PUBLIC VERSION

South Africa Airside Capacity Enhancement Study for Air Traffic Navigation Services

Task 9 Report: Final Report

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LIST OF ACRONYMS

A-CDM..... Airport Collaborative Decision Making
AAR ..... Airport Arrival Rate
AASA ..... Airlines Association of Southern Africa
ACSA ..... Airports Company South Africa
ADR ..... Airport Departure Rate
AFT ..... Airport Flow Tool
ALPA-SA ..... Airlines Pilots Association South Africa
AMC..... Airport Management Center
A-SMGCS ..... Advanced Surface Movement Guidance & Control System
ATC..... Air Traffic Control
ATCC ..... Air Traffic Control Center
ATFM..... Air Traffic Flow Management
ATNS ..... Air Traffic Navigation Services
CAASA ..... Civil Aviation Authority South Africa
CAMU..... Central Airspace Management Unit
CAT..... ILS Category
CCA..... Commissioner of Civil Aviation
CDM..... Collaborative Decision Making
COBT ..... Controlled Off-block Time
CTOT ..... Calculated Take-off Time
FAA..... Federal Aviation Administration
FACT..... Cape Town International Airport
FAOR ..... OR Tambo International Airport
FALA ..... Lanseria International Airport
FALE..... King Shaka International Airport
GA ..... General Aviation
GSE ..... Ground Service Equipment
IACM ..... Integrated Airport Capacity Model
ICAO ..... International Civil Aviation Organisation
IFR..... Instrument Flight Rules
ILS..... Instrument Landing System

LVO..... Low Visibility Operations

NM ..... Nautical Mile

NOTAM ..... Notice to Airmen

PBN ..... Performance Based Navigation

R ..... South African Rand

ROT..... Runway Occupancy Time

RWY..... Runway

SAA..... South Africa Airlines

SA-AIP ..... South African Aeronautical Information Publication

SAWS ..... South African weather Service

SID ..... Standard Instrument Departure

SSI..... Station Standing Instructions

STAR..... Standard Terminal Arrival Route

TMA ..... Terminal Control Area

TMI..... Traffic Management Initiative

TOBT ..... Target Off-block Time

TSAT ..... Target Start-up Approval Time

USTDA..... U.S. Trade and Development Agency

VFR ..... Visual Flight Rules

VMC..... Visual Meteorological Conditions

1 Introduction

Air Traffic and Navigation Services (ATNS) and Airports Company South Africa (ACSA) engaged Metron Aviation, Landrum & Brown, and ACA Associates to conduct a South Africa Airside Capacity Enhancement Study (SA ACES). The team contact information is provided in Table 1.

Table 1: SA ACES Team Contact Information

Company/Address	Role	POC	Phone	Fax
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The study was funded by the U.S. Trade and Development Agency (USTDA).

The purpose of the study was to identify and validate existing ATNS and ACSA capacity enhancing technologies and procedural improvements that lead to reduced delays, and increased efficiency and safety of air traffic movements at the Cape Town, King Shaka (Durban) and O. R. Tambo (Johannesburg) international airports (Figure 1). The study also reviewed economic, environmental, and social impacts—positive and negative—that these enhancements may engender. This report summarises the findings of the previous eight reports, and provides a consolidated summary.

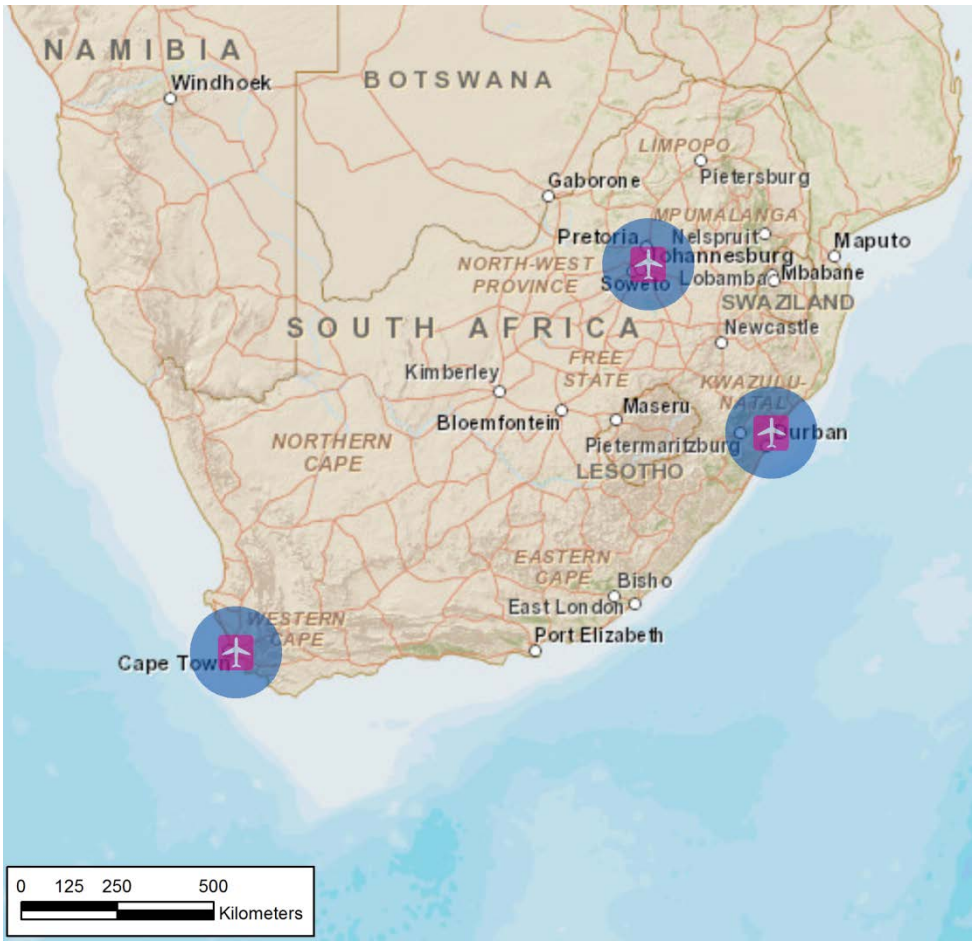

Figure 1: FAOR, FALE, and FACT Airport Locations

2 Report 1: Kickoff Meeting, Work Plan, Document Review, Site Visits

The study commenced with a kickoff meeting during October 2012. The purpose of the meeting was to engage ATNS and ACSA, and to get confirmation of their objectives for this study. The Metron Team successfully aggregated these objectives into the following:

- evaluate the feasibility of utilising capacity enhancements proposed by ATNS and ACSA;
- identify additional capacity enhancements;
- prioritise various criteria;
- identify efficiency gains by capability;
- identify trigger points for implementing new capacity enhancements;
- develop a joint ATNS-ACSA roadmap for capacity gains.

Another outcome of the kickoff meeting was to refine and re-scope the eight remaining tasks that comprise the SA ACES. These tasks include:

- identifying efficiency gains associated with each capability;
- understanding the regulatory framework in which ATNS and ACSA operate;
- conducting a preliminary environmental impact assessment;
- analysing and understand the economic and financial policies that govern ATNS and ACSA;
- proposing a set of capacity enhancements;
- identifying the potential development impacts of the recommended enhancements;
- developing a comprehensive implementation plan.

These tasks were further refined as the study progressed. The participants at the kickoff meeting developed a preliminary work plan that lists the tasks and associated start and end dates.

After the kickoff meeting, the Metron Team visited O.R. Tambo (FAOR), King Shaka (FALE), and Cape Town International (FACT) airports. They also visited the Central Airspace Management Unit (CAMU) and the Airport Management Centre (AMC). The team observed on-going operations, captured input from ATNS and ACSA experts, reviewed documentation, and gained an understanding of the facilities' current and forecast future operating environments. During these visits, the Metron Team identified each facility's demand characteristics, airspace characteristics, and the primary surface, departure, and arrival procedures. These observations served as the starting point for identifying airspace capacity enhancements. ACSA arranged meetings with planners for the local municipalities to discuss the potential relationship of capacity enhancements on the airport vicinities. ATNS facilitated a meeting with the Airlines Association of Southern Africa (AASA) and airlines. AASA and South African Airlines (SAA) were represented at the meeting. A further meeting was held with the Airlines Pilots Association South Africa (ALPA-SA) where the study was explained to the executive board and operational issues were discussed with a smaller group of pilots.

The Metron Team also participated in joint ATNS-ACSA meetings that explored the financial and procurement environments in which both organisations operate. The discussions during those meetings revealed the differing nature of those environments. These differences are partially due to varying ownership structures, investment timelines, and mandates from the national government. Complicating this picture are the airline operators, each of which pursues a different business objective. All participants in these meetings realised that there are certain organisational inefficiencies within ATNS and ACSA that may impact implementation of certain capacity enhancement capabilities; there are already efforts within these organisations as well as within the Ministry of Transport to address these inefficiencies. As a result, the Metron Team conducted its procurement review using the regulations that will be in effect at the end of 2012.

During and subsequent to the October meetings, ATNS and ACSA provided the Metron Team with critical documentation pertaining to airspace and airport operations. A table of potential capacity enhancements (Appendix A) was supplied to the Metron team. It must be noted that many of the enhancements listed are of international best practice. The Metron Team's recommendations included improvements identified in the ATNS/ACSA Airside Capacity Enhancement Initiatives list, as well as those observed directly by the team during the site visits. Other artefacts supplied included maps, radar data, models, standard operating procedures, noise contours, drawings, and governmental regulations and reports. This documentation substantially contributed to the success of this study.

Task 1: Kickoff Meeting, Work Plan, Document Review, and Site Visits, had the following objectives:

- Establish working relationships with ATNS, ACSA, and other stakeholders.
- Gather relevant airside and airspace data and information, and gain an understanding of current and future operations for use in future tasks.
- Gain support for the initial plan and proposed methodologies for future tasks.

This report described the results of the efforts to achieve those objectives.

Report 1 was presented as a means to facilitate the presentation and organisation of the topics. Nevertheless, the Metron Team recognises that issues related to demand and to airport and airspace capacity are intrinsically linked and dependent on one another. As such, the team endeavoured to highlight those issues of interdependency between airspace and airport operations throughout the report.

3 Report 2: Technical Analyses

A primary part of this technical analysis was to analyse the baseline airside infrastructure, facilities, technologies, operations, and procedures at each airport and assess their baseline capacities. An additional requirement of this report was to detail potential airside capacity enhancements or procedures that potentially reduce delay or increase efficiency. The study team was provided an initial list of candidate enhancements and airport Master Plans by ATNS and ACSA, which were used to develop Sections 4 and 5 of Report 2. [1,2,3,4]

The baseline operational capacity validation was completed through analysis of operational standards and procedures, data and statistical analysis of operational flight data provided by both ATNS and ACSA, and the modelling of general traffic flow through the study airports using Metron Aviation's Integrated Airport Capacity Model (IACM).

The conclusions about the declared baseline capacity for the study airports were as follows:

- FAOR declares a valid 60-movement hourly capacity. This capacity aligns with IACM's analytical capacity and with the low number of instances in which demand actually exceeds the declared capacity.

- FALE declares a valid 24-movement hourly capacity. This declared capacity is significantly lower than the IACM declared capacity; therefore, the declared capacity is not validated through IACM, but this does not mean that the declared capacity is invalid. Further investigation is needed into the airspace constraints surround FALE and how these constraints affect the separation requirements for aircraft operating into and out of FALE.

- FACT declares a valid 30-movement hourly capacity. This capacity aligns with IACM's analytical capacity and with the low number of instances in which demand actually exceeds the declared capacity.

Other conclusions about the study airport baseline capacities:

- The minimum separation for departures is two minutes; therefore the theoretical maximum number of departures on a single runway for an operational hour is 30. In order to increase departure capacity for a departure-only runway (e.g., FAOR) this value must be reduced.

- Arrival separation minima need to be reduced below 5 nm to increase arrival capacity for arrival-only runway operations (e.g., FAOR).

[1] "Airside Capacity Enhancement Initiatives – Operations Draft," working version developed by ATNS and ACSA.
[2] "O.R. Tambo International Airport – Master Plan Update," October 2006.
[3] "King Shaka International Airport – Master Plan Update," August 2011.
[4] "Cape Town International Airport – Master Plan," November 2007.

- Although the FALE departure Runway Occupancy Times (ROT) using Runway (RWY) 06 differ from those at FACT, and the demand mix is considerably different between the two airports, IACM showed a similar alternating arrival and departure capacity (40 movements per hour for FALE and 35 movements per hour for FACT). This result suggests that there exists a similar constraint at the two airports that is more of a factor for alternating operations. The factors to explore are arrival and departure separation minima.

Conclusions about IACM:

- IACM provided a parameter-based, fast-time estimate of each study airport's capacity. In all cases, IACM calculated operational capacities that were close to the airports' declared capacities, even though the actual peak hour demand may be less (which is the case at FALE).

- IACM can be used to compare airports with similar capacities, yet different throughput constraints (e.g., FALE and FACT having similar capacities, but different input parameters/constraints).

3.1 Conclusions of Airspace and Operational Capacity Enhancements

The modelled results show that airspace capacity constraints are most affected by the separation minima for both the arrivals and departures. In order to effectively increase capacity at the airport, investment must be made to reduce these minima. Below are some possibilities for such investments:

- Safe reductions in the minima to 3 nm have been accepted at major airports around the world. This reduction was recently implemented in the Johannesburg Terminal Control Area (TMA) in 2012.[5] If the 3 nm separation in the TMA (FAOR) can optimise ROTs, taking other separation criteria into consideration, then it should be investigated.

- The reduction of departure separation minima will need to be accompanied by improved techniques in departure readiness and sequencing. The development of more surface area for multiple departure queues and holding pads can enable techniques for capacity increase, such as grouping by wake turbulence and performance-based Standard Instrument Departures (SID). The optimisation of departure sequencing may also be facilitated through implementation of ramp control and traffic management coordination.

[5] See CAA Aeronautical Information Circular 40.15 for more information on the new separation minimum in the Johannesburg TMA.

- In lieu of the reduction of separation minima on either arrival or departure, the long-term ability to have runway assignments based in part by aircraft turbulence categories to achieve a more homogeneous sequencing of aircraft with similar performance capabilities could minimise the variance in separation between successive operations. This measure would only produce small capacity gains, and requires clear definitions on what aircraft are considered "the same". Some of these practices may be adopted for airport slot assignments, but those efforts need to be recognised in Calculated Take Off Time (CTOT) assignment as well. Further to this, optimisation of runway throughput could be gained by not exclusively reserving arriving and departure flights to a particular runway (RWY03L/21R – departures and R03R/21L – arrivals).

