Asia-Pacific
Economic Cooperation

Air Traffic Management Emissions Reduction

Project Report

APEC Transportation Working Group

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AVIATION

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EXECUTIVE SUMMARY

The Air Traffic Management Emissions Reduction Project addresses one of the most cost-effective means to reduce aviation emissions in the APEC region – the application of Air Traffic Flow Management (ATFM) and Collaborative Decision Making (CDM) processes and technology. Most APEC economies in Asia are experiencing air traffic growth that exceeds the capacity of their prime airports and key en route airspace. This capacity overloading results in airborne traffic delays, unnecessary traffic management reroutes, and excess fuel consumption. While the construction of additional infrastructure will ease this demand and capacity imbalance, it will take time and involve considerable cost. There is an urgent need to make the airport and airspace infrastructure that is available today work more efficiently and to reduce the impact of aviation emissions on the environment. By reducing en route flight times, airborne holding, and airport queuing delays, Air Traffic Management Modernization, to include Air Traffic Flow Management and Collaborative Decision Making tools and procedures, can reduce emissions for APEC economies in advance of extensive research or significant investment in aircraft avionics.

At the Transport and Energy Ministerial Meeting in September 2011, Ministers directed the TPTWG and EWG to cooperate on best practices for the modernization of air traffic management to limit or reduce the environmental footprint for all phases of flight. The reduction of greenhouse gases is a global problem and this project provides an opportunity to improve energy efficiency in a region that is not currently taking advantage all air traffic management techniques.

This Project Report is the result of a study to identify methods and estimate benefits associated with improvements to the air traffic flow in and around Bangkok and Kuala Lumpur, between the two cities, and in the neighboring region based on application of ATFM/CDM procedures and systems. The study included stakeholder discussions, site visits, and operational data analysis in order to identify appropriate ATFM/CDM approaches that will improve the efficiency of the focus area for the study.

The study team included participants from Metron Aviation, APEC, FAA, DCA Thailand, AEROTHAI, DCA Malaysia, AirNav Indonesia, and DCGA Indonesia. In addition to the core team, the study was supported by other key aviation stakeholders from both host economies.

At each host economy kickoff meeting, an overview of ATFM/CDM was provided by Metron Aviation. The overview described the principles identified by ICAO and related these principles to operational examples of ATFM/CDM throughout the world.

Site visits were performed at the following facilities:

- AEROTHAI Headquarters
- Bangkok ATFMU, Bangkok ACC, BKK Approach Control and ATCT, and Don Mueang ATCT

- BKK Operations Center
- Thai Airways Operations Center, Thai AirAsia Operations Center
- KLIA ATCT, KL ACC and Approach Control
- KLIA Airport Operations Center
- Malaysia Airlines Operations Center

At each site, the current operations, operational issues, ATFM/CDM practices, and near term plans were discussed to provide a broad understanding and identify opportunities for applying ATFM/CDM practices to reduce fuel burn and emissions within each host economy.

Operational data was obtained from the study participants to support a quantitative analysis of the key factors impacting efficiency and to form a basis for a first order benefits analysis. The analysis evaluated actual demand profiles, airborne holding, and surface delays for departures. This allowed confirmation of the main operational issues identified by the stakeholders and provided a quantitative basis for benefits estimates achievable with ATFM/CDM processes and tools.

The following table shows the conservative benefits estimate for reduced airborne holding with the use of ATFM/CDM principles:

Airport	Airborne holding benefits pool (hrs/ year)	Conservative Airborne Holding Reduction (hrs/year)	Conservative CO2 emissions reductions (metric tonnes/year)	Conservative Fuel savings (US$/year)
VTBS	352.4	117.5	1,086	0.35M
WMKK	3,611.7	1203.9	11,124	3.53M

The following table shows the conservative benefits estimate for reduced taxi out time with the use of Airport CDM principles:

Airport	Excess Taxi Out Time benefits pool (hours of excess taxi time limited to 4 mins/flight)	Conservative Taxi Out Reduction (hrs/year)	Conservative CO2 emissions reductions (metric tonnes/year)	Conservative Fuel savings (US$/year)
VTBS	3150	1050	679	0.22M
WMKK	3905	1302	842	0.27M

In addition to these quantified benefits, additional benefits from ATFM/CDM include improved aircraft operator efficiency when slot substitutions can reflect their operational priorities, and a reduction in carry fuel due to increased predictability that allows aircraft operators to carry less holding fuel into congested airports.

The study includes the following ATFM/CDM recommendations, in line with ICAO principles, for the host economies:

a) Enhance and Expand Communications and Information Sharing
b) Deploy ATFM/CDM system for demand capacity balancing
c) Deploy Airport CDM for major airports
d) Declare capacity for sectors
e) Post operations analysis of key performance measures
f) Training
g) Airport Strategic Slot Compliance
h) Kuala Lumpur FIR and Singapore FIR combined airspace analysis

Metron Aviation appreciates the support, openness, hospitality, and access to data throughout the study by all participants.

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ACRONYMS

ACC	Area Control Center
AMAN	Arrival Manager
AOCC	Airside Operations Control Center
APP	Approach Control
AOT	Airports of Thailand Public Company Limited
APEC	Asia Pacific Economic Cooperation
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATCT	Air Traffic Control Tower
ATFM	Air Traffic Flow Management
ATFMU	Air Traffic Flow Management Unit
ATNS	Air Traffic and Navigation Services
BKK	Bangkok Suvarnabhumi Airport (IATA code)
BOBCAT	Bay of Bengal Cooperative Air Traffic Flow Management System
CAAS	Civil Aviation Authority Singapore
CAD	Civil Aviation Department
CDM	Collaborative Decision Making
DCA	Department of Civil Aviation
DGCA	Directorate General of Civil Aviation
DMAN	Departure Manager
DMK	Don Mueang Airport (IATA code)
EOBT	Estimated Off Block Time
EWG	Energy Working Group
FAA	Federal Aviation Administration
FIR	Flight Information Region
FL	Flight Level
ICAO	International Civil Aviation Organization
KLIA	Kuala Lumpur International Airport
KUL	Kuala Lumpur International Airport (IATA code)
LCCT	Low Cost Carrier Terminal (at KUL)
LO	Liaison Officer
MAHB	Malaysia Airports Holding Berhad
MAS	Malaysia Airlines (ICAO code)
MDI	Minimum Departure Interval
NM	Nautical Miles
OCC	Operational Control Center
OTP	On Time Performance
PO	Project Overseer
PoC	Point of Contact
SMAN	Surface Manager
SME	Subject Matter Expert
TMI	Traffic Management Initiative

TPTWG	Transportation Working Group
VTBD	Bangkok Don Mueang Airport (ICAO code)
VTBS	Bangkok Suvarnabhumi Airport (ICAO code)
WMKK	Kuala Lumpur International Airport (ICAO code)

1. Background

The Air Traffic Management Emissions Reduction Project addresses one of the most cost-effective means to reduce aviation emissions in the APEC region – the application of Air Traffic Flow Management (ATFM) and Collaborative Decision Making (CDM) processes and technology. Most APEC economies in Asia are experiencing air traffic growth that exceeds the capacity of their prime airports and key en route airspace. This capacity overloading results in airborne traffic delays, unnecessary traffic management reroutes, and excess fuel consumption. While the construction of additional infrastructure will ease this demand and capacity imbalance, it will take time and involve considerable cost. There is an urgent need to make the airport and airspace infrastructure that is available today work more efficiently and to reduce the impact of aviation emissions on the environment. By reducing en route flight times, airborne holding, and airport queuing delays, Air Traffic Management Modernization, to include Air Traffic Flow Management and Collaborative Decision Making tools and procedures, can reduce emissions for APEC economies in advance of extensive research or significant investment in aircraft avionics.

At the Transport and Energy Ministerial Meeting in September 2011, Ministers directed the TPTWG and EWG to cooperate on best practices for the modernization of air traffic management to limit or reduce the environmental footprint for all phases of flight. The reduction of greenhouse gases is a global problem and this project provides an opportunity to improve energy efficiency in a region that is not currently taking advantage all air traffic management techniques.

This Project Report is the result of a study to identify methods and estimate benefits associated with improvements to the air traffic flow in and around Bangkok and Kuala Lumpur, between the two cities, and in the neighboring region based on application of ATFM/CDM procedures and systems. The study included the following four components that worked together to achieve a level of understanding of current operations and constraints in order to identify appropriate ATFM/CDM approaches that will improve the efficiency of the focus area for the study:

- Stakeholder discussions
- Site visits
- Operational data analysis
- Domain expertise

The Project Report is organized as follows:

1. Background
2. Overview of ATFM/CDM
3. Study Team Composition
4. Site Visits

5. Operational Data Analysis
6. Benefits Estimates
7. Recommendations

2. Overview of ATFM/CDM

ATFM/CDM processes and systems support the balancing of demand to the available capacity for constrained resources (e.g., airports, airspaces). CDM with stakeholders throughout the process is a key component to successful ATFM. ATFM/CDM operates across the full spectrum of operations time horizons: strategic, pre-tactical, tactical, and post operations.

ICAO Doc 9971 Part II identifies the objectives of ATFM as follows:

a. Enhance the safety of the ATM system by ensuring the delivery of safe traffic densities and minimizing traffic surges;
b. Ensure an optimum flow of air traffic throughout all phases of the operation of a flight by balancing demand and capacity;
c. Facilitate collaboration among ATM system stakeholders to achieve an efficient flow of air traffic through multiple volumes of airspace in a timely and flexible manner that supports the attainment of the business or mission objectives of Airspace Users and provides optimum operational choices;
d. Balance the legitimate, but sometimes conflicting, requirements of all Airspace Users, thus promoting equitable treatment;
e. Consider ATM system resource constraints and economic and environmental priorities;
f. Facilitate, by means of collaboration among all stakeholders, the management of constraints, inefficiencies, and unforeseen events that affect ATM system capacity in order to minimize negative impacts of disruptions and changing conditions; and
g. Facilitate the achievement of a seamless and harmonized ATM system while ensuring compatibility with international developments.

Additionally, ICAO Doc 9971 Part II identifies the following principles of ATFM:

a. Optimise available airport and airspace capacity without compromising safety;

b. Maximize operational benefits and global efficiency while maintaining targeted safety levels;

c. Promote a timely and effective coordination with all affected parties;

d. Foster international cooperation leading to an optimal, seamless ATM system;

e. Recognise that airspace is a common resource for all Airspace Users and ensure fairness and transparency, while taking into account security and defence needs;

f. Support the introduction of new technologies and procedures that enhance ATM system capacity and efficiency;

g. Be an integral part of world economies, supporting system predictability and helping maximize aviation economic efficiencies and returns, and supporting many other economic sectors such as business, tourism and cargo; and
h. Evolve constantly in terms of airspace, Air Traffic Service (ATS) routes and airports, efficiency, and effectiveness. Thus, ATFM is evolutionary in nature and supports an ever-changing aviation environment.

Figure 1 shows the primary components of ATFM operational management with respect to Demand and Capacity for the operational time horizons.

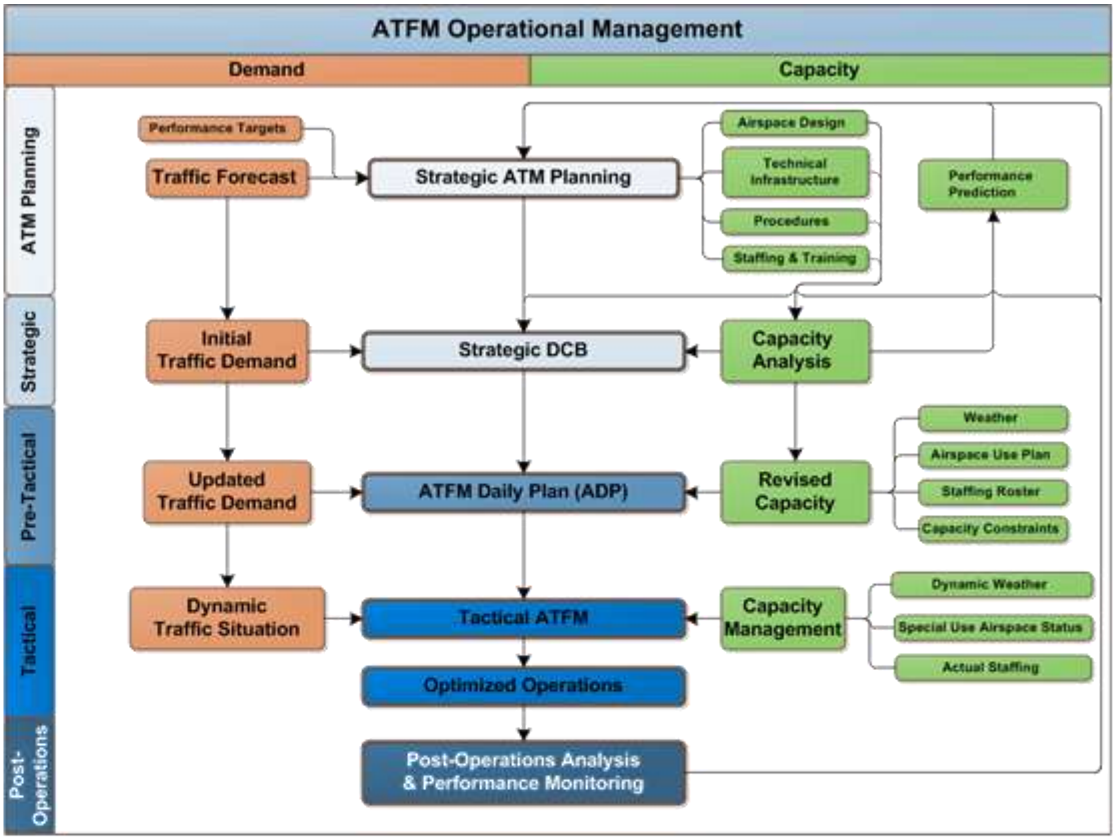

Figure 1. ATFM Operational Management (ICAO Doc 9971 Part II)

A variety of ATFM measures can be used to balance demand with available capacity. ATFM/CDM benefits are realized through automation of pre-tactical measures (e.g., Ground Delay Programs) that can trade airborne holding for ground holding which reduces fuel burn and emissions. Tactical ATFM measures also exist to maintain a safe ATM environment (e.g., airborne holding, diversions, miles-in-trail pass back restrictions); however, tactical approaches are not as efficient as pre-tactical measures. Figure 2 shows the range of ATFM measures available to address demand capacity imbalances.

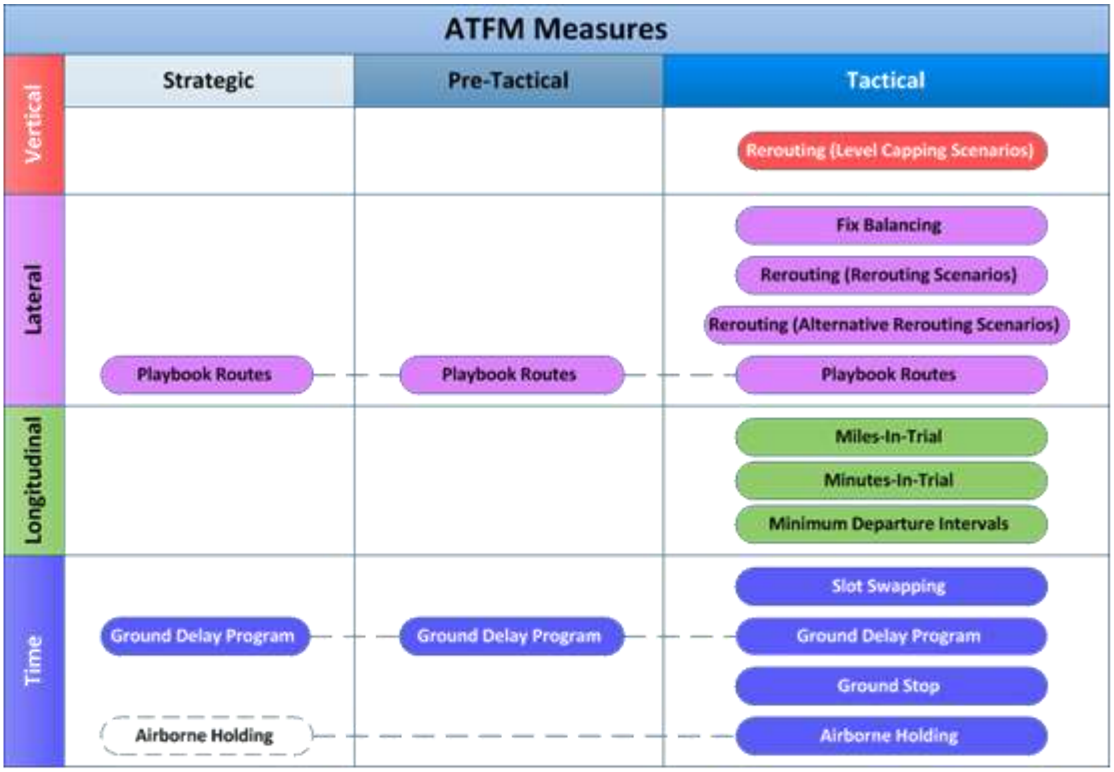

Figure 2. ATFM Measures (ICAO Doc 9971 Part II)

Figure 3 casts the ATFM/CDM functional flow in a manner that showcases the primary functions and involvement of stakeholders. The flow shows the independent evaluation of capacity and demand for the resource, the monitoring of the demand and capacity, the evaluation of Traffic Management Initiatives (TMIs) or ATFM Measures, the involvement of stakeholders through CDM, and the execution and updating to the TMI. Core functions of shared situational awareness and post operations analysis are supported across all functions.

