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Team Heathrow Baggage

The QMOD-ICQSS Conference 2018

Cardiff University, Wales, 22-24 August 2018

IMPROVING MAINTENANCE QUALITY IN AIRPORT BAGGAGE HANDLING OPERATIONS

FRANK KOENIG, PAULINE FOUND, MANEESH KUMAR AND RICHARD MCMEEKIN


AIRLINES LOSE MILLIONS OF BAGS A YEAR
AND HOW WOULD YOU LIKE YOUR BAGS LOST TODAY? ON A WRONG FLIGHT, LEFT BEHIND OR 'WE DON'T HAVE THE FOGGIEST IDEA WHERE THEY'RE AT'?
STAYSKAL
TRIBUNE MEDIA SERVICES 9/07

Presentation

- The Challenge / Opportunity
  - The Context
  - The Environment
  - The Problem
  - Bounded scope for today
- Study, Application & Affect
  - Starting Point
  - Research Question
  - Process for Change
- Change
  - Abrasive wear
  - Chain tension
  - Drive station / missing slats
- Close
  - Findings
  - Conclusion
  - Future
- Q&A

Heathrow Airport - Context

- More than 70million passengers through Heathrow every year
- The third busiest airport in the world
- Every day 1,400 flights take off and land (1 every 45 seconds)
- Flights stop at 23:30 and resume 04:30.
- Around 53million pieces of luggage are processed every year.

The Baggage Cycle - Environment

Check In → Security → Sort → Load

Transfer

0.57% of all checked in bags do not arrive together with their owner

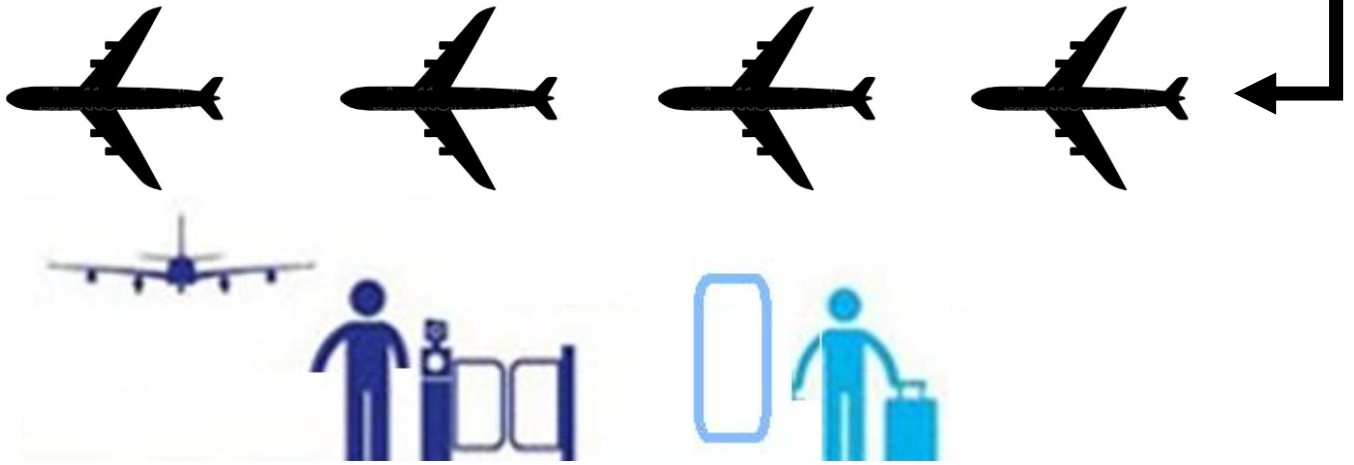
Overall cost US$ 2.1B (SITA 2017)

Unload → Arrival

Airport Digitalisation – The Problem

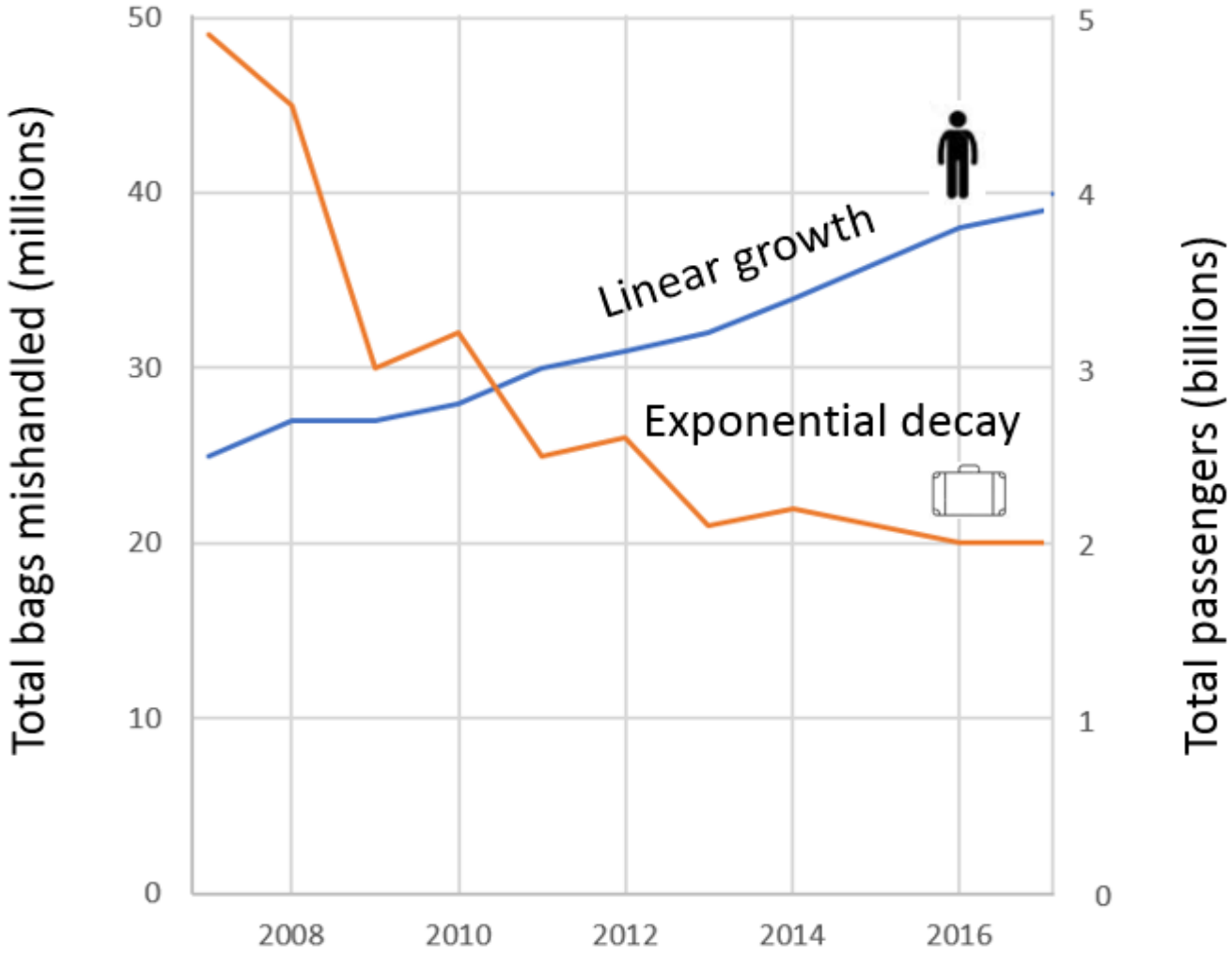
Booking → Check In → Bag Drop → Security → Border Control → Boarding

ITV Heathrow Britain's Busiest Airport; Series 4, Episode 3 of 6; Aired Wednesday 25th July 2018



Border Control → Reclaim

Legislation & Cost - Problem



- Legislation changed 1999 so that passengers are compensated for lost or late bags (Rossi Dal Pozzo, 2015).
- Airline liable for compensation for baggage delay, limited to €1,220 per lost or late bag (SITA, 2017).

