# Aircraft maintenance and engineering (M&E), and maintenance, repair and overhaul (MRO)

**Advanced Information Systems and Business Analytics for Air Transportation**

M.Sc. Air Transport Management

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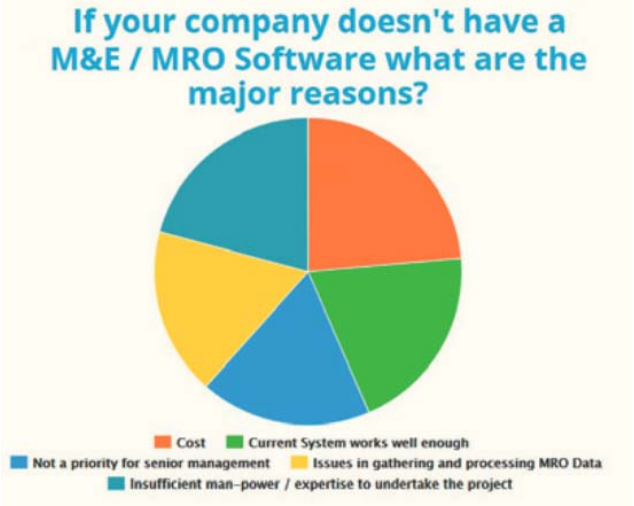
# Operational trends

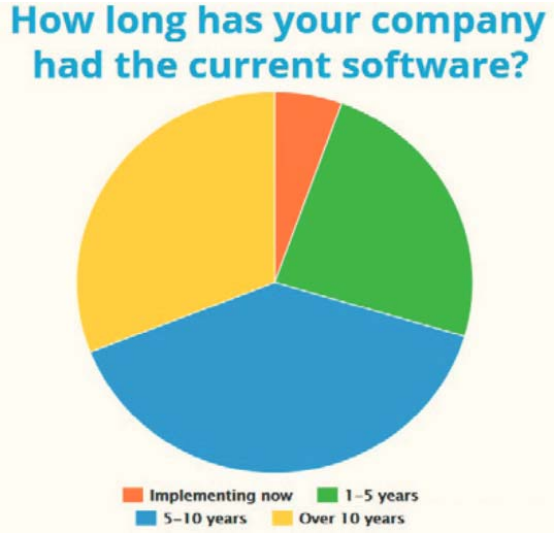
- Over 50% use one MRO software vendor. 11% still use Excel and Access to manage aircraft maintenance.
  - Such software are complex, require regulatory responsibility
  - Possibly high degree of loyalty
- 70% of companies who didn't have a M&E / MRO IT Solution are considering purchasing or developing a Solution. Cost and insufficient man-power / expertise are the major reasons why companies haven't yet implemented a software.
  - Somewhat concerning as they do not recognize yet the power if IT and big data

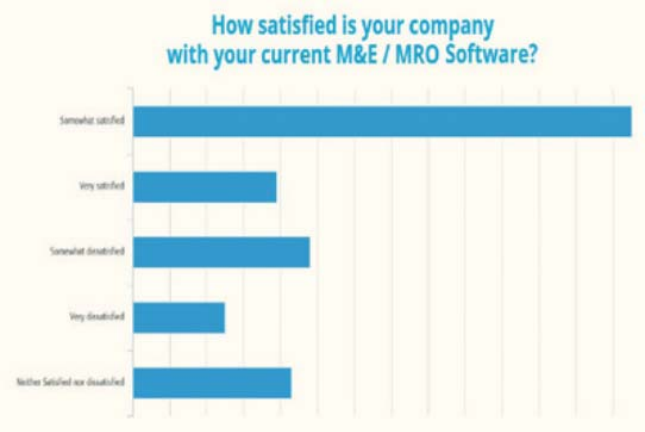




Source: Aircraft IT MRO Survey 2015

# Operational trends

- 47% of companies surveyed have over 500 IT users. 19% have less than 50 IT users
- Over 70% of companies surveyed have used M&E / MRO Software for over five years. 6% are currently implementing a solution.
  - For most organizations the decision is not whether to use an IT system, but rather which solution
  - Trade-off: adopt system that best matches requirements (while experiencing a disruption) or sticking with the vendor who knows you well.
- 26% are dissatisfied with their current M&E / MRO Software. Only 13% are very satisfied

