

# The Remote Airport Traffic Services Concept: Opportunities and Requirements

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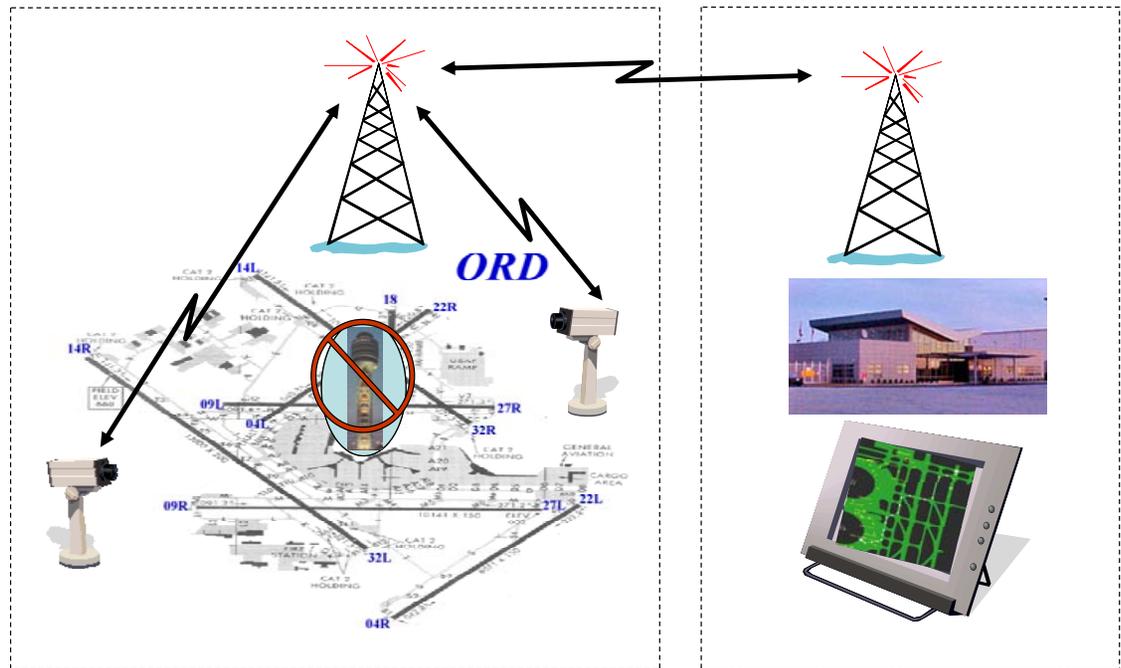
# Presentation Outline

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- Remote Airport Traffic Services Concept Description
- Potential Concept Benefits
- Activity Decomposition of Airport Traffic Services
- Airport Traffic Services Information Requirements
- Future Research Directions
- Conclusion

# Concept Description

- Remote Airport Traffic Services
  - Air Traffic Specialists in a Remote Location Provide All Services of the Current ‘ATC Tower’
    - Replace the ‘Out-the-Window View’ with Surveillance Systems
    - Consolidate Multiple Towers into a Single Remote Service Center
  - Enhanced Networked Information Management
    - To Provide Communication and Coordination of Airport Surface Activities and Constraints
  - Next-Generation Decision Support Tools and Automation
    - To Ensure Safety and Facilitate Efficient Operations



# 'Remote Airport Traffic Services' v. 'Virtual Tower'

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- It's All Semantics
  - But, Semantics can be Important
- 'Tower' Is Misleading
  - Primary Concept Benefit is the Ability to Provide Services Without a Tower
- 'Virtual' May Be Misleading
  - 'Virtual' Connotes 'Not Real' or 'Simulated'
    - The Services to be Provided Must Be Completely Real and Completely Reliable
  - 'Virtual' Should Not Necessarily Imply 'Virtual Reality' Displays
    - Computer Rendering of the Airport Traffic Situation May Not Be the Best Solution



# Surveillance Concepts and Issues

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- Replace the 'Out-the-Window View' with Surveillance Systems
- Electronic Surveillance Can Provide Positions of Aircraft, Vehicles and other Objects
  - Cooperative:
    - ADS-B, Multi-Lateration
  - Non-Cooperative:
    - Primary Radar
- Do These Solutions Satisfy All Requirements?
  - What about Monitoring Bird Activity? Wildlife on Airfield? Debris on Runway? Airport Maintenance and Construction Activities? Security Issues?