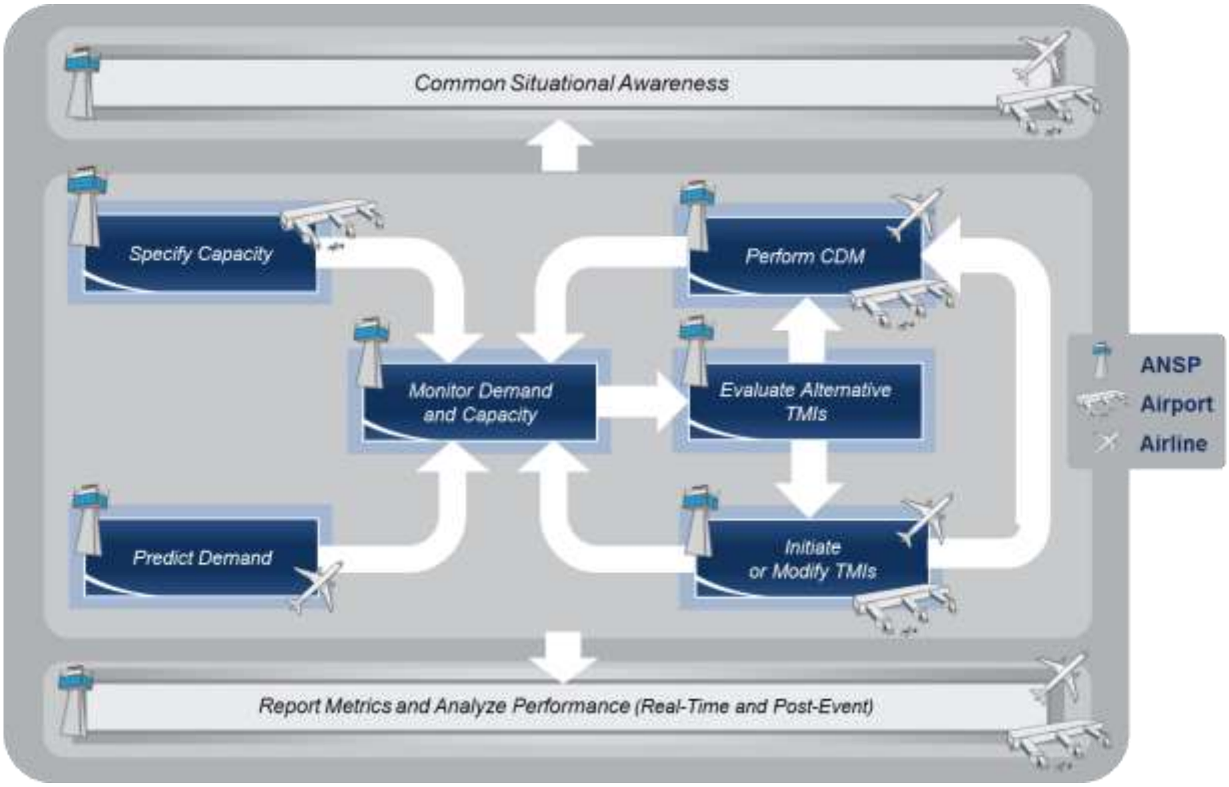

Figure 3. ATFM/CDM Functional Flow

ATFM/CDM has been successfully deployed around the world including the following:

1) United States of America (FAA) / Canada (NAV CANADA) / Mexico (SENEAM)
2) Europe (EUROCONTROL)
3) South Africa (ATNS)
4) Australia (Airservices Australia)
5) Southeast Asia BOBCAT system

3. Study Team Composition

The Study Team was composed of the following individuals and organizations:

Name	Role	Organization
Donald Ward*	Project Overseer	APEC
Stuart Ratcliffe	Lead Consultant, ATFM/CDM SME	Metron Aviation
Greg Feldman	ATFM/CDM SME	Metron Aviation
Brian Bagstad*	FAA SME	FAA
Pawut Harnbumrungkit	Thailand Host Economy Liaison Officer	DCA Thailand
Jirasak Netiprawat	Thailand SME	AEROTHAI
Piyawut Tantimekabut	Thailand SME	AEROTHAI
Suresh Menon	Malaysia Host Economy Liaison Officer	DCA Malaysia
Mohd Rashidi Abdul Rahim	Malaysia SME	DCA Malaysia

Rosedi Salam	Observer	AirNav Indonesia
Awan Kusnawan	Observer	AirNav Indonesia
Arifianti Siregar	Observer	DCGA Indonesia

*: Did not participate in site visits due to the United States Federal Government shutdown.

In addition to the core team, the study was supported by the following organizations:

- Aeronautical Radio of Thailand (AEROTHAI)
- DCA Thailand
- Airports of Thailand (AOT)
- Thai Airways
- Thai AirAsia
- DCA Malaysia
- Malaysia Airlines
- Malaysia Airports Holding Berhad (MAHB)
- AirAsia

Metron Aviation appreciates the support, openness, hospitality, and access to data throughout the study by all participants.

4. Site Visits

In order to perform the study, site visits were coordinated with the host economy liaisons to visit the stakeholders in their operational environments. For each site, a description of the operation, keys issues, current ATFM/CDM practices, and near term ATM plans relevant to the study are described. The following site visits were executed during the week of October 7-11, 2013:

Date	Facility	Host Organization	Report Section
October 7, 2013	AEROTHAI Headquarters*	AEROTHAI	4.1 AEROTHAI Headquarters Site Visit
	Bangkok ATFMU	AEROTHAI	4.2 Bangkok ATFMU Site Visit
	Bangkok ACC	AEROTHAI	4.3 Bangkok ACC Site Visit
October 8, 2013	BKK Operations Center	Airports of Thailand	4.6 AOT Suvarnabhumi International Airport Operations Center Site Visit

Date	Facility	Host Organization	Report Section
	Thai Airways Operations Center	Thai Airways	4.7 Thai Airways Site Visit
	BKK Approach Control and ATCT	AEROTHAI	4.4 Bangkok Approach Control and ATCT Site Visit
October 9, 2013	Don Mueang ATCT	AEROTHAI	4.5 Don Mueang ATCT Site Visit
	Thai AirAsia Operations Center	Thai AirAsia	4.8 Thai AirAsia Site Visit
October 10, 2013	KLIA ATCT	DCA Malaysia	4.9 KLIA ATCT Site Visit
	Kuala Lumpur ACC* and Approach Control	DCA Malaysia	4.10 Kuala Lumpur ACC and Approach Control Site Visit
October 11, 2013	Malaysia Airlines Operations Center	Malaysia Airlines	4.11 Malaysia Airlines Site Visit
	KLIA Airport Operations Center	MAHB	4.12 Malaysia Airports Holding Berhad (MAHB) Site Visit

*: At the beginning of each of these site visits, Metron Aviation presented an overview of ATFM/CDM.

4.1AEROTHAI Headquarters Site Visit

4.1.1 AEROTHAI Headquarters General Description

AEROTHAI provided a general overview of the ATM operations within Thailand, especially related to the Bangkok area. Thailand airspace is part of a single FIR, Bangkok FIR. For the airspace around Bangkok, Bangkok Approach Control handles operations coordinated with the Air Traffic Control Tower (ATCT) facilities including Suvarnabhumi International Airport and Don Mueang International Airport. To reduce congestion and provide for more growth capacity, in October, 2012, Low Cost Carrier Thai AirAsia moved operations to Don Mueang to join other Low Cost Carrier operations including Nok Air. This growth has been realized as seen in the number of operations at each facility:

Time period	Suvarnabhumi (VTBS)	Don Mueang (VTBD)
Prior to April, 2012	900 ops/day	300 ops/day
October, 2013	Over 900 ops/day	Over 400 ops/day

Suvarnabhumi (VTBS) has two parallel runways. The declared capacity at VTBS is 68 ops/hr based on 34 ops/hr for the single runway operation. The current winter strategic slot schedule for VTBS has a peak demand of 61 ops/hr. VTBS has an A-SMGCS.

Don Mueang (VTBD) has two closely spaced parallel runways. The declared capacity at VTBD is 40 ops/hour. The current winter strategic slot schedule for VTBD has a peak demand of 36 ops/hour. VTBD does not have an A-SGMCS.

AEROTHAI anticipates annual growth of 10-15% per annum for traffic throughout Thailand.

Strategic slot coordination for both airports is managed by a committee chaired by DCA Thailand that includes AEROTHAI, AOT, and Thai Airways. AEROTHAI supports the process by providing input about the declared capacity. At present, operational slot compliance is not measured or used in subsequent slot assignments; however, this is an area that is being worked on by the committee.

4.1.2 AEROTHAI Headquarters Operational Issues

In the general discussion, there were not any operational issues raised. In the subsequent site visits, operational issues are identified and covered in those sections of the report. In particular, AEROTHAI does not experience any specific issues associated with the traffic flow between Bangkok and Kuala Lumpur.

4.1.3 AEROTHAI Headquarters Current ATFM/CDM Practices and Opportunities

There are several aspects of ATFM/CDM that are used operationally today within Thailand – led by AEROTHAI.

The VTBS A-SMGCS surface surveillance data and Bangkok airborne surveillance data is provided to both AOT’s VTBS Operations Center and Bangkok Airways to view via an AEROTHAI provided application. Additionally, the airborne surveillance data is also provided to Thai Airways and Nok Air via an AEROTHAI provided application. This data sharing supports common situational awareness of the tactical traffic situation.

VTBS operational event data (e.g., actual take off times, actual landing times) is also provided via an automated data exchange to AOT’s VTBS Operations Center where it is integrated with the operational processes and systems at the airport.

While some data sharing is currently available from AEROTHAI operational systems, there is an opportunity for broader sharing of surface surveillance data and VTBS operational event data.

4.1.4 AEROTHAI Headquarters Relevant Near Term ATM Plans

In the general discussion, there were not any near term ATM plans identified. In the subsequent site visits, relevant near terms identified are covered in those sections of the report.

4.2Bangkok ATFMU Site Visit

4.2.1 Bangkok ATFMU General Description

The Bangkok ATFMU was established in 2006 to administer the BOBCAT system for flights departing Southeast Asia in the evening and crossing into the Kabul FIR (See Figure 4). The ATFMU is staffed 24 hrs/day with a staff commensurate with the workload which increases for the night time departure push to Europe. BOBCAT assigns take off times and levels for flights crossing the Kabul FIR based on aircraft operator requests. The request period is specified and the slot allocation occurs based on the existing requests. Aircraft operators can request adjustments to the slot allocations based on their operational need and availability.

Figure 4. Bangkok ATFMU and Kabul FIR Routes

In addition to administering and providing operational support for BOBCAT, the ATFMU has initiated an airspace demand monitoring capability. Currently, the ATFMU monitors demand for Bangkok FIR Sector 1 which includes the flow between Phuket and Bangkok. If the demand prediction exceeds the sector capacity, the ATFMU coordinates with the ACC. While flight-specific departure times are being calculated by the ATFMU to smooth the demand for Sector 1, the ACC does not use this information. Instead, the ACC uses the information to pass on Minimum Departure Interval (MDI) restrictions to domestic airports to smooth the demand. MDIs are used as a simpler implementation for the departure airports than managing flight-specific departures. This results in a trade of simpler operations for loss of efficiency because the flight-specific times would be a more efficient use of available capacity.

Currently, the airspace demand predictions are based on RPLs and flight plan data updated by the ATS departure message; however, surveillance updates are not included. RPLs are converted to flight plans 19 hours before the operation, and 30-40% of flights use RPLs. For non-RPL flights, the flight plans are submitted 1-2 hours before the operation. The sector demand prediction look ahead time is 2 hours. The sector capacity was determined by a study including sector configuration and traffic analysis that included constraints associated with communication equipment performance and boundary requirements (e.g., separation required for Myanmar FIR handoffs). The capacity is continually evaluated and adjusted based on tactical feedback from the ACC.

Other than BOBCAT, the ATFMU external communication is limited to the current CDM telecon trial with Singapore CAAS and Hong Kong CAD.

4.2.2 Bangkok ATFMU Operational Issues

The ATFMU did not identify any specific operational issues with respect to the flow between Bangkok and Kuala Lumpur.

Compliance with BOBCAT take off times was identified as an area for improvement since non-compliant departures can increase the workload of controllers in the FIRs leading to the Kabul FIR crossing.

4.2.3 Bangkok ATFMU Current ATFM/CDM Practices and Opportunities

BOBCAT is an existing ATFM/CDM capability focused on smoothing the demand into the Kabul FIR during the night time departure of flights heading to Europe.

The operational use of Minimum Departure Intervals (MDIs) for domestic departures to address sector loading is a tactical ATFM measure in use today. While these MDIs are set by the ACC, the information used to determine the values is provided by the ATFMU.

While the current airborne holding and demand levels for Bangkok arrival traffic do not require an immediate action for ATFM/CDM, airspace congestion, particularly in the southern sector(s), could benefit from ATFM/CDM demand capacity balancing automation. As Regional ATFM/CDM systems and procedures are deployed throughout the region, AEROTHAI would be ready to participate in this broader use of ATFM/CDM.

Bangkok ATFMU could be the facilitator for a Thailand stakeholder CDM teleconference that includes the ATFMU, ATC, AOT, aircraft operators, and meteorological services. The teleconferences should focus on actionable information so that the stakeholders can make real-time, pro-active decisions for their operations that will reduce fuel burn and emissions.

Providing the sector demand predictions and MDIs to stakeholders would enhance situational awareness and support proactive scheduling decisions by aircraft operators.

4.2.4 Bangkok ATFMU Relevant Near ATM Term Plans

The ATFMU plans to expand the number of sectors that have demand monitoring.

BOBCAT demand predictions and the sector demand predictions plan to include additional flight data sources including strategic slot data, and third party airline marketing data.

The ATFMU also plans to continue involvement in the Tri-Partite Regional ATFM activities, the EU AATIP study, and future APEC studies.

4.3Bangkok ACC Site Visit

4.3.1 Bangkok ACC General Description

The Bangkok ACC provides Air Traffic Services for all en route traffic within Thailand. As shown in Figure 5, there are 8 en route sectors in the ACC. Kuala Lumpur FIR borders Bangkok FIR on the south. Currently, the ATM automation limits the ACC to 20 controller working positions and 10 for the approach control. This prevents additional sectorization that could increase capacity by reducing individual controller workload.