- Investments in Performance-Based Navigation (PBN) have been shown to improve overall airspace capacity, thereby improving efficiency of flows into and out of the study airports, and would also contribute significantly to achieving the other separation-related benefits discussed above.

- Constraints in the TMAs could lead to capacity restrictions as more demand is placed on the TMAs by satellite airfields. Airspace redesign will mitigate some impact of this new demand, particularly for the FAOR TMA; therefore investment in this capability would help optimise traffic flows.

3.2 Conclusions of Specific Airport Infrastructure Capacity Enhancements

Modelling of the suggested enhancements indicate the possibility of better surface flow that can ultimately reduce the ROT of operations, thereby increasing the airports' capacity.

Observations that could increase efficiency at FAOR:

- Add Rapid Exit Taxiways (RET) to RWY03L/21R. Although a primary departure runway, RWY03L/21R is seldom used for arrivals, but is expected to serve more arrivals as demand continues to increase. The RETs would reduce the ROT for any arrivals, thereby increasing efficiency of the airport's operations.

- Add RETs to RWY03R/21L. As the primary arrival runway, south flow operations would benefit from the addition of an RET for RWY21L, and north flow operations would benefit from the refinement of the current fillets of the connection to TWY Echo. These enhancements could reduce ROTs by enabling more high speed exits.

- Extend the pavement at the end of RWY03L to enable more effective departure queuing for wake vortex category and performance-based SIDs. More effective departure queuing can also help with managing multiple departures with CTOT and effectively reduce the average achieved in-trail departure separation.

Observations that could increase efficiency at FALE:

- Adding parallel taxiway access can reduce conflicts and facilitate taxi queuing. This will reduce the impact of the hot spot located at the intersection of Alpha, Bravo, Golf, and November taxi lanes and reduce delays related to head-to-head taxing.

Observations that could increase efficiency at FACT:

- Adding RETs to RWY24 can minimise arrival ROT by allowing direct access to Alpha and Bravo aprons instead of limiting the flights not capable of making an exit at taxiway Golf to use the full runway length to exit at taxiway Charlie Observations that could increase efficiency at FACT.

- The addition of By-Pass Taxiways at each of the RWY01/19 thresholds enable additional departure queuing distance, and the potential to optimise the sequence of departures as aircraft could enter the runway via the By-Pass Taxiway entry points, giving each runway an additional point of entry.

- Increasing the fillet pavement for Taxiways Charlie and Echo to a radius of 95 would facilitate at least a 90 degree exit in south flow and better visibility for intersection departures.

3.3 Recommended Enhancements

The airspace and airport analyses, along with collaboration with ATNS and ACSA, resulted in a refined list of capacity and efficiency enhancements. A short description of each enhancement is given below.

Minimum Required Separation on Final Approach

This enhancement recommends that under nominal operational conditions, ATNS space aircraft at a minimum of four nautical miles (NM) on final between like wake vortex categories and not provide additional buffers in spacing. Implementation of this enhancement will require cooperation between ATNS and ACSA as it requires action by both entities to get maximum benefit. ATNS will be required to amend procedures and ACSA will require infrastructure changes at all three study airports (RETs and realignment of runway exists).

Pilot Reaction Times (Improved Readiness for Imminent Departure)

Runway occupancy time (ROT) is a key element in airport capacity and Pilot Reaction Times (PRT) can have significant impact on ROTs. The effectiveness of this enhancement is dependent on pilots' awareness of the impact that delays between receiving a clearance and complying with it have on airport capacity and executing clearances in a timely manner.

Pre-Departure Sequencing Automation Improvements

Improved departure sequencing helps to improve runway utilization. This is accomplished by taking into account factors such as variable taxi times, wake turbulence separation, the assigned departure procedure, and aircraft departure performance in order to reduce the spacing between successive departures. In support of this improvement, it was recommended that a pre-departure sequencing tool be procured by ATNS/ACSA to manage the tactical sequencing. Closer integration between the air traffic flow management (ATFM) and Airport Collaborative Decision Making (A-CDM) systems and processes should be optimized.

Airspace Review and Redesign

This recommendation is for airspace review and redesign in the three Terminal Control Areas (TMA) that serve the study airports, with particular attention being placed on the FAOR and

FACT TMAs. As the study has revealed, there are constraints in the TMAs that could lead to capacity restrictions at the three study airports. ATNS needs to ensure that the TMA capacity is equal to or greater than the sum of the capacities of airports contributing to the demand on relevant TMAs.

Low Visibility Operations Review

It is the study team's opinion that the Low Visibility Operations (LVO) currently in practice could be overly conservative. A more extensive study was recommended to compare LVOs for FAOR, FALE, and FACT with those of similar airports based on fleet mix, fleet equipage, runway layout, weather, terminal area automation, and ILS.

Conditional Clearances

The practice of conditional clearances is used frequently in other parts of the world to maintain the flow of traffic, but it is applied at the discretionary judgment of the controller and it must be acknowledged by the pilots. The study recommends investigation of conditional clearances, which could lead to some efficiency improvements.

Limiting Operations to certain aircraft categories during periods of day

It was recommended that ATNS and ACSA, through a consultative process with aircraft operators, identify times of the day when it would be beneficial to have aircraft in similar wake turbulence categories or of similar performance types operate. Excluding or segregating dissimilar types of operations can reduce the complexity of managing different types of operations, thereby reducing controller workload, increasing capacity, and improving efficiency.

Slot Optimisation

This enhancement proposes to optimise the slot assignments for overall improved airport utilisation. Slot assignment is dependent on the agreement of numerous parties including airport authorities, airlines, and traffic management organisations. The effectiveness of slot assignments is dependent on the level of compliance by pilots and ATNS to the assigned times.

CTOT Compliance

While South Africa has an enviable record with regard to slot compliance, it can be improved. A key aspect of effective air traffic management and overall aviation system performance is linked to the accuracy of the time an aircraft actually departs in comparison to its CTOT. This enhancement proposes that every effort be made to ensure compliance to the CTOT.

Supervisory Staff in ATCCs

As a result of the study team observing that there is a lack of supervisory staff in the ATCC at the three study airports, it was recommended that an ATC supervisor staff structure be created at all three of the study airports, using other international ATCCs as a basis

Airspace Flow Programmes

This enhancement recommended that ATNS be able to carry out Airspace Flow Programmes (AFPs) that are completely configurable to ATNS requirements. The CAMU software will need to

be upgraded so that this configurable TMI can be implemented according to operational requirements.

Visual Flight Rules (VFR) traffic included in traffic demand predictions.

There are instances where VFR flights are not included in demand predictions. For example, training flights, particularly at FACT, do not file flight plans. It is important for these flights to be included in the demand predictions, which impacts pre-tactical planning of resources and flow rates during TMI implementation.

Improved Collaborative Decision Making (CDM) Practices

It was recommended that better coordination (CDM) between ATNS (internal and external) and other stakeholders take place, such as ACSA, aircraft operators and the South African Weather Service (SAWS). This is of particular importance during adverse conditions requiring reductions in arrival and departure rates at airports.

Performance-based Standard Instrument Departures and Arrivals

It is clear that to increase the throughput of the runways, a reduction in separation between departing and arriving traffic is required. The reduction of departure separation minima can be improved by revision of departure and arrival procedures. Some of these benefits can be realized through implementation of Performance Based Navigation (PBN) procedures. It was recommended that ATNS/ACSA implement PBN procedures at all three of the study airports.

Standard Taxi Routes

The study team recommended additional research to model a variety of routes and to assess the overall benefits. At a number of airports, standard taxi routes have been formalised with a naming codes for each route. Use of standard taxi routes increases efficiency, reduces the potential for error, and reduces workload associated with communications and read-back of taxi clearances.

Airport Specific Infrastructure Capacity Enhancements

Many of the suggested enhancements are dependent upon or strengthened by associated enhancements of airfield pavement. The enhancements can provide better surface flow that may ultimately enable a reduction in the average in-trail spacing between successive operations, thereby increasing an airport's capacity. The specific infrastructure enhancement recommendations for additional taxiway pavement fall into three functional categories:

- Addition of new RETs or refinements to existing RETs to facilitate reduced ROTs and related improvements in runway throughput:
    - FAOR Addition of RET to RWY 03L/21R
    - FAOR Addition of RET to RWY 21L
    - FAOR Addition of RET to RWY 03R
    - FAOR Change From Master Plan for Taxiway RE
    - FALE Add RETs to RWY 24 toward Alpha and Bravo Aprons
    - FALE Proposed RETs for RWY 24
    - FACT Realignment of Runway Exits

- Improvement to the configuration of runway end hold pads, including the addition of Parallel Taxiway entry points to Runway Thresholds:

- Intersection Departures
- FAOR Extension of Taxiway Pavement at the End of RWY 03L & the Use of Multiple Line Up Queues
- FAOR Taxiway Extension at RWY 03L
- FACT Parallel By-Pass Taxiway at FACT

- Addition of Parallel Taxiway segments at FALE reduces the potential for head-to-head conflicts on single taxiway segments
  - FALE Extension of Taxiway Golf

Addition of Holding Point Lines

It was recommended that ACSA reassess the holding point lines at the three study airports and mark the holding points appropriately to optimize throughput of the runways.

Independent Parallel or Segregated Parallel Runway Operations at FAOR for RWY03/21 & Efficient Runway Utilization

It was recommended that ATNS investigates the use of independent or segregated parallel operations which will allow for increased runway capacity and provide greater flexibility for ATNS and ACSA. It is also noted that this enhancement, will enable more efficient LVOs by removing the dependencies that are currently in place among departing and arriving aircraft.

Intersection Departures

Although, intersection departures are accepted at the discretion of the pilots, appropriate use of intersection departures can help relieve departure separation requirements. Intersection departures are a reasonable option to reduce taxi times for small aircraft that may not need the full runway length. This may provide benefits in increased capacity where the wake vortex minima would be reduced between two departing aircraft as well as a reduction in taxi time for certain aircraft.

The enhancements described above are summarised in Table 2. These enhancements were the basis for further study and elaboration, and ultimately led to the joint final capacity enhancement roadmap for ATNS and ACSA.

Table 2: Recommended Enhancements

Enhancement	Description of Recommendation
Minimum required separation on final approach	Recommended that separation on final approach be optimised so as to allow maximum throughput at all airports.
Pilot reaction time (PRT)	Recommended that PRTs be measured and remedial action taken through collaborative action with aircraft operators.
Departure sequencing	Recommended implementation of a departure sequencing tool which will be integrated with the AFT.

Enhancement	Description of Recommendation
Multiple Line up Queues	So as to facilitate tactical manipulation of departures, recommendations will be made to expand holding point areas. Recommended to increase the pavement areas at the RWY03L holding point.
Standard taxi routes	Recommended standard taxi routes.
Performance based standard instrument departures and arrivals	Recommended PBN arrivals and departures will be recommended.
Arrival/Departure Balancing	Recommended adding RETs to RWY24. This minimises arrival ROT by allowing direct access to Alpha and Bravo aprons instead of flights vacating on taxiway Charlie.
Airspace review and redesign	Recommended airspace review and redesign as required.
Low-visibility operations	The present Low Visibility Operations (LVO) are restrictive. Recommended optimising operations during LVOs.
Intersection departures	Recommended promoting intersection departures.
Conditional clearances	Recommended use of conditional clearances.
Limiting operations of certain aircraft categories during periods during the day	Recommended restricting certain aircraft categories during peak periods to optimise operations. This could include performance and weight category criteria.
Slot optimisation and CTOT compliance	Recommended optimising slot allocation processes, procedures and tools.
Supervisory staff in ATCC	Recommended allocating supervisory staff in ATCC for supervisory and better liaison within the ATCC, CAMU, and adjoin sectors.
Addition of RETs	Recommended adding or repositioning RETs at FAOR and FACT.
Airspace Flow Programmes	The current methodology of implementing Airspace Flow Programmes at all 3 airports is not efficient. Recommended better application of software and procedures.
Visual Flight Rules (VFR) traffic included in traffic demand predictions	VFR traffic which does not file flight plans are not included in demand predictions (particular reference to FACT), which leads to inaccurate predictions of demand leading to inefficiencies when TMIs are implemented. Recommended new flight planning procedures and adaptation of AFT procedures.
Efficient runway utilisation	RWY03L/RWY21R are used almost exclusively for departures and RWY03R/RWY21L for arrivals (as per SSI's). Recommended utilising mixed operations on the runways.
Near-term Implementation of Master Plan elements to enhance taxiway systems	Recommended Master Plan TWY extensions for Alpha and Charlie to enable bypass sequencing and multiple runway entry points for RWY3L at FAOR.

Enhancement	Description of Recommendation
Addition of holding point lines	Recommended painting Cat 1 holding point lines at FALE and FACT, as only Cat 2 lines exist presently.
Improved Collaborative Decision Making (CDM) practices	Recommended improved practices in CDM and how they can be applied in the South African environment.
Independent parallel RWY operations at FAOR for RWY03	Recommended instituting independent operations for RWY03
Segregated parallel RWY operations at FAOR for RWY21 (due to negative threshold stagger)	Recommended instituting segregated Parallel operations for RWY21

4 Report 3: Economic and Financial Analysis

Task 3, Economic and Financial Analysis, served several purposes:

- To understand how the financial and regulatory framework, which determines the financial sustainability of ACSA and ATNS, affects the ability of each to finance capital projects.

- To provide a methodology for evaluating the financial benefits of the airspace capacity enhancement options identified in Task 2 (see Table 2).

- To review ATNS' and ACSA's capacity to finance recommended capacity enhancements.

This section consolidates the summaries of the report findings and identifies the next steps that follow this task.

4.1 Conclusions of Regulatory Review

South Africa has world-class air navigation and airport infrastructure because of ACSA's and ATNS' extraordinary employees and the stability provided by the regulatory process. This infrastructure has been critical to the nation's economic success, and will remain essential to its future growth. It is important to all stakeholders, as well as the national interest of South Africa, that ATNS and ACSA have the financial resources to continue to provide adequate capacity to meet South Africa's transportation needs and that both be allowed to utilise their core competencies to expand internationally.

Continued development of aviation infrastructure requires that the Joint Project Team (JPT) develop regulatory recommendations that allow all stakeholders to reach consensus in a timely manner, and permit both ACSA and ATNS to plan for the future and use those plans to meet the nation's growing air transport needs.

