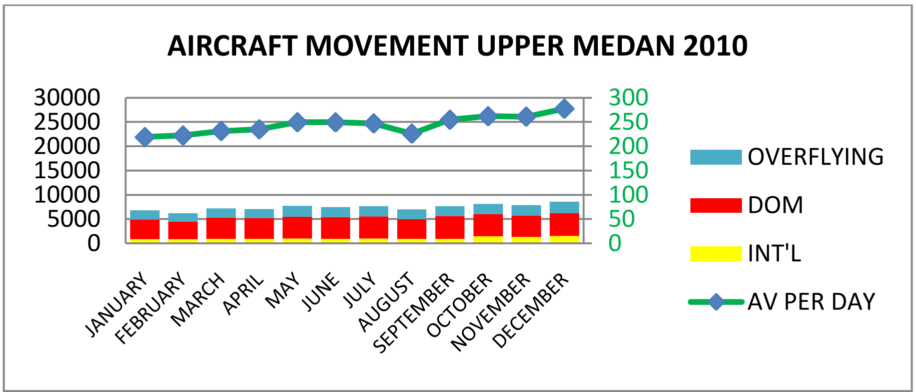


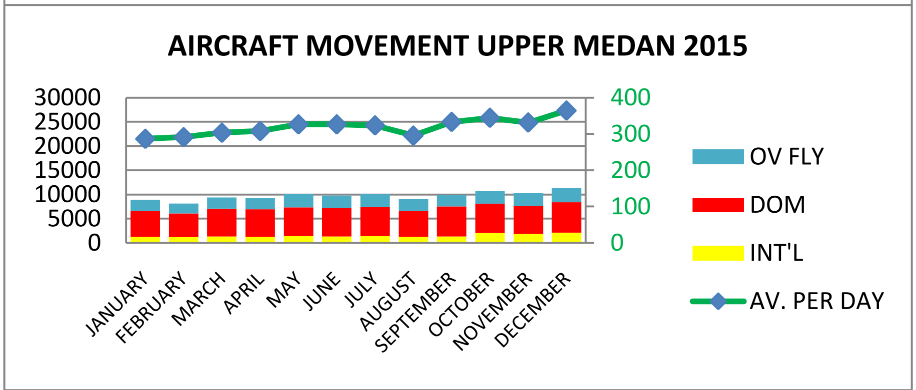


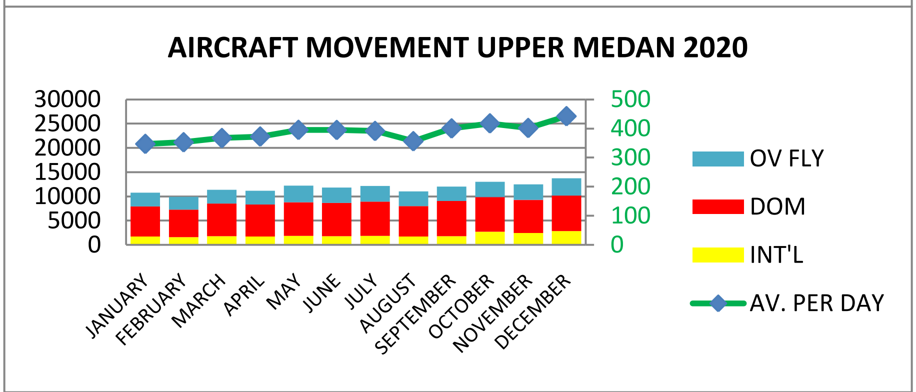


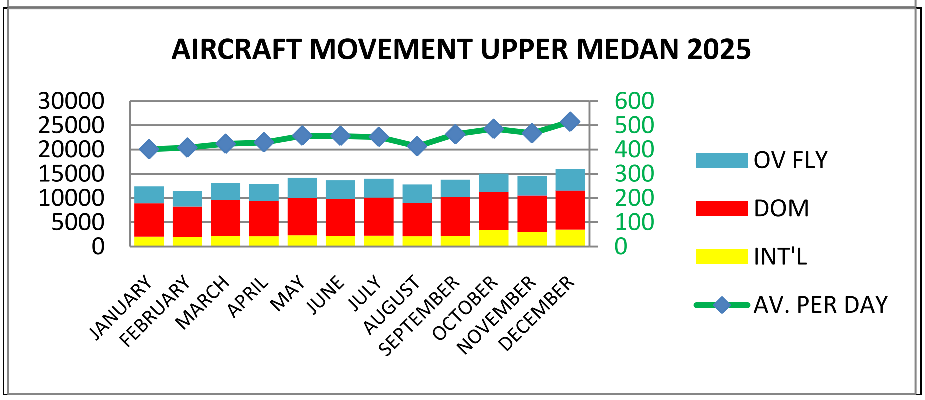
Note: Overflying traffic is virtually non-existent in the Upper Semarang sector.