Source: Godin - 2005

Bounded Scope

In

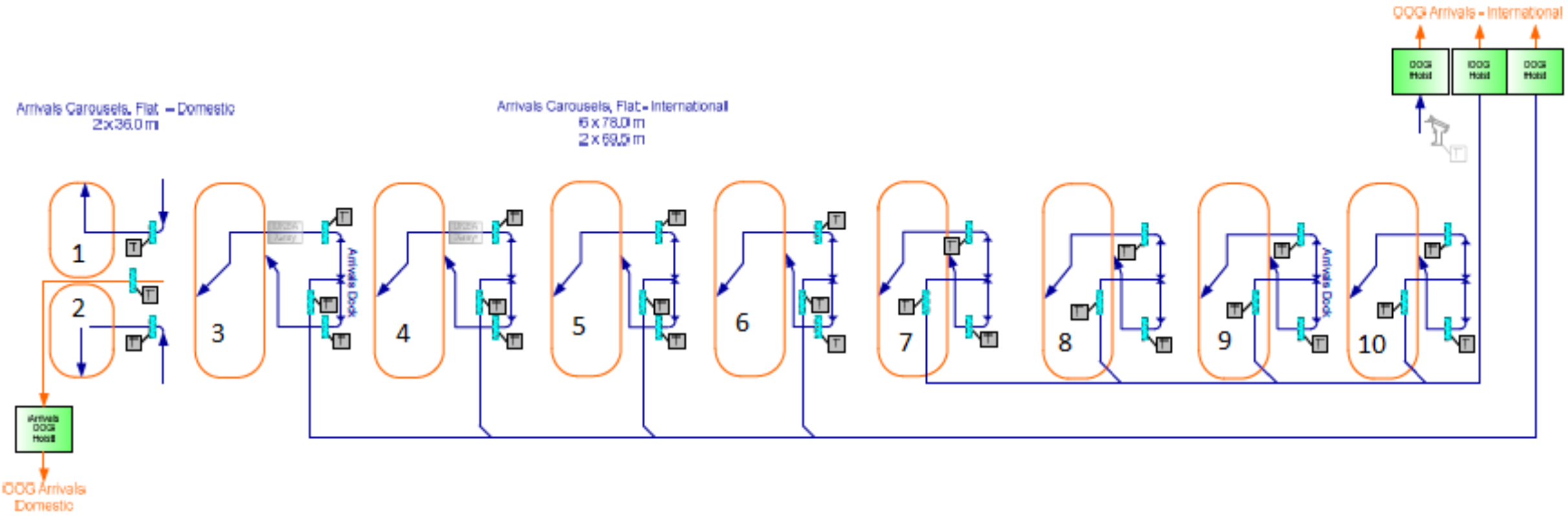
- Heathrow Airport
- Terminal 2
- Baggage Handling system number 2 (1 of 10)
- Delayed baggage
- Maintenance Quality
- Customer Quality expectations

Out

- Full End to End System Improvements
- Poka-yoke of the handling system

The Starting Point

- Historically two reclaim carousels were for contingency, now no redundancy.
- No condition based maintenance solutions known for reclaim carousel technology.
- Detailed analysis required to identify all failure modes causing unexpected downtime.
- Based on analysis, develop & test solutions prior to improving maintenance quality.



Impact of Airport Digitalisation

With the optimised arrival process and the increasing number of passengers with a biometric passport, the **passengers arrive at reclaim carousels up to 20 minutes earlier**.
This led to a significant increase of complains about poor operations as passengers reclaim waiting time increased.

Stakeholder Airline:

- Arrival hall final passenger quality capture point.
- Penalties over £100k/month if 99.97% quality satisfaction target is missed

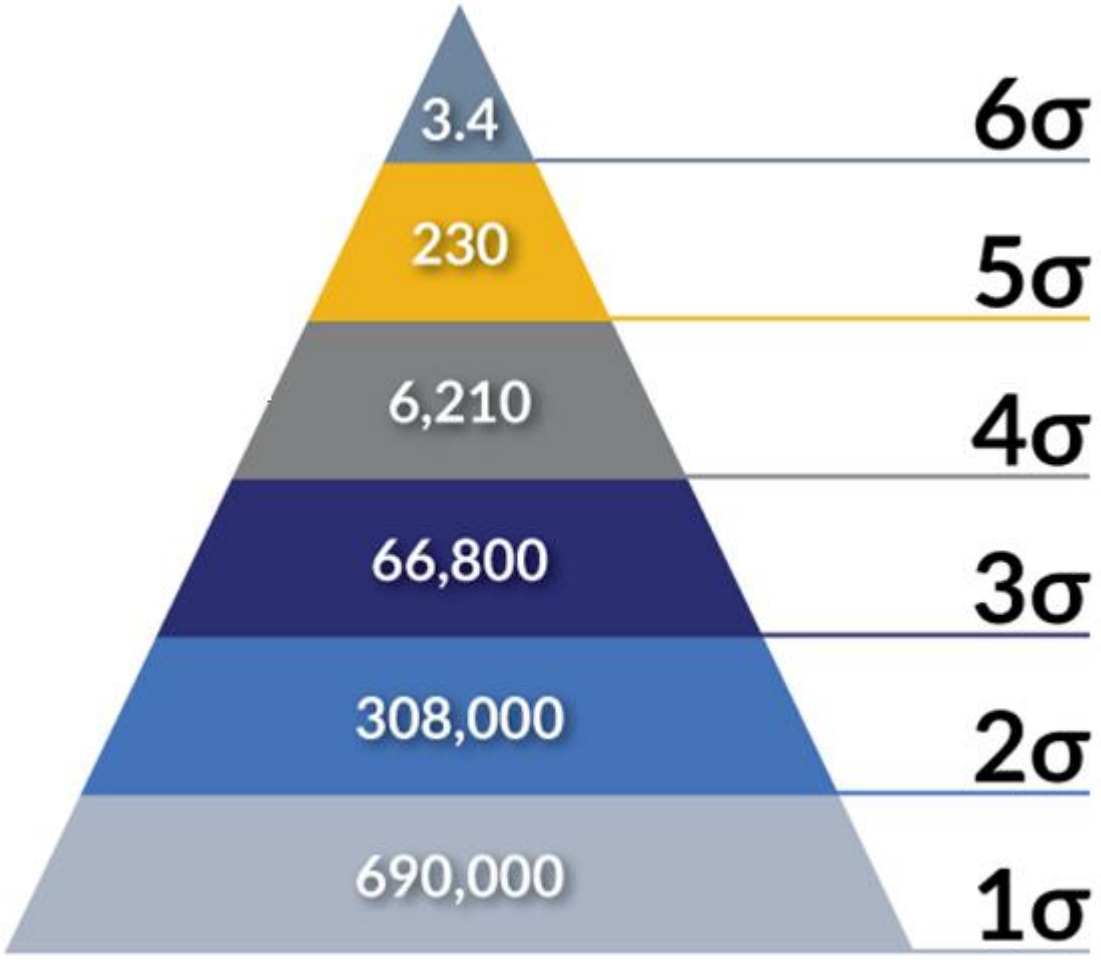
Stakeholder Airport O&M:

- Arrival reclaim focus of improvements
- Target is 100% availability
- Time based or run to failure maintenance questioned
- Condition based maintenance preferred

Customer Perceived Quality Satisfaction

- Civil Aviation Authority (CAA)
- Service Quality Rebate System introduced to identify service standards that **airlines and passengers** could expect at Heathrow
- Passenger Sensitive Equipment (PSE) – which includes arrival baggage reclaim system.
- Heathrow 7% penalty of charges paid for failure to meet quality standards

Baggage Handling Systems – Performance Level



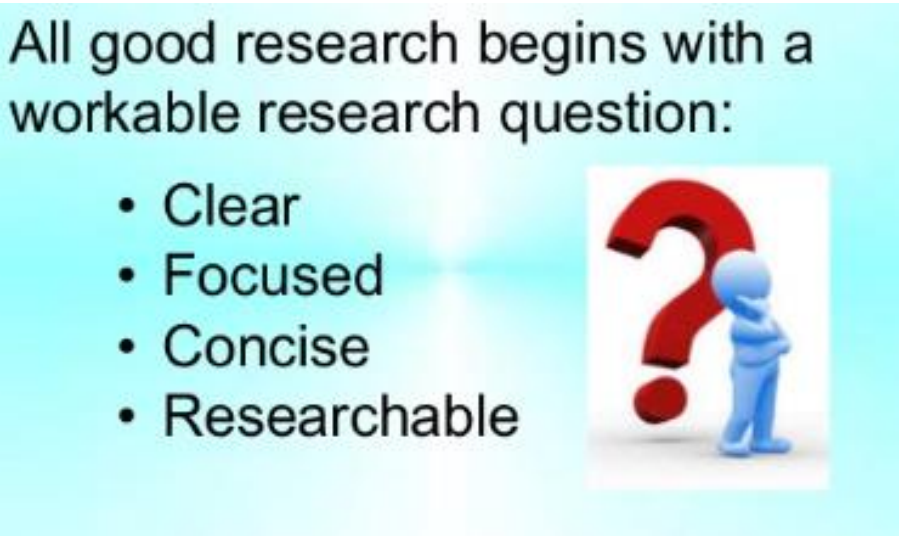
Sigma Level	Defect Rate (per million)	Yield (%)
2	308770	69.11609
3	66811	93.30957
4	6210	99.36906
4.2	5730	99.41706
5	233	99.9667
6	3.44	99.98966

Source: Brenig-Jones - 2015

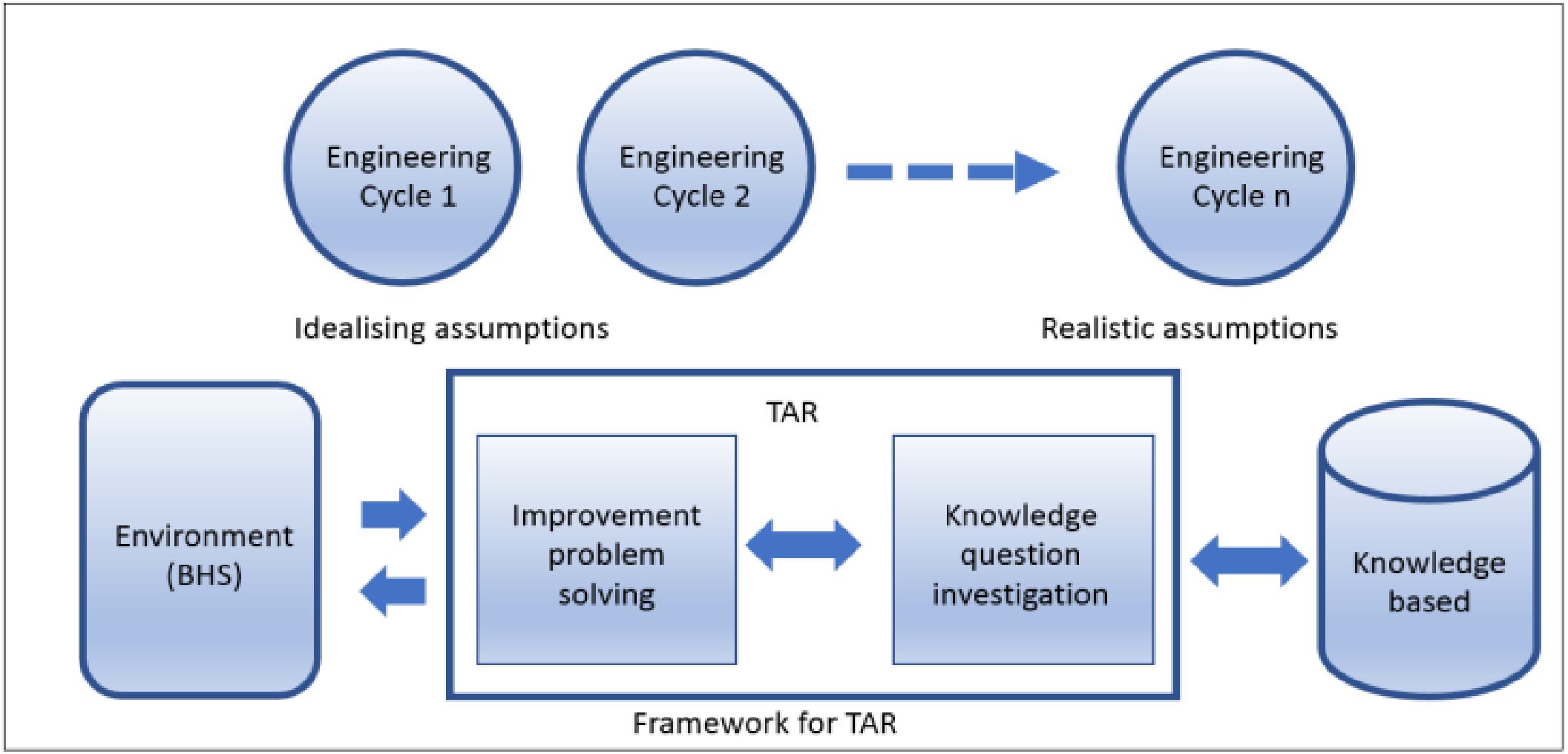
Research Questions

- RQ1: What system features enable or inhibit high levels of reliability in time critical airport logistics?