Finally, none of the above will be possible unless the banking community retains its confidence that the regulatory process will provide predictability for ACSA's and ATNS' financial future. If this confidence is lost, their cost of capital will rise, and result in an increase in the cost of aviation for all stakeholders.

4.2 Conclusions of Stakeholder Engagement

The study team proposed that the capacity enhancements under consideration be evaluated on the basis of expected reduction in delay in the air and on the ground because the value of these time savings can be calculated based on the methodology described in Section 4 of Report 3.

Once a minimum performance standard at an airport or airspace is agreed upon by stakeholders, ACSA and ATNS need to collaborate to determine capacity enhancements that will enable the airport or airspace to achieve the standard. For the stakeholder engagement process to be as effective as possible, ATNS and ACSA should present options to the stakeholders for achieving the performance standard, and hold meaningful discussions with interested parties over a prolonged period to build a consensus.

This study has identified capacity enhancements that will be relatively inexpensive. At the onset, ATNS and ACSA should present these capacity enhancements to stakeholders to start the consensus-building process. Because air traffic is currently lower than forecast, there is time to develop the engagement process (i.e., establish on-going contacts, present master plans, agree on appropriate performance metrics, understand stakeholder concerns) before airport delays become onerous.

4.3 Conclusions of Evaluation Methodology

Air transportation systems are complex and expensive; any inefficiency can result in a high burden on a nation's economy. Seemingly modest system improvements, for example one that shortens a trip by as little as 0.58 seconds at FAOR, can justify a R20 million investment. It is important to financially justify investments that are made to increase capacity, but the level of analysis should be proportionate to the cost of the enhancement. This study team performed minimal analysis of capacity enhancements that cost less than R20 million—those can be justified by an average of less than three seconds of reduced delays at any one of the three airports if the investment has a useful life of at least 10 years. The study team evaluated capacity enhancements that cost more than R20 million on the basis of the value of monetary benefits of time savings to both aircraft operators and their passengers compared with the cost.

Finally, the study team identifies efficiency groupings which produce peak hour capacity increases if implemented as a group. The study team recognizes that peak hour capacity increases are of significant value to stakeholder airlines, and that value may justify their adoption. That decision will be left to the stakeholder airlines.

The benefits included in the financial analysis are quantified by estimating the avoided costs of delays. Those avoided costs are based on: 1) U.S. airline data for direct aircraft operating costs, and 2) EU and FAA studies regarding the value of passengers' time. (South African costs and values will be different, but these data sources are independent and provided data that is reasonable for this study.)

Given the cost of the capacity enhancements that are proposed by this study, the methodology used to estimate the value of their benefits is appropriate. However, in the future if more expensive capacity enhancements are being considered, stakeholders may want to commission a more detailed study to provide a comprehensive understanding of the benefits and how those benefits are distributed among the various stakeholders.

4.4 Conclusions of ATNS and ACSA Financial Review

Both ACSA and ATNS are financially conservative and manage their borrowings to reflect their operating cash flows and future investment requirements. ACSA was able to invest over R17 billion during 2008–2010 in spite of the global financial crisis—a testament to its reputation in the financial markets. Both organisations' history of excellence in operations and conservative financial management provides ACSA and ATNS access to both domestic and foreign financial markets, including commercial banks, development banks, export credit agencies, and sources of private capital. Neither should have difficulty in financing the recommended capacity enhancements.

However, their continued ability to do this depends on the current regulatory impasse being solved as quickly as possible and on the regulatory regime recommended by the JPT being

accepted by stakeholders. ACSA and ATNS have benefitted from a regulatory system that has produced world-class aviation infrastructure and the JPT will serve the interests of all stakeholders by completing their work as quickly as possible.

Both ACSA and ATNS also manage their currency exposure in a prudent manner. As both companies expand regionally and globally, their financial risks will change which provides challenges as well as opportunities. International expansion may generate revenues denominated in currencies (such as the USD and Euro) that currently have low interest rates. Moreover, these international projects may provide both ACSA and ATNS opportunities to obtain funding at sub-market rates from national and regional development banks and from export credit agencies.

Historically, neither ACSA nor ATNS have paid dividends to their owners. This did not matter when both were fully owned by the Department of Transportation (DOT) but is likely to become more important to ACSA because of its private shareholders. It might also be beneficial for ATNS to institute a dividend policy that is appropriate for its cash flows and investment needs.

Both ACSA and ATNS could consider including a financing requirement for equipment that is purchased for their non-regulated businesses, because customer financing can deliver considerable value at no cost to the supplier. This is the case because the sub market pricing of some customer financing is paid for by the citizens of the country where the equipment is made and not by the manufacturer. A customer finance requirement for the regulated businesses is of limited value because ATNS and ACSA command a very high standing in the credit markets.

5 Report 4: Institutional, Legal, Regulatory and Procurement Issues

The purpose of Task 4 was to identify South African laws, regulations, and standards that could impact the implementation of airside capacity enhancements, and to determine how ATNS's and ACSA's procurement rules and regulations are likely to affect the implementation of this study's recommendations.

5.1 Laws, regulations and standards

Task 4 provided an overview of regulations and standards that govern ATNS and ACSA operations. The overview indicated which government regulators are responsible for oversight and approval, and whether the standards are local, national, or international.

- South Africa's civil aviation system is based on Constitution of the Republic of South Africa (1996) and various acts. The primary act, being the Aviation Act, enables the DOT to appoint a Commissioner of Civil Aviation (CCA) who may issue enforce technical standards for civil aviation.

- The Civil Aviation Authority (CAA) is subject to audits by the International Civil Aviation Organisation (ICAO) under its Universal Safety Oversight Audit Programme (USOAP). The most recent published audit (from summer 2007)[6] finds that South Africa's Civil Aviation Regulatory system complies with international standards.

- South Africa's aviation regulatory system is mature and is managed as such with regular audits and interaction and consultation between all stakeholders.

- The study team identified the necessary steps that ATNS and ACSA will need to take to comply with relevant institutional, legal, regulatory and standards requirements when implementing recommended capacity enhancements.

5.2 Procurement

Although the study team reviewed ACSA and ATNS procurement processes as they are articulated in their internal policy guidelines, the focus of the analysis and commentary was on procurement of high-value, high-technology goods and services.

[6] ICAO Universal Safety Oversight Audit Programme, FINAL REPORT ON THE SAFETY OVERSIGHT AUDIT OF THE CIVIL AVIATION SYSTEM OF THE REPUBLIC OF SOUTH AFRICA *(5 to 16 July 2007)*

- This task focused on the Preferred Procurement Policy Framework (PPPF) Act and the impact that this act has on procurement regulations governing broad-based black economic empowerment (B-BBEE) enterprises and its likely impact on the procurement process. These regulations took effect at year-end 2012. During discussions with the study team, ATNS expressed concern that these new regulations may require ATNS to select a low-cost bidder that may not be capable of delivering the required high-technology systems. ACSA is concerned about the effect this regulation may have on procurement lead times. South Africa's procurement regulations are designed to achieve multiple policy objectives, including: meeting international best practices, fostering the growth of broad-based black economic empowerment, and the transfer of advanced technologies to South Africa.

- Many of the capacity enhancements being considered in this study depend on ATNS and ACSA purchasing sophisticated, state-of-the-art products and services from companies outside South Africa. The study found that both organisations employ very detailed internal procurement procedures that meet international best practices.

- The study team's reading of the implementation guideline of the 2011 PPPF Act revealed that the PPPF Act is more likely to help than impede the effectiveness of the procurement process. Procurement of state-of-the-art technology is essential for ATNS and ACSA to maintain their world class status, and the PPPF Act supports this by allowing the purchaser to set technical specifications and specifying minimal acceptable technical scores for a bid to be considered. The qualifying bids will then be weighted on the basis of price and B-BBEE level. While this may require more careful development of technical specifications than in the past, the PPPF Act should not impede the acquisition of technology supplied by non-South African companies.

- It is possible that ACSA's concern that the PPPF Act will result in longer procurement lead times is correct, but once the new procedures are fully operational any extra time should be minimal and easily accommodated within the timeframe required to implement most capacity enhancements.

- The PPPF Act may result in fewer foreign company submitting bids because of the perceived time and expense required by a new bidder to enter the South African market. ATNS and ACSA should use their on-going technical engagement with technology vendors as an opportunity to provide helpful guidelines on how to do business in South Africa.

6 Report 5: Preliminary Environmental Impact Identification

The objectives of Task 5 were to assess: 1) the nature of potential impacts related to capacity enhancement initiatives, 2) where these initiatives might produce either positive or negative impacts, and 3) where detailed environmental analysis and metrics development will likely have to be initiated to quantify the detailed positive or negative impacts of these initiatives.

Task 5 included a comprehensive list of the potential environmental effects of the recommended enhancements identified in the Task 2 Report. This assessment entailed a subjective review of the potential environmental effects of those candidate capacity enhancements affecting airspace and airport operations, but not a full-scale environmental analysis. As per the requirements of ATNS, ACSA and USTDA, the task focused on both the positive and negative implications of the capacity-enhancing capabilities from an environmental perspective.

6.1 Summary of Environmental Impacts

This section summarises conclusions and associated next steps for initiating potential environmental impact assessments as potential capacity enhancement initiatives are planned and eventually implemented, as well as approaches to areas for future detailed environmental analysis of operational and technological solutions to airport and airspace capacity enhancement initiatives.

6.1.1 Environmental Impact Assessment – Potential Scope of Activities Associated with Identified Capacity Enhancement Initiatives

When following the regimented protocol for a detailed EIA, a total of eight factors are to be considered when assessing the potential for impacts through the EIA process that is documented in an EIR. Additionally, when following the EIA process in assessing potential environmental impacts, a goal in the process is to ensure that the analysis is an adequate assessment of the potential environmental impacts and of sufficient relevance and quality for decision making[7]. Once the implementation of a capacity enhancement initiative is deemed necessary to meet operational demand in an unconstrained manner and timing is ripe to embark upon necessary environmental analysis, a sufficiently detailed EIA/EIR should be completed. The EIA/EIR should capture information relative to the following eight factors, which are necessary for making decisions regarding whether to move forward with a project.

1. Factors on public health or risk of life

2. The scale of the negative environmental impacts

[7] Source; South Africa - Guideline Document - Environmental Impact Assessment (EIA); Implementation of Sections 21, 22 and 26 of the Environment Conservation Act, April 1998; Environmental Impact Management; Department of Environmental Affairs and Tourism; Section 3.2.5.2, Review of Environmental Impact Report.

3. The geographical extent of the impacts

4. The duration and frequency of the negative environmental impacts

5. The degree to which the negative impacts are reversible of irreversible

6. Ecological context

7. International, national and provincial importance

8. The degree and likelihood of uncertainty of negative environmental impacts

While items 7 and 8 were not addressed in this high-level subjective overview of potential environmental impacts, these factors would be addressed in any detailed EIA/EIR completed prior to implementation of any part or collective parts of potential capacity enhancement initiatives.

Relative to the scope of the subjective environmental high-level assessment being conducted as part of this task, a number of items need to be addressed for the overall assessment of potential environmental impacts that were deemed of interest to ATNS, ACSA, USTDA, as well as those of multilateral lending agencies (such as World Bank and the African Development Bank). These items were based upon a number of issues in the assessment of the potential capacity enhancement initiatives identified and how these initiatives were assessed from an environmental perspective. The capacity enhancement initiatives were assessed based on criteria provided in the SA ACES statement of work (SOW).

SOW Environmental Assessment Criteria for Task 5

- Individual Preliminary Environmental Impact Assessment of the recommend enhancements for all airports
- Preliminary Environmental Impact Assessment of the recommend enhancements for full implementation for all the enhancements collectively for each airport
- Recommendations for maximising positive impacts and minimising negative impacts
- Steps ATNS/ACSA need to take, subsequent to the study, to comply with environmental requirements of SA and those of multilateral lending agencies

6.1.2 Approaches to Areas for Future Detailed Environmental Analysis of Operational and Technological Solutions to Airport and Airspace Capacity Enhancement Initiatives

As per applicable governing regulations in the South Africa Guideline Document: Environmental Impact Assessment (EIA); Implementation of Sections 21, 22 and 26 of the Environment Conservation Act, April 1998; Environmental Impact Management; Department of Environmental Affairs and Tourism, Section 3.2.5.2, Review of Environmental Impact Report (EIR), analysis of any potential capacity enhancement initiative that supports increased throughput and the associated potential increase in environmental impacts needs to be undertaken as prescribed by applicable guidelines.

The study team recommended that ATNS and ACSA, as applicable and based upon their respective areas of responsibility, engage the appropriate organisations to complete the required environmental analysis in a timely manner that allows for a decision to either move forward with implementation, or look at other alternatives to meet demand.

7 Report 6: Specifications and Recommendations

This task provided recommendations for implementation of the set of airside capacity enhancements researched in Tasks 1 through 5. The enhancements were organised by Efficiency Group, Capacity Enhancement Category, Impact Area (airspace or airside), and Candidate Capacity Enhancement Initiative. A detailed, written description was provided that recommends specific steps to be taken toward implementation of the capacity enhancement initiatives.

Where available, cost data was provided to assist ATNS and ACSA with determination of the budget required for implementation. For those enhancements for which no budget information was provided, it was determined by the study team, ATNS, and ACSA that this information was not readily available and cost information should be updated by ATNS and ACSA after review of the report.

7.1 Airspace Capacity Enhancements Recommendations/Specifications

This section summarises the recommendations and specifications for the proposed airspace enhancements.

7.1.1 Minimum Required Separation on Final Approach

Spacing aircraft at minima requires the ability to manage an increase in the controller workload resulting from closer monitoring, more precise speed control, and increased communication with pilots. In addition, pilot adherence to assigned speeds is a necessity. The reduction in separation to four NM would require the following:

- A certified single sensor airport surveillance radar (ASR) or digital automation system that allows for the flight to be identified up to 40 NM from the antenna.
- Terminal separation standards that allow for longitudinal separations less than or equal to four NM between aircraft.
- The following wake vortex turbulence separation requirements for flights operating directly behind, directly behind and less than 1000 feet below, or following an aircraft conducting an instrument approach.
    - Light behind a large (medium wake vortex category) – four NM.
    - Light behind a B757 – five NM.
    - Light behind a heavy – six NM.
    - All like types as leaders and followers – four NM.

The implementation of new departure procedures for reducing departure separation would require the following:

- A certified single sensor ASR or digital automation system that allows for the flight to be identified up to 40 NM from the antenna.
- Terminal separation requirements that allow for longitudinal separations less than or equal to four NM between aircraft.
- Radar identification with the aircraft is established within one mile of the takeoff runway.