19.5 UPPER MEDAN SECTOR

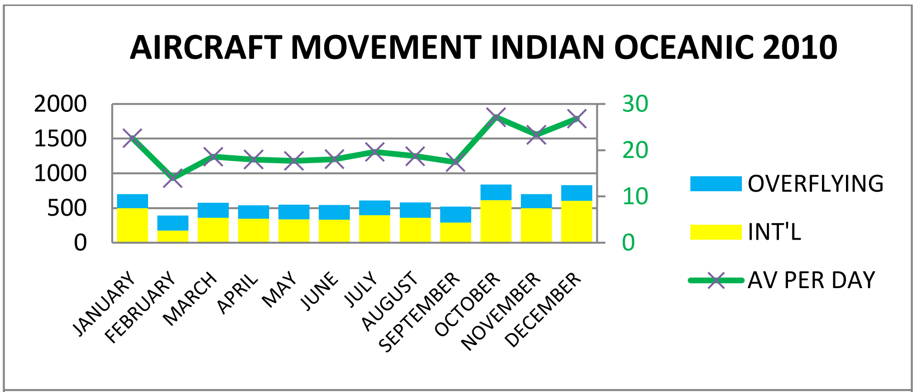


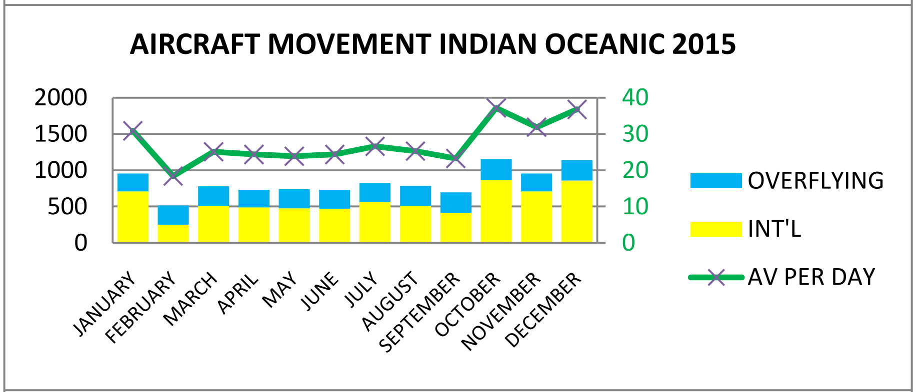


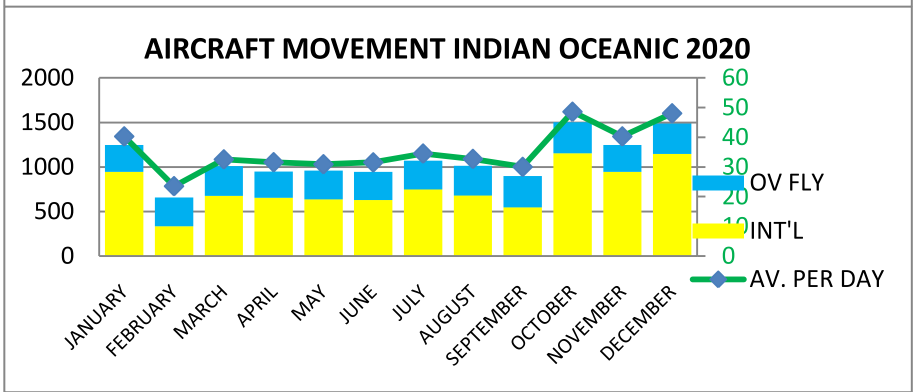


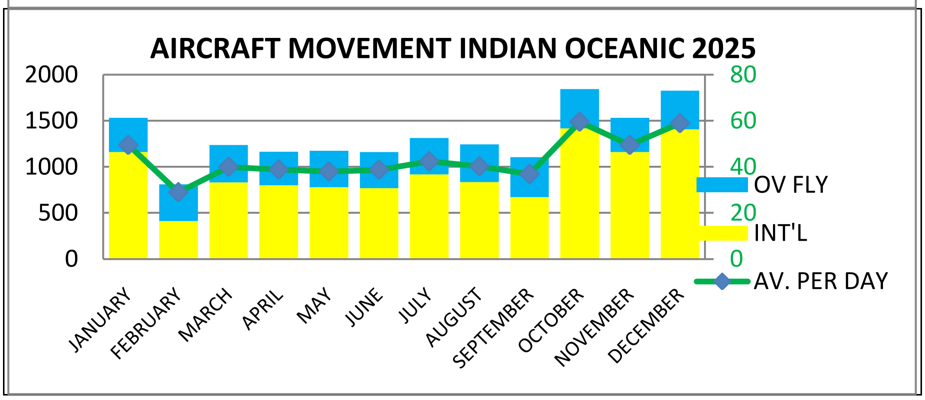


19.6 INDIAN OCEANIC SECTOR



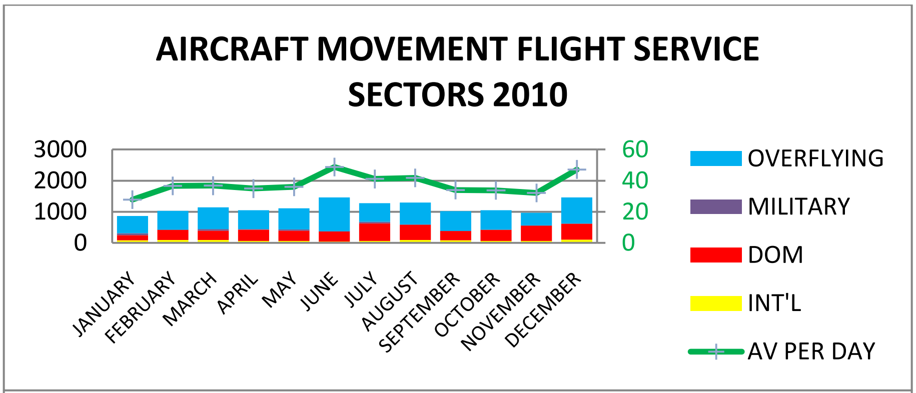


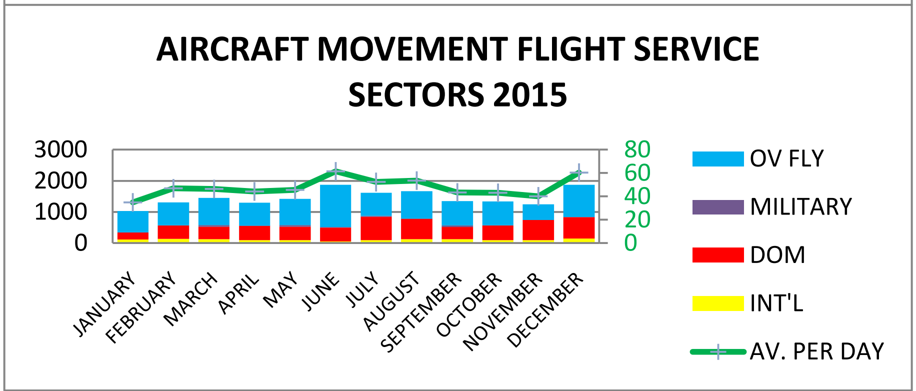


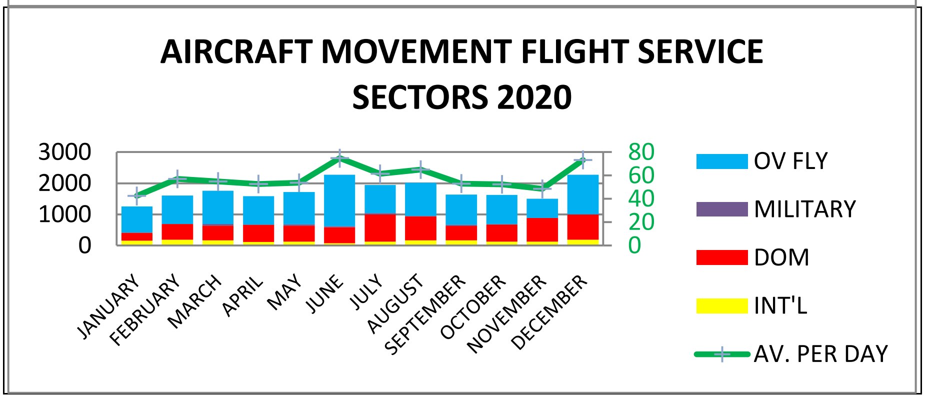


Note: There is no domestic traffic in this sector. Vertical scale differs from previous sections.

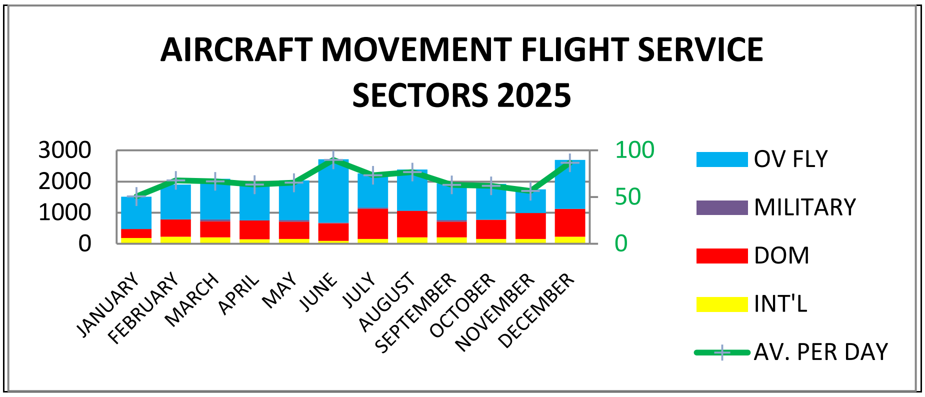
19.7 FLIGHT SERVICE SECTORS[6]







[6] The Flight Service Sector (FSS) concept is explained in section 16.4.