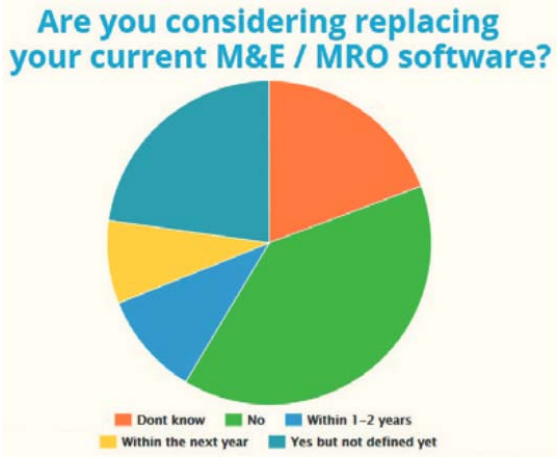


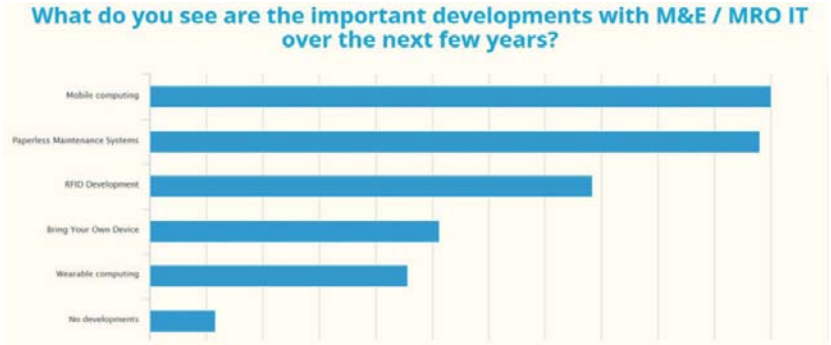




Source: Aircraft IT MRO Survey 2015

# Operational trends

- 18% are considering replacing their current M&E / MRO software in the next two years
- The most important developments over the next few years
  - Mobile computing (27%)
  - Paperless maintenance systems (27%)
  - RFID (19%)
  - Bring your own device (13%)
  - Wearable computing (11%)




Source: Aircraft IT MRO Survey 2015

# MRO Big Data Analytics

**MRO Analytics – Big Data Analytics**

**Operational Effectiveness**

- Total maintenance cost by fleet types, maintenance checks, material & labour
- Actual vs. planned labour and material

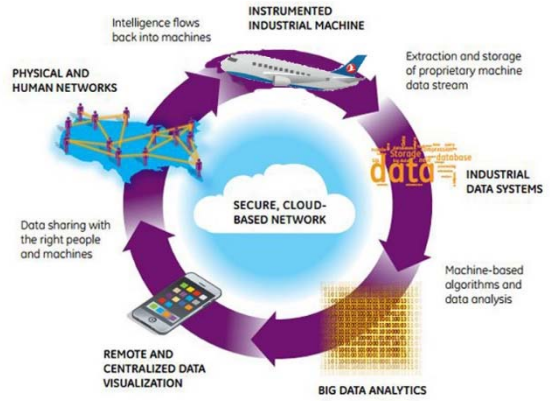
- Labour skill utilization

**Inventory optimization**

- Required vs. available quantity
- Slow and fast moving parts
- Fill rate analysis

**Supply Chain Effectiveness**

- Vendor analysis
- On-time delivery by vendors
- Lead days analysis




**"50+ industry standard KPI's platform agnostic"**



Source: Aircraft IT MRO

# Predictive Maintenance

- Thus far: preventive maintenance
- Can we actually predict when a failure is about to occur?
- Such a system requires significant
  - Data from various sources
  - Appropriate tools for analytics
  - Subject matter expertise
  - Tweaking of the algorithms to refine them over time


Source: Aircraft IT MRO

# Big Data

- Sources of data:
  - Own (ERP)
  - Employees (emails, social media)
  - Suppliers (their ERP)
  - Customers
  - Internet
  - Etc.
- Consolidation of data can lead to
  - Predictive analysis
    - Expecting future outcomes
  - Behavioral analysis
    - On-going improvements in methods and processes
  - Real-time analysis
    - Here-and-now decision making



Source: Aircraft IT MRO

# How would it work

- Consider Flight EX-1234 from New York JFK to Amsterdam-Schiphol
  - During the flight, the systems indicates that one of the flight control computers is failing
  - It needs to be replaced
  - The information is sent to the main platform
  - The system start planning the maintenance procedure
    - Will tap into the inventory information
    - Will look into staff availability
    - It may also communicate with other suppliers' systems, find better/faster solutions
- The system would also improve regular maintenance
- This shall result with
  - more efficient operations
  - Reduction of human errors

Source: Aircraft IT MRO

# AA's M&E tablet program

- Mechanics need **mobility**
  - Cannot run back and forth between aircraft and office
    - Parts availability
    - Aircraft status
    - Past maintenance
    - Progression of maintenance
    - At DFW, with more than 70 gates, aircrafts are not always where they are expected to be, mechanics need real-time information


Source: Aircraft IT MRO

# AA's M&E tablet program

- Benefits:
  - Tablet rings tells mechanic about assignments
  - Upon arrival to gate:
    - Tells what has to be done
    - What has been done in the past
    - Tells Ops ground that mechanic is at the plane
    - If necessary, initiate boarding delay
  - 1,200 CMMs (component maintenance manuals) were digitized
    - Immediately updated
  - Focus on process:
    - Replaces work cards and calculations (elimination of errors)