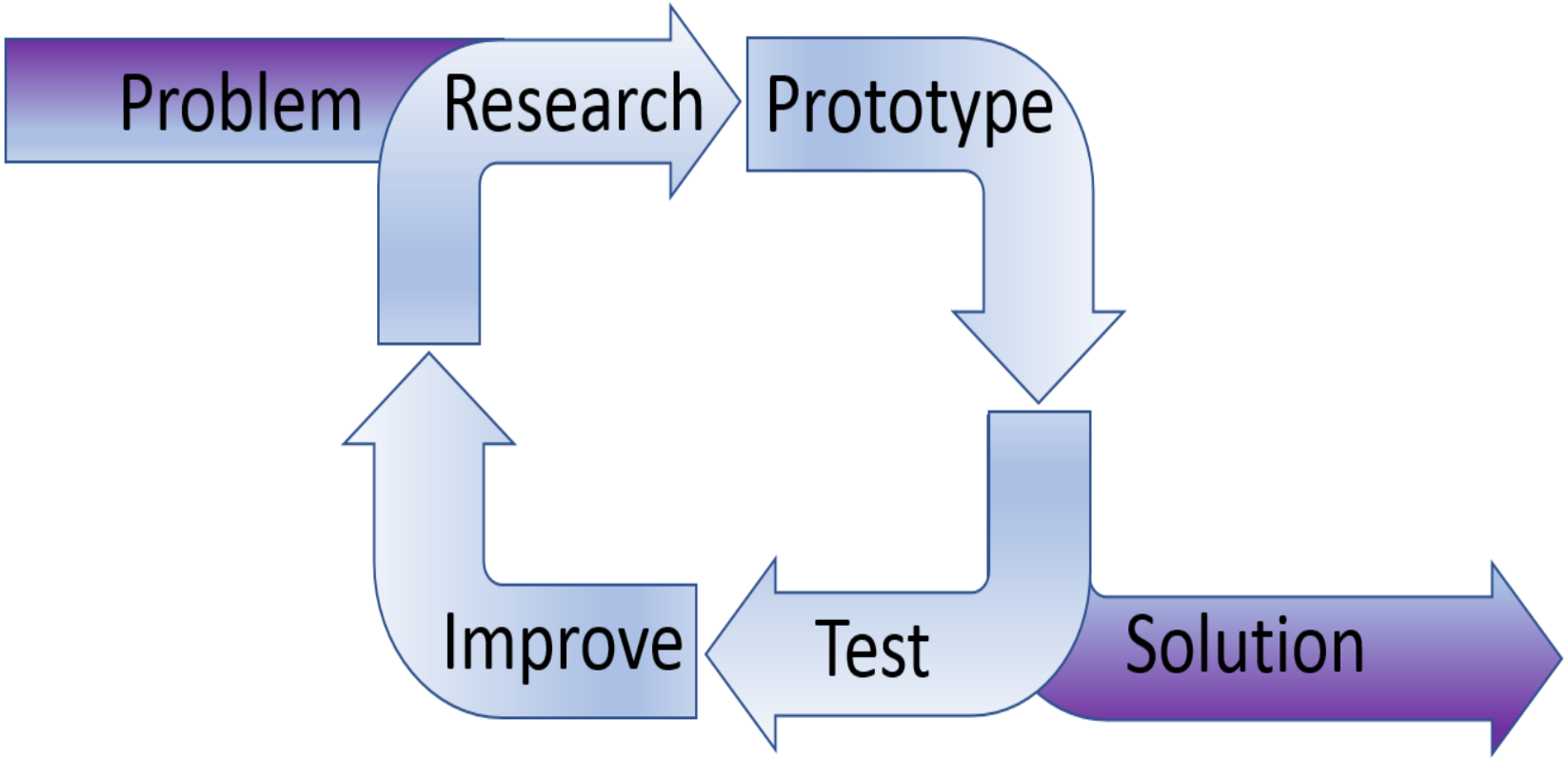
- RQ2: How are innovations embedded into current time critical airport logistics socio-technical systems (adaptation/adoption) ?



Process for Change - Technical Action Research (TAR)

