Real-time Visibility

Deploying RFID & RTLS in Aerospace & Aviation

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Innovative firms in Aerospace and Aviation continually look for ways to increase efficiency and eliminate waste in day-to-day operations. RFID and RTLS provide the necessary visibility and measurability to drive process improvement and cost savings.

Many have leveraged their existing IT infrastructure and focused on automating specific process areas with RFID and RTLS technology, focusing in one of four key areas:

1. Logistics
2. Materials Management
3. Manufacturing Operations
4. Aftermarket Services/MRO

RFID-enabled Process Areas in Aerospace and Aviation

Warehousing  Kitting, Shipping & Receiving  Multi-Facility Assembly  Work Orders
Indirect Materials  Assembly Processes  Tooling & Equipment  Aftermarket Services/MRO
Composite Materials

This guide illustrates specific areas where Aerospace OEMs, Defense Contractors, Suppliers and MRO providers can quickly and cost-effectively real-time enable their operations with RFID and RTLS.

Note: Although RFID and RTLS are referred to specifically within this document, UWB, Wi-Fi, along with other Auto-ID and sensor technologies may be used interchangeably for real-time enabled applications.
This guide lists RFID use cases by process area, although there are use cases which span all aspects of Aerospace and Aviation. For example, aircraft may be assembled across multiple facilities, with one plant specializing in metal fabrication, another in advanced composites, and another in final assembly. Plants may be located miles apart, hundreds of miles apart, even in separate countries. This changes the definition of Work-in-Process tracking from recording when a job moves from work station to work station, to tracking subassemblies as they move from facility to facility – it’s RFID-enabled shipping and receiving. Similarly, Tool and Equipment Tracking spans multiple functions, and is detailed on pages 6 and 7.

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The following table lists some of the most common use cases for RFID and RTLS in Logistics Operations. Sample process flows are illustrated on the next page.

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<th>Application:</th>
<th>RFID/ RTLS Process Automation:</th>
<th>Enterprise Systems Integration Options:</th>
<th>RFID/ RTLS Value-Add:</th>
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<td>Kitting &amp; Shipping</td>
<td>▪ Automated Data Entry for Component Manifest, Shipping Manifest, ASN</td>
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<td>▪ Error-proofing kitting and shipping process</td>
</tr>
<tr>
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<td>▪ Verifying outgoing orders</td>
<td>▪ Compare outgoing goods with Component Manifest/Shipping Manifest</td>
<td>▪ Significantly reduce misshipments, customs delays and costly correction processes</td>
</tr>
<tr>
<td></td>
<td>▪ Expediting rush orders</td>
<td>▪ Compile customs documentation based on component part history records, work orders, customer requirements</td>
<td>▪ Focusing staff on fulfilling orders vs. managing paperwork</td>
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<td></td>
<td>▪ Automated customs documentation for international shipments</td>
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</tr>
<tr>
<td>RTI (Returnable</td>
<td>▪ Tracking reusable containers and contents from location to location</td>
<td>▪ ERP, Project Management, WMS Systems:</td>
<td>▪ Automated check-in/check-out processes</td>
</tr>
<tr>
<td>Transport Item)</td>
<td>▪ Tracking Container Pedigree when hazardous materials are involved</td>
<td>▪ Pull parts manifest for each work order to track components</td>
<td>▪ Real time status of work orders and components</td>
</tr>
<tr>
<td>Tracking</td>
<td></td>
<td>▪ Confirm final destination for each shipment &amp; work order number</td>
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<td></td>
<td></td>
<td>▪ Alert staff with a visual or audible alarm when a work order is received in the wrong location</td>
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<tr>
<td>Inbound Receiving</td>
<td>▪ Automated Receipt, Verification of Goods</td>
<td>▪ ERP, Project Management, WMS Systems:</td>
<td>▪ 100% Automated Tracking &amp; Reliable Identification of Shipments as they are Received</td>
</tr>
<tr>
<td></td>
<td>▪ Expediting Rush Orders</td>
<td>▪ Compare Received Goods with Content Manifest or ASN</td>
<td>▪ Focusing Staff on Exception Handling vs. Administrative Paperwork</td>
</tr>
<tr>
<td></td>
<td>▪ Quarantining and Tracking Non-scheduled Shipments</td>
<td>▪ Flag Rush Orders by Comparing Order Number and Special Instructions</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>▪ 100% Automated Tracking &amp; Reliable Identification of Shipments as they are Received</td>
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<td>▪ Focusing Staff on Exception Handling vs. Administrative Paperwork</td>
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</tbody>
</table>