Source: Aircraft IT MRO

# AA's M&E tablet program

- Challenges
  - Connectivity
    - An issue when you operate in 50 countries
      - Developed expertise in buying tablets overseas and replacing cellular cards
    - Mix of cellular (better outside) and wi-fi (better at terminal)
    - Offline capabilities (at cockpit)
  - Regulation
    - Compatibility with FAA
      - Coordinated process and explained benefits to CMO (certificate management office)
  - Initially only Samsung
    - Some prefer iPad, but had to resolve infrastructure security issues
    - Now employees have choice (but no Microsoft yet)
    - HTML 5 works anywhere
  - Suitability for mechanics
    - Minimal typing
    - Zoom, touch
  - Frequent updating
    - Every 30-45 days addressing comments from mechanics


Source: Aircraft IT MRO

# RFID at TAP

- Started due to external requirement in 2007:
  - An engineering customer wanted to ensure tools are kept separately
    - Parts/tools can be mislaid
    - Raising safety, quality, efficiency concerns
- Teamed up with Airbus: project MEERA (Mobile Enabled Engine Repair Application)
  - Took 3 years to go live
  - Mistakes in the development process:
    - Proof of concept shall replicate normal operations, conditions
    - However, done separate from production, so everything went well
    - Back in production, realized many labels were missing
  - Investment: €750,000;
    expecting 4 times ROI within a year

Source: Aircraft IT MRO

# RFID at TAP

- ROI expectations too optimistic
  - Slow learning curve
    - Knowing where the parts are is not sufficient, still need to scan
    - Need to train mechanics how to place parts on the rack
      - Enable quick scanning
      - Solved by purchasing circular polarization RFID
  - Need to educate: will not solve all problems.
    - Will make some processes more efficient. Need to identify.
- Develop strategy
  - This is not a separate tool
  - Start with engine parts
  - Next proceed with tools and GSEs (ground support equipmer

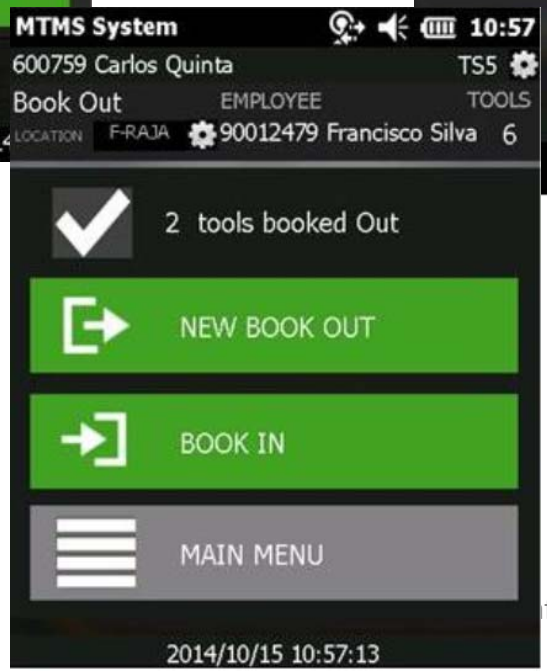

  - Future delivery of A350 come with integrated RFID
  - Will follow with chemical products and lastly in line maintenance

Source: Aircraft IT MRO

# RFID at TAP


MTMS System
09:08
MAINTENANCE
& ENGINEERING
M T M S S Y S T E M
SIGN IN
approach badge to scanner
2014/10/01 09:08


MTMS System
12:14
600759 Carlos Quinta
Tool
Book
In
Out
Transfer
Tool
GSE
Locate
Tool
GSE
Identify
Tool
GSE
Inventory
GSE
Comissioning
Tool
GSE
Location
2014/10/01 12:14:13
Menu


MTMS System
10:57
600759 Carlos Quinta
TS5
Book Out
EMPLOYEE
TOOLS
F-RAJA
90012479 Francisco Silva
6
2 tools booked Out
NEW BOOK OUT
BOOK IN
MAIN MENU
2014/10/15 10:57:13


MTMS System
09:36
600759 Carlos Quinta
TS5
Locate GSE
Locating Tool
TP129002-0001
Abastecimento de Skydrol
-44dbm
MAIN MENU
LOCATE ANOTHER TOOL
2014/09/23 09:36:54
Back
Menu

# RFID at TAP

- Tools and GSE
  - RFID and barcode (to leverage existing technology)
  - Many tools: half specific, half generic
  - Existing tool system is offline: four stores relying on manual updating
  - Existing GSE not controlled, relying on proper return
    - A lot of time spent due to misplacement
  - Cost benefit analysis does not justify investment…
    - Focus on quality, safety, and image
    - This is also part of the comprehensive solution
  - Used RFID for GSEs but not for tools
    - Tools are already barcoded
    - 20,000 tools; hundreds of different sizes and sha results with many RFID tag types
    - Which tools to tag? Too many small tools
    - Importantly, fast inventory is required frequently for tools
    - Existing barcode system works well
  - Required the installation of wireless infrastructure

Source: Aircraft IT MRO

# Trends

- Maturing mobility
- Additive manufacturing
  - 3D printing
- Wearable devices
- Analytics