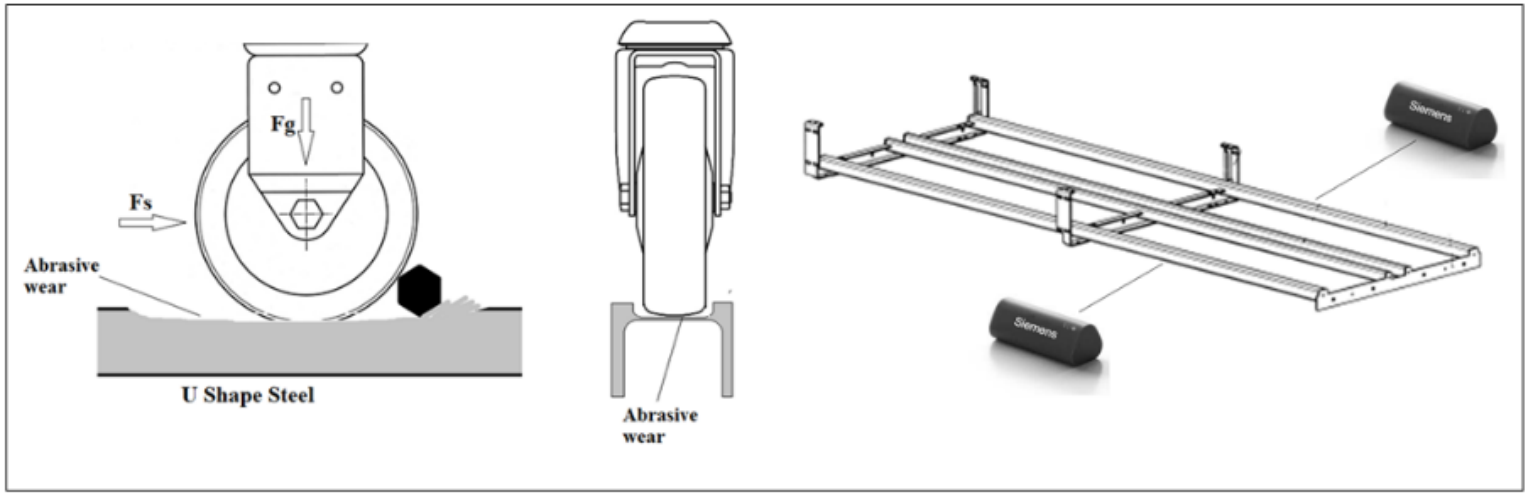


The Engineering Cycle



Source: Tidd

Abrasive Track Wear Detection
Instant Detection to avoid heavy Wear

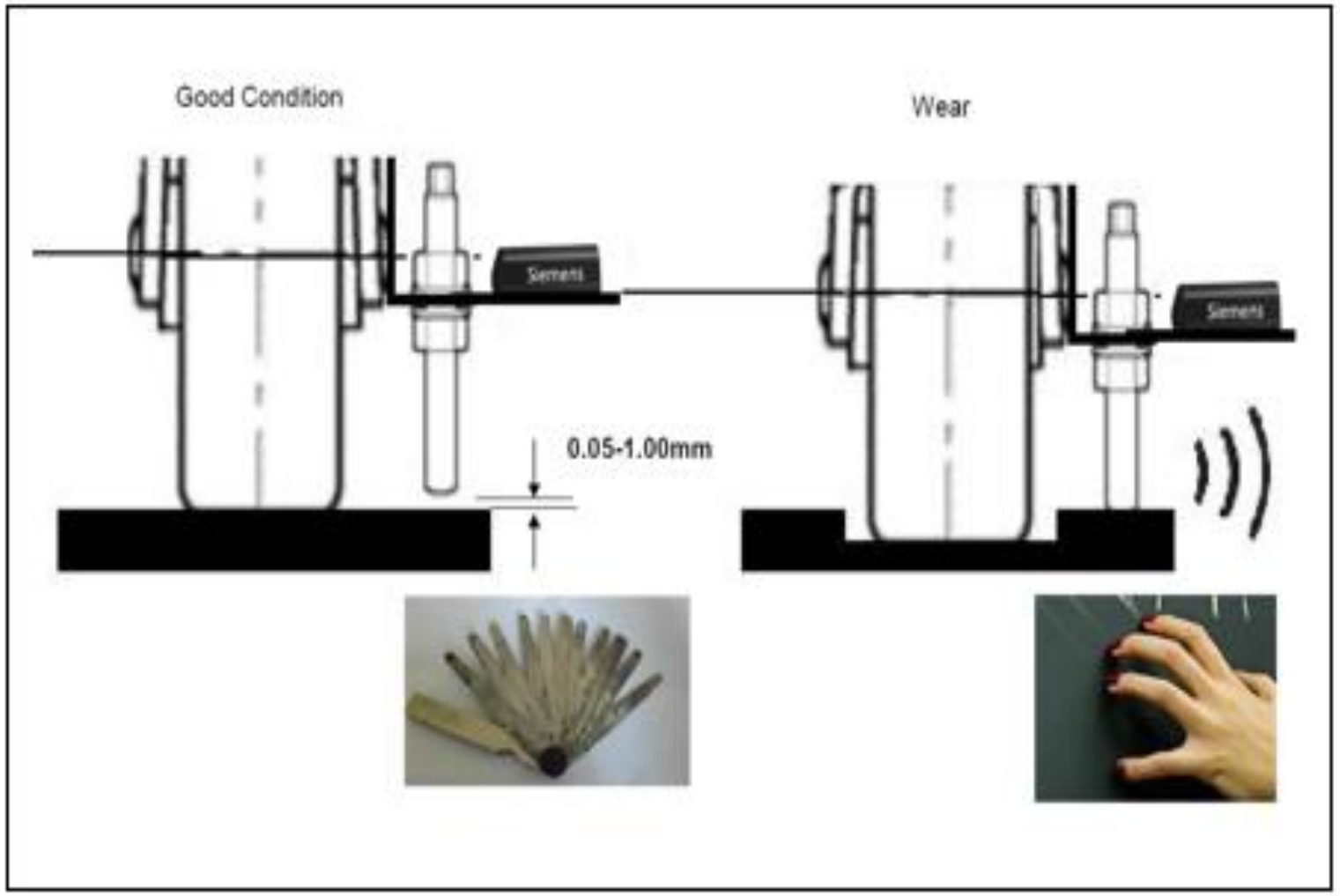


Problem:
Objects such as locks, handle, coins, bands, zippers and tags that squeezed in between slats, falling on the track, blocking a wheel and get carried around ‘forever’. The event remains unnoticed as happening behind slats and stainless cladding.

Comment:
Abrasive wear on tracks and worst case heavy loss of track material causing tracks to collapse under load.

Measures to increase Maintenance Quality:
Early detection of the situation with 2 wireless iBeacon vibration sensors ‘listening’ to scratch noise.

Abrasive Track Wear Detection
Detecting critical Threshold

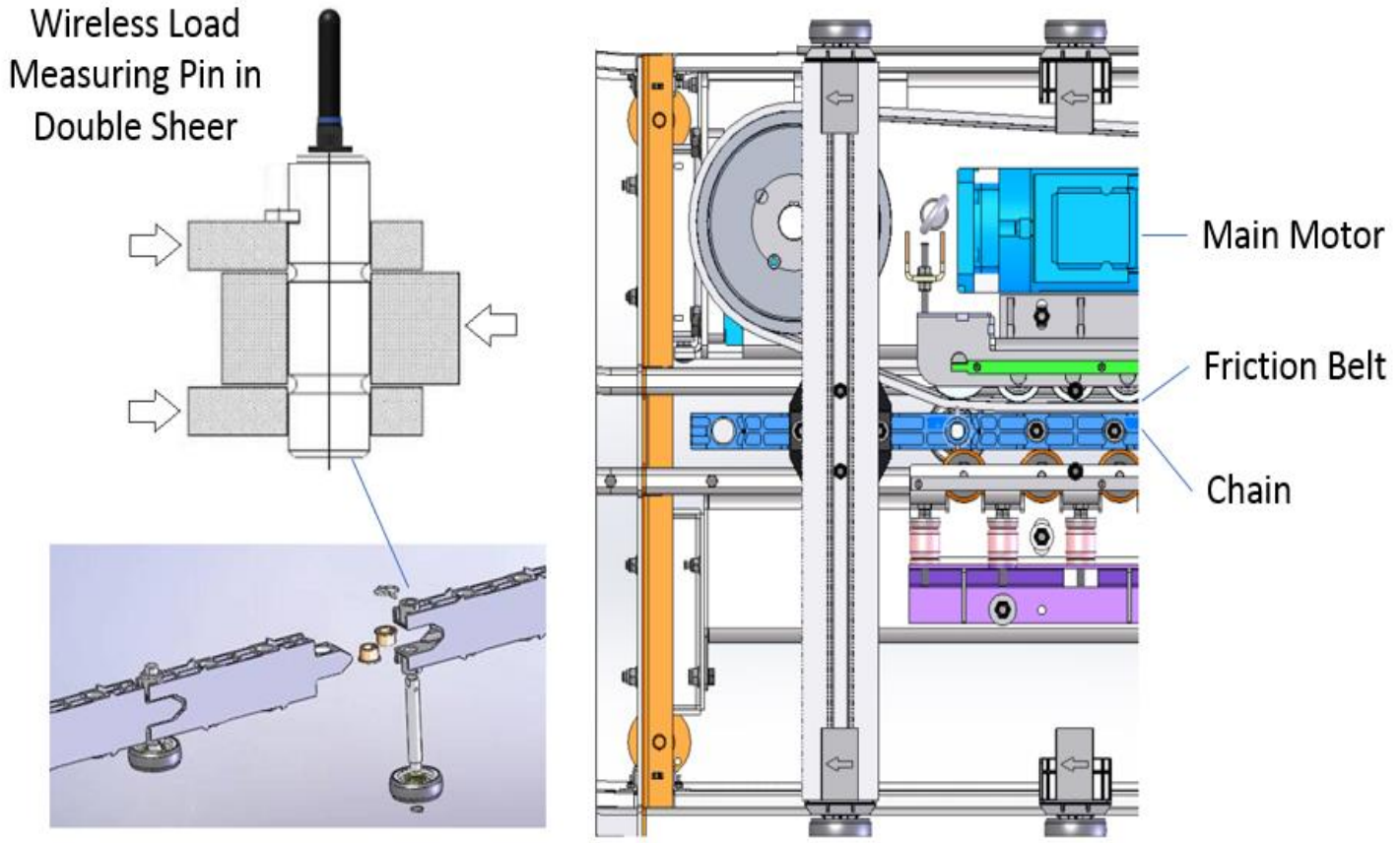


Problem:
Time consuming track wear inspections. Usually there are 50+ reclaims with over 1km tracks in an capital airport. It is a time consuming task to check and find wear on equipment hidden behind slats and cladding.

Comment:
System that detect if a critical threshold is reached and send warnings via SMS or email.

Measures to increase Maintenance Quality:
Adjustable needle that will touch the track in case the critical threshold was reached. A iBeacon vibration sensor picks up the generated vibration what triggers an alarm.

Wrong Chain Tension
Detecting critical Threshold



Problem:
Following the manufacturers O&M manual, chain tension need to be checked weekly. The process is time consuming.

Comment:
Over or under tensioned chains are the main reason for roller wear.

Measures to increase Maintenance Quality:
Wireless load pin that measures the chain tension continually.

