GTAA IoT Pilot Project

Real Time Asset Health Analytics

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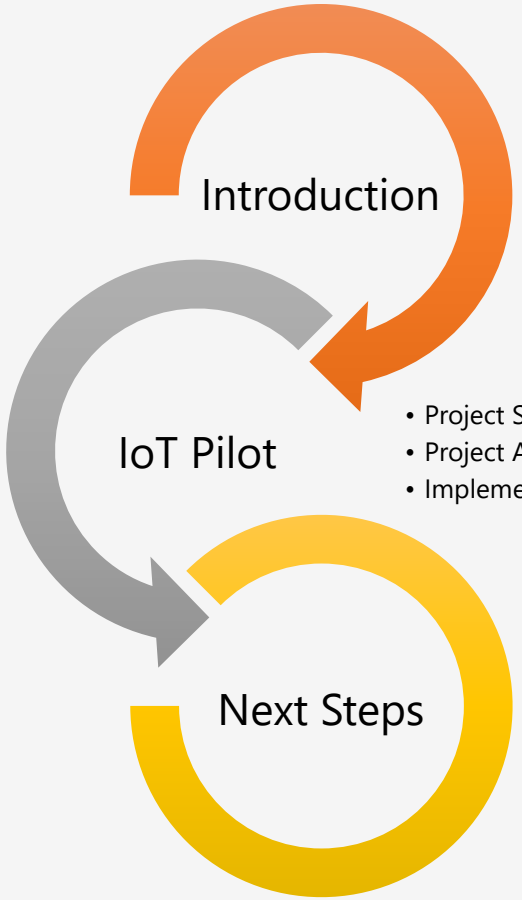
AGENDA



- About Toronto Pearson
- Problem Statement
- Solution (IoT) / Expected Results
- Why?

- Project Scope
- Project Architecture
- Implementation

- Current Status
- Gathering of Data
- PMQ
- Predictive Maintenance
- Feasibility
- Lessons Learned

About Toronto Pearson

100% Self-funded (no government funding)

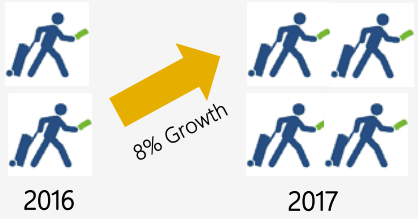
- **Largest Airport in Canada** with 180 destination
- 44+ Million Passengers
- 7.1% Avg. Growth in the Past 3 Years
- *440,000+ Aircraft Movements*
- **45% of Canada's Air Cargo**
- *23rd Busiest Airport by Total Passenger Traffic*
- **15th Busiest Airport by Flights**
- 2nd Largest International Airport in North America
  (second only to JFK)

Toronto Pearson Assets

- **$7B GTAA Managed Assets**
  - 100+ Passenger Boarding Bridges
  - *22+ KM of Baggage Handling Systems*
  - ***117MW Co-Generation Plant***
  - 2 Terminals & 5 Runways
- **300+ People Moving Devices**
  - Cable Driven Automated Terminal Link Train
  - *200M SQFT of Airport Land*
  - Sewage Lifts & Storm water Facilities