Example

Inbound Receiving:
An Aerospace OEM worked with OAT to automate receipt of shipments from Component Suppliers, resulting in a significant reduction in handling time and labor costs

▪ Auto-ID Technology: RFID, Wi-Fi, Barcode
▪ Enterprise Systems: SAP, Baan ERP
Example: Shipping

ERP / WMS System

- Get Order Details from ERP/WMS
- Assign/schedule delivery to site
- Execute ERP/WMS transactions (update goods issue, send ASN, etc.) and capture event data

OATxpress™

- Get delivery manifest details for dock door 17
- Validate against manifest
- Send manifest fulfillment details

OATdevice manager™

- Final inspection at dock door 17
- Read package, asset, contents
- Operator feedback

Auto-ID Devices & Sensors

- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

Example: Receiving

ERP / WMS System

- Get Order Details from ERP
- Assign/schedule delivery to site
- Execute ERP transactions (update goods issue, send ASN, etc.) and capture event data

OATxpress™

- Get delivery manifest details for dock door 4
- Validate against manifest
- Send manifest fulfillment details

OATdevice manager™

- Receipt at dock door 4
- Read package, asset, contents
- Operator feedback

Auto-ID Devices & Sensors

- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

MANIFEST CONFIRMED
Ready for Shipment at Dock Door 017

ALERT! Shipment Does NOT match manifest. Verify with Shipper
The following table lists some of the most common use cases for RFID and RTLS in Materials Management. Sample process flows are illustrated on the next page.

<table>
<thead>
<tr>
<th>Application:</th>
<th>RFID/ RTLS Process Automation:</th>
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<td>• Tracking Freezer Out-Time for Perishable Materials</td>
<td>ERP, Material Management Systems (MMS)</td>
<td>• Reduction in Scrap Material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Monitor Out-time while Material is in Cutting, Layup stages</td>
<td>• Reduction in Quality Risk</td>
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<tr>
<td></td>
<td></td>
<td>▪ Alert Staff When Out-Time Threshold is Imminent</td>
<td></td>
</tr>
<tr>
<td>Indirect Materials Management</td>
<td>▪ Real-time Tracking of Indirect Materials used in Manufacturing and Transport</td>
<td>ERP, Project Management, WMS Systems:</td>
<td>• Immediate Location of Conveyances Reduces Shipping Delays</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Verify and Update Location and Status of Molds, Jigs and Conveyances</td>
<td>• Reduction in Spares Inventory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Pre-stage specific materials for each Work Order</td>
<td>• Reduced Quality Risk from Molds Exceeding Duty Cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Audit Trail of Right-to-Use Equipment</td>
</tr>
<tr>
<td>Tool &amp; Equipment Tracking</td>
<td>▪ Real-time Tracking of Tooling and Specialized Equipment</td>
<td>ERP, Project Management, WMS Systems:</td>
<td>• Automated Inventory Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Verify and Update Tool Location and Maintenance Records when Tools are checked in and out</td>
<td>• Reduction in Tool Spares</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Fewer Lost Tools, Increasing Manufacturing Uptime</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Audit Trail of Tool Usage and Maintenance Simplifies Compliance</td>
</tr>
</tbody>
</table>

**Composite Material & Tooling Tracking:**

A Tier 1 Supplier of Composite Aerostructures worked with OAT to track perishable composite materials and custom tooling through a multi-step manufacturing process. The resulting system provides automated tracking of freezer out-time of composite materials, duty cycles of tooling and overall work-in-process, improving program performance while reducing excess inventory and scrap material.