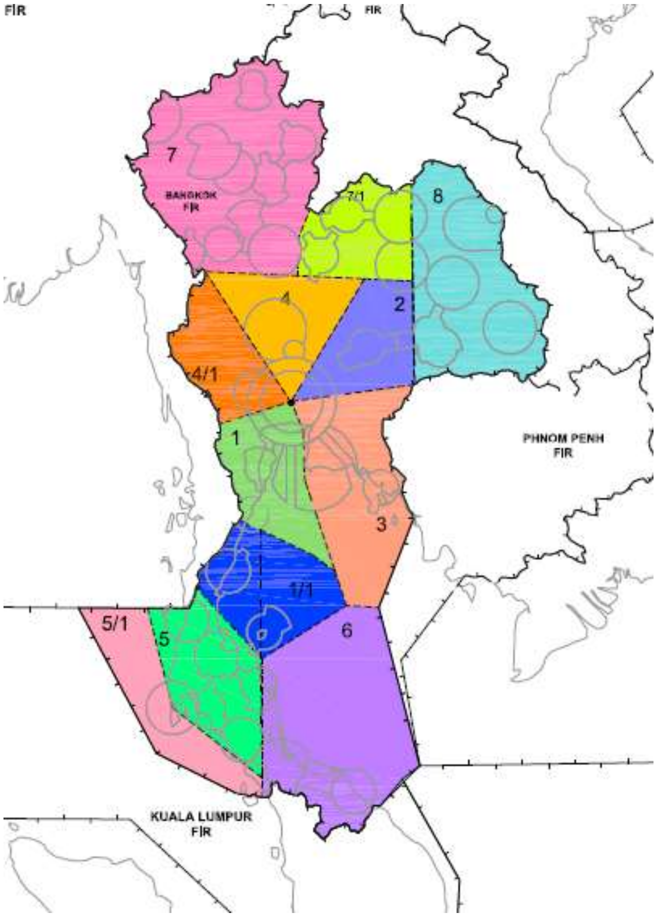

Figure 5. Bangkok FIR and Sectorization

Coordination with neighboring FIRs occurs directly between the ACC and the neighboring ACCs. At this time, it is rare for Bangkok FIR to provide any restrictions to neighboring FIRs. A recent case of a disabled aircraft at VTBS for an extended period did require coordination within the region and this occurred smoothly as reported by AEROTHAI as well as the DCA Malaysia and airline participants in this study.

There is a military liaison in the ACC during normal business hours for coordinating tactical availability of conditional routes. The AIP specifies conditional route availability for planning purposes; however, the military can provide additional access to the routes. When this tactical adjustment is made, there are some domestic routes (e.g., Phuket-Bangkok) that can file these conditional routes. Additionally, some domestic flights may receive a Direct-To route via the conditional route when it is available.

The Bangkok ACC and Approach Control use an AMAN for tactical flow management. The AMAN flight-specific times and sequencing are not used operationally for time based metering over the arrival fixes; however, the predicted delays are used to manage flights in the Approach Control holding stacks and when to start holding aircraft in the ACC holding stacks.

4.3.2 Bangkok ACC Operational Issues

There are no specific operational issues associated with the Bangkok-Kuala Lumpur flow.

When the demand for Sector 1 is predicted to exceed the capacity, MDIs are used for domestic traffic to tactically smooth the demand.

4.3.3 Bangkok ACC Current ATFM/CDM Practices and Opportunities

The Bangkok ACC uses MDIs for domestic airports to tactically smooth demand when an en route airspace sector is predicted to be over capacity.

Bangkok ACC does not declare sector capacities. Since these airspaces are often the constrained resource requiring flow management, starting with a declared capacity to allow ATFM/CDM measures to be identified is an important step.

4.3.4 Bangkok ACC Relevant Near ATM Term Plans

A new ATC automation system contract is under evaluation with plans for the system to be operational in 2015. This will include the ability to support additional working positions to provide 20-30% additional capacity to support an anticipated traffic growth of up to 15% per annum. The new ACC will have 56 positions which include the ACC and 4 or 5 positions for terminal approaches for 19 provincial airports. The new ATC automation will also automate more flight data functions which will include electronic flight strips and reduce the need for flight data operators as part of each operational position. The new ATC automation system does not include new AMAN/DMAN/SMAN or ATFM functionality. AEROTHAI is following the ICAO Airspace System Block Upgrade recommendations for the timing of automation improvements.

AEROTHAI is planning an airspace change for the southern airspace to be implemented by the end of 2013. Two parallel routes to Kuala Lumpur, two to Singapore, and two to the southwest for domestic traffic will be provided. This will reduce the current route loading and provide additional capacity for these flows. In addition to this change, the current sector 5 is planning to be split into two sectors in 2015. The new sector is identified as “5/1” in Figure 5.

4.4Bangkok Approach Control and ATCT Site Visit

4.4.1 Bangkok Approach Control and ATCT General Description

Bangkok Approach Control airspace covers a 50 NM radius from VTBD and from 3,000ft above MSL to FL160. The VTBS and VTBD traffic zones cover a 5 NM radius from the airport reference point and from the ground up to 2,000ft above MSL. Figure 6 shows the sectorization of the Bangkok Approach Control.

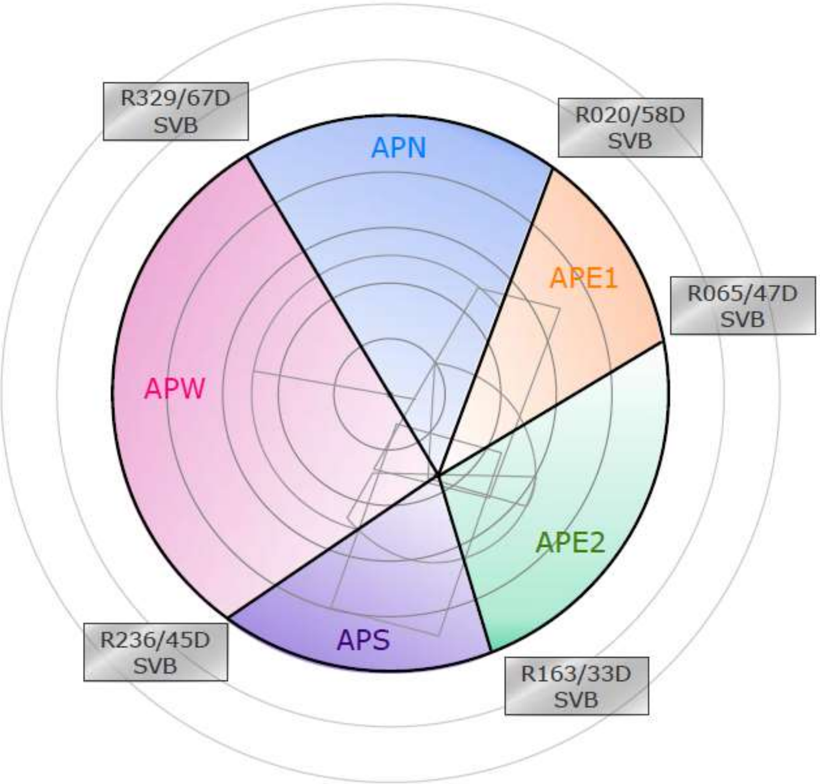

Figure 6. Bangkok Approach Control Sectorization

Figure 7 shows the Approach Control operational facility. The Eurocat-X automation system is used for the Approach Control and the ATCTs.

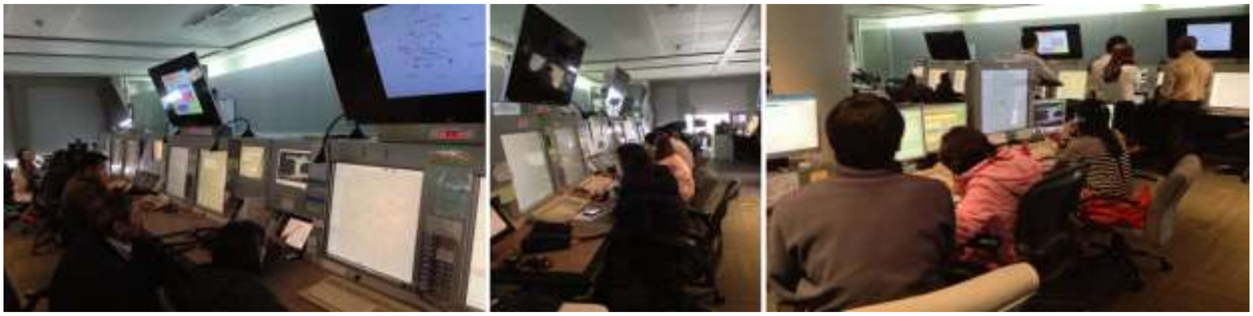

Figure 7. Bangkok Approach Control

The AMAN system used in the ACC is also used in the Approach Control for arrivals to VTBS. The communication between the ACC and Approach Control for the AMAN is not automated which results in increased workload for this additional voice coordination. The arrival tactical delay is coordinated manually between the Approach Control holding stacks and the ACC holding stacks. Internal to the Approach Control, 2 or 3 aircraft can be held at each of 5 initial approach fixes for VTBS. Once these holding stacks are full, the ACC will initiate holding.

VTBD has separate holding fixes from VTBS. The terminal airspace traffic demand does not require ground holds for flights departing VTBS or VTBD.

There is not a DMAN system for either VTBS or VTBD.

The capacity of the terminal airspace sectors is not declared. The declared capacity for VTBS is 68 operations/hour. The airports parallel runways are 1.3 NM apart and support ILS CAT 2 operations. There are 124 parking stands with 51 contact stands and 73 remote stands. There is capacity for eight A-380 aircraft at contact stands. The declared capacity for VTBD is 40 operations/hour. Figure 8 shows the VTBS ATCT working position and view of the aprons.

Figure 8. VTBS ATCT

Operationally, final approach spacing is targeted between 4 and 5 NM even though 35% of the flights are in the Medium wake turbulence category which would allow for some 3 NM spacings on final. This conservative approach is not currently causing arrival delays due to the current demand level consistently below the available capacity.

VTBS generally operates with segregated runway operations. Mixed mode operations occur for select flights when supported by the traffic demand. There will not be simultaneous approaches until after 2015 when new automation will support additional working positions to include the required final approach monitor position. Due to noise abatement procedures, arrivals are split across the runways in an 80/20 split when the operating configuration is for 34 arrivals and 34 departures per hour.

4.4.2 Bangkok Approach Control and ATCT Operational Issues

During departure pushes, the VTBS ATCT institutes a Gate Hold procedure to reduce the number of actively taxiing aircraft. Aircraft call for pushback clearance, and if the Gate Hold is in place, an Off Block Time is provided manually by ATC on a first call first served basis. A locally developed spreadsheet supports the determination of the pushback times.

There are no regular arrival demand capacity imbalance issues. There are no specific issues with the flow between Bangkok and Kuala Lumpur.

Additionally, there are some conflicts between the SIDs and STARs for VTBS and VTBD that complicate terminal area ATC. Due to the current demand, these conflicts are not causing significant operational delays; however, with increased use from VTBD, procedure redesign is underway to deconflict these terminal procedures.

4.4.3 Bangkok Approach Control and ATCT Current ATFM/CDM Practices and Opportunities

There are not any existing ATFM/CDM practices at Bangkok Approach Control and ATCT.

AEROTHAI does not declare a Bangkok Approach Control capacity. Since this airspace can be the constrained resource requiring flow management, starting with a declared capacity to allow ATFM/CDM measures to be identified is an important step.

An Airport CDM system for VTBS would reduce taxi out times, promote information sharing, and improve the overall efficiency of the turnaround operation. This would include the processes and technology associated with a local Airport CDM solution. Airport CDM optimization would automate the existing periods of the manual Gate Hold operations, improve airport efficiency and reduce emissions.

4.4.4 Bangkok Approach Control and ATCT Relevant Near ATM Term Plans

A new ATC automation system contract is under evaluation with plans to be operational in 2015 – same contract and system planned for the Bangkok ACC. This will include the ability to support additional ACC and Approach Control working positions to provide 20-30% additional capacity. The new ACC will have 56 positions which include the ACC and 4 or 5 positions for terminal approaches for 19 provincial airports. The contract for the ATC automation system does not include new AMAN functionality or DMAN/SMAN or ATFM functionality. AEROTHAI is following the ICAO Airspace System Block Upgrade recommendations for the timing of automation improvements.

Additionally, there are some conflicts between the SIDs and STARs for VTBS and VTBD that are being addressed.

4.5Don Mueang ATCT Site Visit

4.5.1 Don Mueang ATCT General Description

Don Mueang International Airport (VTBD) provides additional capacity for the Bangkok terminal area. In April, 2012, the AirAsia operation was moved from VTBS to VTBD and has continued to grow. Overall, there are more than 400 operations/day which includes flight training and military operations. There are two closely spaced parallel runways that are operationally handled as a single runway operation. VTBD has 91 parking stands with 32 contact gates and 69 remote stands. Figure 9 shows the VTBD ATCT operations area.

Figure 9. VTBD ATCT

4.5.2 Don Mueang ATCT Operational Issues

There are no demand/capacity or surface congestion issues at VTBD. There are no issues associated with the flow to or from Kuala Lumpur.

4.5.3 Don Mueang ATCT Current ATFM/CDM Practices

There are no current ATFM/CDM practices at VTBD.

4.5.4 Don Mueang ATCT Relevant Near ATM Term Plans

A new ATCT is under construction for operational use in 2014.

4.6AOT Suvarnabhumi International Airport Operations Center Site Visit

4.6.1 AOT VTBS Operations Center General Description

The AOT Airside Operations Control Center (AOCC) at VTBS tracks flights inbound to VTBS from departure point through the arrival phase, turn-around, and departure from VTBS. The primary responsibility for the AOCC is airport resource allocation including parking stands. The AOCC has a combination of automation and manual processes to provide flight event data to an AODB and internal decision support tools. The AODB has access to a rich set of flight and airport data that feeds systems throughout the airport including check-in counters, parking stands, and flight information displays. Allocation systems for check-in counters and parking stands are managed within the AOCC. AOCC operators choose the “best” data based on information from AFTN, SITA, monitoring the A-SMGCS, or looking at the cameras posted at each contact stand. Figure 10 shows the VTBS AOCC.

Figure 10. AOT VTBS Airside Operations Control Center

Parking stand allocations occur 24 hours in advance for all aircraft operators except Thai Airways and Bangkok Airways. Allocations are locked in 3 hours in advance.

Actual Off Block Times from the AOCC are provided to ATC, and AOT receives the assigned runway from ATC. There is an intranet page for approved external users to gain access to some of the data from AODB.

AOT also shares information with the 6 airports under their control: Bangkok Suvarnabhumi International Airport, Bangkok Don Mueang International Airport, Phuket International Airport, Chiang Mai International Airport, Hat Yai International Airport, and Mae Fah Luang International Airport.

4.6.2 AOT VTBS Operations Center Operational Issues

AOT did not identify any current operational issues associated with demand and capacity imbalances.

4.6.3 AOT VTBS Operations Center Current ATFM/CDM Practices and Opportunities

The sharing of AODB data via the intranet is the extent of CDM. There is an opportunity to expand the data sharing both in terms of data content shared and the ease of access for aircraft operators.

Additionally, even though AOT manages the strategic airport slot allocations for Thailand slot coordinated airports, the post analysis and procedures to track slot compliance and incorporate compliance into future slot allocations is not occurring. Better adherence to strategic airport slots reduces tactical demand “bunching” which reduces fuel burn and emissions.

4.6.4 AOT VTBS Operations Center Relevant Near Term ATM Plans

AOT VTBS plans to implement a formal Airport CDM program in the future.

4.7Thai Airways Site Visit

4.7.1 Thai Airways General Description

Thai Airways Operations Center focuses on achieving On-Time Departures. With a target of 87%, Thai Airways is currently operating to 86-90% of On-Time Departures. The operations center covers three main functions: Operations Planning, Operations Control, and Flight Monitoring.

Operations Planning occurs up to 48 hours in advance of the flight. Thai Airways has a fleet of 96 aircraft and operate 280 sectors/day – 190 International and 90 Domestic.

Operations Control handles the day of operation (Figure 11). The center has access to all operational elements including crew, ground handling, and maintenance. Specific strategies are in place to stay on track when tactical issues arise including, but not limited to, change of aircraft, combine flights, reroute flight to avoid weather, cancel flight, add a flight, charter from another operator, or ferry to reposition an aircraft. The groups use an internal messaging system to communicate about specific flights and actions. All parking stands at VTBS are shared and under the control of AOT.

Figure 11. Thai Airways Operations Control Center

Flight Monitoring via SITA AIRCOM is able to monitor flight status and location for the fleet – system wide.

Except for European operations that are handled by an operations center in Germany, all Thai Airways operations are supported by this operations center.

4.7.2 Thai Airways Operational Issues

The main challenge for Thai Airways at VTBS is airport congestion for large departure or arrival pushes. Departure gate holds and long taxi out times impact current flight performance as well as downstream segments for the airframe, crew, and passenger connections (e.g., the nominal passenger connection time is 55 minutes).