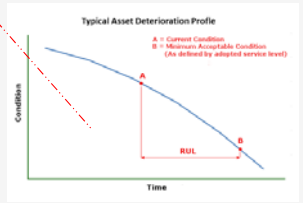
Toronto Pearson – Challenge of Growth

Passenger Growth

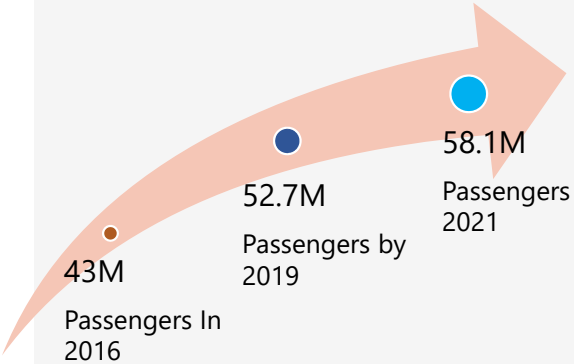


Impact on Airport

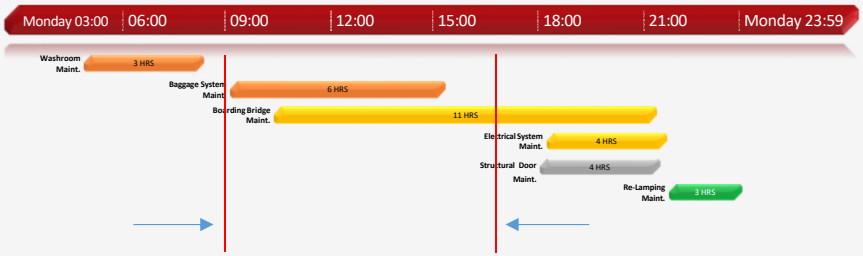
Impact on Asset Health



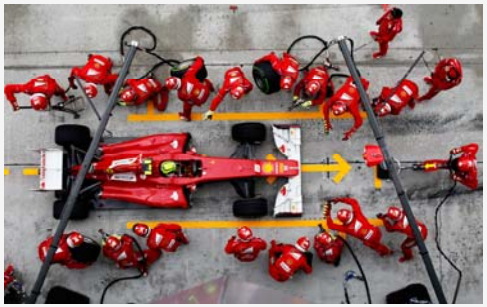
Maintenance Impact



118,000 PAX / Day in 2016
159,000 PAX / Day in 2021



Shorter Maintenance Windows



Pit Stop Precision & Efficient Maintenance

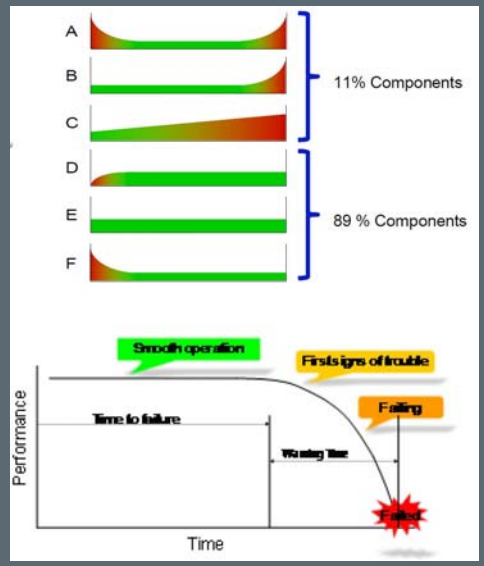
Problem

1 **Most Organizations have Tons of DATA but not the RIGHT data or USEFUL Information**

In 2016 GTAA Dispatch Centre Handled:

PWC: **1386** Dispatch Calls
ESC/MW: **8338** Dispatch Calls
T1/T3 BHS: **9286** Dispatch Calls

2 **Approximately 11% of components of a complex asset fail over time. 89% fail randomly over time.**