- Between aircraft departing the same runway or parallel runways separated by less than 2,500 feet− separation will be one mile if courses diverge by 15 degrees immediately after departure; otherwise use terminal separation value if flights do not diverge. (This will require implementation of revised Standard Instrument Departures (SID)).
- Separate Instrument Flight Rules (IFR)/VFR aircraft taking off behind a heavy jet/B757 departure by a minimum of two minutes.

Lastly, continued research into the requirements for FAOR, FALE, and FACT to reduce separation minima in Visual Meteorological Conditions (VMC) conditions is necessary including research into International Civil Aviation Organisation (ICAO) and CAA regulatory requirements.

7.1.2 Pilot Reaction Times (Improved Readiness for Imminent Departure)

PRTs should be monitored on a twice per year cycle at the three airports. Whatever procedure is used to monitor the PRTs, it must be followed precisely in each instance to ensure correct and accurate monitoring. Staff carrying out the timing measurements must have good understanding that the effort is to measure the time difference between when the take-off clearance is given and the commencement of take-off roll. Graphs should be produced which will clearly show actual PRTs, improvements in PRTs over time, and/or trends. ATNS and ACSA should meet with aircraft operators after each survey and discuss the associated results. Additionally, ATNS and ACSA need to be able to demonstrate that all initiatives, no matter how small, will provide increased throughput or improved system efficiency.

7.1.3 Pre-Departure Sequencing Automation Improvements

It was recommended that a pre-departure sequencing tool be procured by ATNS/ACSA to manage the tactical sequencing. The tool should be able use the Controlled Off-block Time (COBT) issued by the Airport Flow Tool (AFT) as the initial Target Off-block Time (TOBT). Based on aircraft progress and the tactical traffic situation on the movement areas, ATC can provide a Target Start-up Approval Time (TSAT), which places each aircraft in an efficient pre-departure sequence. This results in regulated traffic flows towards the runways. Controllers remain responsible for ensuring runway throughput, the efficient use of capacity, and the maintenance of safety.

7.1.4 Airspace Review and Redesign

It is understood by the study team that a complete review and re-design of the Gauteng airspace is underway. This effort is timely and it was recommended that the review and re-design study concentrate much of its attention on the airspace design in the north western sector of the TMA because most of the constraints brought to the study team's attention were in this region. Procedures to de-conflict Lanseria International Airport (FALA) traffic from FAOR traffic need to be developed. Once this is done, amendments to the airspace can be designed to best accommodate these flows. This may require re-location or curtailment of sport aviation in the vicinity of the three airports. It is also recommended that a complete study be done to analyse the benefits of implementing an approach control service for FALA from the FAOR ATCC. The development of PBN procedures at any of the three study airports or satellite airports may require review and redesign of the airspace.

7.1.5 Low Visibility Operations Review

The study team recommends a more extensive study to compare LVO for FAOR, FALE, and FACT with those of similar airports based on fleet mix, fleet equipage, runway layout, weather, terminal area automation, and ILS. The goal of the analysis would be to establish new LVO separation standards that could increase the capacity of the airport during periods of inclement weather.

7.1.6 Conditional Clearances

Given the current traffic levels in South Africa, conditional clearances pose little short-term benefit due to the duration and volume of traffic at the study airports and due to the mandatory smoothing of demand via the AFT tool. If the reductions in separation minima, improvements in departure sequencing, and enhancements to the AFT flow control process are successful, then conditional clearances may provide additional benefits. However, those benefits may only be on the order of tens-of-minutes per day, which is a fraction of the benefit from other recommendations presented in this document.

7.1.7 Limiting Operations to certain aircraft categories during periods of day

It was recommended that ATNS and ACSA, through a consultative process with aircraft operators, identify times of the day when it would be beneficial to have aircraft in similar wake turbulence categories or of similar performance types operate. This enhancement may be implemented by excluding certain classes of operations during specific time periods. The exclusion must specify its scope. An example of scope may be to outline what General Aviation (GA) operations are restricted at what times; e.g., only RNP-equipped GA during an arrival push at FAOR.

In order for this enhancement to work, all stakeholders (ATNS, ACSA, and Airlines Association of Southern Africa (AASA), CAA, etc.) must collaborate in the definition of the objectives and the development of benefits. It was recommended that ATNS and ACSA include this discussion in their regularly held stakeholder meetings to develop and refine the concept of limited operations. These collaborative meetings should use demonstrations and simulations to assess the feasibility at each airport. This enhancement also requires further research of demand, procedures, infrastructure, and technologies that will enable implementation.

7.1.8 Slot Optimisation

This enhancement recommended allocating slots based on the direction of turn after takeoff to avoid suboptimal runway and airspace usage. It was recommended that ATNS and ACSA consider re-classifying the category of FALE to either a level I or II airport. Further consideration could be given to removing application of TMI's from FALE on a daily basis and implement them only when the Airport Arrival Rate (AAR) and Airport Departure Rate (ADR) is constrained. It also recommended that aircraft not be issued a CTOT or that the CTOT be ignored when they are departing from FALE and FACT to non-regulated airfields.

7.1.9 CTOT Compliance

This enhancement proposed that every effort be made to ensure compliance to the CTOT. It was recommended that a daily telephone conference be initiated by the Central Airspace Management Unit (CAMU) with ATCC, AMC, aircraft operators and SAWS. The CAMU

should provide a full post-event briefing on the previous day's events, along with a CTOT compliance report. Finally, monthly reports and statistics should be supplied to the aircraft operators to incentivize them to be more compliant.

7.1.10 Supervisory Staff in ATCCs

It was recommended that an ATC supervisor staff structure be created at all three of the study airports. Using other international ATCCs as a basis, it was recommended that ATNS implement a management structure as follows: At the two larger centers – FAOR and FACT, a Watch Supervisor would assume overall responsibility for operational service delivery during a shift. A supervisor for each discipline (tower approach and en route) in the ATCC would be overseen by the Watch Supervisor. At FALE, it was recommended that a supervisor be appointed for each discipline (tower and approach). Supervisory staff could also be appointed to other ATCCs depending on positions and staffing levels.

7.1.11 Airspace Flow Programmes

ATNS needs to procure an upgrade of their existing software solution in order to carry out AFPs. The CAMU software needs to be upgraded so that this configurable TMI can be implemented according to operational requirements.

7.1.12 Visual Flight Rules (VFR) traffic included in traffic demand predictions

It was recommended that ATNS meet with aircraft operators (flight schools included) and come to an agreement that all flights arriving or departing from any of the three study airports must file flight plans. It was recommended that ATNS publish a Notice to Airmen (NOTAM) stating the requirement to file flight plans and follow the NOTAM with a publication in the South African Aeronautical Information Publication (SA-AIP).

7.1.13 Improved Collaborative Decision Making (CDM) Practices

ATNS, through the CAMU, should conduct at least a daily telephone conference. It was recommended that the CAMU host and facilitate a morning telephone conference where aircraft operators, military operations (FUA), ATCC, ACSA (other relevant airport operators), and SAWS are able to call into a common phone number. The call should include a description of the daily airspace plan and a post-event analysis of the previous day's operations with feedback from all parties.

7.1.14 Performance-based Standard Instrument Departures and Arrivals

The reduction of departure separation minima can be improved by revision of departure and arrival procedures. It was recommended that a review of SIDs be accomplished taking into account noise footprints of modern aircraft, and that ATNS/ACSA implement PBN procedures at all three of the study airports.

7.2 Airport/Airside Capacity Enhancements Recommendations/Specifications

This section summarises the recommendations and specifications for the proposed airport/airside enhancements.

7.2.1 Standard Taxi Routes

The study steam recommends additional research to model a variety of taxi routes commonly used between gate areas and departure runways to assess the overall benefits.

7.2.2 Airport Specific Infrastructure Capacity Enhancements

All infrastructure enhancements recommended for the airports are additions of taxiway pavement. As such, the specifications for inclusion of these enhancements would be consistent with the ACSA standards for taxiway pavement, including layer-works, and edge lighting. The specifications and recommendations for this set of enhancements are very detailed and available in the Task 6 report.

7.2.3 Intersection Departures

It was recommended that ATNS and ACSA promote the use of intersection departures to help facilitate departure sequencing for optimal throughput. Intersection departures can allow a smaller aircraft taxiing behind a heavy to depart before the heavy, thereby minimising the wake vortex turbulence separation minima from two minutes to a smaller separation requirement that would be needed to just maintain terminal radar separation. It was noted that intersection departures are accepted at the discretion of the pilots.

7.2.4 Addition of Holding Point Lines

It was recommended that ACSA reassess the holding point lines at the three study airports and mark the holding points appropriately to optimize throughput of the runways. This enhancement requires appropriate policy changes to realise the additional capacity provided by the additional lines.

7.2.5 Independent Parallel or Segregated Parallel Runway Operations at FAOR for RWY03/21 & Efficient Runway Utilization

There are several recommendations for implementing this enhancement. FAOR should update the missed approach procedures, which require that the missed approach track for one approach diverges by at least 30 degrees from the missed approach track of the adjacent approach. Also, current spacing standards should be reduced. ATNS and ACSA, along with their stakeholders, must conduct an assessment of all current procedures, regulations, and standards affecting the implementation of independent and segregated parallel operations.

High-level specifications were also provided, where applicable, and summarized by Efficiency Group. Summary tables are available in Appendix B, Table 4 through Table 14. The team also provided a short list of suggested US service providers and manufacturers that can assist with the implementation of the recommended enhancements (Appendix B, Table 15).

Finally, a high level process for developing evaluation criteria was provided. It was recommended that all stakeholders should agree in advance on the criteria that will be used to evaluate capacity enhancements. ATNS and ACSA understand their own organizations' needs but will benefit from the guidance of well-designed and clearly articulated evaluation criteria, which are acceptable to all stakeholders.

8 Report 7: Development Impacts

Demand for air transport has increased steadily over the past years with passenger and freight traffic growing by 45% and 80%, respectively. While South Africa has one of the more sophisticated aviation sectors in Africa, the African aviation industry is still lagging behind those of the rest of the world. Over the period 2010–2015, Africa will be the third fastest growing region in the world in terms of international traffic. There will be an average growth rate of 6.1%, compared to the global average of 5.8%, and 7.9% and 6.9% for the Middle East and Asia Pacific, respectively, while Europe, Latin America and North America are projected to record lower international passenger growth of 5.0%, 5.8% and 4.9%, respectively.[8]

The reasons for this growth are robust economic activity, demographic boom, increasing urbanisation, and emergence of a middle class. Air transportation plays a vital role in the country's growth process by accelerating convergence of goods and persons. The contribution of air transport far exceeds that of road transportation sevenfold. Growth in air transportation directly influences economic growth through creation of direct and indirect jobs in the industry and other auxiliary sectors such as tourism and other service sectors. Expansion in air transportation creates market opportunities for local entrepreneurs by creating regional and global economic centres. In 2010, the aviation industry in Africa supported about 7 million jobs (including 257,000 direct jobs) through travel and tourism which translated into R617 billion of the continent's Gross Domestic Product (GDP). Forecasts indicate that the aviation industry's impact on African economies is set to grow. Over the next 20 years, implied job creation by the industry is projected at 879,000.

So as to remain the leading aviation country in Africa, ATNS and ACSA have adopted various strategies of ensuring that capacity remains ahead of demand at FAOR, FALE, and FACT. The South African Airside Enhanced Capacity Enhancement study is a key tactic of these strategies.

The experience within South Africa and throughout the world is that deploying capacity-enhancing initiative engenders positive and negative impacts in the surrounding areas. This report included a qualitative assessment of those impacts, categorising them as follows:

- Infrastructure—Addition or modification of airport infrastructure, such as taxiways, apron areas, runway exists or other airside pavement enhancements
- Human Capacity Building—Creation of jobs or enhancement of skills
- Technology Transfer and Productivity Enhancement—Sharing or introduction of new systems or processes that enhance the productivity of the aviation stakeholders

[8] African Development Bank Group. *Africa's Aviation Industry: Challenges and Opportunities*. http://www.afdb.org/en/blogs/afdb-championing-inclusive-growth-across-africa/post/africas-aviation-industry-challenges-and-opportunities-10025/

- Market-Oriented Reforms—Institutional, legal, regulatory, standard, and procurement practices

- Economic—Direct and indirect jobs, income streams, and tax revenue collections at the local and national levels

- Others—General impacts

9 Report 8: Implementation Plan

This report culminates the assessment of airside capacity enhancements for FAOR, FALE, and FACT and proposes a framework for implementing a set of recommended enhancements. The implementation framework considers the role of triggers in determining when airport and airspace capacity enhancements need to be made. A preliminary analysis estimated increased traffic at varying demand growth rates and applied the new demand to the declared capacity rates. The preliminary results (Figure 2) illustrated the trade-offs between growth and average delay per flight.

- An estimated 50-to-60% traffic increase by 2020 at current capacity rates increases flight delay to 10 to 11 minutes.
- A 5% increase in traffic in the near-term may add an additional minute of delay per flight.
- In the mid-term, flights may experience four to seven minutes of additional delay without capacity enhancements at the airports.