Additionally, Thai Airways will load holding fuel for segments where airborne holding is anticipated. This decision is not based on ATC input, but from operational experience. For example, 30 minutes of holding fuel is regularly added for flights to Shanghai, China. Currently, additional holding fuel is not added for Kuala Lumpur, Singapore, or Hong Kong segments.

Occasionally, Thai Airways will hold flights on the ground at Phuket, Thailand to avoid diversions on return to VTBS. These decisions are based on operational experience and not any holding or delay information from ATC. Thai Airways does not have access to AEROTHAI sector demand predictions or advance notice of when Bangkok ACC has issued MDIs for domestic airports.

Thai Airways would like to be more involved in recovering from adverse conditions. Following a thunderstorm that disrupts VTBS departures, flights are departed on a first-come first-served basis; however, Thai Airways would prefer to influence this order based on business priorities.

Thai Airways does not have access to VTBS surface surveillance data for situational awareness. When there is a taxi out delay due to maintenance or congestion, the operations center does not have any advance notice and finds out when notified by the pilot.

Currently, Thai Airways is not experiencing increased block times related to the Bangkok – Kuala Lumpur flow. This is due to a small number of flights (3 flights per day) and the times of the flights are during low demand periods. Thai Airways is experiencing increased block times for long haul flights.

4.7.3 Thai Airways Current ATFM/CDM Practices

Thai Airways has regular and open communications with AEROTHAI regarding operations; however, tactical information related to taxi out delays or airborne holding on arrival are not provided.

4.7.4 Thai Airways Relevant Near Term ATM Plans

There were no plans identified for Thai Airways in the near term.

4.8Thai AirAsia Site Visit

4.8.1 Thai AirAsia General Description

Thai AirAsia is based at Don Mueang International Airport. Thai AirAsia's fleet contains 31 Airbus A320 aircraft. Thai AirAsia serves 34 destinations with 212 flights per day. The schedule results in an average air time per aircraft of 12 hours per day. Thai AirAsia is proud of their best in Asia On Time Performance (OTP) of 93.46%.

Regarding the flow between Bangkok and Kuala Lumpur, Thai AirAsia operates 11 flights per day between DMK and KUL. The DMK to KUL flights have an OTP in the high 90%s with short taxi times to and from the parking stands at DMK (~5-7 minutes).

With an interest in cost efficient operations, Thai AirAsia operations use an aircraft configuration that uses less flap settings on approach to save fuel. The result is a higher approach speed, 5-10 kts, which is not an issue for ATC and still allows breaking time to use the rapid exit taxiways. Thai AirAsia has performed an analysis that the fuel savings are worth the increased wear on the brakes and related aircraft systems.

4.8.2 Thai AirAsia Operational Issues

Thai AirAsia is concerned about fuel usage and emissions. The following items were raised as operational issues:

- SID and STAR conflicts with VTBS causes conflicts and delays due to crossing arrivals
- Flights receive speed control and altitude constraints from AEROTHAI which reduces efficiency
- Limited parking options at KUL impact OTP due to aircraft ready to push being blocked by other aircraft
    - The KUL departures for DMK have an OTP in the mid 80%s.

Thai AirAsia does experience airborne holding due to congestion for arrivals into KUL. When this is on the order of 10 minutes per flight, this does not cause a disruption to operations. Holding due to congestion is not a problem at DMK. Holding occurs occasionally due to military operations that share DMK or weather in the terminal area. Even though the current DMK final approach separation can be between 5-10 NM, the lack of periods of high demand has not caused a focus on this operational behavior. As demand increases at DMK, additional coordination with the military may be necessary to reduce separation on final and increase the arrival capacity.

4.8.3 Thai AirAsia Current ATFM/CDM Practices

Thai AirAsia receives some operational data from AEROTHAI and AOT. Airborne surveillance data and the AOT block times are available. Thai AirAsia would like additional operational data; however, the reliability and predictability of the data is a critical factor for their operations. Improved weather forecasts for flights within a 1 hour flying time from DMK would be beneficial.

Based on the ATFM/CDM overview, Thai AirAsia was open to use of Ground Delay Programs for periods of predicted over demand. With a strong focus on OTP, the preference would be to split the delay assigned between the ground and in the air. For example, if assigned a 20 minute delay as a result of ATFM procedures, taking 5 or 10 minutes at the parking stand would be preferred and then the rest could be taken pre-take-off or in flight.

4.8.4 Thai AirAsia Relevant Near Term ATM Plans

Thai AirAsia is looking forward to the upcoming changes at KUL to use independent departures. This operational change will increase the departure rate and reduce congestion at the Low Cost Carrier Terminal apron.

When the KLIA2 project completes in May, 2014, Thai AirAsia will move operations from the LCCT to the new terminal.

Thai AirAsia identified the following changes to their fleet and operation by the end of 2013:

- Increase fleet from 31 to 35 Airbus A320s
- Increase the flights per day from 212 to 250

4.9KLIA ATCT Site Visit

4.9.1 KLIA ATCT General Description

Kuala Lumpur International Airport (KLIA/KUL/WMKK) operates 182,000 international and 98,500 domestics operations annually. With the October, 2013 schedule, this will increase to approximately 1,050 flights/day. There are 2 parallel runways separated by approximately 1.3 NM that currently operate in a segregated mode or a semi-mixed mode. This operating mode has a declared capacity of 68 operations/hour. The operating modes for KLIA are as follows:

- Runway 32 (or 14) segregated (arrive Left and depart Right)
- Runway 32 semi-mixed mode (arrive both and use one for departures)
- Runway 14 mixed mode
- Single runway operations (each of the runways)

The KLIA operational configurations are dependent on the configurations at Subang airport; however, KLIA has priority in determining the configuration. With prior request and approval, and off configuration runway can be used operationally for a specific flight.

Starting the week of October 11, 2013, independent departures will be used which will reduce departure delays. The declared capacity is not being adjusted due to this operational change. Figure 12 shows the KLIA ATCT, main terminal, new KLIA2 terminal and ATCT, and surface surveillance display.

Figure 12. KLIA ATCT

Airport slots for KLIA are coordinated by Airport Coordination Malaysia. The declared capacity is for 32 arrivals and 36 departures per hour. The current operational schedule is below this capacity, but tactical variations and airspace limitations cause airborne holding. The airport slot compliance is not monitored for consideration in future slot coordination activities.

Due to departure procedure constraints in the approach control airspace, departure restrictions can apply 3 or 5 minute spacing on specific departure routes. When these restrictions are in place, DCA Malaysia issues a NOTAM. If the departure delay for a specific flight is anticipated to be greater than 10 minutes due to the departure restrictions, ATC will try to hold the flight at the parking stand to reduce taxi time and the associated fuel burn and emissions.

Parking stand allocation is managed by Malaysia Airport Holding Berhad (MAHB). Flights rarely receive inbound taxi in delay due to parking stand assignment for any terminal.

KLIA has an A-SMGCS system with multi-lateration that provides full surveillance coverage of the surface including the aprons and parking stand areas.

4.9.2 KLIA ATCT Operational Issues

The operational staff identified several issues impacting KLIA efficiency. The issues were not specific to the Bangkok-Kuala Lumpur flow.

Congestion resulting in airborne holding is a significant problem. The holding is due to airspace capacity and not airport capacity. Due to the significant growth in traffic in 2013 from ~750 operations/day to over 900 operations/day, airborne holding is a common occurrence each afternoon. When there is convective weather, the holding increases and there may also be flight diversions. Convective weather issues tend to last only about 30 minutes and are difficult to forecast with accuracy.

When the airborne holding due to congestion became a regular occurrence, DCA Malaysia published a NOTAM (see sample in Figure 13) indicating expected holding and required 20 minutes of holding fuel. The airlines didn’t want this specified and wanted to work fuel loading based on expected holding from operational experience. The NOTAM was modified to only state the time period of expected holding, but no requirement for holding fuel is stated. This is the extent of providing delay information to the airlines. There is not any tactical delay information based on expected congestion levels for a specific day or time. When holding occurs, the pilot is the first to know and this information is provided to the airline operations center to factor in to future planning.

System NOTAM

A2022/13 NOTAMR A2021/13

Q) WMFC/QXXXX/IV/NBO/A /000/999/0244N10141E005
A) WMKK B) 1308310430 C) 1312311530 EST
D) DLY BTN 0430-1530 UTC.
E) DUE TO TFC CONGESTION, ARR TFC TO EXP DLA

Figure 13. DCA Malaysia NOTAM Indicating Arrival Delays

Apron congestion, especially at the Low Cost Carrier Terminal (LCCT), causes departure delays. There is a departure push between 6-8AM local time when a manual gate hold is instituted on a first come first served basis. Tactically, 6-7 aircraft are targeted for the surface holding points and when this is exceeded, the gate hold is put into effect. The LCCT has limited maneuvering space and this can lead to delays at pushback due to other taxiing aircraft. With the addition of independent departures in October, 2013, the increased departure capacity should result in a reduction in departure delays which will also reduce taxi out fuel burn and emissions.

The airspace arrangement with the Singapore FIR to the East combined with the volume of East/West traffic results in departure restrictions because there is only 1 route and 3 levels through the Singapore FIR to reach East Malaysia. These departure restrictions are on the order of 10 minutes between east bound departures. There is sufficient surface pad and taxiway area to stage departures when these restrictions are in place.

Another operational issue identified is the inefficiency of changing the runway in use at the airport due to un-forecast changes in the tail wind direction and magnitude. If the runway configuration can be changed in advance during a period of lower demand, the complexity, workload, and inefficiency of this occurring on short notice would be reduced.

4.9.3 KLIA ATCT Current ATFM/CDM Practices and Opportunities

KLIA supports flights that have departure times associated with BOBCAT. KLIA ATC will coordinate with the flights to achieve a +/-5 minute departure compliance with the BOBCAT assigned wheels up time.

KLIA shares the surface surveillance and electronic flight strips with the airport operations center; however, this data is not available to the airlines. Both Malaysia Airlines and AirAsia expressed interest in access to this data.

RPLs are used for short sector flights (e.g., up to 1 hour flying time), and FPLs are used for all other flights. Dispatchers finalize FPLs 3 hours before EOBT and submit the FPL 2 hours before EOBT.

An opportunity exists for DCA Malaysia to share KLIA surface surveillance data with aircraft operators and the airport authority. This increased situational awareness will allow proactive operational decisions to improve efficiency and reduce emissions.

An Airport CDM system for WMKK would reduce taxi out times, promote information sharing, and improve the overall efficiency of the turnaround operation. This would include the processes and technology associated with a local Airport CDM solution. Airport CDM optimization would automate the existing periods of the manual Gate Hold operations, improve airport efficiency and reduce emissions.

4.9.4 KLIA ATCT Relevant Near Term ATM Plans

The KLIA2 project is a major infrastructure enhancement for the airport planned to be operational in May, 2014. KLIA2 adds a 3rd parallel runway, additional new control tower, approach control airspace redesign, and a new Low Cost Carrier terminal. When the new runway opens, the initial operation will include simultaneous parallel approaches with two departures and 2 arrivals at a capacity of 78 operations/hour. With operational experience in the new configuration, the capacity is expected to increase to 85-90 operations/hour.

An en route airspace redesign is planned to be operational in 2016. When this completes, the operations are expected to handle mixed mode operations for all 3 runways for an expected capacity of 108 operations/hour.

4.10Kuala Lumpur ACC and Approach Control Site Visit

4.10.1Kuala Lumpur ACC and Approach Control General Description

The Kuala Lumpur ACC and Approach Control are operated from the same facility in Subang. The ACC covers the airspace for West Malaysia and borders Bangkok FIR, Singapore FIR, Chennai FIR, Jakarta FIR, and Yangon FIR. The Approach Control includes three airports: Kuala Lumpur International Airport (KLIA/KUL/WMKK), Subang (WMSA), and a military airport (WMKF) that is planning to be closed. Primary commercial operations are from KLIA; however, low cost operations from Subang are increasing. Figure 14Figure 15 shows the ACC positions and Figure 15 shows the Approach Control positions.

Figure 14. KL ACC

Figure 15. KL Approach Control

The Approach Control includes a flow position that manually determines arrival sequence and delays to reduce the workload for the approach controller. The flow controller reviews the tactical demand and recommends a landing sequence and speed advisories or crossing times, if necessary, to achieve the sequence. The approach controller can use these recommendations or implement a different landing sequence.

Due to close proximity to KLIA, Kuantan Airport (military base) is required to Call For Release as part of standard operations. During periods of high arrival demand, departure times for domestic airports and Singapore are manually determined tactically. Additionally, KL ACC may contact Singapore FIR to request that departures to KLIA from Singapore are staggered by 10-15 minutes in order to tactically reduce congestion.

Even though en route congestion is high, with RVSM and available levels, KL ACC does not pass en route restrictions to other FIRs.

There are no declared capacities for the KL ACC sectors or the terminal airspace. Additionally, there is not a capability to predict the future demand for the airport, terminal airspace or en route sectors.

4.10.2Kuala Lumpur ACC and Approach Control Operational Issues

There is a daily arrival rush from 1230-2300 local time with the main rush from 2000-2200 local time. During the evening rush, 20-30 minutes of airborne holding is common.

KLIA has significant arrival traffic from East Malaysia. Due to the airspace boundaries and access to surveillance data, KL ACC has visibility into these flights up to 250 NM from KLIA. Then, the flights enter Singapore FIR and remain under Singapore control until approximately 25 minutes from landing. Singapore FIR routing and descent profiles for handoff to KL ACC are constrained to work within the airspace constraints associated with Changi International Airport arrivals and departures. This boundary relationship with Singapore FIR is inefficient for KLIA arrivals since the airspace constraints and coordination with Singapore prevent an earlier descent that is more efficient when considering KLIA traffic.

4.10.3 Kuala Lumpur ACC and Approach Control Current ATFM/CDM Practices and Opportunities

There are no existing ATFM/CDM practices at the KL ACC and Approach Control. The tactical flow management for arrivals is an integral process for tactical flow control. There is not any information sharing with stakeholders from the ACC or Approach Control.

The extent of airborne holding coupled with the multi-year plan to improve airspace capacity warrants an early look at deploying ATFM/CDM. DCA Malaysia could establish a flow management position within the ACC or plan for a separate flow management unit that provides the national ATFM/CDM function including demand capacity balancing for KLIA. As Regional ATFM/CDM systems and procedures are deployed throughout the region, DCA Malaysia would be ready to participate in this broader use of ATFM/CDM.

KL ACC could be the facilitator for a Malaysia stakeholder CDM teleconference that includes the ATC, the airport authority, aircraft operators, and meteorological services. The teleconferences should focus on actionable information so that the stakeholders can make real-time, pro-active decisions for their operations that will reduce fuel burn and emissions.

DCA Malaysia does not declare sector or approach control capacities. Since these airspaces are often the constrained resource requiring flow management, starting with a declared capacity to allow ATFM/CDM measures to be identified is an important step.

Additionally, a broader review of airspace, routing, and capacity declarations between Singapore FIR and Kuala Lumpur FIR could be undertaken to explore mutually beneficial operational changes for both DCA Malaysia and Civil Aviation Authority Singapore (CAAS).

4.10.4 Kuala Lumpur ACC and Approach Control Relevant Near Term ATM Plans

The KLIA2 project will include modifications to the sectorization and airspace routes within the Approach Control airspace. These additional routes will include additional PBN routes.

Following KLIA2, there are plans to redesign the en route airspace to provide additional capacity for KLIA.

The ACC automation system from Selex is testing an AMAN function for use at KL ACC and Approach Control. The system automates the flow controller sequence and advisory determination. At this time, the system does not have a target operational date due to performance and controller acceptance items still to be completed.

4.11Malaysia Airlines Site Visit

4.11.1Malaysia Airlines General Description

The Malaysia Airlines (MAS) Operational Control Center (OCC) (Figure 16) is responsible for the realization of the operational plan within 48 hours prior to departure. This is a system-wide facility for Malaysia Airlines operations. Additionally, post operations analysis is performed by the OCC.

Figure 16. Malaysia Airlines Operational Control Center

Malaysia Airlines operates 300 flights per day with 148 domestic flights and 152 international flights.