NTSB, Accident Report AAB01/01 for American Airlines 1340 on February 9, 1998

- *"The two main landing gear and parts of the airplane's lower aft section and left and right wings were strewn across the runway and along the debris path. Although ground visibility was poor, the south local tower air traffic controller did not instruct the flight crew to contact the ground controller after landing nor did he monitor the progress of the airplane after it was cleared to land, as required by FAA Order 7110.65M, "Air Traffic Control Handbook." For the first 5 minutes after the accident, the south local controller and his supervisor were unaware that the airplane had crashed. As a result, the south local controller cleared two air carrier flights to land on the debris-strewn runway after the accident. One of the airplanes landed uneventfully, and the other performed a touch-and-go, as directed by the south local controller after the driver of an airport ground vehicle observed debris on the runway and contacted the tower."*

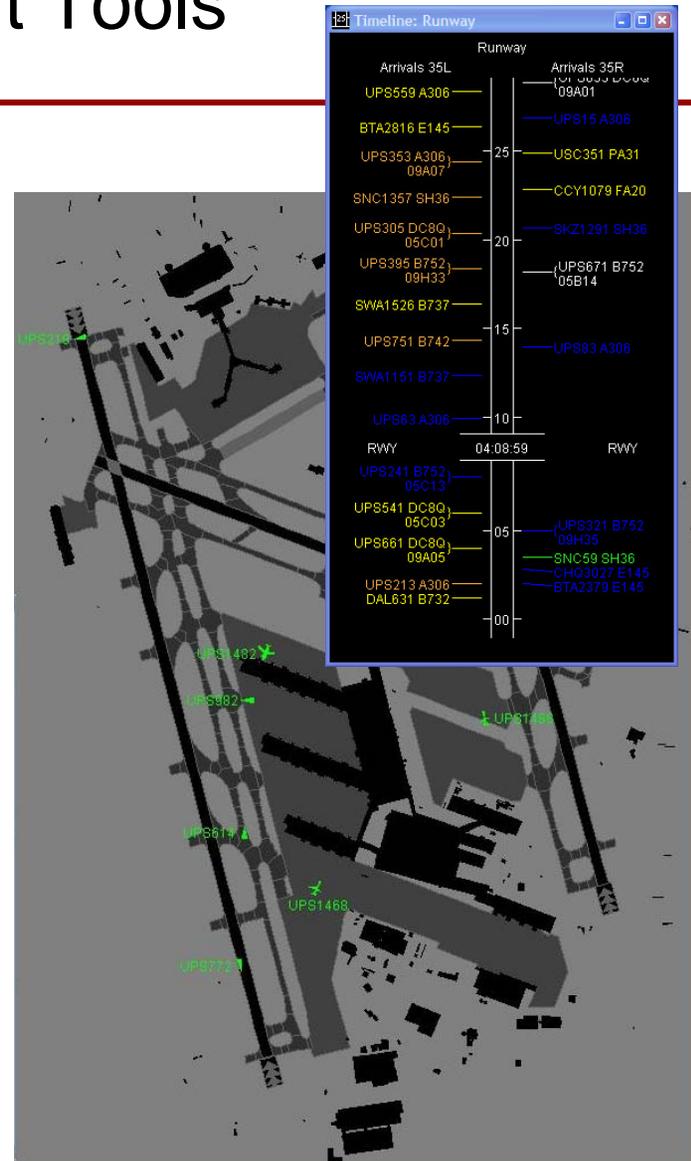
# Information Management

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- Turning Surveillance Data into Information
  - Target Correlation
    - ‘What Object Does That Surveillance Data Represent?’
    - Even Cooperative Surveillance is Imperfect
      - ASDE-X / Multi-Lateration is Vulnerable to Beacon Code Errors and Beacon Code Re-Use
  - Remote Tower Operations will Require ‘Radar Identification’ without the Out-the-Window View
- Correlating Surveillance Information with Flight Information
  - ‘Where is Arrival Flight XYZ111 Destined on the Airfield?’
  - ‘What is the Status of Flight ABC222?’
  - ‘Flight DEF333 is in Out Status, Where is the Surveillance?’