Note: FSS cover lower airspace and have visible volumes of military traffic.

19.8 AP 1 SECTORS

Data for AP1 sectors have not been provided for later years than 2007. In the opinion of the Team, the information is too obsolete to form a basis for forecasts and it is highly unlikely that the situation in the AP 1 sectors would differ significantly from the sectors accounted for in the previous sections.

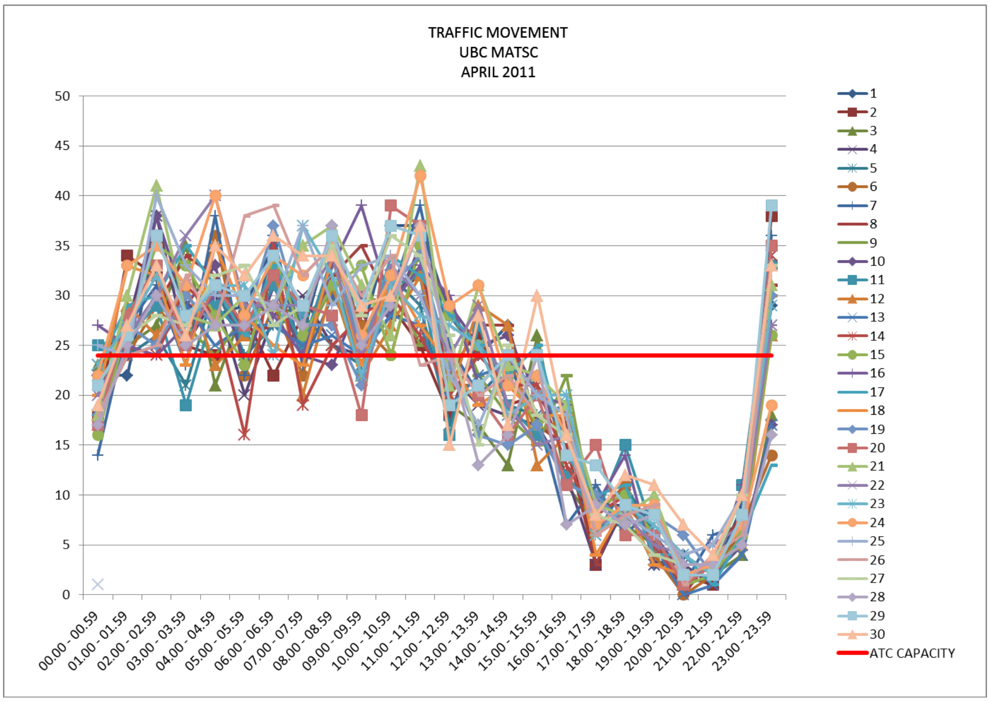
Regarding division of upper airspace between AP 1 and AP 2, see

Figure 37 and Figure 39.