Malaysia Airlines is very focused on OTP and has a detailed departure process that can identify the specific steps and organizations associated with any delays. This is used for causal analysis and process improvements. For 2012, the OTP was 85%, and for the 15% of flights with a departure delay greater than 15 minutes, 44% of these are due to external factors (e.g., late inbound flight). Delays from external factors are categorized as “consequential” when analyzing post operations data. A 40 minute turn-around time is used for their fleet of B737-800s. This keeps the pressure on operating efficient turn-around processes to maintain their high OTP.

The MAS operations staff recognizes that updated information and the ability to factor new information into operational decisions will improve their operations. Otherwise, delayed decisions become obsolete.

4.11.2 Malaysia Airlines Operational Issues

The primary operational issue for MAS is the impact due to airborne holding and subsequent late arrivals into KLIA. This manifests in several operational and economic impacts:

1) Due to expected holding into KLIA, MAS carries extra fuel resulting in $16M US extra carry annually. This is the cost to carry the fuel, whether the holding occurs and the aircraft uses the fuel or not.
2) The block times for the Singapore and Jakarta to Kuala Lumpur sectors have increased due to ground congestion and airborne holding into KLIA. While there has been some reduced OTP on the Bangkok to Kuala Lumpur sector, this is not seen as a problem compared to the Singapore and Jakarta sectors.
3) The large taxi out times from Jakarta and the airborne holding into KLIA is a significant concern for MAS. This route provides a significant number of connecting passengers for the ongoing flights to Europe. When the inbound flight is delayed, there are times when the outbound long haul flight is delayed and requires a new BOBCAT slot which are often limited when requested late.

4.11.3 Malaysia Airlines Current ATFM/CDM Practices

At this time, there are no current ATFM/CDM practices with MAS, the airport authority, or DCA Malaysia.

4.11.4 Malaysia Airlines Relevant Near Term ATM Plans

The 2013 Northern Winter schedule will increase operations by 20% to 360 flights/day with 169 domestic flights and 152 international flights.

4.12 Malaysia Airports Holding Berhad (MAHB) Site Visit

4.12.1 MAHB General Description

The site visit to MAHB was limited to a general discussion at the airports operations control center. The operations room and a separate Flight Operations Center at KLIA were not available for the visit. A presentation of the airside operations was provided; however, the content of the prepared material was not directly related to the study. The material covered areas including: vehicle registrations, document management, quality assurance, wildlife, vehicle escorts, and runway FOD inspections. An area of relevance was the coordination between the airport and DCA Malaysia for runway inspections that occur 4 times each day and require a minimum of 10 minutes for each inspection. The inspections are currently coordinated for periods of low demand.

Parking stand allocations are the responsibility of MAHB and are coordinated at the Flight Operations Center at KLIA.

4.12.2 MAHB Operational Issues

Operational issues related to airside operations, parking stand management, or apron congestion were not available.

4.12.3 MAHB Current ATFM/CDM Practices and Opportunities

At this time, there are no ATFM/CDM practices between MAHB and the other stakeholders.

Even though MAHB manages the strategic airport slot allocations for Malaysia slot coordinated airports, the post analysis and procedures to track slot compliance and incorporate compliance into future slot allocations is not occurring. Better adherence to strategic airport slots reduces tactical demand “bunching” which reduces fuel burn and emissions.

4.12.4 MAHB Relevant Near Term ATM Plans

There were no plans identified by MAHB.

5. Operational Data Analysis

Operational data analysis based on stakeholder inputs was performed for the study to:

- Provide background information prior to the site visits
- Correlate qualitative discussions with quantitative data analysis
- Identify benefits opportunities for ATFM/CDM processes and tools
- Correlate data from multiple data sources to confirm trends

In order to support the study, a broad set of operational data was requested from the stakeholders. The data request was provided in advance of the site visits. At a meeting held in Singapore prior to the site visits, the data requests and received data were reviewed and clarified. Figure 17 shows the rationale for the broad data request and not a focus on traffic specific to the Bangkok-Kuala Lumpur flow.

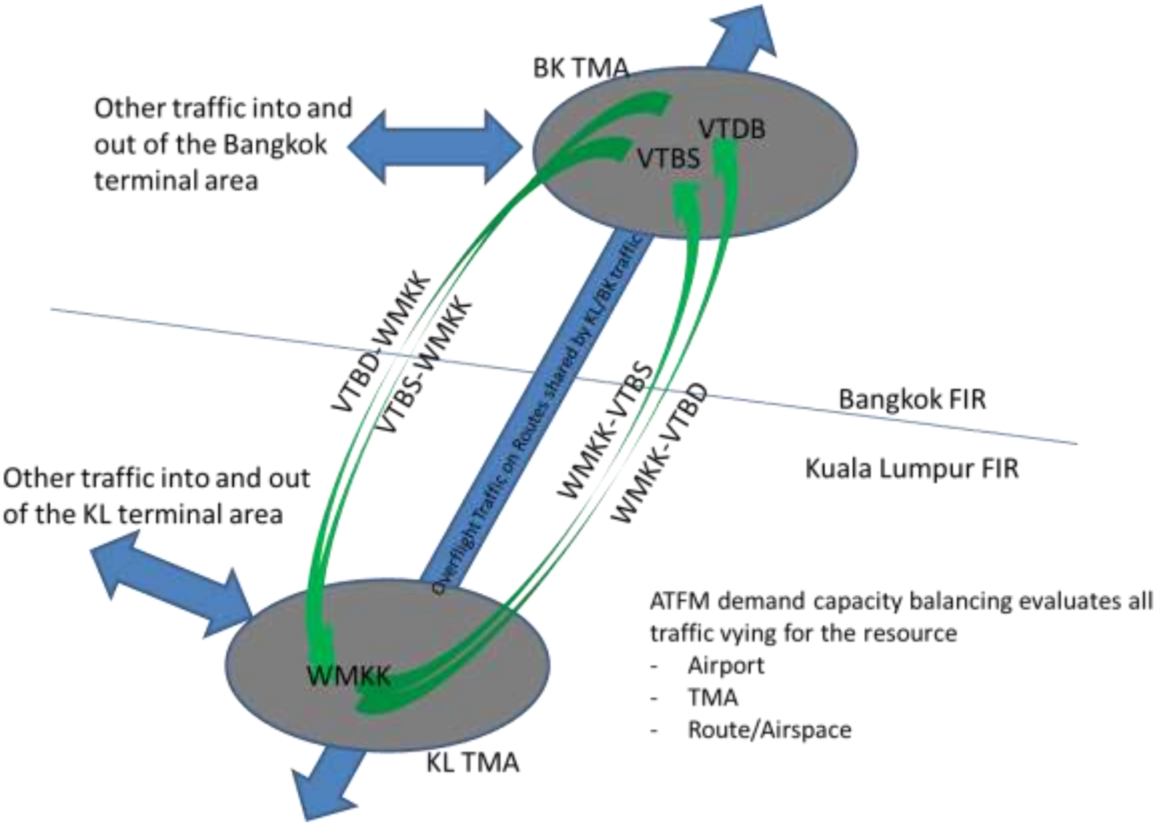

Figure 17. Broad scope of data request for ATFM/CDM analysis

5.1 Operational Data Requests

The data request was provided to the following stakeholders:

- ANSPs: AEROTHAI and DCA Malaysia
- Airports: Bangkok Suvarnabhumi International Airport, Bangkok Don Mueang International Airport, and Kuala Lumpur International Airport
- Airlines: Thai Airways and Malaysia Airlines.

Data was provided for January and August, 2013.

The data requested was as follows:

ANSP Data:

- General Information
    - Airspace Charts
    - Airport layout charts (airside)
    - Airport runway configurations and resulting capacities (nominal case)
        - Airport arrivals per hour
        - Airport departures per hour
        - Noise Abatement procedures

        - Curfews
    - Airspace sector configurations and resulting capacities (nominal case)
    - Letters of Agreements between ANSPs
    - Existing Flow Control agreements between ANSPs
    - Letters of Agreement between ANSP and military Authorities relating to FUA
    - Standard Operating Procedures for the En Route, Terminal and ATCT environments and any automated capabilities supporting these procedures (exchange of position data, automated handoff, etc.)
- Operational Data
    - AFTN ATS message data for all traffic controlled by the ANSP (Text file format) including actual take off and actual landing times
    - Processed surveillance position report data for all traffic controlled by the ANSP (Text file format)
    - Delays
        - Arrival Delays
            - Airborne Holding data
        - Departure Delays
            - Gate pushback
            - Taxi Out delays
    - Runway Occupancy Time Data
    - Tactical arrival and departure capacity
        - Identify operational days in the sample that are “good” days and “bad” days
        - Reasons for capacity reduction (e.g., weather)

Airport Data:

- Airport Slot allocations for the season that coincides with the operational data
- Actual Off Block Times
- Actual In Block Times
- Parking Stand assignments

Airline Data:

- Schedule data
- Actual Off Block Times
- Actual Take Off Times
- Actual Landing Times
- Actual In Block Times
- Parking Stand assignments
- Identify operational days in the sample that are "good" days and "bad" days

5.2 Operational Data Received

A significant set of data was provided by AEROTHAI and DCA Malaysia. Operational data was also provided by AOT for VTBS operations. Operational data was not received from the airlines.

The following table identifies the data received from the ANSPs including information received during the site visits. For the DCA Malaysia data where "Not all flights included" is identified, this indicates that data was provided for Bangkok-Kuala Lumpur flights; however, the context of this data for all flights to and from KLIA is not available for analysis.

Data Type	AEROTHAI	DCA Malaysia
General/Static data		
Airspace Charts	Yes	Yes
o Airport layout charts (airside)	Yes	Yes
o Airport runway configurations and resulting capacities (nominal case)	Yes	Yes
§ Airport arrivals per hour	Yes	Yes
§ Airport departures per hour	Yes	Yes
§ Noise Abatement procedures	Yes	N/A
§ Curfews	N/A	N/A
o Airspace sector configurations and resulting capacities (nominal case)	Yes	Configs (Yes), Capacity (No)

Data Type	AEROTHAI	DCA Malaysia
o Letters of Agreements between ANSPs	Yes	No
o Existing Flow Control agreements between ANSPs	Yes, BOBCAT	No
o Letters of Agreement between ANSP and military Authorities relating to FUA	Available in Thai	No
o Standard Operating Procedures for the En Route, Terminal and ATCT environments and any automated capabilities supporting these procedures (exchange of position data, automated handoff, etc.)	Yes	AIP (Yes), no info on automation
Dynamic operational data		
o AFTN ATS message data for all traffic controlled by the ANSP (Text file format) including actual take off and actual landing times	Yes	Provided in PDF
o Processed surveillance position report data for all traffic controlled by the ANSP (Text file format)	Yes	No
o Arrival Delays	No	Not all flights included
§ Airborne Holding data	No	Not all flights included
o Departure Delays	will look for flight-specific data	Not all flights included
· Gate pushback	Periods of Gate Hold identified	Not all flights included
· Taxi Out delays	Periods of Gate Hold identified	Not all flights included
o Runway Occupancy Time Data	No	Yes
o Tactical arrival and departure capacity	No	No
§ Identify operational days in the sample that are “good” days and “bad” days	Yes	Yes
§ Reasons for capacity reduction (e.g., weather)	Yes	Yes

The following table identifies the data received from the Airports including information received during the site visits.

Data Type	AOT	KLIA
Airport Slot allocations for the season that coincides with the operational data	Yes	No
Actual Off Block Times	Yes	Yes
Actual In Block Times	Yes	Yes
Parking Stand assignments	Yes	Yes

5.3 Operational Data Analysis

Based on the information from the site visits, a first order data analysis evaluated the actual operations profiles, airborne holding, and surface delays for departures. This allowed confirmation of the main operational issues identified by the stakeholders and provided a quantitative basis for benefits estimates achievable with ATFM/CDM processes and tools.

5.3.1 Demand Profiles

Determination of the actual demand profiles for arrival and departure operations provides insight into the typical day operations compared to the declared capacities. As other metrics (e.g., airborne holding, surface delays) are analyzed, referencing the operational demand may identify causal relationships that support recommendations for improved efficiency and reduced emissions.

5.3.1.1 Bangkok Suvarnabhumi International Airport (VTBS)

The operational data from AOT was used to determine the actual operations profiles for VTBS. For each month of data (January, 2013 and July, 2013), the maximum number of actual operations (arrivals, domestic arrivals, departures, and total operations) for each hour of the day was determined. Figure 18 and Figure 19 show these profiles for Bangkok Suvarnabhumi (VTBS).

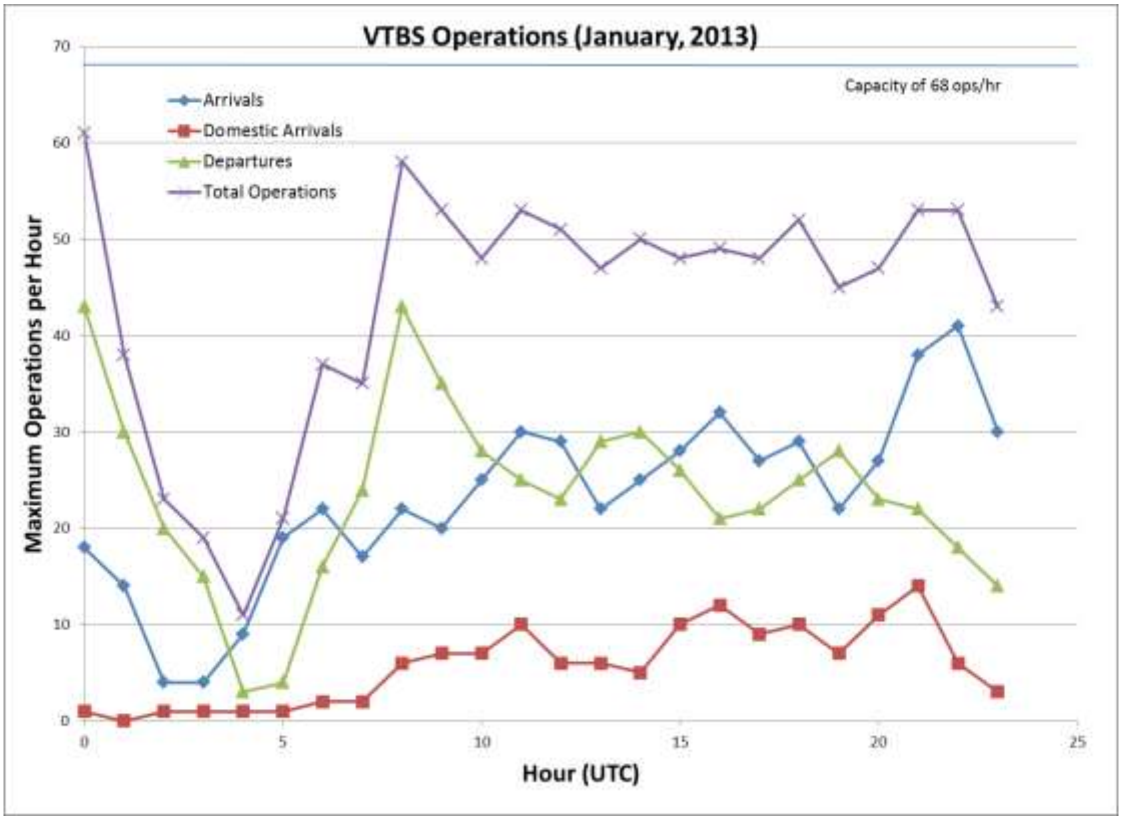

Figure 18. VTBS Maximum Operations - January, 2013

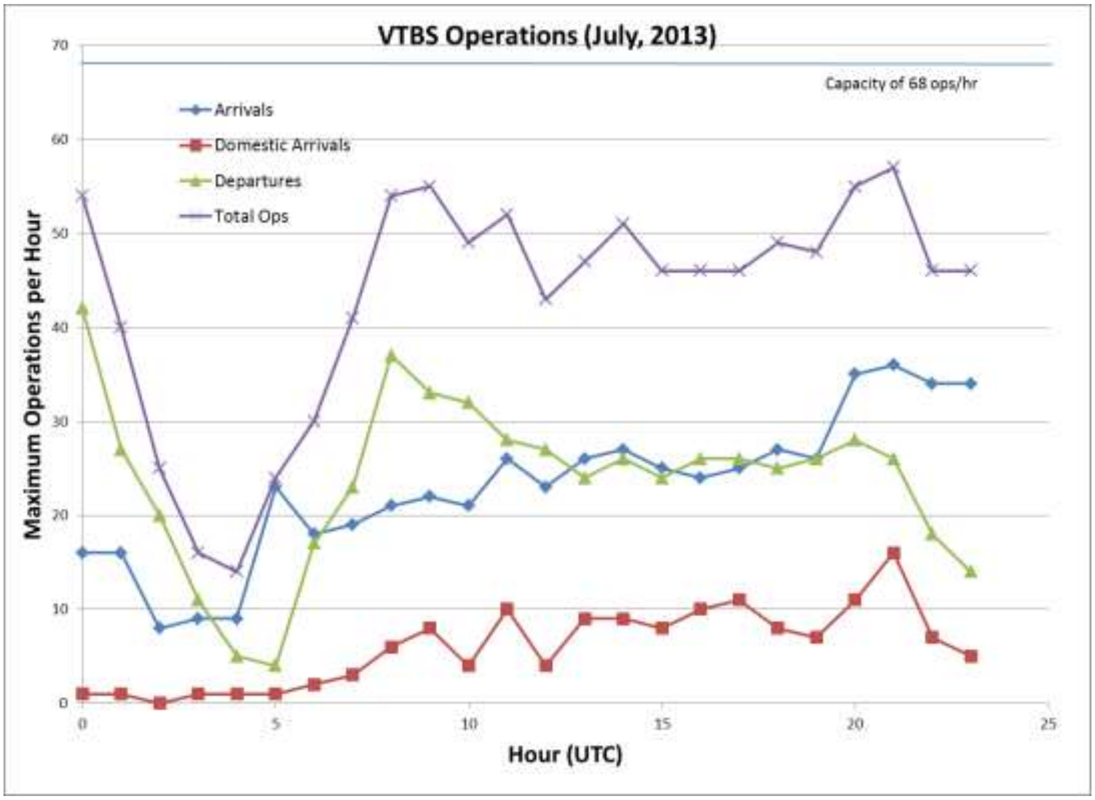

Figure 19. VTBS Maximum Operations, July, 2013

5.3.1.2 Kuala Lumpur International Airport (WMKK)

Operational data was also provided by DCA Malaysia to support a similar analysis of actual operations. Figure 20 and Figure 21 show these profiles for Kuala Lumpur International Airport (WMKK).