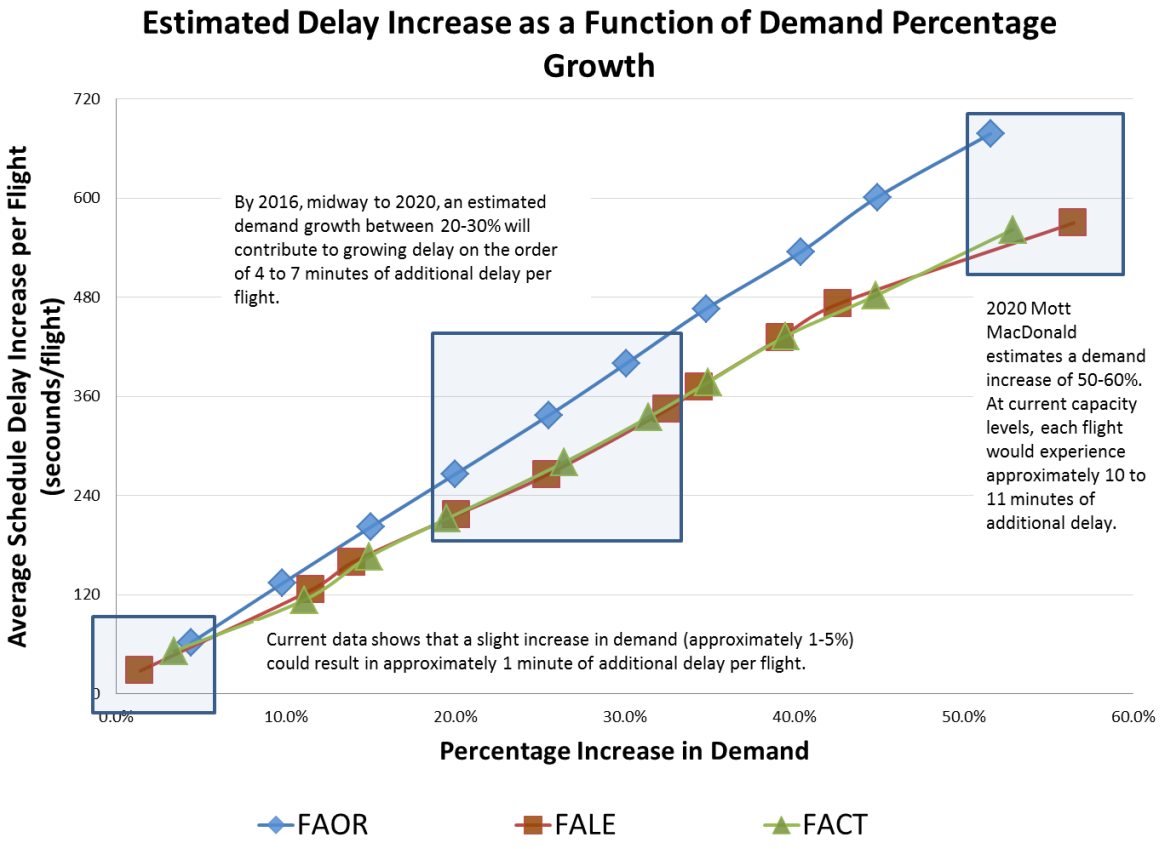

Figure 2: Demand Growth will Increase Average Delays at each of the Study Airports

This is not a comprehensive analysis, but it does show an estimation of the impacts of the demand growth to help focus some attention on the trigger years in which we can apply some capacity enhancement indicatives to reduce the impacts of traffic growth.

The implementation process for enhancements should be initiated when the activity growth curve intersects the advance time required for the particular enhancement (Typically 12-18 months in advance of need).

The enhancement groupings evolved from the groupings developed in Task 5 to the four Implementation Groups proposed in Task 8: Arrival Capacity Improvements, Departure Capacity Improvements, Overall Capacity Improvements, and Overall Efficiency Improvements. The proposed airside enhancements were grouped into these four groups, and estimated capacity increases and time to implementation were provided for each group and enhancement (Table 3).

A proposed joint roadmap (Figure 3) provides a framework to provide an indicative schedule for the implementation of the recommended near-term enhancements. The implementation takes into consideration the goals and priorities of ATNS and ACSA, their stakeholders, implementation risks and dependencies, and benefits of implementation of the recommended airside capacity enhancements. The study team understands that this is the first step in the process. This report and the initial joint roadmap should generate discussions among ATNS, ACSA, and their stakeholders, and lead to refinement of the roadmap.

The total duration for each implementation group is shown by the heavy black bars:

- Arrival Capacity Improvements – 785 days
- Departure Capacity Improvements – 817 days
- Overall Capacity Improvements – 180 days
- Overall Efficiency Improvements – 785 days

The colored bars are defined as follows:

- Blue – Primary responsibility for implementation belongs to ATNS
- Pink – Primary responsibility for implementation belongs to ACSA
- Green – Primary responsibility for implementation belongs to ATNS and ACSA

The durations are noted to the left of each colored bar.

Table 3: Proposed Implementation Groupings

Implementation Group	ID	Efficiency Group	Capacity Enhancement Category	Impact Area	Candidate Capacity Enhancement Initiative	Time to Implementation
Arrival Capacity Improvements Estimated Arrival Capacity increase FAOR: 3 - 5 FALE: 2 - 4 FACT: 2- 3	1	Runway/Taxiway Utilisation Focus for Greater Throughput	Minimum required separation on final approach	Airspace	• Apply Minimum Authorised Separation on Final • Reduce Minimum Separation	FAOR-6 months FALE-18 months FACT-18 months
			Addition of RETs	Airside	• Add RETs to RWY03L/21R (FAOR) • Add RETs to 03R/21L, refine Echo, and add additional RET (FAOR) • Add RETs (Rwy24) for direct access to Alpha & Bravo apron gates (FALE) • Realignment of Runway Exits (FACT)	2-3 years
			Near-term Implementation of Master Plan	Airside	• Near term implementation of the extension of taxiway Golf for Rwy24 (FALE)	2-3 years
	3	Efficient Runway & Arrival/ Departure Capacity Utilisation	Performance Based Navigation	Airspace	• Performance-Based Standard Instrument procedures (PBN)	3 years
	5	Balancing of Arrival/Departure Demand	Arrival/ Departure Balancing	Airside	• Arrival/Departure Balancing • Increase mix ops/arrivals on RWY03L/21R (FAOR)	1.5 years

Implementation Group	ID	Efficiency Group	Capacity Enhancement Category	Impact Area	Candidate Capacity Enhancement Initiative	Time to Implementation
Departure Capacity Improvements Estimated Departure Capacity increase FAOR: 3 - 5 FALE: 2- 3 FACT: 2 -3	1	Runway/Taxiway Utilisation Focus for Greater Throughput	Near-term Implementation of Master Plan	Airside	• Add extended taxiway pavement at the end of RWY03L (FAOR)	2-3 years
	2	Airfield Operational Efficiencies	Pilot Reaction Time (PRT)	Airspace	Readiness for Immediate Departure (Improved Pilot Reaction Times)	3 months
			Increase Holding Point areas and frequency	Airside	• Multiple Departure Line-up Queues • Multiple Intermediate Departure Holding Points • Add CAT I hold lines and allow CAT I holds pre-departure (FALE, FACT) • Parallel By-Pass Taxiway (FACT)	2-3 years for design & construction (<6 months for procedural and hold lines)
			Intersection Departures	Airspace	• Intersection Departures	3 months
	3	Efficient Runway & Arrival/ Departure Capacity Utilisation	Departure Sequencing	Airspace	Departure Sequencing (PDS)	2-3 years
			Performance-Based Navigation	Airspace	• Performance-Based Standard Instrument procedures (PBN)	3 years
	5	Balancing of Arrival/Departure Demand	Arrival/ Departure Balancing	Airside	• Arrival/Departure Balancing • Increase mix ops/arrivals on RWY03L/21R (FAOR)	1.5 years

Implementation Group	ID	Efficiency Group	Capacity Enhancement Category	Impact Area	Candidate Capacity Enhancement Initiative	Time to Implementation
Overall Capacity Improvements Will improve arrival capacity during LVO	12	Low Visibility Operations	Review of Low Visibility Operations	Airspace	• Specific studies of reducing separation standards during Low Visibility Operations	1-1.5 years
Overall Efficiency Improvements No direct capacity increase; however, efficiency gains, which will enable capacity increases.	4	Efficiency & Predictability in Taxiway Utilisation	Standard Taxi Routes	Airside	• Standard (Coded) Taxi Routes	1.5 years
	6	Updates to Airport Flow Tool for Better Airport/Airspace Management	Airspace Review and Redesign	Airspace	• Airspace Review and Redesign • Modify Airport Flow Tool (AFT) to gain better airspace management, GDPs, AFPs	3 years
	7	Efficiencies Based on Conditional Clearances	Conditional Clearances	Airspace	• Conditional Clearances	6 months
	8	Peak Demand/Non-Std. Ops. Performance Limits & Traffic Management	Limiting Operations During Periods of Day	Airspace	• Limit operations during Peak Periods by aircraft category • Limit Operations of Non-Standard Performance (Best equipped best served)	> 2 years

Implementation Group	ID	Efficiency Group	Capacity Enhancement Category	Impact Area	Candidate Capacity Enhancement Initiative	Time to Implementation
	9	Airfield & Airspace Slot Optimisation	Slot Optimisation and CTOT Compliance	Airspace	• Slot Optimisation	.5-1 year
	10	Traffic Management Coordination	Supervisory staff in ATCCC (Traffic Management Coordination)	Airspace	• Supervisory staff in ATCCC • Tower Coordinator • Traffic Management Coordination	1.5-2 years (3-6 months for TMC)
	11	Airspace/Airport Demand Prediction Awareness	VFR traffic included in traffic demand predictions	Airspace	Use historical VFR demand predictions, or restrict VFR traffic	1.5-2 years

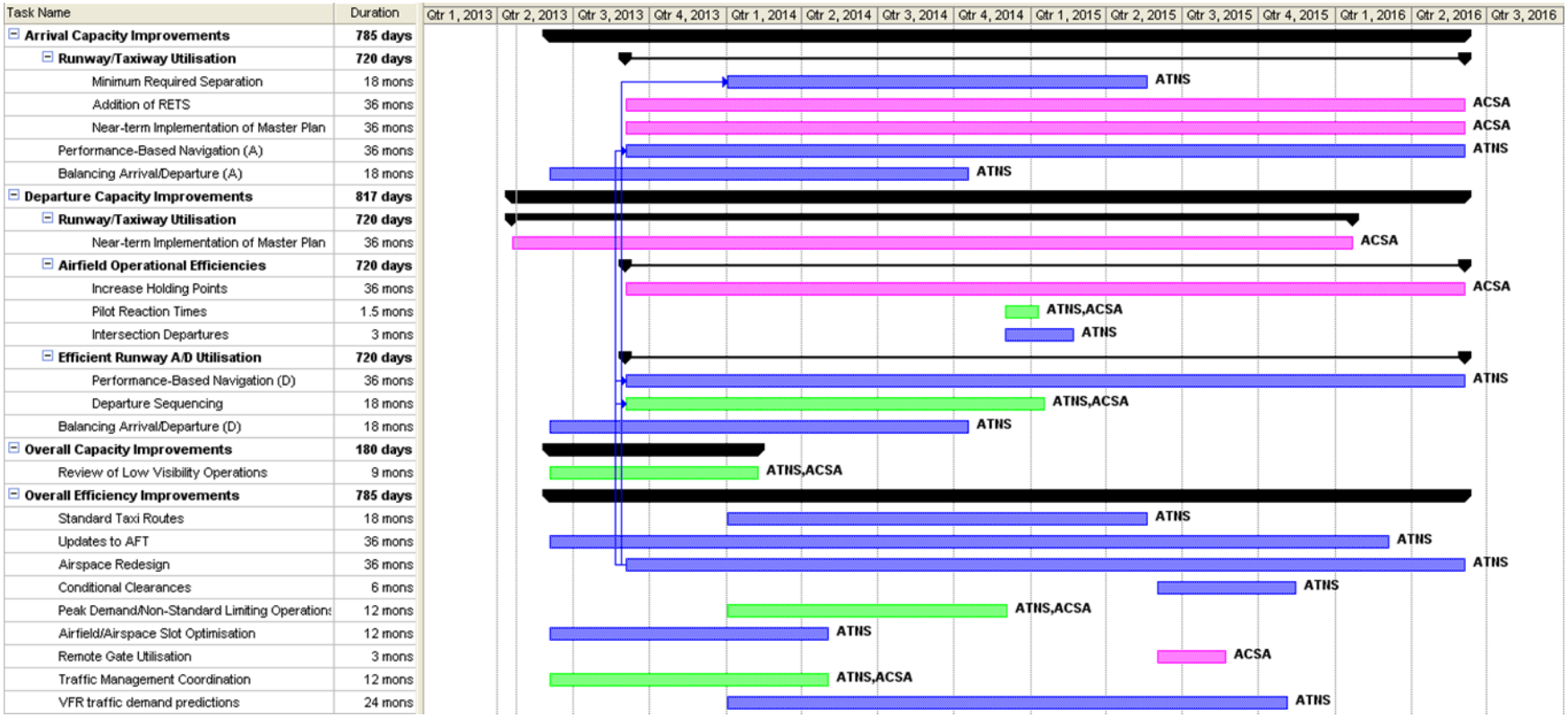

Figure 3: Proposed Joint Airside Capacity Enhancements Roadmap

10 Conclusions and Next Steps

From the outset of this study The Metron Aviation team have been given complete access to information, staff and data so as to complete this study. The proposed airside capacity enhancements and implementation roadmap are the result of successful collaboration among ATNS, ACSA, their stakeholders, and the SA-ACE study team. This collaboration to develop a joint roadmap for capacity enhancements between the ANSP and airport authority is unique. While many other entities throughout the world continue to plan in isolation, this initiative by ATNS and ACSA to develop a joint roadmap, should ensure that the capacity of the three study airports remains ahead of the demand in the near to medium terms with optimized investment. This continued collaboration will prove to be most useful in the successful implementation of the recommended capacity enhancements. As the scope of the study was to validate and recommend capacity enhancements, continued study of the enhancements is needed to further refine the specific details of implementation. ATNS and ACSA should continue to engage each other and stakeholders during this process to ensure that everyone's objectives and concerns are considered.

The study team is grateful for the opportunity to assist with this study and looks forward to the potential of a continued partnership in an effort to fulfill the implementation of the proposed enhancements.