19.9 DAILY VARIATION

The 24-hour traffic pattern has been analysed for five upper airspace sectors and compared to declared air traffic control (ATC) capacity in April, 2011. Severe cases of overload have been found, although the fact that ATC somehow manages to cope with massive overload every day indicates that declared capacities are on the conservative side.

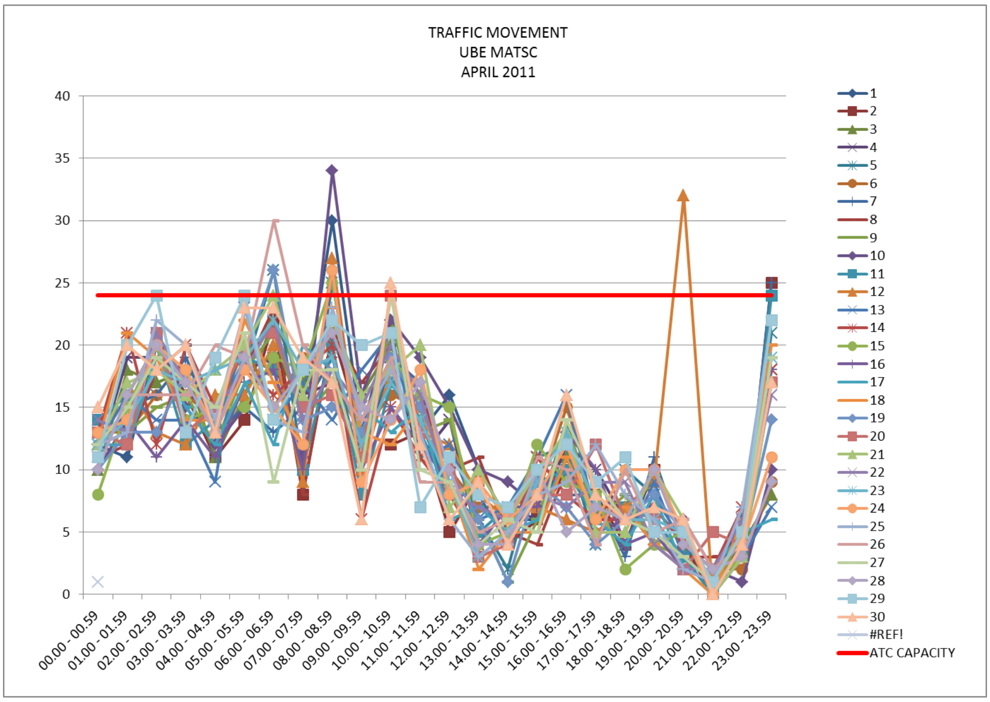
Figure 69: Upper Bali Central



Source: compiled from AP I data.

Upper Bali Central sector is the worst case with overloads from midnight to around noon frequently hitting 50 percent of the declared 24 movements/hour capacity. Interestingly, capacity utilisation is very low in the late afternoon evening hours, bringing the average utilisation close to capacity and setting the stage for efficient demand management. Another option could be to redistribute traffic between Upper Bali Central and East sectors as the latter has a much lower load:

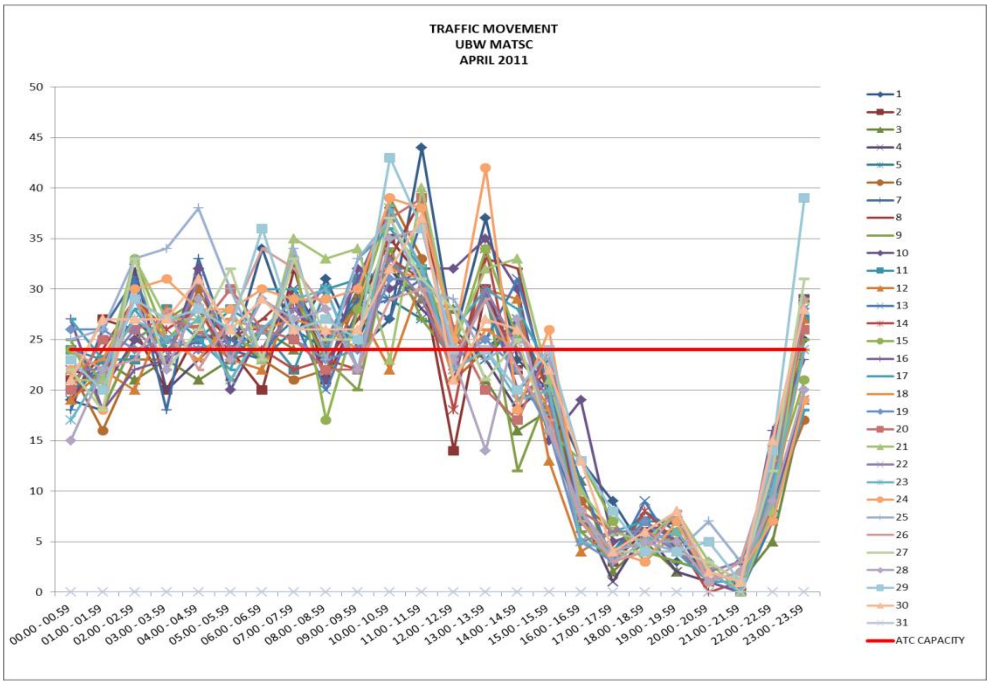
Figure 70: Upper Bali East



Source: compiled from AP I data

In the Upper Bali East sector, traffic load rarely exceeds declared capacity and the average utilisation falls far below.