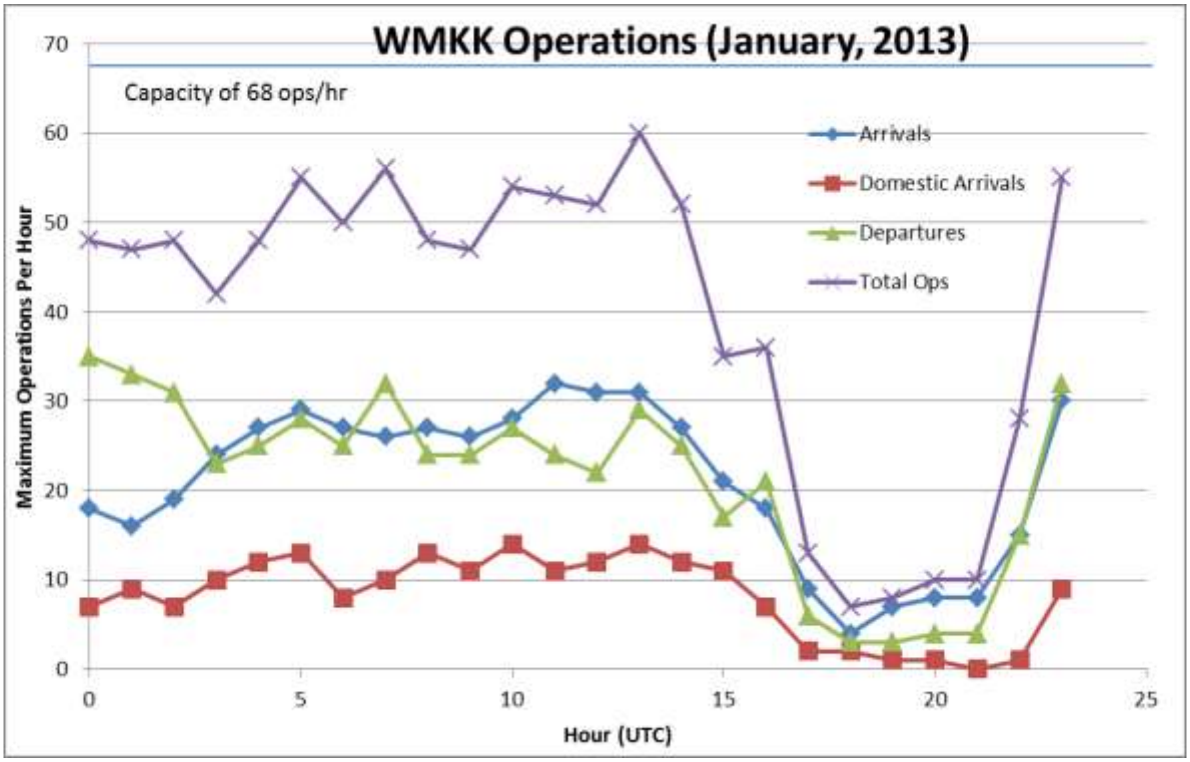

Figure 20. WMKK Maximum Operations, January 2013

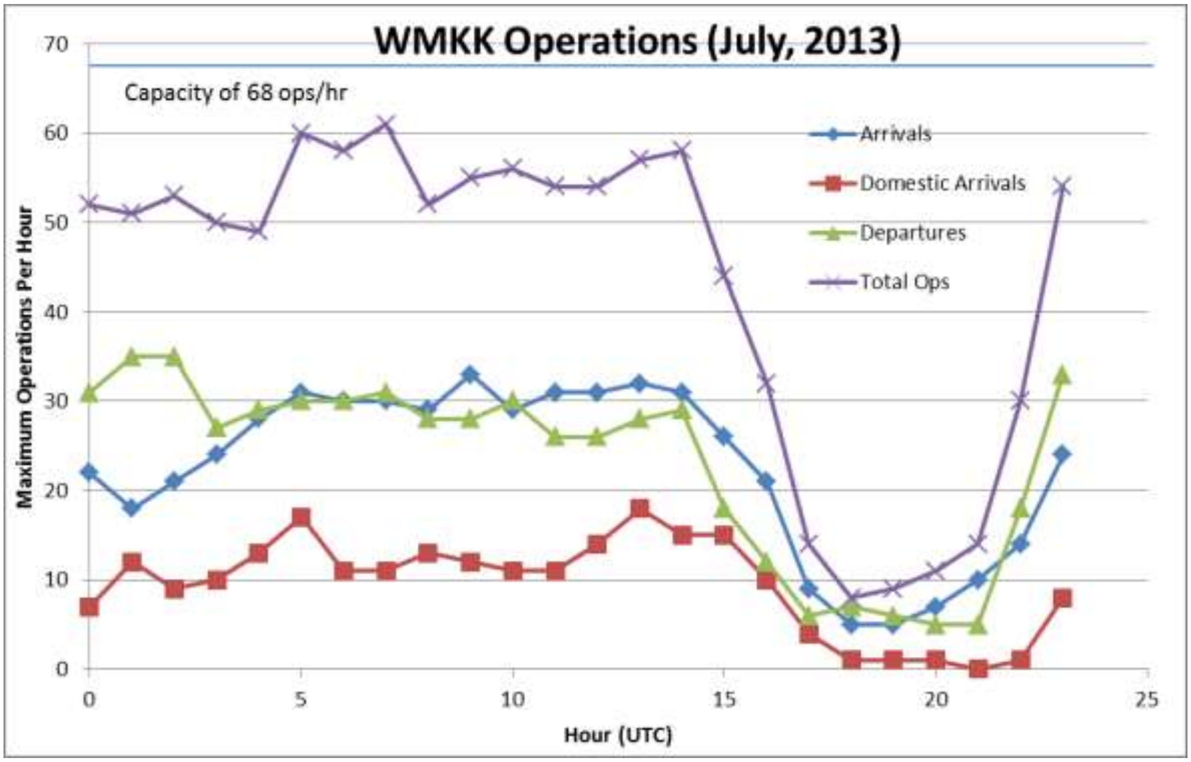

Figure 21. WMKK Maximum Operations, July, 2013

5.3.2 Airborne Holding

Airborne Holding data provides tactical efficiency information related to a key element of ATFM/CDM technologies and processes. Since a fundamental operational benefit of ATFM/CDM is to trade airborne holding for ground holding, which reduces fuel burn and emissions, through the use of pre-tactical and tactical traffic management initiatives, determining the benefits pool available based on current operational holding is important.

5.3.2.1 Bangkok Suvarnabhumi International Airport (VTBS)

VTBS airborne holding data was provided for the period of January, 2013 through July, 2013. The data included non-identifying flight-specific data, the initial approach fix, and the holding that occurred. The table below summarizes the VTBS provided holding data:

Month, 2013	# Flights Held / Total Arrivals*	Duration Held (HH:MM)	Max Hold
Jan	61 / 12346	7:23	19 min
Feb	181	24:29	20 min

Month, 2013	# Flights Held / Total Arrivals*	Duration Held (HH:MM)	Max Hold
Mar	89	12:25	16 min
Apr	17	2:08	10 min
May	142	22:22 (7:41 of this was due to a closed runway)	2 hours
Jun	471	70:24	1:27
Jul	310 / 12533	37:01	17 min
Jan-Jul	1271	176:12	

*: Total arrival data was only available for January and July, 2013

This data projects to an annual estimate of VTBS airborne holding of 352 hours and 24 minutes.

5.3.2.2 Kuala Lumpur International Airport (WMKK)

WMKK airborne holding was determined from analysis of the data provided. WMKK operational data provided by DCA Malaysia included the crossing time for the holding fix and the landing time. To determine flight-specific airborne holding, a nominal transit time from the holding fix to landing was used to determine excess transit times. The excess transit time was attributed to airborne holding which may have included vectoring or speed control due to congestion in addition to specific holding patterns. Some individual data records were removed due to anomalies that resulted in negative transit times or excessively large transit times. The airborne holding analysis for January and July, 2013 determined the following:

- Jan, 2013 – 13,857 minutes of holding for 3345 flights
- Jul, 2013 – 22,260 minutes of holding for 4343 flights

This data projects to an annual estimate of WMKK airborne holding of 3,611 hours and 42 minutes.

5.3.3 Surface Delays for Departures

Surface delays for departures are influenced by a number of operational factors including, but not limited to:

- Late arrival of previous segment aircraft
- Aircraft operator turn around delays (e.g., mechanical, crew, passengers, baggage/cargo)

- ATC gate hold
- Taxi out delay

The operational data received supports analysis of the above factors except for aircraft operator impacts. This limitation is considered in the analysis to identify areas of opportunity to apply ATFM/CDM concepts to reduce fuel burn and emissions related to surface departure activities.

5.3.3.1 Bangkok Suvarnabhumi International Airport (VTBS)

Off Block Times and taxi out data from AEROTHAI was analyzed to determine the surface delay available for improvements in efficiency, reduced fuel burn and reduce emissions.

AEROTHAI provided summary taxi statistics covering 2008 to mid-2013. The data analyzed the taxi times for each runway to parking stand combination and determined a nominal taxi time as the 20th percentile taxi value. This was determined for both taxi in and taxi out operations. Taxi efficiency was determined as the excess taxi time above the nominal value. As a monthly aggregate, Figure 22 is the AEROTHAI provided chart of taxi out and taxi in efficiency (Departures shown in Blue and Arrivals shown in Red).

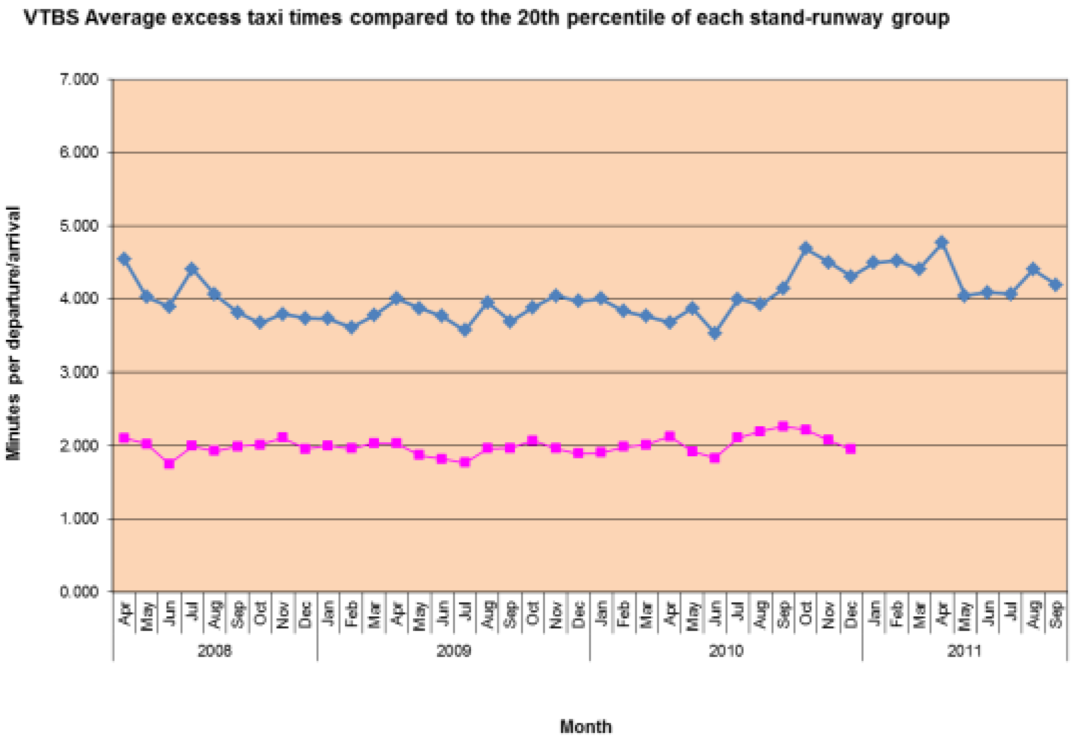

Figure 22. AEROTHAI Taxi Efficiency Summary Statistic for VTBS

Nominal taxi out time data can be used to determine excess taxi times for specific flights. Excess taxi times can be an indication of surface congestion or operational inefficiencies that can be reduced with CDM practices. Reduced surface congestion and taxi out times also reduces the fuel burn and emissions. The AEROTHAI approach using the 20% percentile values for each parking stand/runway combination resulted in some large variations of values used for parking stands in the same area of the airport. This was due in part to limited sample sizes for some combinations that influenced the statistics. Therefore, the AEROTHAI taxi out data statistics were used to generate the set of nominal taxi out times used for this analysis.

The VTBS parking stands were organized into parking stand groups as shown in Figure 23. The parking stand groups represent similar locations and taxi out paths to aggregate the data while still accounting for variations in the taxi times to each runway from each parking location.