# Decision Support Tools

- Controller Productivity Enhancements through Decision Support Tools
  - Computer Monitoring, Modeling and Recommendations for:
    - Taxi Path and Sequence (i.e., full taxi trajectory)
    - Runway Sequence (arrivals, departures and crossings)
  - Safety Logic
    - Taxi Conformance Monitor
    - Airport Surface Conflict Alert
- Direct Link to Cockpit
  - Taxi Trajectory via Datalink
  - Conflict Alert to Cockpit
  - Automated Airport Surface Lighting
    - Controlled via Decision Support Tools



# Potential Concept Benefits

## Tower Construction Costs:

\$1 Million to > \$30 Million

Total Number of Towers (FY2002): 290

Total Annual Tower Ops Costs (FY2002):  
\$197 Million

Average Annual Tower Ops Cost (FY2002):  
\$680,000

Source: DOT-IG Report AV-2003-057, "Safety, Cost and Operational Metrics of the Federal Aviation Administration Visual Flight Rule Towers"



- Cost of Tower Operations and Contract Tower Program
  - Costs Not Eliminated
    - But Facilities and Work-Force can be Consolidated
    - Further Analysis Required to Identify Potential Savings
- Cost of Tower Construction
  - Future Tower Construction Eliminated
    - Maintenance of Existing Towers, until End-of-Life
    - Maintenance of Remote Airport Traffic Service Facilities

# Potential Concept Benefits (cont.)

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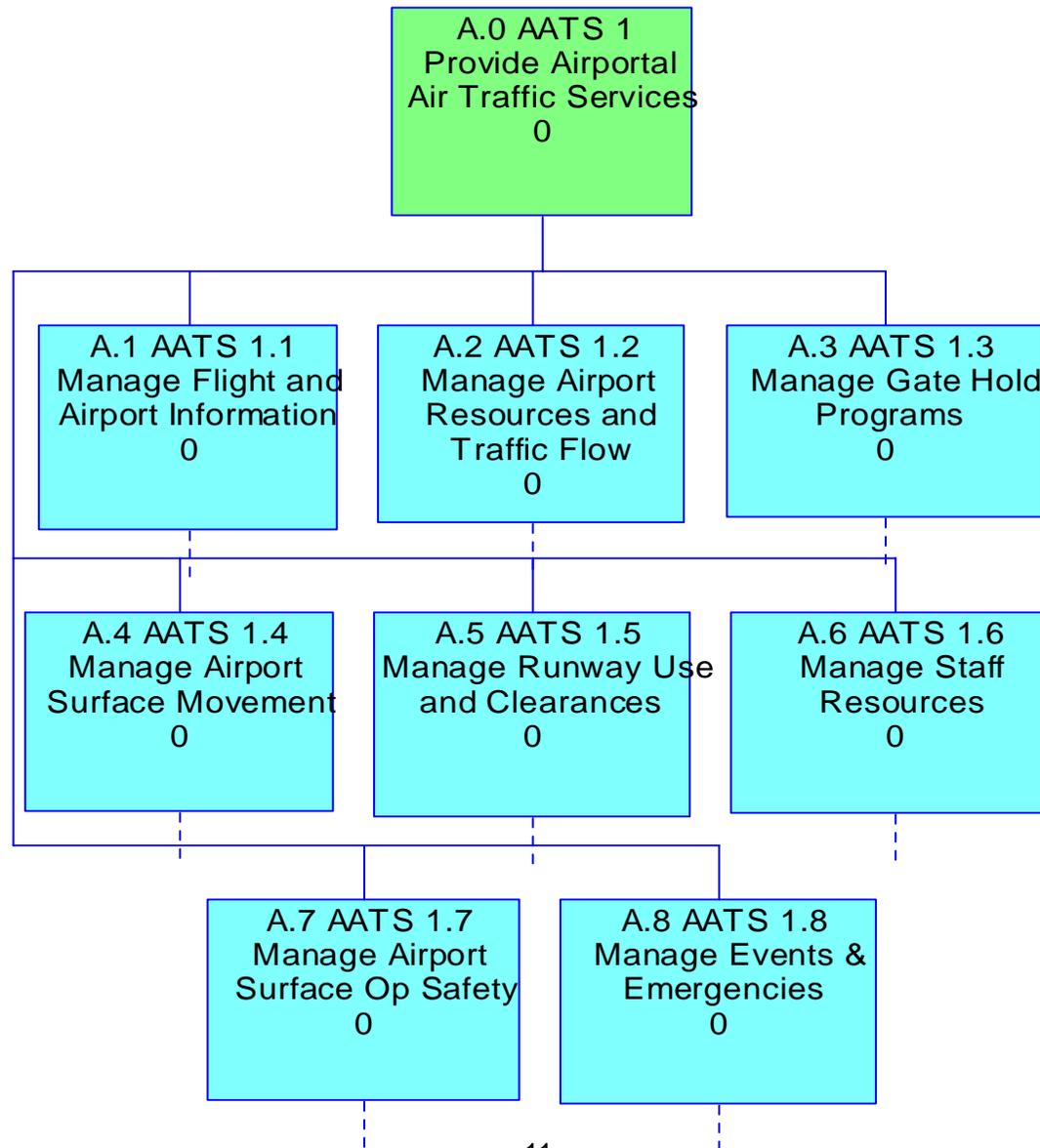
- Efficiency
  - Potential to Increase Efficiency through Co-Location of Remote Airport Traffic Service Facilities with Airspace ATC Facility
    - Facilitate Coordination of Arrival/Departure Clearances and Constraints
- Security
  - Increased Electronic Surveillance of Airport Area for ATC Services
    - Also Provides Increased Sensor Capability and Information for Real-Time and Automated Security Monitoring