Appendix A Initial List of Capacity Enhancement Initiatives Recommended by ATNS and ACSA

OR TAMBO						
Ref. No	**Category**	**Initiative Description**	**Implementation**	**Responsible Organisation**	**Capacity Implication**	**Comment**
1.	**Infrastructure**					
1.1.	Communication	CPDLC (Data link), reduce verbal communication between ATC and pilots; improve awareness, safety & capacity. Allow proactive planning of taxiway exits and routes prior to departure. This initiative to be coordinated with AMC to minimise bay changes to the same apron area. In addition aircraft must be equipped to make use of this facility.	Short Term	ATNS, Airlines	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning • CNS
1.2.	Surveillance	Implement ground surveillance e.g. ASMGCS. Equip all aircraft and vehicles with "transponders". Improve safety and reduce risk (runway incursions), improve situational awareness as ATC can focus on critical control functions and therefore improve capacity. NDoT to make installation of transponders compulsory. Installation of vehicle transponders at ACSA Airports in progress. This initiative to be initially implemented at ORTIA and CTIA. The tracking and management of ramp equipment and vehicles can also result in improved apron operations e.g. reduction of turn-around times.	Short Term: Vehicle Transponders	ACSA, ATNS	Indirect, contribute to improved efficiencies.	• Ops support • ATM Planning • CNS
			Long Term: Aircraft Transponders	NDoT, ATNS, ACSA & Airlines	Indirect, contribute to improved efficiencies.	• Ops support • ATM Planning • CNS
1.3.	Navigation See 2.11	Wide Area Augmentation System (WAAS). WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.	Medium to Long Term	ATNS, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • CNS
1.4.	RET'S & RAT's See 2.1, 2.2	RET's needs to match consistent performance from a range of aircraft and pilot performance. Rapid exit taxiways are crucial in minimising runway occupancy time – but only if they are correctly designed, positioned and well marked.	Short to medium term	ACSA, ATNS, Airlines	Substantial capacity gains due to reduction of ROT's in conjunction with the correct procedures.	• Ops support • ATM Planning

		The efficiency of a RET depends on how well it is matched in design and positioning to the performance of the aircraft and pilots comprising the expected (design) traffic mix. At OR Tambo an additional RET on 21L south of Echo Taxiway must be considered and the possible reconfiguration of "RET" Echo as well as a RET and RAT study to understand optimal positioning and numbers. The possibility of RET's and RAT's at CTIA in the interim must be investigated. Operating a runway system in mixed mode will demand additional infrastructure.				
1.5.	Bypass taxiway	Will be required when Midfield (ORTIA) is in operation to minimise runway crossings, especially when aircraft are towed from SAA Technical area. Simulation required showing capacity benefits of this taxiway south of 03L threshold prior to "midfield operations".	Short Term	ACSA, ATNS	Substantial capacity and safety gains as runway crossings are reduced.	• Ops support • ATM Planning
1.6.	Holding Bays	An area where aircraft can be held or bypassed, to facilitate efficient surface movement. Holding bays are useful for last minute changes to the departure sequence. At OR Tambo the reconfiguration if existing holding bays at 21R to be investigated. The extension of Charlie taxiway to the threshold of 03L must be considered and the reconfiguration of the taxiway system at holding point N on F1 to facilitate by-pass movements and intersection departures on 21R.	Short term	ACSA, ATNS	Substantial departure capacity gains as a number of operational improvements can be facilitated through this infrastructure.	• Ops support • ATM Planning
1.7.	Remote Holding Areas	When aircraft are held on the parking stand congestion can occur as well as late stand changes for subsequent inbound aircraft. Freeing of stands and use of remote holding areas removes a bottleneck that causes congestion. Remote holding areas have no function other than to allow the freeing of parking stands. It requires sufficient space to safely hold aircraft prior to departure without encroaching on runways, taxiways, etc. Investigate location for remote holding areas at OR Tambo (possibly golf apron & papa taxiway).	Short term	ACSA, ATNS	Limited capacity gains should be used as a last resort.	• Ops support • ATM Planning
1.8.	Visual Aids	• Review of runway and taxiway signs in	Short term	ACSA, ATNS,	• Indirect, contribute to	• Ops support

		line with latest developments and trends in consultation with ALPA-SA. • CAT III for OR Tambo to be investigated in consultation with ALPA and ATNS.		Airlines	improved efficiencies. • Limited capacity gains ROT"s will be reduced slightly as travel time to runway threshold will be shorter.	• ATM Planning
2.	**Procedures**					
2.1.	RET's See 1.4, 2.2	New procedures to ensure the optimal use of RET's in line with parking bay to reduce ROT's. See comments below re separations.	Short Term	ATNS	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure.	• Ops support • ATM Planning • Airline engagement
2.2.	Separations See 1.4, 2.1	Applying the minimum authorised spacing between aircraft on final will ensure that capacity is not wasted. In order to consistently achieve minimum spacing, the runway mode of operation and the prevailing traffic must be taken into account. For example, in mixed mode operations, wake vortex of departing aircraft need not be factored in when there is a gap in departures while minimum spacing based on radar surveillance, consistent with the wake turbulence category of subsequent aircraft, can be maintained at all times for arrival only runways. Reduced separations at OR Tambo (3 nm). RET numbers and positioning to support reduced separations.	Short Term	ATNS, ACSA	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	Ops implementation
2.3.	Reaction Times	Issuing the line-up and take-off clearance as early as possible prompts pilots to complete all necessary checks and move from the taxiway to the runway without stopping. If instructed to wait at a runway holding point, pilots should complete as many take off checks as possible while waiting. This saves valuable time once line-up is authorised Awareness programme to be initiated to reduce ROT's. ASMGCS system will be used to measure ROT's. .	Short Term	ACSA, ATNS, Airlines	Capacity gains due to reduction of ROT's. 5 sec / ATM = Possible 2 to 3 additional movements.	• Ops support • ATM Planning • Airline engagement
2.4.	Sequencing See 1.6	The sequence of aircraft at the runway holding points should take into consideration wake vortex categories, aircraft speed and SID's. These procedures must be supported by the slot process. Review CTOT parameters as it is may be in conflict with sequencing.	Short Term	ACSA, ATNS	Substantial capacity gains due to reduction of ROT's	CAMU

2.5.	Multiple line-ups See 1.6	This procedure ensures that an aircraft will be ready to depart as soon as the take-off clearance is given. Priority should always be given to ensure that unnecessary delays do not occur in issuing clearance to line up.	Short Term	ATNS	Capacity gains due to reduction of ROT's.	Current practise
2.6.	Fixed taxi routes	Where the taxiway infrastructure allows, a one way system should be introduced on the taxiways. This makes orientation easier and taxiing safer, ensuring a swifter flow of traffic. Dependant on allocated parking bay, ensures predictability, reduce unnecessary communications.	Short Term	ATNS	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning • Fast time simulation
2.7.	Aircraft specific SIDS See 2.4	Instructing departing aircraft to turn away from runway heading as soon as possible after take-off allows the number of subsequent departures in a given period of time to be maximised. Standard Instrument Departures (SIDs) should be designed with tracks diverging as soon as possible after departure. SIDs may be developed for aircraft meeting specified noise level requirements and/or light aircraft, facilitating their speedy departure. These may be used in conjunction with early turn departure and visual separation techniques. Consider a new turnout to east at OR Tambo, probably subject to an EIA process	Medium Term	ATNS	Airspace capacity gains and reduction of ROT's as slower aircraft are "cleared" faster.	• Ongoing • National airspace review
2.8.	Speed control See 3.2	This is essential for the optimum use of the runway and available airspace as well as to enable terminal area and aerodrome controllers to accurately assess the intervals between aircraft. Use of standard speeds aids efficiency and removes unpredictability for both pilot and controllers. Related to aircraft performance, policy to support this initiative. Poor performing aircraft to be operated outside peak period. This initiative also to be supported by new slot allocation "rules".	Short to medium term	ATNS SACAA, NDoT	Airspace capacity gains and the reduction of ROT's.	• Current practise
2.9.	Turbulence Grouping	If arrivals and departures are sequenced according to wake turbulence category, the additional separation behind heavier aircraft can be avoided, enabling higher throughput. This technique is particularly useful when used for traffic approaching a runway which is used exclusively for either take-off or landing traffic, or during peak periods of arrivals to a runway used	Short term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement

		for mixed mode (arrival and departure) operations.				
2.10.	ARR & DEP Grouping	In cases of mixed mode runway operations, giving priority to departures or arrivals, depending on demand during a given peak, the utilisation of the runway can be maximised.	Short Term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement
2.11.	PBN (RNP & RNAV) See 1.3	Subject to workings of PBN Implementation Team coordinated by ATNS. Major airspace capacity advantages. Ground capacity must match airspace capacity.	Medium Term	ATNS, ACSA, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • Airline engagement
2.12.	Airspace review	Redesign/Review of Gauteng airspace	Long Term	ATNS	Substantial airspace capacity gains	• Ongoing • National airspace review
2.13.	Other	Review LVO procedures	Short Term	ATNS	Indirect, contribute to improved efficiencies.	• ATNS Operations to undertake
2.14.	Separate Apron Control	Allocate additional resources to apron manoeuvring. Improve capacity and safety as controllers can focus on critical functions.	Short Term	ACSA, ATNS	Indirect, contribute to improved efficiencies.	• ACSA / ATNS • Airline engagement • CAMU
2.15.	Multiple Holding Points See 1.6, 2.4. 2.5	Enhance runway efficiency by allocating different holding points for use by aircraft on specific SIDs. In other words the optimum aircraft is immediately available at a departure hold to line-up. When the controllers are unable to initially achieve the best possible order the existence multiple runway holding points will enable the controller to rectify this problem using overtaking procedures at the holding point. Intermediate holding points are also used to expedite matters when there is a possibility that an aircraft may miss its CTOT. This ensures that the aircraft concerned does not go into the departure queue. Gatwick Airport has multiple holding points and dual line-ups in place.	Short term	ATNS, ACSA	Capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	• ACSA / ATNS • Airline engagement • CAMU
2.16.	Intersection Departures See 2.5	Intersection departures decrease taxi times and improve the management of the departure sequence. Obliquely angled taxiways, that limit the ability of the flight crew to see the runway threshold/final approach area, should be avoided when using this procedure.	Short term	ATNS, Airlines	Capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	• Ongoing
2.17.	Conditional Clearances	Conditional clearances expedite traffic by allowing pilots to proceed immediately after the condition has been satisfied instead of having to wait for the controller to issue the clearance.	Short term	ATNS	Indirect, contribute to improved efficiencies	• ATM / SRA • SA CAA

		For example, an aircraft can be issued with a runway line-up, entry or crossing clearance that is conditional upon one other movement only, be that a landing or a departing aircraft.				
3.	**Policy**					
3.1.	GA	Limit GA operations during peak periods. Must be supported by slot rules.	Medium Term	ACSA , ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / GA Engagement • ATNS implementation
3.2.	Aircraft Performance See 2.8	Limit A/C which cannot perform to a specific standard.	Medium Term	ACSA, ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / Airline Engagement • ATNS implementation
3.3.	Slots	Compliance with slot rules to allow for optimisation. Slot rules to also support reduction of ROT initiatives.	Medium Term	ACSA, ATNS, NDoT		• ACSA / Airline engagement • CAMU
3.4.	ATC/Pilot Discipline	Early starts not allowed, no preferential treatment, compliance with CTOT (Not issuing start-up clearance unless sure that the aircraft can make the departure slot time (CTOT). Early departures/arrivals not allowed.	Short Term	ACSA, ATNS, Airlines	Indirect, contribute to improved efficiencies.	
4.	**Resourcing**					
4.1.	ATC/Pilot/ACSA Ground Staff awareness See 2.14	See Separate Apron Control. The use of a coordinator/watch manager role enables the wider airfield picture to be seen by the tower.	Short Term	ACSA & ATNS	Indirect, contribute to improved efficiencies.	• ACSA • ATNS ATM • Ops implementation
4.2.	CAMU/AMC liaison	Improve CAMU/AMC coordination	Short Term	ACSA & ATNS	Indirect, contribute to improved efficiencies.	• CAMU / AMC

CAPE TOWN						
Ref. No	**Category**	**Initiative Description**	**Implementation**	**Responsible Organisation**	**Capacity Implication**	**Comment**
1.	**Infrastructure**					
1.1.	Communication	CPDLC (Data link), reduce verbal communication between ATC and pilots; improve awareness, safety & capacity. Allow proactive planning of taxiway exits and	Short Term	ATNS, Airlines	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning

		routes prior to departure. This initiative to be coordinated with AMC to minimise bay changes to the same apron area. In addition aircraft must be equipped to make use of this facility.				• CNS
1.2.	Surveillance	Implement ground surveillance e.g. ASMGCS. Equip all aircraft and vehicles with "transponders". Improve safety and reduce risk (runway incursions), improve situational awareness as ATC can focus on critical control functions and therefore improve capacity. NDoT to make installation of transponders compulsory. Installation of vehicle transponders at ACSA Airports in progress. This initiative to be initially implemented at ORTIA and CTIA. The tracking and management of ramp equipment and vehicles can also result in improved apron operations e.g. reduction of turn-around times.	Short Term: Vehicle Transponders	ACSA, ATNS	Indirect, contribute to improved efficiencies.	• Ops support • ATM Planning • CNS
			Long Term: Aircraft Transponders	NDoT, ATNS, ACSA & Airlines	Indirect, contribute to improved efficiencies.	• Ops support • ATM Planning • CNS
1.3.	Navigation See 2.11	Wide Area Augmentation System (WAAS). WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.	Medium to Long Term	ATNS, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • CNS
1.4.	RET'S & RAT's See 2.1, 2.2	RET's needs to match consistent performance from a range of aircraft and pilot performance. Rapid exit taxiways are crucial in minimising runway occupancy time – but only if they are correctly designed, positioned and well marked. The efficiency of a RET depends on how well it is matched in design and positioning to the performance of the aircraft and pilots comprising the expected (design) traffic mix.	Short to medium term	ACSA, ATNS, Airlines	Substantial capacity gains due to reduction of ROT's in conjunction with the correct procedures.	• Ops support • ATM Planning
1.5.	Holding Bays	An area where aircraft can be held or bypassed, to facilitate efficient surface movement. Holding bays are useful for last minute changes to the departure sequence.	Short term	ACSA, ATNS	Substantial departure capacity gains as a number of operational improvements can be facilitated through this infrastructure.	• Ops support • ATM Planning
1.6.	Remote Holding Areas	When aircraft are held on the parking stand congestion can occur as well as late stand changes for subsequent inbound aircraft. Freeing of stands and use of remote holding areas removes a bottleneck that causes congestion. Remote holding areas have no function	Short term	ACSA, ATNS	Limited capacity gains should be used as a last resort.	• Ops support • ATM Planning

		other than to allow the freeing of parking stands. It requires sufficient space to safely hold aircraft prior to departure without encroaching on runways, taxiways, etc.				
1.7.	Visual Aids	• Review of runway and taxiway signs in line with latest developments and trends in consultation with ALPA-SA.	Short term	ACSA, ATNS, Airlines	• Indirect, contribute to improved efficiencies. • Limited capacity gains ROT''s will be reduced slightly as travel time to runway threshold will be shorter.	• Ops support • ATM Planning
						• Ops support • ATM Planning
2.	**Procedures**					
2.1.	RET's See 1.4, 2.2	New procedures to ensure the optimal use of RET's in line with parking bay to reduce ROT's (Runway Occupancy Times). See comments below re separations.	Short Term	ATNS	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure.	• Ops support • ATM Planning • Airline engagement
2.2.	Separations See 1.4, 2.1	Applying the minimum authorised spacing between aircraft on final will ensure that capacity is not wasted. In order to consistently achieve minimum spacing, the runway mode of operation and the prevailing traffic must be taken into account. For example, in mixed mode operations, wake vortex of departing aircraft need not be factored in when there is a gap in departures while minimum spacing based on radar surveillance, consistent with the wake turbulence category of subsequent aircraft, can be maintained at all times for arrival only runways.	Short Term	ATNS, ACSA	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	Ops implementation