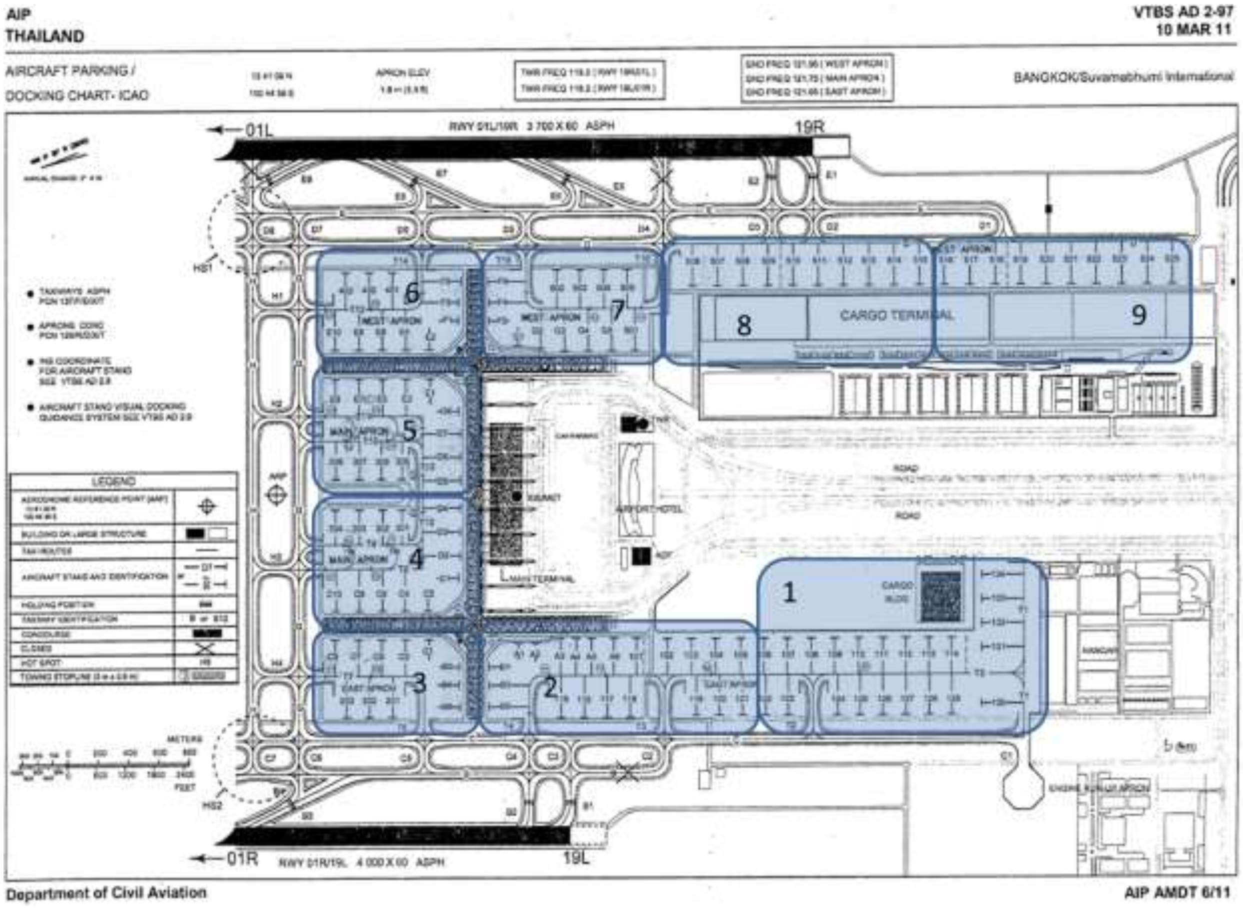

Figure 23. VTBS Parking Stand Groups for Taxi Out Analysis

For each gate group and runway combination, the 20% percentile values were reviewed only for cases where there were at least 300 samples. These values were all reviewed to ensure that there were not any outliers from this method and then the average of these values was determined. The table below shows the resulting taxi out times per runway and parking stand group. From the airport layout, these times values appear to reflect an expected variation based on group location and runway.

Parking Stand Group	Runway 01L (mins)	Runway 01R (mins)	Runway 19L (mins)	Runway 19R (mins)	Max Time for any Runway (mins)
1	12.5	10.4	6.1	None	12.5
2	12.1	10.1	6.1	12.7	12.7
3	12.2	11.6	7.9	12.5	12.5
4	11.7	13.3	10	11.8	13.3
5	11.3	13.9	10.5	11.2	13.9
6	10.8	14.8	12.1	9.8	14.8
7	11.6	16.5	14.1	9.3	16.5
8	10.5	None	12.6	5.7	12.6
9	12	None	14.7	7.4	14.7

The maximum time for any runway was used for flight specific excess taxi time determination. Additionally, the taxi time excess was limited to 30 minutes for any single flight in to reduce data anomalies from impacting the results. The operational data containing actual off block time and take off time did not include the departure runway. Therefore, the analysis to identify excess taxi out time conservatively used the maximum value for each runway for each parking stand group as the nominal case. The computed excess taxi out time value is conservative because the taxi time difference based on the runway used is in excess of 6 minutes and only excess time above the maximum time used for the nominal taxi time is considered in the benefits pool.

From this analysis, the following excess taxi out time was identified.

- Jan, 2013: 367.5 hours of excess taxi out time for 6527 flights
- Jul, 2013: 391.5 hours of excess taxi out time for 5937 flights

This results in annual estimate of 4,554 hours of excess taxi out time impacting 74,784 flights.

These summary values are less than the values that would be determined using the direct AEROTHAI values from Figure 22; however, the elimination of outliers impacting the 20th percentile values and the conservative calculation based on nominal runway times support this reduced value.

Off Block departure delays are also a factor in surface efficiency. AEROTHAI reported that Gate Hold procedures are used to reduce taxi out time. These procedures are implemented manually with the assistance of a spreadsheet. A log of Gate Hold periods was provided that identified two primary periods during the day when this procedure is in place: 0100-0230UTC and 0800-0900UTC. In order to isolate parking stand delays to periods most likely to be impacted by ATC, the following formula for Gate Delay was applied to the flight-specific data provided by AEROTHAI:

$$\text{Gate Delay} = \begin{cases} 0, \text{ if turn time to achieve on time departure} < 45 \text{ min} \\ \text{Actual Off Block Time} - \text{Scheduled Off Block Time} \end{cases}$$

Only Gate Delay values less than one hour were considered for inclusion in a benefits pool since larger delays are likely due to aircraft operator impacts and not congestion.

Gate Delay, Excess Taxi Time, and the sum of Gate Delay and Excess Taxi Time were evaluated against the operating time of day and the departure demand for the specific hour of the flight operation. These comparisons were performed to identify if the existing manual Gate Hold procedure is apparent in the operational data via increased Gate Delays during period of high departure demand while preventing large taxi out times.

Using January data, Figure 24 shows the flight specific values for Gate Delay and Excess Taxi Time based on Departure Hour and the Departure Demand.

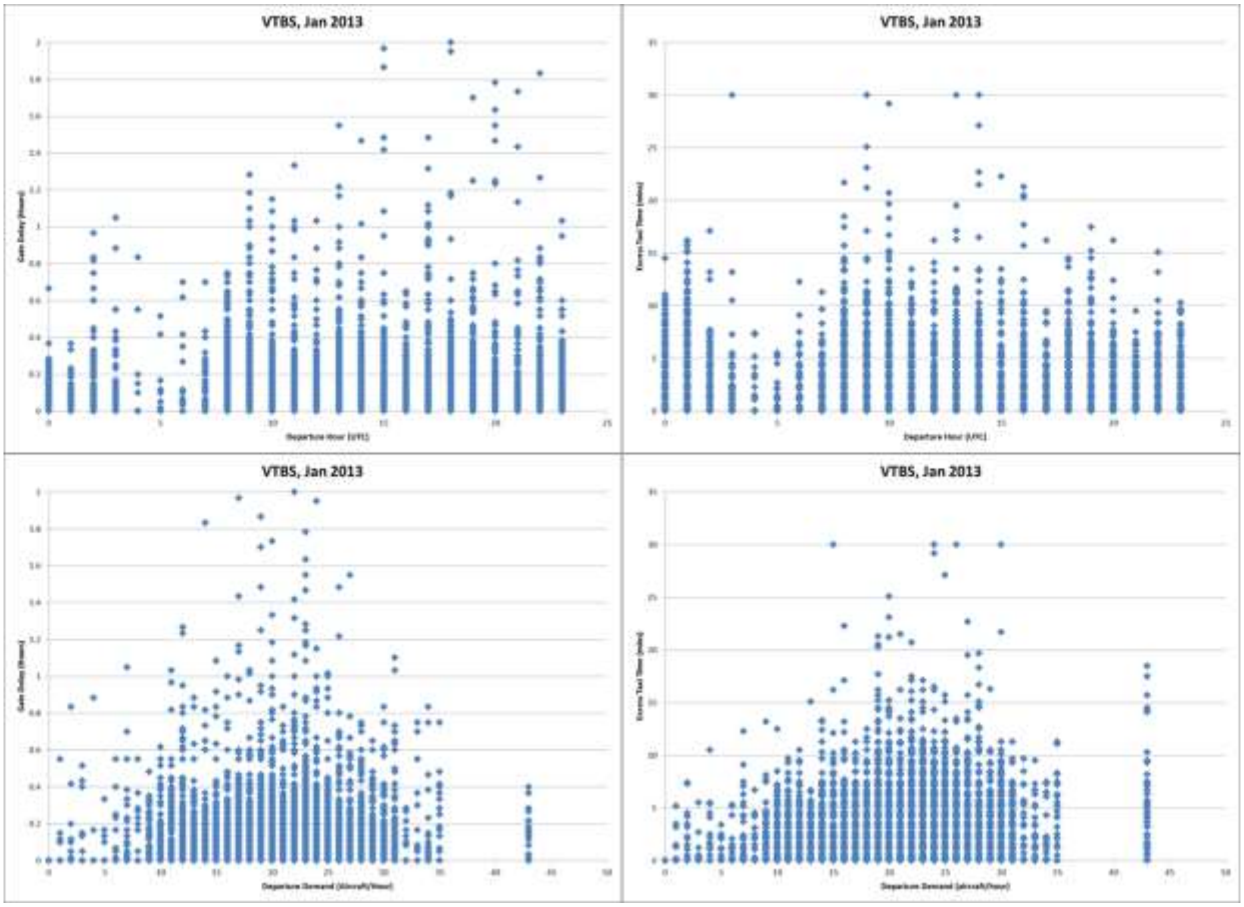

Figure 24. VTBS Surface Delay

With the exception of periods of low demand to VTBS, the Gate Delay and Excess Taxi Time do not vary significantly throughout the day even though the Gate Hold logs indicate only a few hours of manual Gate Hold procedures per day. However, the surface delays do not continue to increase with increasing demand indicating that the combination of gate holds and taxi durations are working together to not have significant increasing surface delays at the parking stand and while taxiing during periods of high departure demand.

From the January data, VTBS experienced 694 hours of Gate Delay and 367.5 hours of excess taxi time. With the declared capacity of VTBS of 68 operations/hour, the amount of surface delay when the delivered departure demand is well before 34 departures/hour indicates an opportunity for improved surface efficiency that will reduce excess taxi times, optimize gate hold times, and deliver aircraft for departure closer to the declared capacity. CDM principles can support this type of surface efficiency.

5.3.3.2 Kuala Lumpur International Airport (WMKK)

Operational data for WMKK departure surface events included the runway, parking stand, actual off block and actual take off times. This data was analyzed to determine nominal taxi out times and the resulting excess taxi out times and potential operational causes (e.g., congestion). Scheduled time data was not available to explore parking stand related delay. Figure 25 shows the parking stand arrangement at WMKK and the groups used in the taxi analysis. The groups, A, B, C, and F, are the prefix used in the parking stand identifiers. Group F is the Low Cost Carrier Terminal. Group C is the Satellite A set of parking stand that includes the 3 parking stand for A-380 aircraft. Groups A and B are the Main Terminal parking stands.

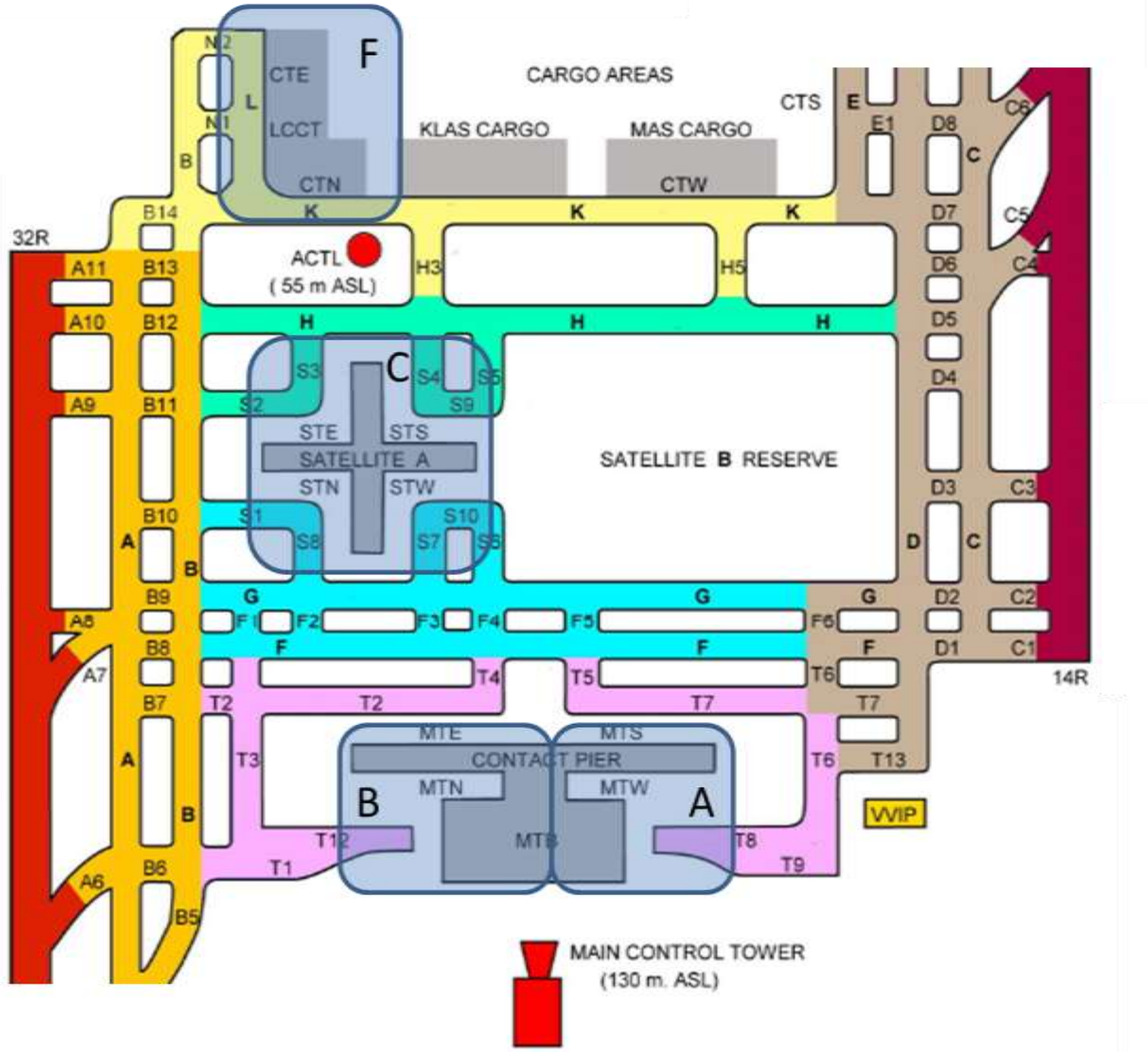

Figure 25. WMKK Parking Stands and Groups

The operational data for January, 2013 and July, 2013 showed the majority of the departures used runway 32R. Figure 26 shows the taxi out times for runway 32R from January for each of the parking stand groups. The taxi out for July, 2013 was similar. The data shows a comparable nominal taxi time to runway 32R of approximately 9 minutes and also shows that the Low Cost Carrier Terminal taxi times have a wider distribution which is consistent with the information provided by the operational staff regarding LCCT apron congestion.