# Remote Tower Research Issues

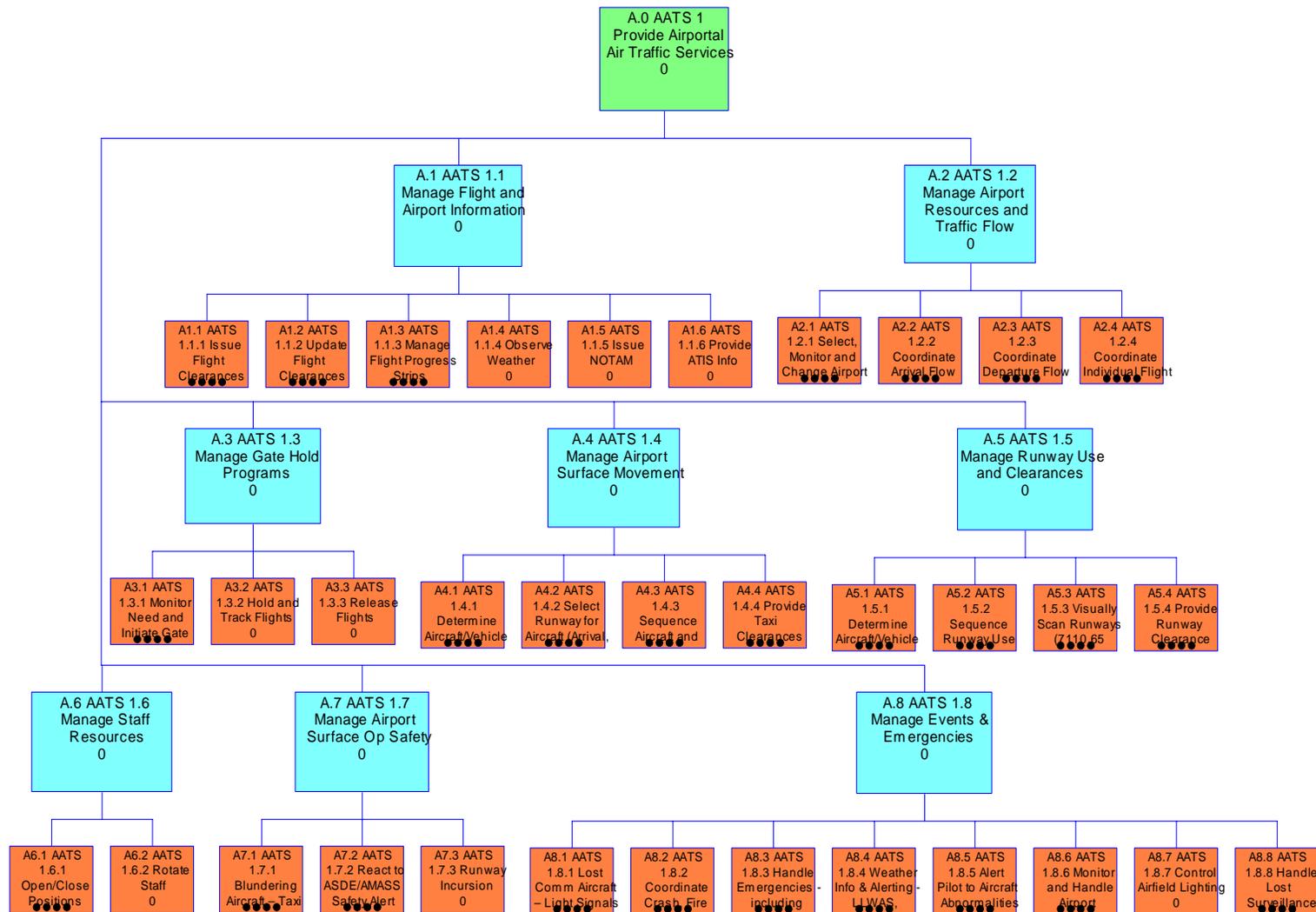
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- Can all 'standard' airport traffic services be provided remotely? Or only a sub-set?
  - What is the degradation of service and benefit due to the limitation of services to be provided?
- What are the procedures for handling training and staffing of Remote ATC Towers?
  - What technology is required to support training and operations for multiple airport environments?
- How is safety ensured during equipment outages?
- How can the greatest level of situational awareness be provided to the Remote Airport Traffic Services Specialist, through electronic aircraft and vehicle surveillance, and video surveillance?
  - What are the technology requirements for the comprehensive Remote Airport Traffic Services automation system?