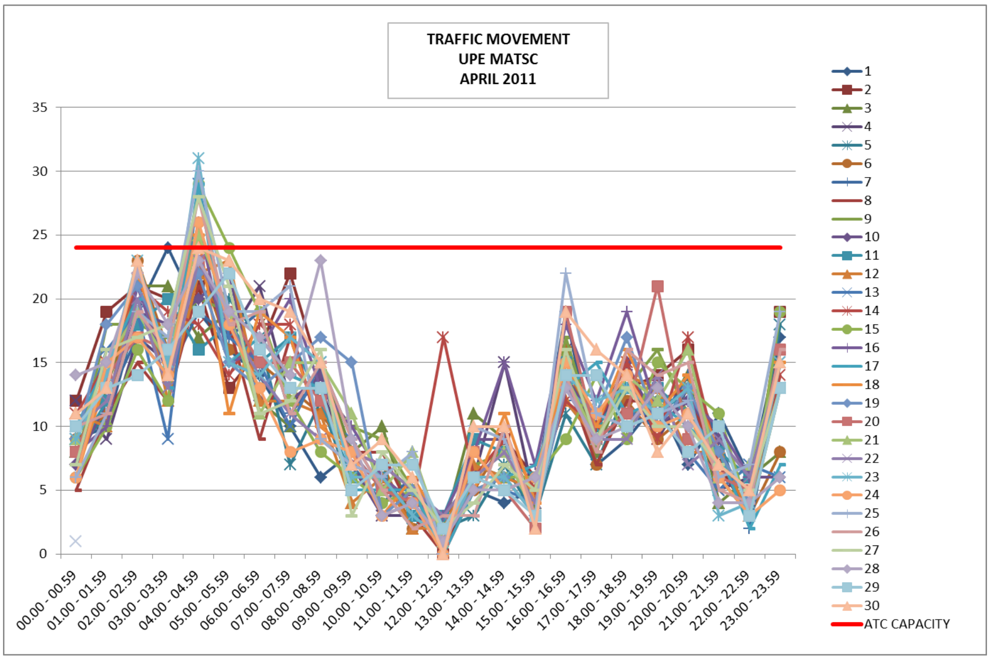
Figure 71: Upper Bali West



Source: compiled from AP I data

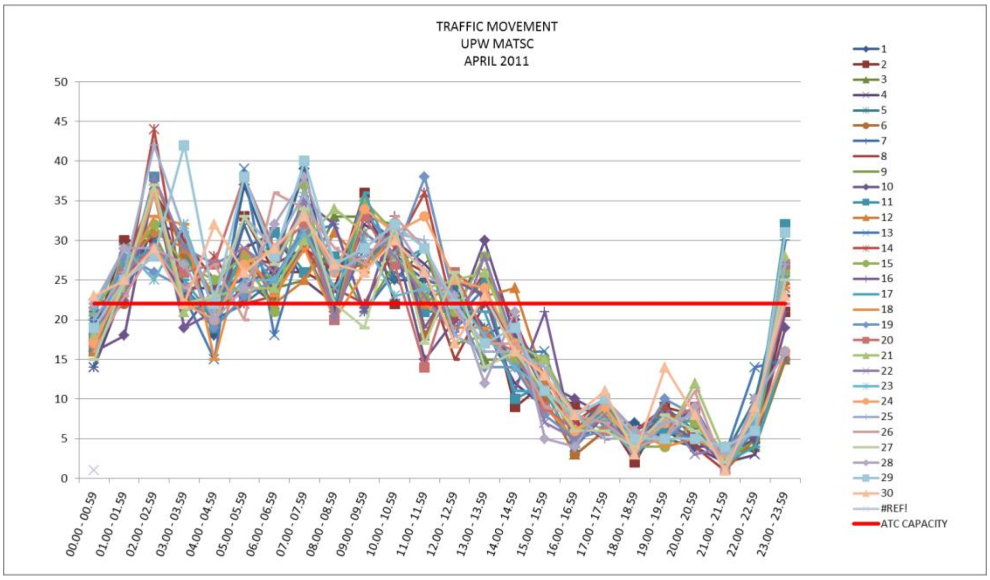
Upper Bali West resembles the Central sector but has a lower night load. Morning, afternoon and evening loads appear similar to the Central sector, leading to the same conclusion regarding redistribution to the East sector. Finally, Ujung Pajang Upper East mirrors Upper Bali East and Ujung Pajang Upper West mirrors Upper Bali West. There is no Upper Central sector in Ujung Pajang Area Control Centre.

Figure 72: Ujung Pajang Upper East



Source: compiled from AP I data

Figure 73: Ujung Pajang Upper West



Source: compiled from AP I data

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ICAO Doc 9683 – H F Training Manual Part 1 and 2

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ANNEXES

ANNEXE 1 ANALYSIS OF AIRCRAFT EQUIPMENT LEVEL

Even though Indonesia a developing country, most aircraft operating in its airspace are modern and fully capable of area navigation (RNAV)/required navigation performance (RNP) navigation. Data provided by Garuda Indonesia shows a very high maturity of the fleet when it comes to equipment levels and navigation capabilities.

Table 15: December 2010 fleet status

Table 2.12.1 List of Airline Companies and Fleet Profile: Air Operator Certificate in Operation 121 as of December 2010