		RET numbers and positioning to support reduced separations.				
2.3.	Reaction Times	Issuing the line-up and take-off clearance as early as possible prompts pilots to complete all necessary checks and move from the taxiway to the runway without stopping. If instructed to wait at a runway holding point, pilots should complete as many take off checks as possible while waiting. This saves valuable time once line-up is authorised Awareness programme to be initiated to reduce ROT's. ASMGCS system will be used to measure ROT's. .	Short Term	ACSA, ATNS, Airlines	Capacity gains due to reduction of ROT's. 5 sec/ATM = Possible 2 to 3 additional movements.	• Ops support • ATM Planning • Airline engagement
2.4.	Sequencing See 1.6	The sequence of aircraft at the runway holding points should take into consideration wake vortex categories, aircraft speed and SID's. These procedures must be supported by the slot process. Review CTOT parameters as it is may be in conflict with sequencing.	Short Term	ACSA, ATNS	Substantial capacity gains due to reduction of ROT's	CAMU
2.5.	Multiple line-ups See 1.6	This procedure ensures that an aircraft will be fully lined-up and ready to depart as soon as the take-off clearance is given. Priority should always be given to ensure that unnecessary delays do not occur in issuing clearance to line up.	Short Term	ATNS	Capacity gains due to reduction of ROT's.	Current practise
2.6.	Fixed taxi routes	Where the taxiway infrastructure allows, a one way system should be introduced on the taxiways. This makes orientation easier and taxiing safer, ensuring a swifter flow of traffic. Dependant on allocated parking bay, ensures predictability, reduce unnecessary communications.	Short Term	ATNS	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning • Fast time simulation
2.7.	Aircraft specific SIDS See 2.4	Instructing departing aircraft to turn away from runway heading as soon as possible after take-off allows the number of subsequent departures in a given period of time to be maximised. Standard Instrument Departures (SIDs) should be designed with tracks diverging as soon as possible after departure. SIDs may be developed for aircraft meeting specified noise level requirements and/or light aircraft, facilitating their speedy departure. These may be used in conjunction with early turn departure and visual	Medium Term	ATNS	Airspace capacity gains and reduction of ROT's as slower aircraft are "cleared" faster.	• Ongoing • National airspace review

		separation techniques.				
2.8.	Speed control See 3.2	This is essential for the optimum use of the runway and available airspace as well as to enable terminal area and aerodrome controllers to accurately assess the intervals between aircraft. Use of standard speeds aids efficiency and removes unpredictability for both pilot and controllers. Related to aircraft performance, policy to support this initiative. Poor performing aircraft to be operated outside peak period. This initiative also to be supported by new slot allocation "rules".	Short to medium term	ATNS SACAA, NDoT	Airspace capacity gains and the reduction of ROT's.	• Current practise
2.9.	Turbulence Grouping	If arrivals and departures are sequenced according to wake turbulence category, the additional separation behind heavier aircraft can be avoided, enabling higher throughput. This technique is particularly useful when used for traffic approaching a runway which is used exclusively for either take-off or landing traffic, or during peak periods of arrivals to a runway used for mixed mode (arrival and departure) operations.	Short term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement
2.10.	ARR & DEP Grouping	In cases of mixed mode runway operations, giving priority to departures or arrivals, depending on demand during a given peak, the utilisation of the runway can be maximised.	Short Term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement
2.11.	PBN (RNP & RNAV) See 1.3	Subject to workings of PBN Working Group coordinated by ATNS. Major airspace capacity advantages. Ground capacity must match airspace capacity.	Medium Term	ATNS, ACSA, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • Airline engagement
2.12.	Airspace review	Redesign/Review of FACT airspace	Long Term	ATNS	Substantial airspace capacity gains	• Ongoing • National airspace review
2.13.	Other	Review LVO procedures	Short Term	ATNS	Indirect, contribute to improved efficiencies.	• ATNS Operations to undertake
2.14.	Separate Apron Control	Allocate additional resources to apron manoeuvring. Improve capacity and safety as controllers can focus on critical functions.	Short Term	ACSA, ATNS	Indirect, contribute to improved efficiencies.	• ACSA / ATNS • Airline engagement • CAMU
2.15.	Multiple Holding	Enhance runway efficiency by allocating different	Short term	ATNS, ACSA	Capacity gains	• ACSA / ATNS

	Points See 1.6, 2.4. 2.5	holding points for use by aircraft on specific SIDs. In other words the optimum aircraft is immediately available at a departure hold to line-up. When the controller are unable to initially achieve the best possible order the existence multiple runway holding points will enable the controller to rectify this problem using overtaking procedures at the holding point. Intermediate holding points are also used to expedite matters when there is a possibility that an aircraft may miss its CTOT. This ensures that the aircraft concerned does not go into the departure queue. Gatwick Airport has multiple holding points and dual line-ups in place.			due to reduction of ROT's in conjunction with adequate infrastructure	• Airline engagement • CAMU
2.16.	Intersection Departures See 2.5	Intersection departures decrease taxi times and improve the management of the departure sequence. Obliquely angled taxiways, that limit the ability of the flight crew to see the runway threshold/final approach area, should be avoided when using this procedure.	Short term	ATNS, Airlines	Capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	• Ongoing
2.17.	Conditional Clearances	Conditional clearances expedite traffic by allowing pilots to proceed immediately after the condition has been satisfied instead of having to wait for the controller to issue the clearance. For example, an aircraft can be issued with a runway line-up, entry or crossing clearance that is conditional upon one other movement only, be that a landing or a departing aircraft.	Short term	ATNS	Indirect, contribute to improved efficiencies	• ATM / SRA • SA CAA
3.	**Policy**					
3.1.	GA	Limit GA operations during peak periods. Must be supported by slot rules.	Medium Term	ACSA , ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / GA Engagement • ATNS implementation
3.2.	Aircraft Performance See 2.8	Limit A/C which cannot perform to a specific standard.	Medium Term	ACSA, ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / Airline Engagement • ATNS implementation
3.3.	Slots	Compliance with slot rules to allow for optimisation. Slot rules to also support reduction of ROT initiatives.	Medium Term	ACSA, ATNS, NDoT		• ACSA / Airline engagement • CAMU

3.4.	ATC/Pilot Discipline	Early starts not allowed, no preferential treatment, compliance with CTOT (Not issuing start-up clearance unless sure that the aircraft can make the departure slot time (CTOT). Early departures/arrivals not allowed.	Short Term	ACSA, ATNS, Airlines	Indirect, contribute to improved efficiencies.	
4.	**Resourcing**					
4.1.	ATC/Pilot/ACSA Ground Staff awareness See 2.14	See Separate Apron Control. The use of a coordinator/watch manager role enables the wider airfield picture to be seen by the tower.	Short Term	ACSA & ATNS	Indirect, contribute to improved efficiencies.	• ACSA • ATNS ATM • Ops implementation
4.2.	CAMU/AMC liaison	Improve CAMU/AMC coordination	Short Term	ACSA & ATNS	Indirect, contribute to improved efficiencies.	• CAMU / AMC

KING SHAKA						
Ref. No	**Category**	**Initiative Description**	**Implementation**	**Responsible Organisation**	**Capacity Implication**	**Comment**
1.	**Infrastructure**					
1.1.	Communication	CPDLC (Data link), reduce verbal communication between ATC and pilots; improve awareness, safety & capacity. Allow proactive planning of taxiway exits and routes prior to departure. This initiative to be coordinated with AMC to minimise bay changes to the same apron area. In addition aircraft must be equipped to make use of this facility.	Short Term	ATNS, Airlines	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning • CNS
1.2.	Surveillance	Comment				
1.3.	Navigation See 2.11	Wide Area Augmentation System (WAAS). WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area.	Medium to Long Term	ATNS, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • CNS
1.4.	RET'S & RAT's	RET's needs to match consistent performance from	Short to medium	ACSA, ATNS,	Substantial	• Ops support

	See 2.1, 2.2	a range of aircraft and pilot performance. Rapid exit taxiways are crucial in minimising runway occupancy time – but only if they are correctly designed, positioned and well marked. The efficiency of a RET depends on how well it is matched in design and positioning to the performance of the aircraft and pilots comprising the expected (design) traffic mix.	term	Airlines	capacity gains due to reduction of ROT's in conjunction with the correct procedures.	• ATM Planning
1.5.	Holding Bays	An area where aircraft can be held or bypassed, to facilitate efficient surface movement. Holding bays are useful for last minute changes to the departure sequence.	Short term	ACSA, ATNS	Substantial departure capacity gains as a number of operational improvements can be facilitated through this infrastructure.	• Ops support • ATM Planning
1.6.	Remote Holding Areas	When aircraft are held on the parking stand congestion can occur as well as late stand changes for subsequent inbound aircraft. Freeing of stands and use of remote holding areas removes a bottleneck that causes congestion. Remote holding areas have no function other than to allow the freeing of parking stands. It requires sufficient space to safely hold aircraft prior to departure without encroaching on runways, taxiways, etc.	Short term	ACSA, ATNS	Limited capacity gains should be used as a last resort.	• Ops support • ATM Planning
1.7.	Visual Aids	• Review of runway and taxiway signs in line with latest developments and trends in consultation with ALPA-SA. • CAT 1 holding lines to be implemented at KSIA	Short term	ACSA, ATNS, Airlines	• Indirect, contribute to improved efficiencies. • Limited capacity gains ROT''s will be reduced slightly as travel time to runway threshold	• Ops support • ATM Planning

					will be shorter.	
2.	**Procedures**					
2.1.	RET's See 1.4, 2.2	New procedures to ensure the optimal use of RET's in line with parking bay to reduce ROT's. See comments below re separations.	Short Term	ATNS	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure.	• Ops support • ATM Planning • Airline engagement
2.2.	Separations See 1.4, 2.1	Applying the minimum authorised spacing between aircraft on final will ensure that capacity is not wasted. In order to consistently achieve minimum spacing, the runway mode of operation and the prevailing traffic must be taken into account. For example, in mixed mode operations, wake vortex of departing aircraft need not be factored in when there is a gap in departures while minimum spacing based on radar surveillance, consistent with the wake turbulence category of subsequent aircraft, can be maintained at all times for arrival only runways. RET numbers and positioning to support reduced separations.	Short Term	ATNS, ACSA	Substantial capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	Ops implementation
2.3.	Reaction Times	Issuing the line-up and take-off clearance as early as possible prompts pilots to complete all necessary checks and move from the taxiway to the runway without stopping. If instructed to wait at a runway holding point, pilots should complete as many take off checks as possible while waiting. This saves valuable time once line-up is authorised Awareness programme to be initiated to reduce ROT's.	Short Term	ACSA, ATNS, Airlines	Capacity gains due to reduction of ROT's. 5 sec/ATM = Possible 2 to 3 additional movements.	• Ops support • ATM Planning • Airline engagement
2.4.	Sequencing See 1.6	The sequence of aircraft at the runway holding points should take into consideration wake vortex categories, aircraft speed and SID's. These procedures must be supported by the slot process. Review CTOT parameters as it is may be in conflict	Short Term	ACSA, ATNS	Substantial capacity gains due to reduction of ROT's	CAMU

		with sequencing.				
2.5.	Multiple line-ups See 1.6	This procedure ensures that an aircraft will be fully lined-up and ready to depart as soon as the take-off clearance is given. Priority should always be given to ensure that unnecessary delays do not occur in issuing clearance to line up.	Short Term	ATNS	Capacity gains due to reduction of ROT's.	Current practise
2.6.	Fixed taxi routes	Where the taxiway infrastructure allows, a one way system should be introduced on the taxiways. This makes orientation easier and taxiing safer, ensuring a swifter flow of traffic. Dependant on allocated parking bay, ensures predictability, reduce unnecessary communications.	Short Term	ATNS	Indirect, contribute to improved efficiencies	• Ops support • ATM Planning • Fast time simulation
2.7.	Aircraft specific SIDS See 2.4	Instructing departing aircraft to turn away from runway heading as soon as possible after take-off allows the number of subsequent departures in a given period of time to be maximised. Standard Instrument Departures (SIDs) should be designed with tracks diverging as soon as possible after departure. SIDs may be developed for aircraft meeting specified noise level requirements and/or light aircraft, facilitating their speedy departure. These may be used in conjunction with early turn departure and visual separation techniques.	Medium Term	ATNS	Airspace capacity gains and reduction of ROT's as slower aircraft are "cleared" faster.	• Ongoing • National airspace review
2.8.	Speed control See 3.2	This is essential for the optimum use of the runway and available airspace as well as to enable terminal area and aerodrome controllers to accurately assess the intervals between aircraft. Use of standard speeds aids efficiency and removes unpredictability for both pilot and controllers. Related to aircraft performance, policy to support this initiative. Poor performing aircraft to be operated outside peak period. This initiative also to be supported by new slot allocation "rules".	Short to medium term	ATNS SACAA, NDoT	Airspace capacity gains and the reduction of ROT's.	• Current practise
2.9.	Turbulence Grouping	If arrivals and departures are sequenced according to wake turbulence category, the additional separation behind heavier aircraft can be avoided, enabling higher throughput. This technique is particularly useful when used for traffic approaching a runway which is used exclusively for either take-off or landing traffic, or	Short term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement

		during peak periods of arrivals to a runway used for mixed mode (arrival and departure) operations.				
2.10.	ARR & DEP Grouping	In cases of mixed mode runway operations, giving priority to departures or arrivals, depending on demand during a given peak, the utilisation of the runway can be maximised.	Short Term	ATNS, Airlines	Airspace capacity gains and the reduction of ROT's	• CAMU • Airline engagement
2.11.	PBN (RNP & RNAV) See 1.3	Subject to workings of PBN Working Group coordinated by ATNS. Major airspace capacity advantages. Ground capacity must match airspace capacity.	Medium Term	ATNS, ACSA, Airlines, SACAA, NDoT	Substantial airspace capacity gains.	• Ops support • ATM Planning • Airline engagement
2.12.	Airspace review	Redesign/Review of FALE airspace	Long Term	ATNS	Substantial airspace capacity gains	• Ongoing • National airspace review
2.13.	Other	Implement/Review LVO procedures	Short Term	ATNS	Indirect, contribute to improved efficiencies.	• ATNS Operations to undertake
2.14.	Separate Apron Control	Allocate additional resources to apron manoeuvring. Improve capacity and safety as controllers can focus on critical functions.	Short Term	ACSA, ATNS	Indirect, contribute to improved efficiencies.	• ACSA / ATNS • Airline engagement • CAMU
2.15.	Multiple Holding Points See 1.6, 2.4. 2.5	Enhance runway efficiency by allocating different holding points for use by aircraft on specific SIDs. In other words the optimum aircraft is immediately available at a departure hold to line-up. When the controllers are unable to initially achieve the best possible order the existence multiple runway holding points will enable the controller to rectify this problem using overtaking procedures at the holding point. Intermediate holding points are also used to expedite matters when there is a possibility that an aircraft may miss its CTOT. This ensures that the aircraft concerned does not go into the departure queue. Gatwick Airport has multiple holding points and dual line-ups in place.	Short term	ATNS, ACSA	Capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	• ACSA / ATNS • Airline engagement • CAMU