# Airport Traffic Services Activity Decomposition



# Airport Traffic Services Activity Decomposition



# Activity References

Name	Leaf	Standards
AATS 1 Provide Airportal Air Traffic Services	F	
AATS 1.1 Manage Flight and Airport Information	F	
AATS 1.1.1 Issue Flight Clearances	T	7110.65 2-10-3, 2-2, 2-3, 4-2, 4-3, 4-4, 7210.3 10-4-2
AATS 1.1.2 Update Flight Clearances	T	7110.65 2-10-3, 2-2, 2-3, 4-2, 4-3, 4-4, 7210.3 10-4-2
AATS 1.1.3 Manage Flight Progress Strips	T	7110.65 2-3-3, 7210.3 10-1-8
AATS 1.1.4 Observe Weather	T	7110.65 2-6-6
AATS 1.1.5 Issue NOTAM	T	7110.65 2-1-9
AATS 1.1.6 Provide ATIS Info	T	7110.65 2.9, 7210.3 10-4-1
AATS 1.2 Manage Airport Resources and Traffic Flow	F	
AATS 1.2.1 Select, Monitor and Change Airport Configuration	T	7110.65 3.5, 7210.3 10-1-6
AATS 1.2.2 Coordinate Arrival Flow Restrictions	T	7210.3 10-7, 17-6-9
AATS 1.2.3 Coordinate Departure Flow Restrictions	T	7210.3 17-6-9
AATS 1.2.4 Coordinate Individual Flight Manual Release Times	T	7110.65 4-3-4, 7210.3 17-6-13
AATS 1.3 Manage Gate Hold Programs	F	
AATS 1.3.1 Monitor Need and Initiate Gate Hold Programs	T	7110.65 3-9-2, 7210.3 10-4-3
AATS 1.3.2 Hold and Track Flights	T	7110.65 3-9-2, 7210.3 10-4-3
AATS 1.3.3 Release Flights	T	7110.65 3-9-2, 7210.3 10-4-3
AATS 1.4 Manage Airport Surface Movement	F	
AATS 1.4.1 Determine Aircraft/Vehicle Position for Taxi	T	7110.65 3-1-7, 3-6-2
AATS 1.4.2 Select Runway for Aircraft (Arrival, Departure)	T	7110.65 3.5
AATS 1.4.3 Sequence Aircraft and Vehicles	T	7110.65 3.7
AATS 1.4.4 Provide Taxi Clearances	T	7110.65 3.7
AATS 1.5 Manage Runway Use and Clearances	F	
AATS 1.5.1 Determine Aircraft/Vehicle Position for Runway Use	T	7110.65 3-1-7, 3-10-7
AATS 1.5.2 Sequence Runway Use (Arrivals, Departures, Crossing Aircraft, Vehicles)	T	7110.65 3.8
AATS 1.5.3 Visually Scan Runways (7110.65 Section 3-1-12).	T	7110.65 3-1-12, 3-1-5
AATS 1.5.4 Provide Runway Clearance (Cross, TIPH, Take-Off, Land, Exit Runway, Taxi on R	T	7110.65 3-1-3
AATS 1.6 Manage Staff Resources	F	
AATS 1.6.1 Open/Close Positions	T	7210.3 4-6
AATS 1.6.2 Rotate Staff	T	7210.3 4-6
AATS 1.7 Manage Airport Surface Op Safety	F	
AATS 1.7.1 Blundering Aircraft – Taxi Out-of-Conformance	T	7210.3 2-1-20
AATS 1.7.2 React to ASDE/AMASS Safety Alert	T	7110.65 3-6-4, 7210.3 11-9-3
AATS 1.7.3 Runway Incursion	T	721-.3 2-1-20
AATS 1.8 Manage Events & Emergencies	F	
AATS 1.8.1 Lost Comm Aircraft – Light Signals	T	7110.65 3-2-1
AATS 1.8.2 Coordinate Crash, Fire Rescue	T	7110.65 10-1
AATS 1.8.3 Handle Emergencies - including security issue	T	7110.65 10-1, 10-2
AATS 1.8.4 Weather Info & Alerting - LLWAS, Microburst	T	7110.65 2-6, 3-1-8
AATS 1.8.5 Alert Pilot to Aircraft Abnormalities	T	7110.65 3-1-10
AATS 1.8.6 Monitor and Handle Airport Condition Issues (Rwy Closure, Braking Action, Debris	T	7110.65 3-3
AATS 1.8.7 Control Airfield Lighting	T	7110.65 3.4
AATS 1.8.8 Handle Lost Surveillance (due to aircraft malfunction, etc.)	T	