Drive Station Monitoring
Recognise Noise generated by Failure

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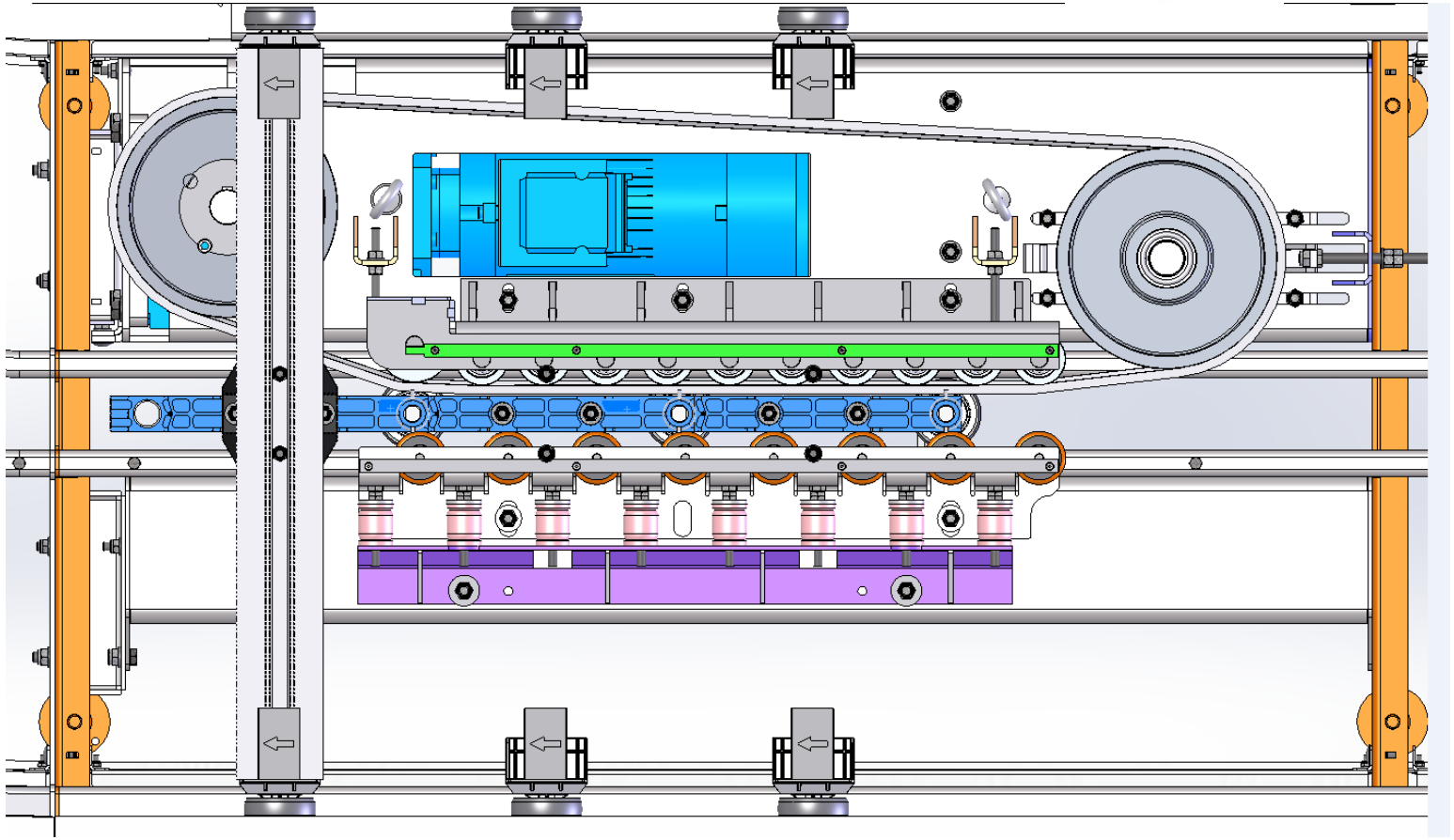
Wireless Microphone

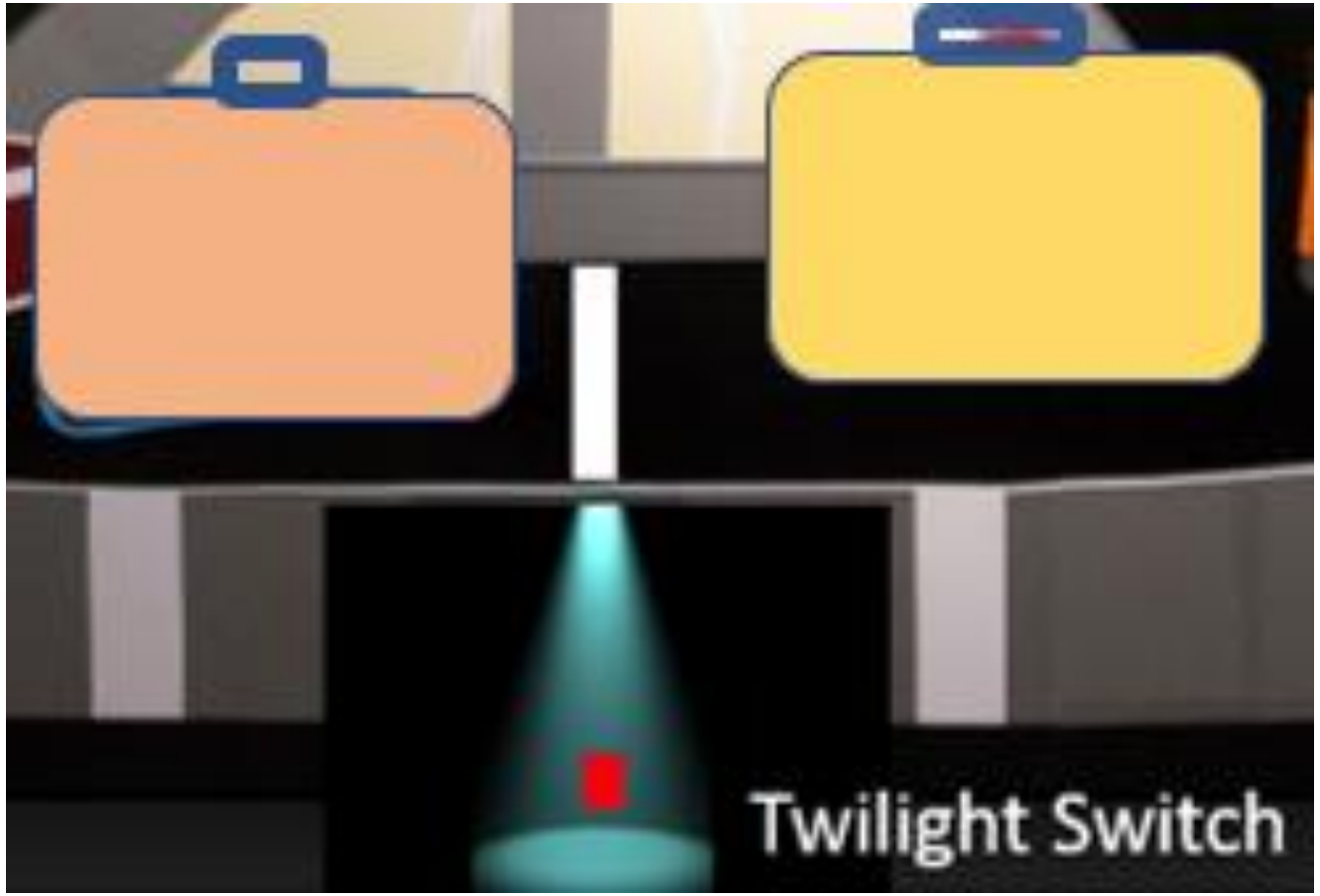


Problem:
Drive station mechanical parts wear over time or get impacted by debris

Comment:
Unnormal noise generated

Measures to increase Maintenance Quality:
Recording and reporting of noise deviation as a early warning of a developing failure.