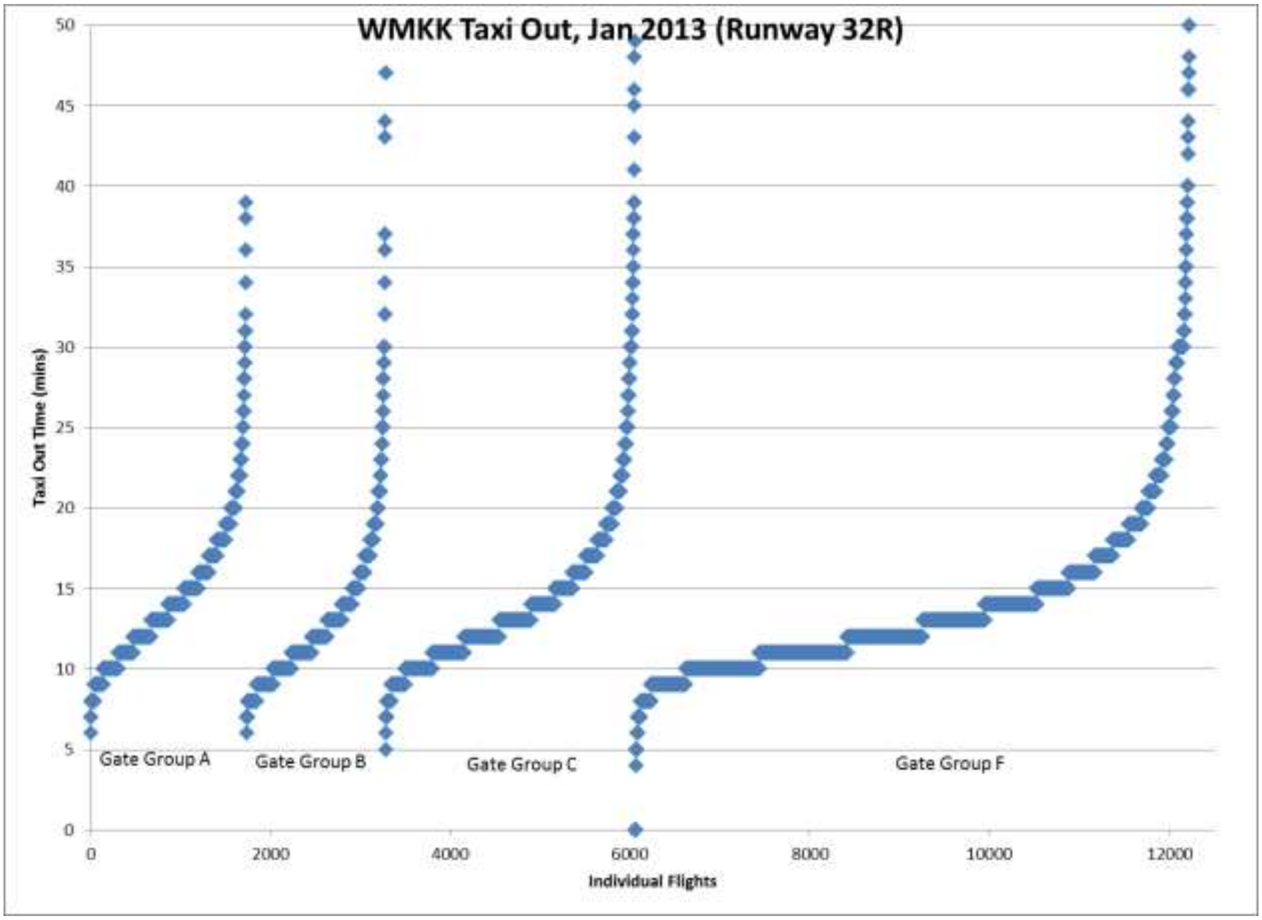

Figure 26. WMKK Taxi Out Times

Taxi Out time was also analyzed based on departure operations. Figure 27 shows that flight-specific taxi out times increase with increasing demand. The data also shows that taxi out times have significant variation from the nominal taxi times even when the number of departure operations is well below the declared capacity. This excess taxi out time is an opportunity for reduced fuel burn and reduced emissions to be realized with the application of CDM principles. Using a 9 minute nominal taxi out time, and allowing an additional 3 minutes of taxi time and a maximum excess taxi time of 90 minutes for a conservative benefits pool, the following was calculated:

- WMKK – Jan, 2013 – 538 hours of excess taxi out time for 7531 flights
- WMKK – Jul, 2013 – 578 hours of excess taxi out time for 7171 flights

This results in an annual estimate of 6,696 hours of excess taxi out time for 88,212 flights.

One aspect of this analysis for WMKK is the introduction of simultaneous departures that occurred after the data capture for this report. The operational impact of this change is increased departure capacity which would result in reduced surface congestion; however, the extent of this improvement is not known. As with the existing data, the taxi delays that are occurring when the departure demand is less than capacity indicates that operational efficiencies are likely to still be available even in with simultaneous departures.

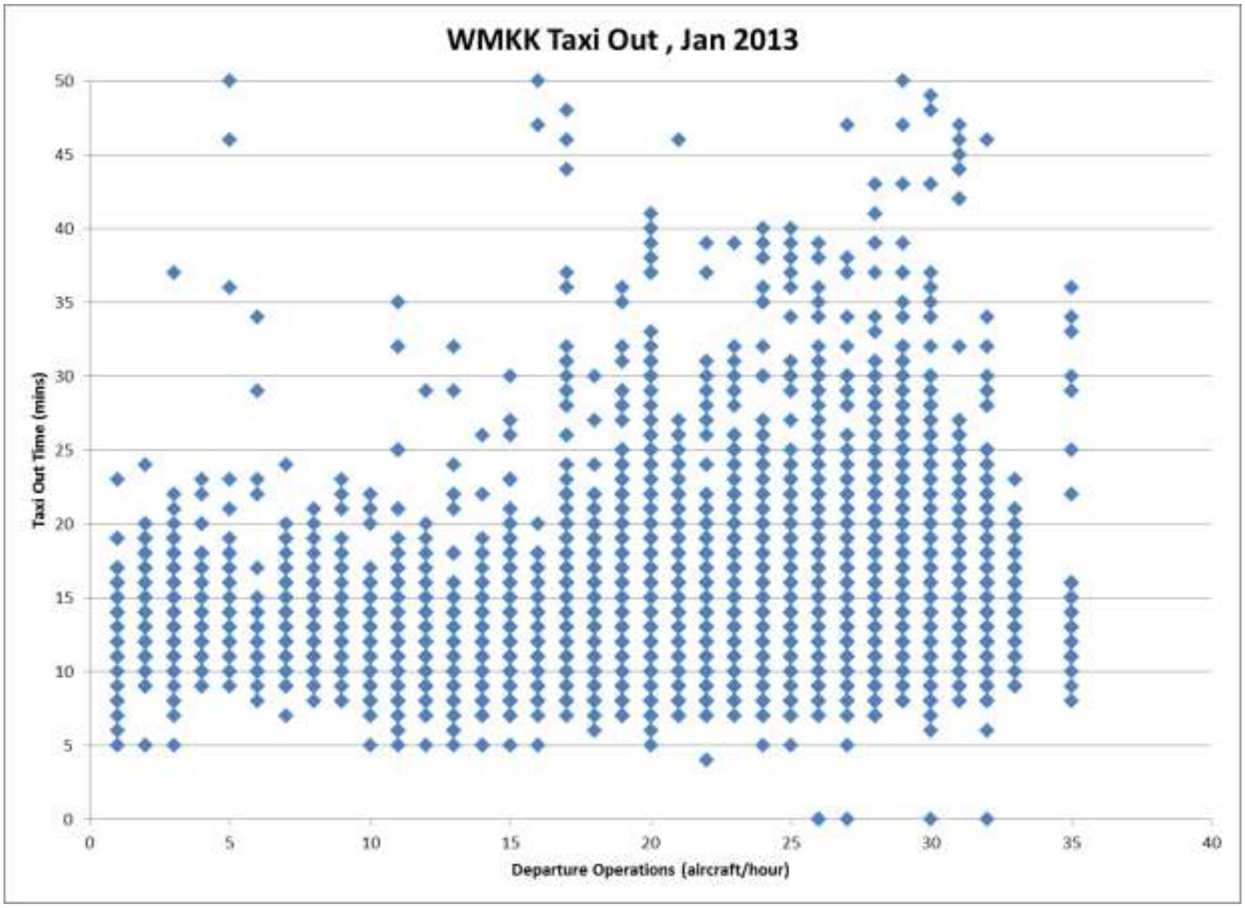

Figure 27. WMKK Taxi Out based on Departure Operations

6. Benefits Estimates

From the operational data analysis, the following benefits mechanisms that directly reduce emissions can be supported with ATFM/CDM principles:

- Reduced airborne holding
- Reduced taxi out times

6.1 Reduced Airborne Holding

ATFM/CDM demand capacity balancing has a primary benefit of trading airborne holding for ground delay. This benefit is proven operationally throughout the world including the United States, Europe, Australia, and South Africa. The data analysis identifies the benefits pool available related to airborne holding; however, tactical variations, practical experience with ATFM, and uncertainty in the benefit project warrants a conservative estimate of the expected benefits from implementing ATFM/CDM for demand/capacity balancing. Therefore, 33% of the benefits pool is used in the benefits estimate for reduced airborne holding. In order to determine the environmental and economic impact of these benefits, the following values are used:

- 49 kg/min of fuel burned
- 154 kg/min of CO2 emissions
- US$ 1 / kg fuel price

The following table shows the benefits estimate for reduced airborne holding

Airport	Airborne holding benefits pool (hrs/ year)	Conservative Airborne Holding Reduction (hrs/year)	Conservative CO2 emissions reductions (metric tonnes/year)	Conservative Fuel savings (US$/year)
VTBS	352.4	117.5	1,086	0.35M
WMKK	3,611.7	1203.9	11,124	3.53M

6.2 Reduced Taxi Out Times

Airport CDM is a local airport solution for surface congestion that is also connected to the network-wide ATFM/CDM solution. Airport CDM provides improved surface efficiency and reduced taxi out times while also improving the departure compliance for ATFM/CDM initiatives. For the specific airports analyzed in this study, Airport CDM processes and technology would reduce the excess taxi out times through information sharing, improved predictions, and active control of the pushback activity to smooth the surface flow to the departure runway(s).

In order to estimate the reduction in taxi out time from Airport CDM, an analogous case study is used. Frankfurt airport deployed Airport CDM and realized approximately 4 minutes per departure operation reduction in taxi out time. Applying this factor conservatively to 33% of the number of flights currently experiencing excess taxi time is a conservative method of estimating the benefits of deployed Airport CDM processes and technology to VTBS and WMKK. The benefit determination allowed up to 4 minutes of excess taxi time to be saved for each flight due to Airport CDM. This total was conservative reduced to 33% to account for tactical operational behavior and the uncertainty in the benefits projection. For scaling emissions and fuel savings, 7%[i] of the airborne holding savings values are used for taxi out operations.

Airport	Excess Taxi Out Time benefits pool (hours of excess taxi time limited to 4 mins/flight)	Conservative Taxi Out Reduction (hrs/year)	Conservative CO2 emissions reductions (metric tonnes/year)	Conservative Fuel savings (US$/year)
VTBS	3150	1050	679	0.22M
WMKK	3905	1302	842	0.27M

6.3 Additional Benefits

In addition to the quantitative benefits estimates, ATFM/CDM principles also provide additional benefits opportunities for aircraft operators to improve their operations.

An operationally proven CDM principle of slot substitution allows aircraft operators to adjust the ATFM slots allocated to their flights in order to meet specific business objectives. For example, substitutions for high priority inbound flights with connecting passengers for a lower priority flight allows the long haul international flight to retain its optimal BOBCAT departure slot.

Aircraft Operators regularly carry extra fuel into KL and other congested airports when airborne holding is anticipated. With the deployment of ATFM/CDM, airborne holding is reduced and the predictability of the operation is improved which allows for a reduction in the extra carry fuel for each flight. This increases the fuel and emissions savings due to ATFM/CDM because the operational impact to carry the extra fuel is reduced or eliminated.

7. Recommendations

Based on the information learned from the site visits, the operational data analysis, ICAO recommendations for ATFM/CDM, and our operational experience with ATFM/CDM processes and technology around the world, the following recommendations have been identified to improve the flow between Bangkok and Kuala Lumpur, improve the flow in the Bangkok and Kuala Lumpur terminal areas, and to realize the benefits identified in this report.

a) Enhance and Expand Communications and Information Sharing
    a. AEROTHAI expand availability to aircraft operators
        i. Surface surveillance data
        ii. Sector demand predictions and MDIs when in place
    b. AOT expand access and data available from the AODB to aircraft operators
    c. Hold internal Thailand teleconferences with ATC, ATFMU, aircraft operators, and airports to help with decisions about operations. These are distinct from the Tri-Partite teleconferences held with AEROTHAI, CAAS, and Hong Kong CAD and are focused on Thailand operations. Some results may be relevant to carry forward to the Tri-Partite. The teleconferences should focus on actionable information so that the stakeholders can make real-time, pro-active decisions for their operations that will reduce fuel burn and emissions.
    d. DCA Malaysia data sharing
        i. KLIA surface surveillance data to aircraft operators
    e. Hold internal Malaysia teleconferences with ATC, aircraft operators, and airports to help with decisions about operations. These are distinct from the Tri-Partite teleconferences and are focused on Malaysia operations. Some results may be relevant to carry forward to the Tri-Partite. The teleconferences must focus on

    actionable information so that the stakeholders can make real-time, pro-active decisions for their operations that will reduce fuel burn and emissions.

b) Deploy ATFM/CDM system for demand capacity balancing
    a. For DCA Malaysia, the extent of airborne holding coupled with the multi-year plan to improve airspace capacity warrants an early look at deploying ATFM/CDM. The limiting resource of the terminal airspace can be used as the constraint for an ATFM/CDM program to reduce airborne holding, reduce emissions, and improve predictability. An ATFM/CDM system can be deployed independent of ATC Automation system improvements. Additionally, an ATFM/CDM system can support the transition to new ATC technologies by smoothing the demand to a lower capacity during the transition period.
    b. For AEROTHAI, the current airborne holding and demand levels for Bangkok arrival traffic does not require an immediate action for ATFM/CDM. The airspace congestion, particularly in the southern sector(s), could benefit from ATFM/CDM demand capacity balancing automation. Airspace Flow Programs are a proven technology that monitors demand for airspaces and identifies departure times for flights to smooth the demand to the available capacity. For airport demand capacity balancing, a proactive program to deploy ATFM/CDM would prevent airborne holding from becoming an operational issue given the projected growth of demand. Additionally, as ATFM/CDM is deployed throughout the region, AEROTHAI will be better suited to support these efforts if there is a Thailand ATFM/CDM system in place that follows the same principles. An ATFM/CDM system can also be used as needed when there are capacity reducing events such as a disable aircraft on runway for several hours or several days.

c) Deploy Airport CDM for major airports
    a. An Airport CDM system for VTBS and WMKK would reduce taxi out times, promote information sharing, and improve the overall efficiency of the turnaround operation. This would include the processes and technology associated with a local Airport CDM solution. For both VTBS and WMKK, Airport CDM optimization would automate the existing periods of the manual Gate Hold operations, improve airport efficiency, and reduce emissions.

d) Declare capacity for sectors
    a. While both AEROTHAI and DCA Malaysia declare the capacity for the major airports, the terminal airspaces and sectors do not have declared capacities. Since these airspaces are often the constrained resource requiring flow management, starting with a declared capacity to allow ATFM/CDM measures to be identified is an important step.

e) Post operations analysis of key performance measures with access to regular (e.g. daily, weekly) information on operations

    a. Measure actual operational rates for configurations
    b. Measure airborne holding
    c. Measure taxi out delays

f) Training
    a. Controller and supervisor training related to the declared capacities and the factors influencing efficient operations.
        i. Taxi out delays during periods of lower demand can be improved with a focus on performance and training
        ii. Even though the current DMK separation can be between 5-10 NM, the lack of periods of high demand has not caused a focus on this operational behavior. As demand increases at DMK, additional coordination with the military may be necessary to reduce separation on final and increase the arrival capacity.

g) Airport Strategic Slot Compliance
    a. While both AEROTHAI and DCA Malaysia have slot coordinated airports according to the IATA Worldwide Scheduling Guidelines, better adherence to these strategic airport slots can be undertaken which reduces the tactical demand “bunching”.
        i. After issuance and acceptance of slots, a process of verifying the aircraft operator schedules match the actual slot issued.
        ii. Aircraft operators should apply for new slots when there are schedules changes or aircraft changes.
        iii. Post operational analysis for transparent access to strategic slot compliance should be performed and integrated into the slot allocation process for future scheduling periods. This will encourage aircraft operators to comply with the allocated strategic airport slots on the day of operation.

h) Kuala Lumpur FIR and Singapore FIR combined airspace analysis
    a. A broad review of airspace, routing, and capacity declarations between Singapore FIR and Kuala Lumpur FIR could be undertaken to explore mutually beneficial operational changes for both DCA Malaysia and Civil Aviation Authority Singapore (CAAS). The close proximity of KLIA and Changi International Airport in Singapore coupled with the FIR boundary operational coordination challenges and the flow between East and West Malaysia warrant a combined analysis.

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[i] ICAO Engine Emissions databank, ICAO Committee on Aviation Environmental Protection (CAEP) as referenced by SENSITIVITY ANALYSIS TO THE COST OF DELAY MODEL FOR NEXTGEN BENEFITS ANALYSIS, Sherry, Lance, et. al.