# Activity Information Requirements

Name	Requires Electronic Airport Surveillance	Requires Optical View	Potential Decision Support Benefits
AATS 1.1.1 Issue Flight Clearances	F	F	F
AATS 1.1.2 Update Flight Clearances	F	F	F
AATS 1.1.3 Manage Flight Progress Strips	F	F	T
AATS 1.1.4 Observe Weather	F	T	F
AATS 1.1.5 Issue NOTAM	F	F	F
AATS 1.1.6 Provide ATIS Info	F	F	F
AATS 1.2.1 Select, Monitor and Change Airport Configuration	T	F	T
AATS 1.2.2 Coordinate Arrival Flow Restrictions	F	F	T
AATS 1.2.3 Coordinate Departure Flow Restrictions	F	F	T
AATS 1.2.4 Coordinate Individual Flight Manual Release Times	T	F	T
AATS 1.3.1 Monitor Need and Initiate Gate Hold Programs	F	F	T
AATS 1.3.2 Hold and Track Flights	T	F	T
AATS 1.3.3 Release Flights	T	F	T
AATS 1.4.1 Determine Aircraft/Vehicle Position for Taxi	T	F	
AATS 1.4.2 Select Runway for Aircraft (Arrival, Departure)	F	F	T
AATS 1.4.3 Sequence Aircraft and Vehicles	T	F	T
AATS 1.4.4 Provide Taxi Clearances	T	F	T
AATS 1.5.1 Determine Aircraft/Vehicle Position for Runway Use	T	F	F
AATS 1.5.2 Sequence Runway Use (Arrivals, Departures, Crossing Aircraft, Vehicles)	T	F	T
AATS 1.5.3 Visually Scan Runways (7110.65 Section 3-1-12).	T	T	F
AATS 1.5.4 Provide Runway Clearance (Cross, TIPH, Take-Off, Land, Exit Runway, Taxi on Runway)	T	F	F
AATS 1.6.1 Open/Close Positions	F	F	F
AATS 1.6.2 Rotate Staff	F	F	F
AATS 1.7.1 Blundering Aircraft – Taxi Out-of-Conformance	T	F	F
AATS 1.7.2 React to ASDE/AMASS Safety Alert	T	F	F
AATS 1.7.3 Runway Incursion	T	F	F
AATS 1.8.1 Lost Comm Aircraft – Light Signals	T	F	F
AATS 1.8.2 Coordinate Crash, Fire Rescue	T	T	F
AATS 1.8.3 Handle Emergencies - including security issue	T	T	F
AATS 1.8.4 Weather Info & Alerting - LLWAS, Microburst	F	F	F
AATS 1.8.5 Alert Pilot to Aircraft Abnormalities	T	T	F
AATS 1.8.6 Monitor and Handle Airport Condition Issues (Rwy Closure, Braking Action, Debris on Airport, Wildlife on Airport, etc.)	T	T	F
AATS 1.8.7 Control Airfield Lighting	F	F	F
AATS 1.8.8 Handle Lost Surveillance (due to aircraft malfunction, etc.)	N/A	T	F

# Key Findings

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- Requirements Regarding Airfield Electronic Surveillance:
  - Surveillance Required for All Aircraft and Vehicles Using the Movement Area
  - 'Out' Status Notification Required for All Flights
    - Possibly via Data Communication, not Surveillance
  - Surveillance of Flight Locations Required in Ramp Area
    - Spot/Alleyway Conflict Avoidance
    - Management of Gate Hold Programs
- Airport Traffic Service Activities that Require an Optical View of the Airfield (i.e., Electronic Surveillance is Not Sufficient):
  - Observe Weather
  - Visually Scan Runways
  - Coordinate Crash, Fire & Rescue
  - Handle Emergencies/Security Issues
  - Alert Pilot to Aircraft Abnormalities
  - Monitor and Handle Airport Conditions/Issues
  - Handle Lost Surveillance

## Key Findings (cont.)

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- Potential Decision Support Tool Benefits
  - Generation of Taxi Routes
  - Sequencing and Runway Assignment
  - Flight Progress Information Tracking (Electronic Flight Strips)
  - Coordination of Flow Management Initiatives
- Additional Requirements:
  - Airport Lighting must be Controllable Remotely
  - Tower Light Signals must be Controllable Remotely
    - Aircraft with Lost Comm May Also Lose Cooperative Surveillance
    - Light Signals must be Controllable Remotely with Targeting via Exclusively Passive Sensors
      - i.e., Optical, Infrared and Primary Radar

# Future Research Directions

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- Surveillance Concepts
  - Integration of Surveillance View with Optical View
- Information Management
  - Accurate Target Correlation
- Decision Support Tools
  - Conflict Free Taxi Trajectory Planning
  - Taxi Trajectory Data-Link to Aircraft
  - Conformance Monitoring and Alerting
  - Closed Loop Taxi Operations

# Conclusion

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- Operational Activity Decomposition Provides a Detailed Requirements Analysis Approach for Remote Airport Traffic Services
- Analysis of Remote Airport Traffic Services Requirements, Information Needs, and Possible Solutions Conducted
  - Results Indicate that the Requirements for Remote Airport Traffic Services are Beyond the Capabilities of Today's Electronic Airport Surveillance Systems
- However, a Combination of Capabilities May Satisfy the Remote Airport Traffic Services Requirements:
  - electronic airport surveillance
  - optical surveillance
  - advanced decision support tools
- Significant Benefits in Increased Efficiency and Reduced Operating Costs May Be Possible