Missing Slats
Detecting a serious H&S Problem



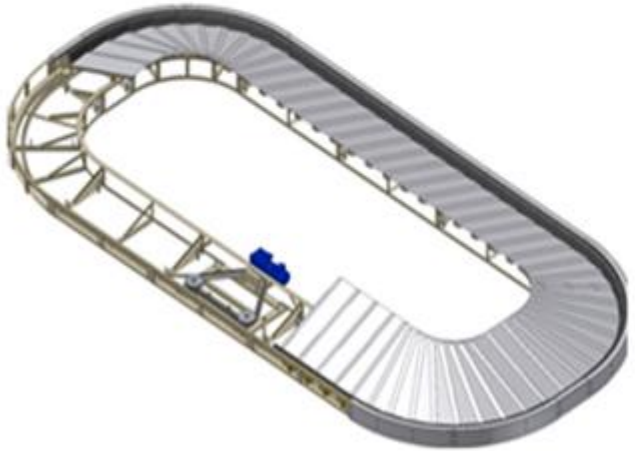
Problem:
Following O&M reports, bags or rucksacks with bags get caught underneath slats. Passengers trying to get their sucked bags and rip of slats.

Comment:
Missing slats are a serious health and safety problem.

Measures to increase Maintenance Quality:
Twilight switch detecting missing slats by the light that gap let go through.

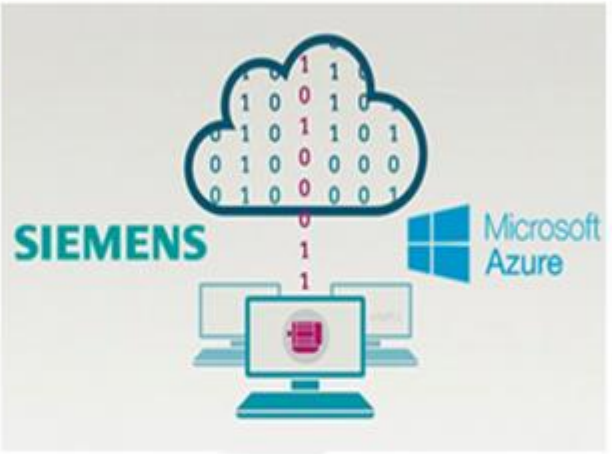
Baggage Handling System as a Business

Chain Tension > Strain Gauge
Vibration > Abrasive Wear
Temperature > Panel Equipment
Twilight > Missing Slats
Sound > Part Condition

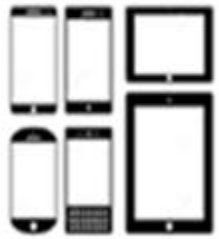


Data Pre-Processing and transmission to Siemens IoT Ecosystem Mindsphere

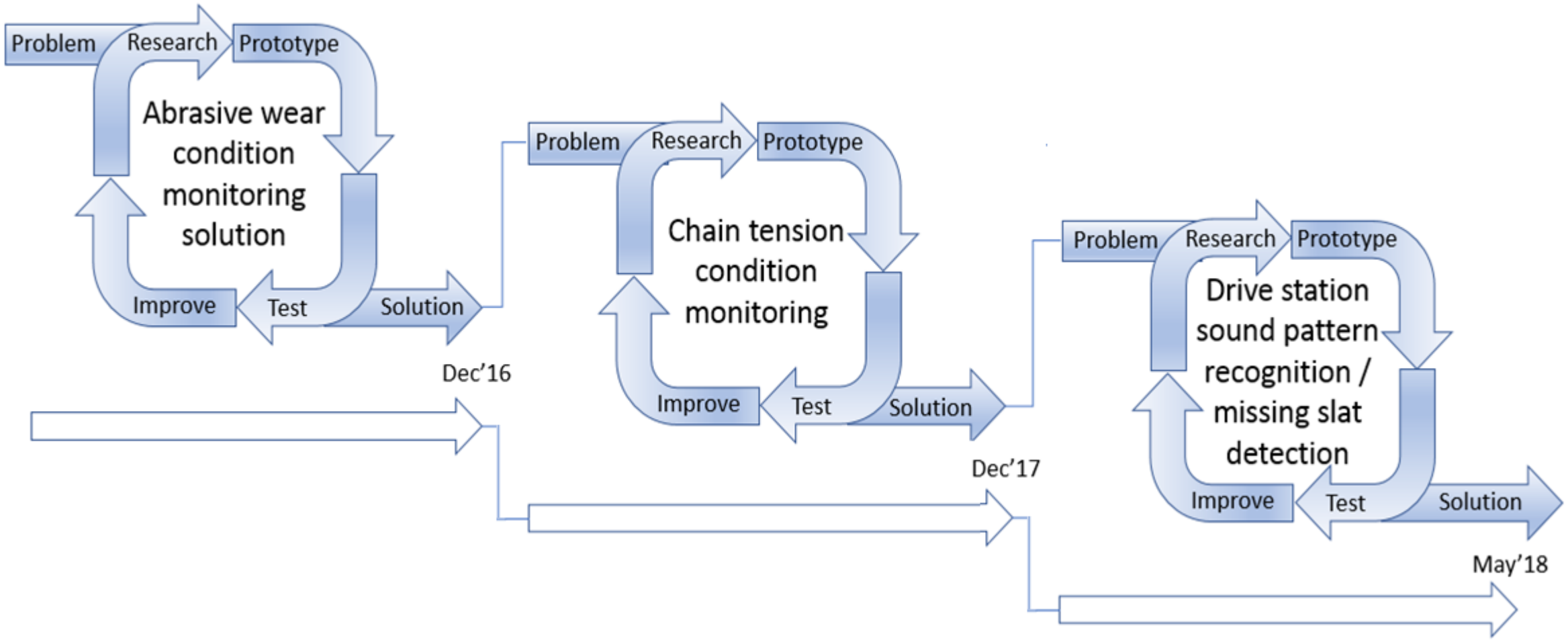
Siemens Mindsphere Portfolio



Dasboards and instant Alarms (Email or SMS)