2.16.	Intersection Departures See 2.5	Intersection departures decrease taxi times and improve the management of the departure sequence. Obliquely angled taxiways, that limit the ability of the flight crew to see the runway threshold/final approach area, should be avoided when using this procedure.	Short term	ATNS, Airlines	Capacity gains due to reduction of ROT's in conjunction with adequate infrastructure	• Ongoing
2.17.	Conditional Clearances	Conditional clearances expedite traffic by allowing pilots to proceed immediately after the condition has been satisfied instead of having to wait for the controller to issue the clearance. For example, an aircraft can be issued with a runway line-up, entry or crossing clearance that is conditional upon one other movement only, be that a landing or a departing aircraft.	Short term	ATNS	Indirect, contribute to improved efficiencies	• ATM / SRA • SA CAA
3.	**Policy**					
3.1.	GA	Limit GA operations during peak periods. Must be supported by slot rules.	Medium Term	ACSA , ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / GA Engagement • ATNS implementation
3.2.	Aircraft Performance See 2.8	Limit A/C which cannot perform to a specific standard.	Medium Term	ACSA, ATNS, NDoT	Airspace capacity improvements & reduction of ROT's	• ACSA / Airline Engagement • ATNS implementation
3.3.	Slots	Compliance with slot rules to allow for optimisation. Slot rules to also support reduction of ROT initiatives.	Medium Term	ACSA, ATNS, NDoT		• ACSA / Airline engagement • CAMU
3.4.	ATC/Pilot Discipline	Early starts not allowed, no preferential treatment, compliance with CTOT (Not issuing start-up clearance unless sure that the aircraft can make the departure slot time (CTOT). Early departures/arrivals not allowed.	Short Term	ACSA, ATNS, Airlines	Indirect, contribute to improved efficiencies.	
4.	**Resourcing**					
4.1.	ATC/Pilot/ACSA Ground Staff awareness	See Separate Apron Control. The use of a coordinator/watch manager role enables the wider airfield picture to be seen by the	Short Term	ACSA & ATNS	Indirect, contribute to improved	• ACSA • ATNS ATM • Ops

	See 2.14	tower.			efficiencies.	implementation
4.2.	CAMU/AMC liaison	Improve CAMU/AMC coordination	Short Term	ACSA & ATNS	Indirect, contribute to improved efficiencies.	• CAMU / AMC

Appendix B Summary of Specifications and Recommendations for Capacity Enhancing Initiatives

Table 4: Summary of Runway/Taxiway Utilisation Focus for Greater Throughput

Specification	Separation	Low Visibility Operations	Additional RETs	Near-term Master Plan
Budget	Costs estimates may include: • South African CAA approval process for reduce separation requirements • Training • Certification for terminal radar systems • Cost of STAR/SID development/simulation	The resources allocated to the task will determine the budget.	R45.6, R48.3, R40.2, R59.1, R59.1, R7.4, R8.6	FAOR RWY 21 L RET- R48.3 Million FAOR TWY extensions at RWY 03L - R185.7 Million FALE RETS for RWY 24 - R64.4 Million x 2 FALE Extension of TWY Golf - R9.7 Million FALE Extension of TWY Bravo - R48.3 Million
Quality	N/A	N/A	Per ACSA Standards	Per ACSA Standards
Reliability	N/A	N/A	Per ACSA Standards	Per ACSA Standards
Durability	N/A	N/A	Per ACSA Standards	Per ACSA Standards
Warranties	N/A	N/A	Per ACSA Standards	Per ACSA Standards
Standards	N/A	N/A	ACSA, ICAO Code E & Code F Taxiway standards	ACSA, ICAO Code E & Code F Taxiway standards
Regulations	• ICAO Annex 11 • ICAO PANS-ATM • ICAO Doc 9689 • ICAO Doc 9859	• CAO Doc 9476 Manual of Surface Movement and Guidance Control Systems, Chapter 5	ACSA, ICAO,	ACSA, ICAO,

		• ICAO Doc 9830* Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual. • IR-OPS Subpart E Low Visibility Operations (LVO) • Acceptable Means of Compliance (AMC) and Guidance Material (GM) to IR-OPS Part-SPA • EU-OPS 1 Subpart E (All Weather Operations). • UK CAP 168: Licensing of Aerodromes, Appendix 2B • European Action Plan for the Prevention of Runway Incursions, All Appendices • ICAO Doc 9870 App B - Best Practices on the Flight Deck • European Action Plan for the Prevention of Runway Incursions App D - Flight Crew Best Practices • ICAO Doc 7013* "European Guidance Material On Aerodrome Operations Under Limited Visibility Conditions		

Guidance	• Safety Assessment: Annex 11 and PANS-ATM direct States to undertake safety assessments for significant changes in airspace organisation, ATS procedures or the introduction of new equipment, systems or facilities. • Information on performing safety assessments is contained in the Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689) and in the Safety Management Manual (Doc 9859). • CARS and Cats: These regulations would probably not require amendment • AIP, SSI's: Amendments required • User consultation: Required	• AIP, SSI's: Amendments required • User consultation: Required	ATNS, ACSA, ICAO	ATNS, ACSA, ICAO

Table 5: Summary of Airfield Operational Efficiencies

Specification	Pilot Reaction Times (PRT)	Addition of Holding Point Lines	Intersection Departures
Budget	Minimal costs to conduct periodic reviews of PRTs, maintain data, and conduct supporting analyses.	Cost of paint and services	To be determined by ATNS after consultation with airlines
Quality	N/A	To be determined by ACSA	N/A
Reliability	N/A	To be determined by ACSA	N/A
Durability	N/A	To be determined by ACSA	N/A
Warranties	N/A	To be determined by ACSA	N/A
Standards	A standard PRT will need to be set for each airport (the study team recommends 6 seconds as an initial bench mark). However, the PRT standard will not be fixed, but evaluated every 6 months or so.	To be determined by ACSA	CAASA, ICAO, Environmental (Noise Impact) assessment would be required
Regulations	No regulations needed.	N/A	No amendments to regulations anticipated
Guidance	ATNS, ACSA	ATNS, ACSA, AASA, ALPA consultation on required policy changes	• AIP, SSI's- Amendments required • User consultation- Required

Table 6: Summary of Efficient Runway & Arrival/Departure Capacity Utilisation

Specification	Departure Sequencing	Performance-Based SID/Navigation
Budget	R4.5million	R4million per runway
Quality	N/A	N/A
Reliability	N/A	N/A
Durability	N/A	N/A
Warranties	N/A	N/A
Standards	N/A	N/A
Regulations	ICAO and CAA regulations need to be adhered to	ICAO and SACAA regulations need to be adhered to.
Guidance	ATNS, ACSA, SADOT, and SACAA guidance will be required for implementation.	ATNS, ACSA, SADOT, and SACAA guidance will be required for implementation.

Table 7: Summary of Efficiency & Predictability in Taxiway Utilisation

Specification	Standard Taxi Routes
Budget	To be determined by ATNS, will include simulation costs.
Quality	N/A
Reliability	N/A
Durability	N/A
Warranties	N/A
Standards	CAASA, ICAO
Regulations	ATNS, ICAO,
Guidance	ATNS, ACSA, ICAO

Table 8: Summary of Balancing of Arrival/Departure Demand

Specification	Independent and Segregated Parallel Runway Operations
Budget	To be determined by ATNS
Quality	N/A
Reliability	N/A
Durability	N/A
Warranties	N/A
Standards	• ICAO Annex 14 Aerodromes • ICAO Doc 4444 PANS-ATM • ICAO Doc 8168 PANS-OPS • ICAO Doc 9643 Manual on Simultaneous Operations on Parallel or near parallel Instrument Runways (SOIR) • ICAO Doc 9870 App B - Best Practices on the Flight Deck • ICAO Doc 9870 App C - Air Traffic Control Best Practices
Regulations	• CARS and CATS: change probably not required. • AIP, SSIs: require amendments • ICAO: Compliance with the documents listed as references
Guidance	ATNS, ACSA, ICAO

Table 9: Summary of Updates to Airport Flow Tool for Better Airport/Airspace Management

Specification	Airspace Review and Design	Airspace Flow Programs
Budget	Average of ~$300,000 USD per terminal area. Highly dependent on level of modeling and simulation and required coordination	To be determined by ATNS, but should include: • Software requirements analysis • Software development and testing
Quality	N/A	N/A
Reliability	N/A	N/A
Durability	N/A	N/A
Warranties	N/A	Determined by software provider
Standards	ATNS airspace redesign standards	Recognized software standards
Regulations	Environmental Impact Assessment (EIA) Regulations, Implementation of Sections, 21 22 & 26 of the Environment Conservation Act, April 1998	N/A
Guidance	ATNS, ACSA	ATNS, ACSA

Table 10: Summary of Efficiencies Based on Conditional Clearances

Specification	Conditional Clearances
Budget	To be determined by ATNS, but should include: • training of controllers and pilots on new procedures.
Quality	N/A
Reliability	N/A
Durability	N/A
Warranties	N/A
Standards	N/A
Regulations	ICAO and CAA regulations need to be adhered to
Guidance	ATNS, ACSA, SADOT, and SACAA guidance will be required for implementation.

Table 11: Summary of Peak Demand/Non-Std. Ops. Performance Limits & Traffic Management

Specification	Limiting Operations	Supervisory Staff	Improved CDM Practices
Budget	To be determined by ATNS but should include: • Development of new procedures • Technology acquisition or enhancement • Required infrastructure	To be determined by ATNS, but should include: • Additional staffing numbers will need to be amended and additional budgeting for extra staffing undertaken.	To be determined by participants, but should include: • Cost of teleconference equipment
Quality	N/A	N/A	N/A
Reliability	N/A	N/A	N/A
Durability	N/A	N/A	N/A
Warranties	N/A	N/A	N/A
Standards	N/A	• US FAA Order 7210.3X[9] • US FAA Staffing Outlook[10]	N/A
Regulations	CARS and CATS: Approval would be required from the Commissioner of Civil Aviation, with amendments to be determined.	Investigation of Licensing requirements for supervisory staff.	N/A
Guidance	• AIP, SSI's: Definite amendments required • User consultation required	ATNS	ATNS, ACSA, AASA, ALPA, other stakeholders

[9] http://www.faa.gov/documentLibrary/media/Order/FAC.pdf
[10] US FAA, *A Plan for the Future, 10-Year Strategy for the Air Traffic Control Workforce, 2012-2021*. 2012.

Table 12: Summary of Airfield & Airspace Slot Optimisation

Specification	Slot Optimisation	CTOT
Budget	Possible amendments to functionalities of Score and AFT.	To be determined by participants, but should include: • Teleconferencing equipment
Quality	N/A	N/A
Reliability	N/A	N/A
Durability	N/A	N/A
Warranties	N/A	N/A
Standards	CTOT compliance standards will need to be high for concept to be successful.	CTOT compliance standards are to be set both for ATC and aircraft operators.
Regulations	Regulations would need to be formulated.	Amendment to the CTOT compliance regulations
Guidance	ATNS, ACSA, SADOT, and SACAA guidance will be required for implementation.	None required

Table 13: Summary of Traffic Management Coordination

Specification	Supervisory Staff in ATCCC
Budget	To be determined by ATNS, but should include: • Additional staffing numbers will need to be amended and additional budgeting for extra staffing undertaken.
Quality	N/A
Reliability	N/A
Durability	N/A
Warranties	N/A
Standards	• US FAA Order 7210.3X[11] • US FAA Staffing Outlook[12]
Regulations	Investigation of Licensing requirements for supervisory staff.
Guidance	ATNS

[11] http://www.faa.gov/documentLibrary/media/Order/FAC.pdf
[12] US FAA, *A Plan for the Future, 10-Year Strategy for the Air Traffic Control Workforce, 2012-2021*. 2012.

Table 14: Summary of Airspace/Airport Demand Prediction Awareness

Specification	VFR Traffic Included in Traffic Demand Predictions
Budget	To be determined by ATNS but expected to be minimal.
Quality	N/A
Reliability	N/A
Durability	N/A
Warranties	N/A
Standards	N/A
Regulations	Published requirement for all traffic departing and arriving at study airfields to file flight plans.
Guidance	ATNS, ACSA

Table 15: Sample of Suggested US Suppliers

Company	POC	Address	Phone	Fax	Email	Goods/Services
Metron Aviation	James Gaughan	45300 Catalina Court, Suite 101 Dulles, VA 20166	+1-703-456-0123	+1-703-456-0133	info@metronaviation.com	ATM products and services, airspace design, procedures development
Landrum & Brown Worldwide Services, Inc.	Doug Goldberg	11279 Cornell Park Drive Cincinnati, OH 45242	+1-513-530-1219		dgoldberg@landrum-brown.com	Aviation and airport planning

ACA Associates, Inc.	Don Schenk	545 Fifth Avenue, Suite 640 New York, NY 10017	+1-212-808-4420		dpschenk@aca-assoc.com	Consulting and financial advisory
The Burns Group	John E. Burns	6700 Old McLean Village Drive, Suite 201 McLean, VA 22101	+1- 703-760-9076	+1-215-405-2510	jburns@burns-group.com	Airport design and construction
Ennis-Flint		115 Todd Court Thomasville, NC 27360	+1-336-475-6600	+1-336-475-7900	sales@flinttrading.com	Airfield Marking/Striping
Honeywell	Chris Benich	101 Constitution Ave NW Washington, DC 20001	+1-202-662-2662		chris.benich@honeywell.com	Airport solutions
Iridium Communications		**Headquarters**: 1750 Tysons Boulevard, Suite 1400 McLean, VA 22102 USA	+1-703-287-7400	+1-703-287-7450		
Iridium Communications		**Europe/Middle East/Africa**: Thremhall Park Bishop's Stortford Herts, CM22 7WE UK	+44 1279 874455	+44 1279 874456		