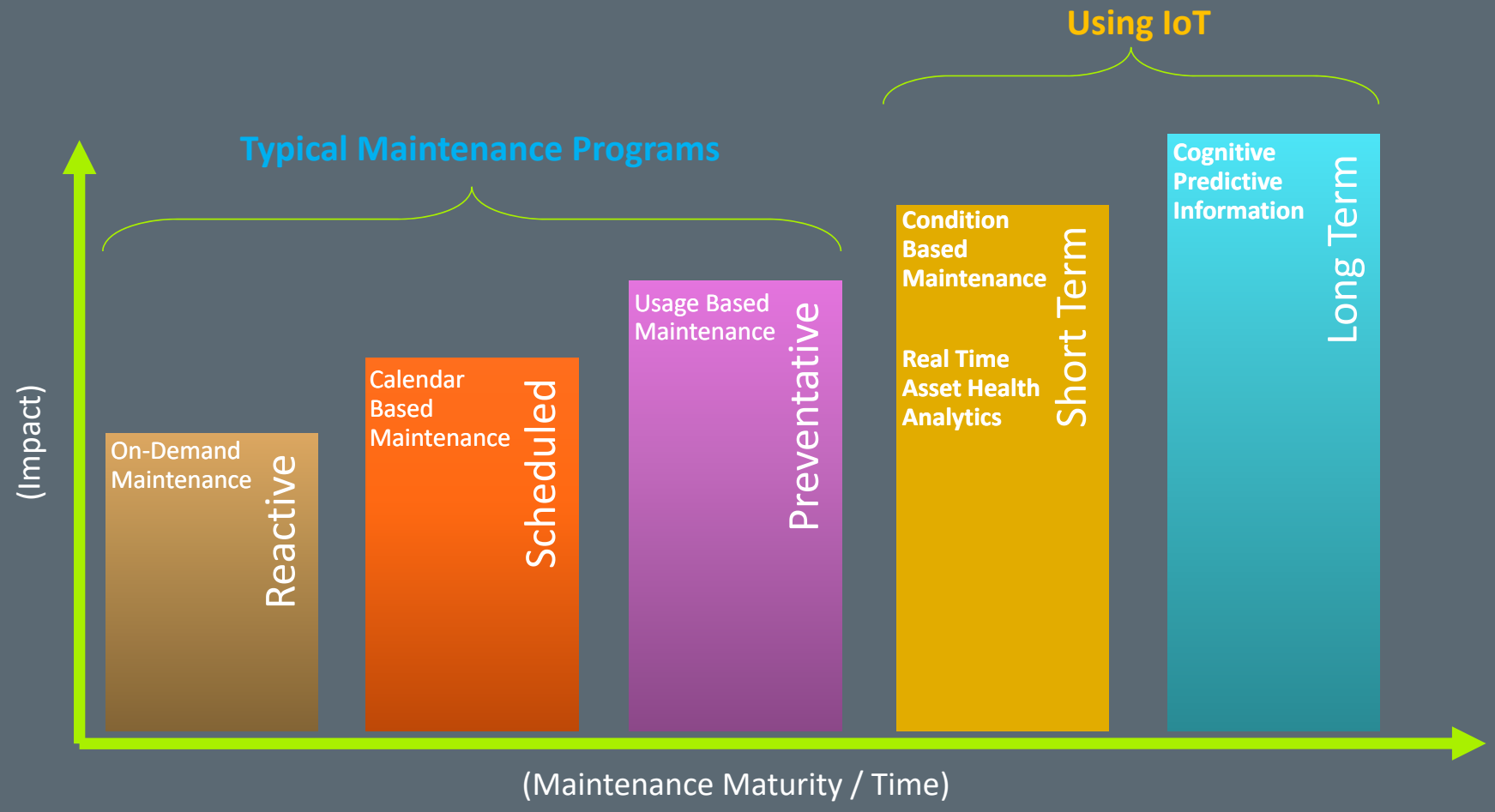


Solution (IoT)

The **Internet of Things** (**IoT**) is the networking of physical devices or "things" embedded, with electronics, software, sensors, and connectivity to enable objects to collect and exchange data.

- Experts estimate that the IoT will consist of almost 50 billion objects by 2020
- IoT helps organizations move to advanced stages of Asset Management
- Addressing the 89% random failures with a combination of Asset Data, Operations Data, Maintenance Data and supported by Technology (IoT and PMQ) is key to being a leader in this challenge

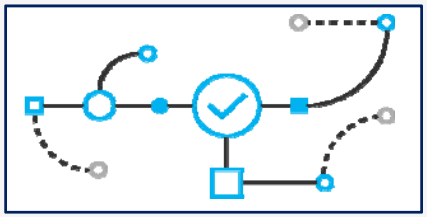
EXPECTED RESULTS



What is Cognitive Analytics

There are three capabilities that differentiate cognitive systems from traditional programmed computing systems

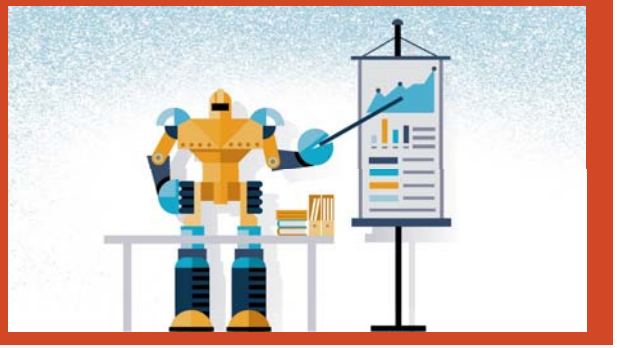
Understanding
Cognitive systems understand like humans do, whether that's through natural language or the written word; vocal or visual.



Reasoning
They can understand information but also the underlying ideas and concepts. This reasoning ability can become more advanced over time.

Learning
They never stop learning. As a technology, this means the system actually gets more valuable with time. They develop "expertise".

Intelligent Assets



Understanding

"I am not feeling well today. My sensors are telling me I am overheating and have unusual vibration. My last service was four days ago and the service completed was a motor replacement. My next scheduled maintenance is in three weeks"

Reasoning

"Based on past failure conditions, I know I am going to fail within the next (3) Days!"

Learning

"I suggest you replace my drive bearing"

WHY?