- **Auto-ID Technology**: RFID, Barcode
- **Enterprise Systems**: Solumina MMS, Impresa ERP
**Materials Management: Functional Process Flows**

**Example: Tool Tracking**

**ERP / WMS / MRO System**
- Get tool/equipment serial # and calibration schedule from ERP /MES/ Service & Maintenance
- Assign tool to operator/location for specific time period
- Update tool maintenance schedule
- Send maintenance details to systems of record

**OATxpress™**
- Get location details for tool store
- Validate against inventory/calibration table

**OATdevice manager™**
- Receipt at tool store
- Read tool, operator ID, location
- Operator feedback

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

**Example: Composite Materials Tracking**

**MMS / ERP / WMS System**
- Update system with time/date of receipt, batch #, mfr
- Start tracking freezer out-time based on mfr recommendations
- Decrement freezer out time

**OATxpress™**
- Record receipt of material
- Record material movement
- Confirm out time counter

**OATdevice manager™**
- Receive perishable composite material, place in storage freezer with time/date stamp
- Remove material from freezers for layup process
- Operator feedback at freezer

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

**Alert!** Tool# 75622 Requires Calibration Please Service

**Alert!** 310 out of 400 hours of freezer out time have elapsed. Use batch #2789 immediately
The following table lists some of the most common use cases for RFID and RTLS in Manufacturing Operations. Sample process flows are illustrated on the next page. (Tool and Equipment Tracking process flows, which span functional areas, are detailed on page 6).

<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| Work-in-Process Tracking | Real-time Tracking of Manufacturing Work Orders, Component Parts & Subassemblies | ERP, MES, Project Mgmt. Systems  
- Update Inventory Levels and Component Parts at each Step of the Assembly Process  
- Alert Operator or Replenish Part Stores when Inventory Levels fall below a Pre-Defined Threshold |  
- 100% Automated Tracking & Reliable Identification of Work Orders through the Manufacturing Process  
- Reduction in Safety Stock and Reusable Containers  
- Help Prevent Missing Orders and Rework, Increasing Manufacturing  
- Audit Trail of Components, Batch Numbers for Finished Products |
| Kanban Management Cycle Counting | Proactive Inventory Management & Automatic Replenishment | ERP, Project Management, WMS Systems:  
- Compare Expected Inventory with Actual Inventory  
- Alert Operator or Replenish when Inventory Levels are Low |  
- Automated Stock Taking and Replenishment  
- Reduction in Safety Stock, Labor Costs |
| Work Order Tracking | Real-time Tracking of Customer Work Orders | ERP, MES, Project Mgmt. Systems  
- Update Component Part Inventory as Custom Components are Assigned to Work Orders.  
- Pre-stage Materials, Tooling and Indirect Materials for Custom Work Orders |  
- Tracking Visibility of Customer Orders at Each Stage of the Assembly and Finishing Process  
- Fewer Substitutions, Rework and Rush Shipments Due to Missing Components  
- Improved Customer Satisfaction  
- Documented Audit Trail of Components, Batch Numbers for Finished Products |

**Example**

**Work Order Tracking**
A Specialized Aircraft Manufacturer worked with OAT to track subassemblies and whole goods being shipped directly to customers, resulting in reduced costs for outbound shipping and reduced labor costs for preparing customs paperwork.