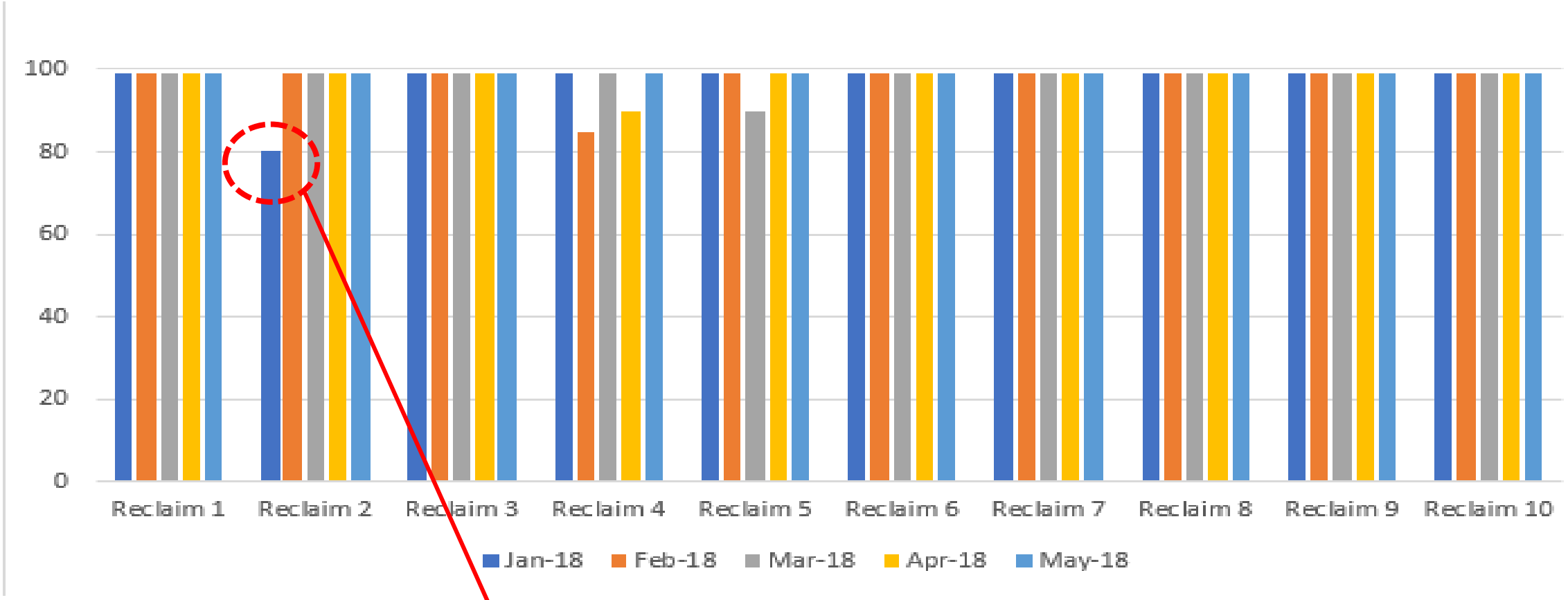
Baggage Handling System Approach



Findings

- Predictive quality maintenance through condition based monitoring for hidden assets in near constant use, using wireless beacon technology has demonstrated benefits.
- The study highlighted the value of changing from antiquated ‘run to failure’ maintenance of hidden assets in airport baggage handling carousels methods to high quality maintenance, through use of Condition Monitoring using wireless vibration sensors linked to a cloud based IoT ecosystem.
- Run to failure maintenance not conducive to meet increased demand and customer expected levels of quality service.
- Using the cloud based Internet of Things (IoT) and Airport 4.0. has also necessitated many sophisticated checks and further measures, now in development.

Heathrow Baggage Handling System

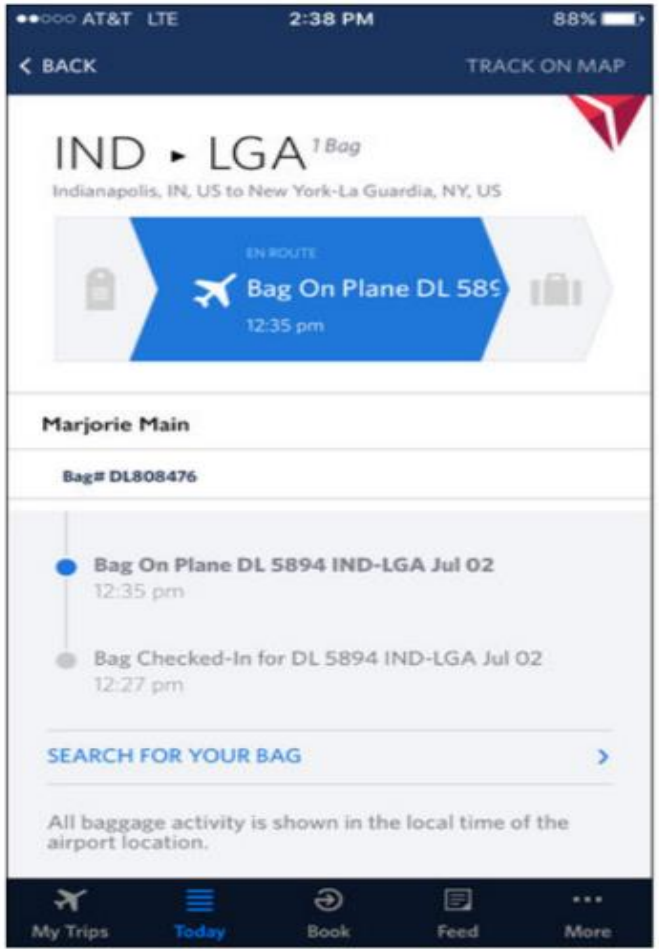


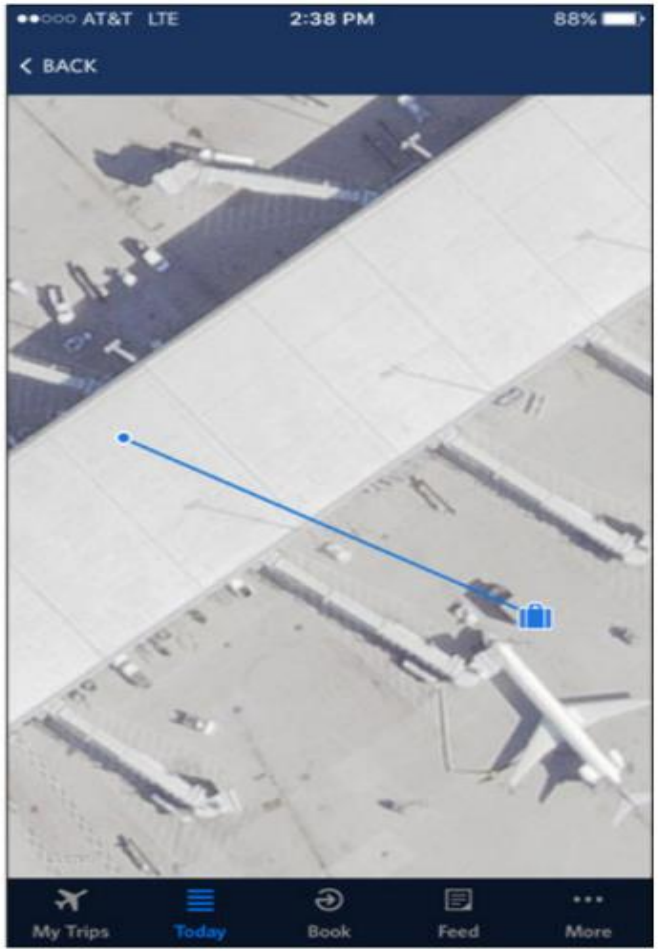
Worse performing reclaim station

Conclusion – Where are we going?

- Maintenance quality approved, changed & demonstrated.
- Heavy damage and delays can be avoided.
- Solution addresses variety of hidden equipment problems.
- Quality of service on critical assets.
- Customer (passenger) expected quality service can be achieved.
- Customer (airline) expected quality service can be achieved.
- Approach is conducive to support full end to end improvements and innovation.
- Profit £, Customer expectations & digital age

Future Research





Problem:

Airlines investigate in RFID technology that allows passengers to locate their bags. Stranded bags due to baggage handling system failure will have the risk that passengers go for a search by themselves.

Future Research

Impact:

- Passengers in restricted areas.

Future Research:

- Impact of digitalisation in the passenger area on baggage handling.

Future Research

- Expand E2E view of the customer experience

- How tap in to social media for the informal truth (metric) that shapes customer perception

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