Airline Companies		Aircraft Registered (as of December 2010)
1	Garuda Indonesia	B747: 3, A330: 11, B737: 76
2	Merpati Nusantara Airlines	B737: 13, F100: 2, F28: 2, F27: 3, CN235: 3, CN212: 5, DHC6: 8, MA60: 9, ATR72: 1
3	Kartika Airlines	B737: 2, MD83: 1
4	Mandala Airlines	A319: 2
5	Trigana Air Services	B737: 4, ATR72: 3, ATR42: 6, F27: 2, DHC6: 3, DHC4A:1, CESSNA: 2
6	Metro Batavia	B737: 40, A319: 2, A320: 7,A330: 2
7	Pelita Air Services	F28: 6, DHC7: 6, C212: 8, AVRO146: 1, AS332: 1, BELL412: 2, BELL430: 3, BO105: 9, PA31:T: 1, SA330: 3, SIKORSKY S76A: 3
8	Indonesia Air Asia	B737: 54, B747: 2, MD: 4
9	Lion Mentari Airlines	B737: 5, A320: 14
10	Wing Abadi Airlines	MD82: 6, DHC8: 3, ATR72: 9
11	Cardig Air	B737: 2
12	Riau Airlines	F50: 3, B737: 1, F27: 2
13	Tri MG Intra Asia Airlines	B727: 2, B737: 2, LET410: 2
14	Manunggal Air Services	BAE146: 2, TRANSALL C160: 1
15	Nusantara Air Charter	BAE146: 2, CL601-3A: 1
16	Indonesia Air Transport	F27: 4, AS365: 1, ATR42: 3, B1900D: 2, EC155: 4, Falcon20F: 1
17	Sriwijaya Air	B737: 27
18	Kal Star Aviation	ATR-42: 3
19	Travel Express Aviation Services	B737: 5, D328: 6
20	Asialink Cargo Express	F27: 2
21	Republic Express Airlines	B737: 2
22	Air Maleo	F28: 2

Source: JICA 2011 report

The dominant carrier Garuda is further analysed below:

Table 16: Garuda fleet status

Garuda fleet navigation capability			Garuda fleet equipment status		
RNAV 5	100	%	CPDLC	39	%
RNAV 1&2	100	%	ADS-B	57	%
RNP 10	83	%	ADS-B/C	39	%
RNP 4	37	%			
RNP APCH	61	%			

Source: Garuda, status as of 29 April, 2011.

The entire Garuda fleet has navigation capability down to RNAV1 and 61 percent of the fleet is capable of RNP ACPH. With the current phase-out of older Boeing 737 Classic models in favour of the modern 737 NG, the RNP APCH share will continue to improve. A majority of the aircraft also have automatic dependent surveillance-broadcast capability and around 40 percent are approved for controller-pilot data link communications and automatic dependent surveillance - contract. This is further improved by the large domestic operator Lion Air which soon will operate an all 737 NG fleet.

ANNEXE 2 COST ESTIMATES - CNS RECOMMENDATIONS

To the extent possible within the ToR for the Air Traffic Management (ATM) Master Plan study, costs have been estimated for the communication, navigation and surveillance recommendations in this report. Estimations refer to ATM *equipment* costs, or the manpower cost for satisfactorily investigating an issue in the case this is required. Barring a few exceptions, only investments recommended for implementation in the short term are included as estimates of medium and long term recommendations will be much too unreliable. There is a high degree of uncertainty even in the short term estimates.

Recommendations are assigned costs one by one but there are significant gains to be found in grouping related recommendations into the same project. Costs are stated in Euros (€), in June 2011 having an exchange rate of Rp 11,700. Only direct costs in terms of equipment and manpower are quoted. These are relevant inter alia for outright replacement of stand-alone, unmanned equipment. For more complicated systems, planning and design, plus project management, support costs and training may very well double the sheer equipment or direct work costs.

Equipment

In the communication field, there are 13 very high frequency extended range (VHF-ER) stations more than 20 years old and these should be on the list for short term replacement. The replacement cost is around € 15,000.

For the navigation system there are four VHF Omni-directional range (VOR) stations and eight distance measuring equipment (DME) stations more than 20 years old. A replacement plan is therefore needed. The replacement cost for a VOR station is around € 500,000 and for a DME station around € 180,000. There are also more than 60 non-directional beacon (NDB) stations more than 20 years old. Replacement of the NDP equipment should be carefully considered in the light of activity 71, MAV-11: Phase out NDB equipment. The replacement cost for a NDB station is around € 70,000.

Regarding surveillance, the current Jakarta Advanced Air Traffic Control System (JAATS) is old and in urgent need for replacement. *The estimated cost for a new JAATS system is € 45 million.* This does not include the costs for specification of the system, training of personnel, system validation and verification and a new building.

The automatic dependent surveillance-broadcast system installed 2008-2010 is expected to have a life-span of 20 years. There are primary surveillance radar (PSR) stations more than 20 years old and they should therefore be replaced in the near future. There are also 16 secondary surveillance radars (SSR) and two monopulse SSR more than 20 years old. For these eight stations a replacement with wide area multilateration (WAM, activity 85: SUR-12: Phase out of conventional radar) should be investigated. The cost for replacement of a PSR station is around € 4.75 million. A Mode S radar station replacing an SSR or MSSR costs around € 2 million. To install a WAM station instead of a Mode S station costs € 1 MEUR

Using this information, the equipment cost for planned CNS installations will be roughly as follows:

Table 38: CNS equipment cost

18 VHF-ER stations pre-1995	Figure 59	€ 270,000
2 VOR/DVOR	Figure 65	€ 1,000,000
20 DME	Figure 66	€ 3,600,000
11 primary radars pre-1995	Figure 60	€ 49,500,000
16 secondary radars pre-1995	"	€ 32,000,000
2 monopulse radars pre-1995	"	€ 4,000,000
TOTAL AROUND		**€ 90 MILLION**

Manpower

Table 39: Cost estimates for communication

	Horizon	Short term							
	Project description (abbreviated)	2011	2012	2013	2014	2015	**ACTIVITY**	**DAYS**	**€ 1,000**
	Communication (COM)								
45	Communication operational concept	■	■				Production	35	47
46	Communication maintenance plan	■	■				Production	40	53
47	Improved VHF coverage in eastern Indonesia		■	■	■		Study	15	20
48	Use of DOC 4444 messages		■	■	■		Study	10	13
49	ATN network 1			■	■		Study	25	33
50	Communication monitoring		■	■			Study	10	13
51	AMHS implementation		■	■			Review status	10	13
52	Use of CPDLC			■	■	■	Study	15	20
57	Implement AIDC	■					-		
58	Use of AIDC for ACC			■	■	■	-		
							TOTAL	**160**	**213**

In the communications area, eight activities have been estimated. Total cost is fully € 200,000.