- **Auto-ID Technology:** RFID, Barcode
- **Enterprise Systems:** SAP ERP
Example: **Kanban Management / Cycle Counting**

**ERP / WMS System**
- Get expected inventory levels from ERP/WMS
- Decrement inventory levels in ERP System and/or Kanban board
- Trigger inventory replenishment for low stock items

**OATxpress™**
- Get specific inventory levels for Component Store #2
- Validate against actual inventory
- Send inventory fulfillment details

**OATdevice manager™**
- Cycle count items in Component Store #2
- Operator feedback

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

Example: **Work-in-Process Tracking**

**ERP / Program Management System**
- Get Work Order details from ERP/Program Mgt system
- Assign work order to operator
- Execute ERP transactions (update component inventory, work order status) & capture event data

**OATxpress™**
- Get assembly instructions and component list for workstation #3
- Validate against Work Order
- Send work order status

**OATdevice manager™**
- Receipt at workstation #3
- Read component serial #s, batch #s, test data
- Operator feedback

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...
The following table lists some of the most common use cases for RFID and RTLS in Aftermarket Services/MRO Operations, including line maintenance, overhaul and the management of tools and equipment. Sample process flows are illustrated on the next page (Tool and Equipment Tracking process flows, which span functional areas, are detailed on page 6).

<table>
<thead>
<tr>
<th>Application</th>
<th>RFID/ RTLS Process Automation:</th>
<th>Enterprise Systems Integration Options:</th>
<th>RFID/ RTLS Value-Add:</th>
</tr>
</thead>
</table>
| Line-Side Maintenance        | Automated parts replenishment and service documentation for line-side maintenance | ERP, MRO, Service & Asset Mgmt. Systems  
  - Compare maintenance schedule and service parts against current service history, update history as service is performed  
  - Alert operator to components which need to be checked and replaced  
  - Compare and update physical parts and tool inventory, place replenishment orders when stock runs low | 100% Automated Tracking & Reliable Identification of Work Orders through the Overhaul Process  
  - Reduce Rework, Labor and Inventory Costs |
| Overhaul Operations          | Real-time Tracking of M&E Operations such as engine overhaul | ERP, MRO, M&E Systems:  
  - Update Work Order Status as Service is Performed  
  - Update Inventory Levels and Component Parts are Assigned to New Work Orders  
  - Alert Operator or Replenish Part Stores when Inventory Levels fall below a Pre-Defined Threshold | 100% Automated Tracking & Reliable Identification of Work Orders through the Overhaul Process  
  - Reduce Rework, Labor and Inventory Costs |
| Tool & Equipment Tracking    | Real-time Tracking of Tooling and Specialized Equipment | ERP, Project Management, WMS Systems:  
  - Verify and Update Tool Location and Maintenance Records when Tools are checked in and out | 100% Automated Tracking & Reliable Identification of Work Orders through the Overhaul Process  
  - Reduce Rework, Labor and Inventory Costs |

**Example**

**Engine Overhaul Tracking:**
An International Airline worked with OAT to track components and work-in-process for engine overhaul operations, resulting in increased efficiency, on-time delivery and significant labor savings.

- **Auto-ID Technology:** RFID, Barcode
- **Enterprise Systems:** In-house M&E Application
Example: **Line-Side Maintenance**

**ERP / WMS / MRO System**
- Get BOM Details from MRO System
- Schedule Service Call
- Update Service History, Component Information

**OATxpress™**
- Get Spare Part Details at Service Bay #11
- Validate Against BOM
- Send Service Call Details

**OATdevice manager™**
- Receipt at Service Bay #11
- Read Part Information
- Operator feedback

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

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Example: **Engine Overhaul Tracking**

**Maintenance & Engineering (M&E) System**
- Get Work Order details from M&E System
- Assign work order to technician
- Execute M&E transactions (update component inventory, work order status) & capture event data for documentation

**OATxpress™**
- Get assembly documentation and component list for airline work order
- Validate against Work Order
- Send work order status

**OATdevice manager™**
- Receipt at overhaul area
- Read component serial #s, batch #s, test data
- Operator feedback

**Auto-ID Devices & Sensors**
- RTLS, UWB, Wi-Fi, Barcode, Active/Passive RF, Alarms...

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**Alert!** Part # TR783-065 is Recalled. Please Substitute with Part# CR782-0621.
What’s Driving the Adoption of RFID & RTLS in Aerospace and Aviation?