Table 40: Cost estimates for navigation

	Horizon	Short term					Med.				
	Project description (abbreviated)	2011	2012	2013	2014	2015	2016-2017	2018-2020	ACTIVITY	DAYS	€ 1,000
	Navigation (NAV)										
60	Conventional Navigation Structure								Develop strat.	25	33
61	Implement Augumentation								Study	20	27
62	Implement standardized in-and outbound proc.								Implement	50	67
63	Develop regulation for the use of augmented GNSS								Develop reg.	20	27
64	Implement augmented GNSS step 1								Implement		0
65	Implement augmented GNSS step 2								Implement		0
66	Review use of conventional ground navigation aids								Review	25	33
67	Navigation operational concept								Production	35	47
68	Navigation maintenance plan								Production	40	53
69	Calibration procedures plan								Production	15	20
70	WGS-84 validation, publication and amendments								Study	25	33
71	Start of NDB phase out								Phase out		0
									TOTAL	**255**	**339**

Out of 12 activities in the navigation field, three carry no cost. The NDB phase-out will actually lead to savings due to avoided repair and maintenance. Total cost will be around € 340,000.

Table 41: Cost estimates for surveillance

	Horizon	Short term							
	Project description (abbrev)	2011	2012	2013	2014	2015	ACTIVITY	DAYS	€ 1,000
	Surveillance (SUR)								
74	Surveillance operational concept						Production	35	47
75	Operational Manual						Production	55	73
76	Surveillance maintenance plan						Production	40	53
77	Sharing of surveillance information						Study	15	20
78	Objective for Surveillance coverage						Define	10	13
79	Declare Operational separation criteria						Define	15	20
80	Radar fall-back						Study	20	27
82	Wide Area Multilateration En-route and TMA						Study	25	33
86	Develop integrated SID/STAR trajectories						Develop	20	27
89	Safety net Jakarta ACC						Study	10	13
90	Safety nets Ujung Pandang ACC						Study	15	20
91	Planning tool MTCD						Study	10	13
92	Sequencing tool						Study	15	20
							Total	**285**	**379**

Compared to the equipment cost for replacing JAATS, around € 45 million, manpower costs for the other short-term surveillance activities amount to change money, around € 400,000.

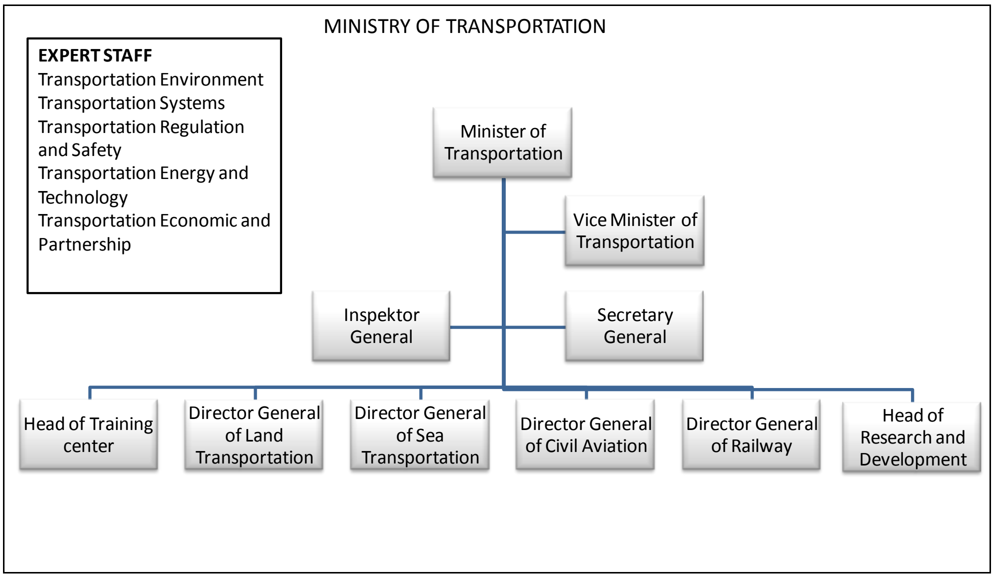
All in all, the manpower costs in the entire CNS domain for short term activities, including the three navigation activities extending into medium term, will be around one million Euros.

ANNEXE 3 ORGANISATION CHARTS

This chapter shows organisation maps relevant for the civil aviation sector.