Aerospace and Aviation operations have common characteristics:

- Significant investment in capital assets
- Core processes are either customer-facing or contract-driven
- High operational and regulatory risk
- High business complexity

These factors are driving the adoption of RFID and RTLS.

PRIMARY DRIVERS OF RFID & RTLS IN AEROSPACE & AVIATION

Cost Pressure  
CFOs are putting capital asset inventory under scrutiny since working capital allocation is a prime component of operating profit – enterprises need additional visibility to proactively manage these assets across diverse, geographically distributed operations.

New Programs  
Large scale projects require more resources and more tightly managed processes, as stakeholders demand transparency throughout the program, not just at program completion.

Quality, Safety & Compliance  
With increased focus on quality, safety, FOD (foreign object debris) and program compliance, flagging errors and exceptions at the process level is more important than ever.

Process Efficiency  
Lean initiatives are gaining importance in manufacturing, logistics and service operations. As organizations are asked to increase throughput with existing resources, process automation becomes a priority.
## MEASURING RFID/RTLS ROI FOR AEROSPACE & AVIATION

<table>
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<th>ROI Metric</th>
<th>Related to</th>
<th>How They are Calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in Equipment/Tooling/Indirect Material Inventory</td>
<td>Working Capital Allocation</td>
<td>Buffer inventory of tooling, equipment to compensate for missing or out-of-spec tools, as a percentage of overall inventory</td>
</tr>
<tr>
<td>Reduction in FOD (Foreign Object Debris)</td>
<td>Quality, Safety &amp; Compliance, Cost Pressure</td>
<td>Process risk reduction/capital allocation reduction by finance, Reduction in fines, Process KPIs (incl. time in service)</td>
</tr>
<tr>
<td>Increase in Labor Utilization</td>
<td>Process Efficiency, Cost Pressure</td>
<td>Average labor rate and # of employees involved with equipment tracking, - multiplied by % of non-value added activities - locating tools, locating service history and specific work instructions</td>
</tr>
<tr>
<td>Improved Asset Utilization</td>
<td>Working Capital Allocation</td>
<td>Redundant inventory of capital assets, assets that have not been used in &gt;6 months or duplicate inventory, Percentage of capital assets not being utilized - missing or under repair</td>
</tr>
<tr>
<td>Improved On-Time Performance Reduced Schedule Risk</td>
<td>Process Efficiency, New Programs</td>
<td>Reduction in days outstanding for accounts receivable, Reduction in revenue recognition delays, Customer make-goods, discounting to make up for late orders, Fines for breach of contract</td>
</tr>
<tr>
<td>Improved Process Tracking Reduced Quality Risk</td>
<td>Process Efficiency, Quality, Safety &amp; Compliance</td>
<td>Reduction in rework costs, Customer make-goods, discounting to make up for quality issues, Reduction in out-of-spec equipment and tooling, Fines for non-compliance based on quality errors</td>
</tr>
</tbody>
</table>
OATSystems has helped hundreds of companies take advantage of RFID & RTLS to streamline operations, enhance customer satisfaction and increase bottom line results. OAT is the recognized Auto-ID solution leader with software that empowers businesses to achieve a competitive advantage and ROI from real-time visibility. As a pioneer in the development of Auto-ID technology, OAT has been setting the standard in RFID for over a decade and has provided RFID & RTLS-enabled solutions to leading Aerospace and Industrial companies such as Airbus, ATK, Parker Hannifin, Cessna, Rockwell Collins, Bell Helicopter, Monsanto, Chevron, TAP Air Portugal, Cephalon, Shell and others.

Contact OATSystems today at www.oatsystems.com or 781-907-6100 and get ready to take control of your operations.

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