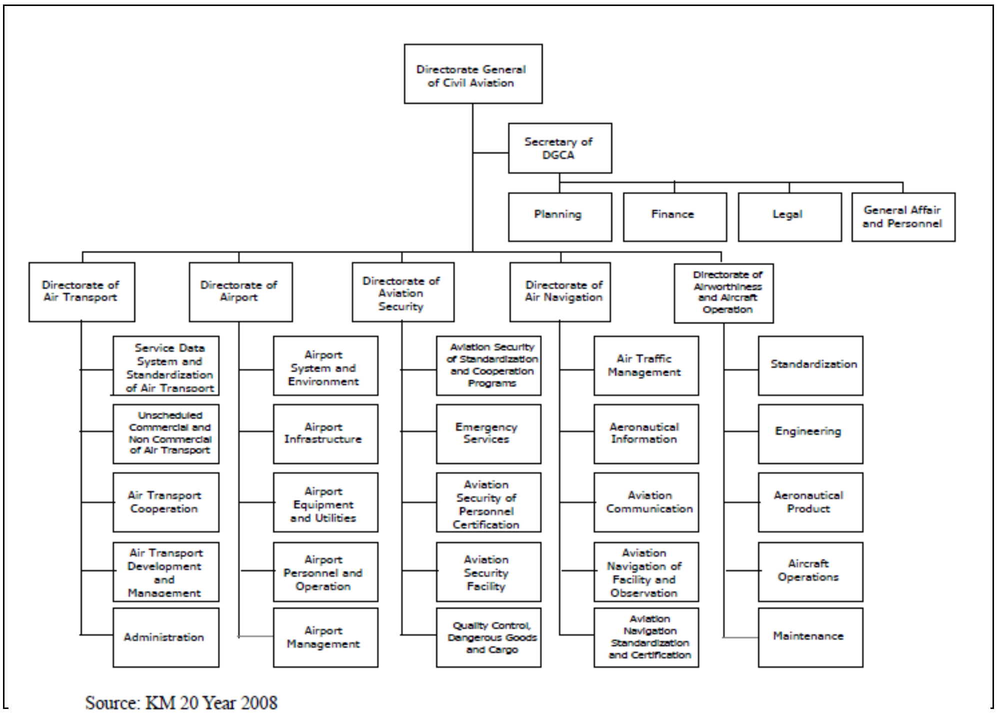
Ministry of Transportation

The chart below is the organisational chart for the Ministry of Transport.



Directorate General of Civil Aviation

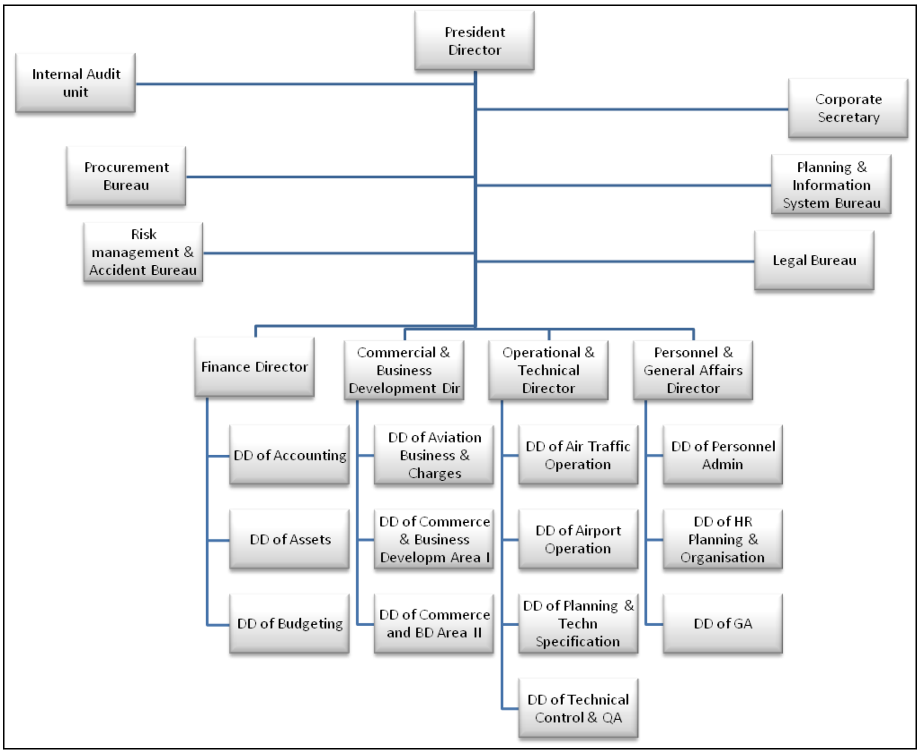
The chart below is the organisational chart within the Directorate General of Civil Aviation.



Source (secondary): JICA 2011 report

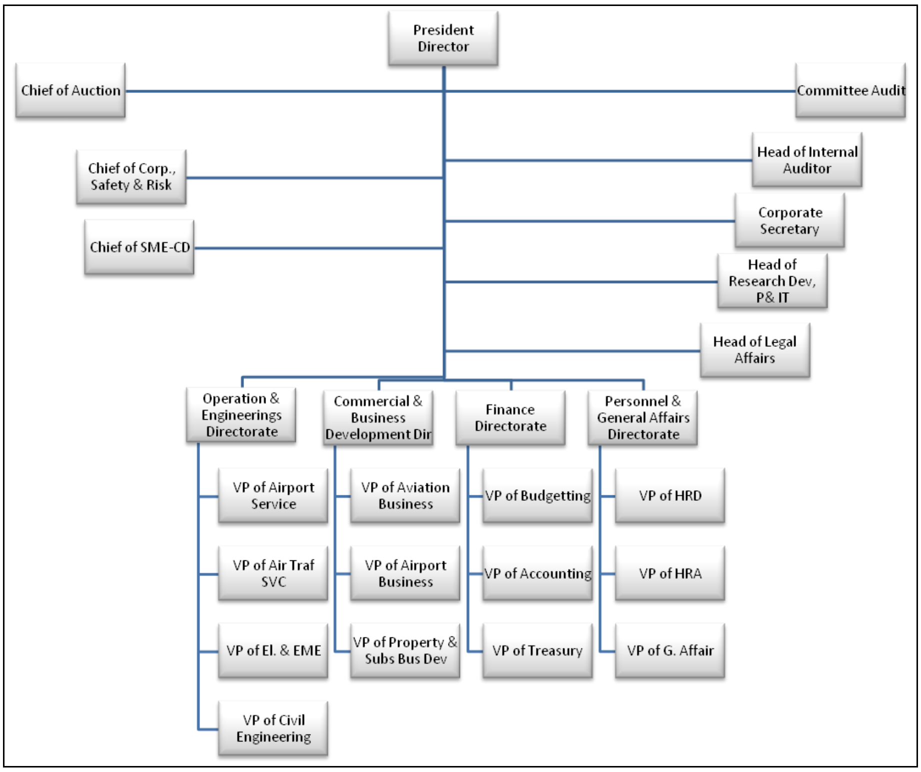
Angkasa Pura 1

The chart below is the organisational chart for PT Angkasa Pura 1.



Angkasa Pura 2

The chart below is the organisational chart for PT Angkasa Pura 2.



Source: DGCA