Value Proposition

Extend Asset Life

- Improve return on investment

Improve Reliability

- Minimize downtime/failure
- Increase service availability

Optimize Maintenance

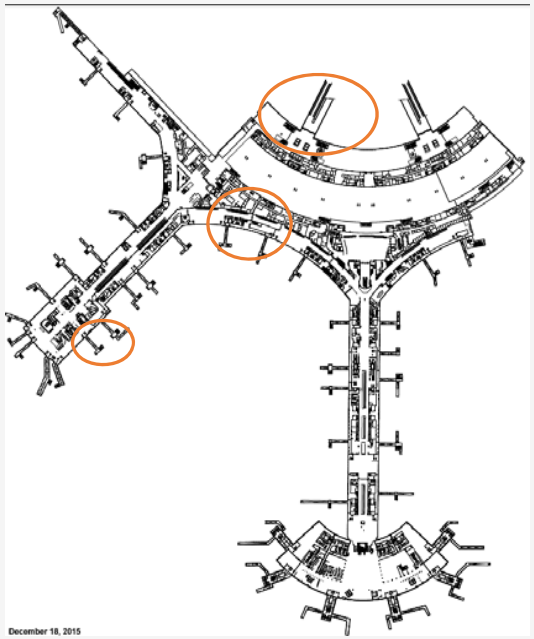
- Optimize asset performance
- Reduce operating cost

Customer Experience

- Reduce Customer Impact
- Best Airport in the World

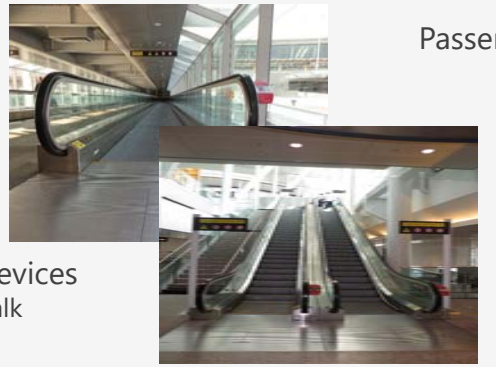
Project Scope

GTAA has teamed with EDI, Arrow Electronics and IBM to implement an IoT pilot project which will deliver real time data for asset health monitoring and predictive failure analytics. The pilot will be focused on three key customer facing systems:



1

People Moving Devices
- Moving Walk
- Escalator



2

Passenger Boarding Bridge
- Potable Water Cabinet

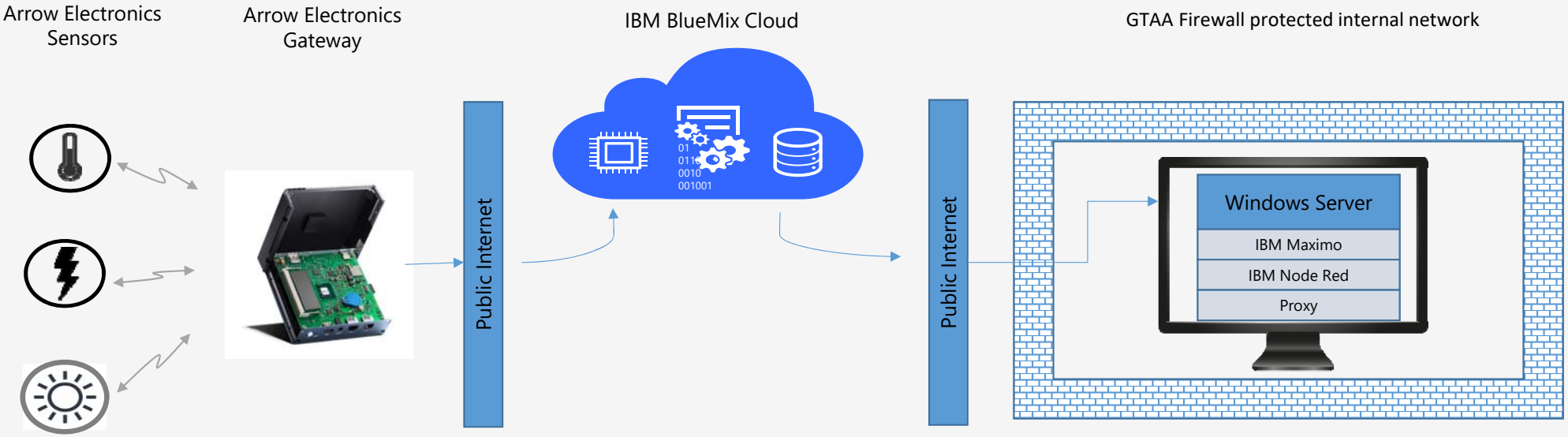
3

Baggage Handling System
- Power Turn Conveyor

Project Architecture

Publish and Subscribe based flow

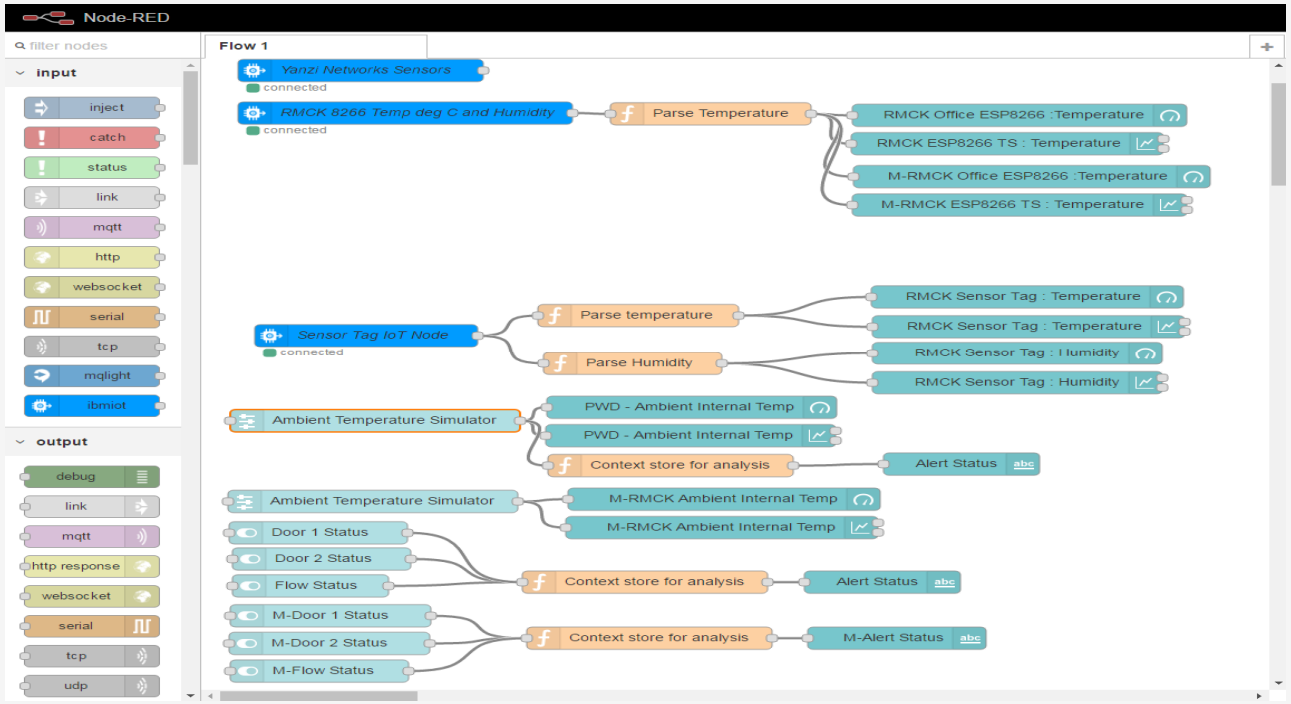
- Sensors connect to Arrow Connect Gateway – Arrow Connect Gateway **publishes** sensor messages to IBM Cloud
- Sensor data is rendered into dashboards using IoT Platform and Node Red
- Node Red used to apply logic and rules to the data so that automatic work orders are produced in Maximo
- Asset meter objects collect data from the IoT Platform by subscribing to meter events
- Data is stored in a cloud based database for longer term historic analysis (Required for predictive analytics)



Project Architecture

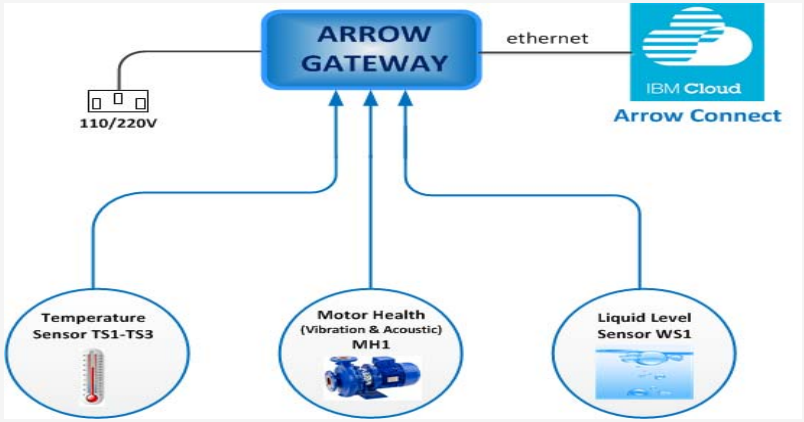
IBM BlueMix/Node Red

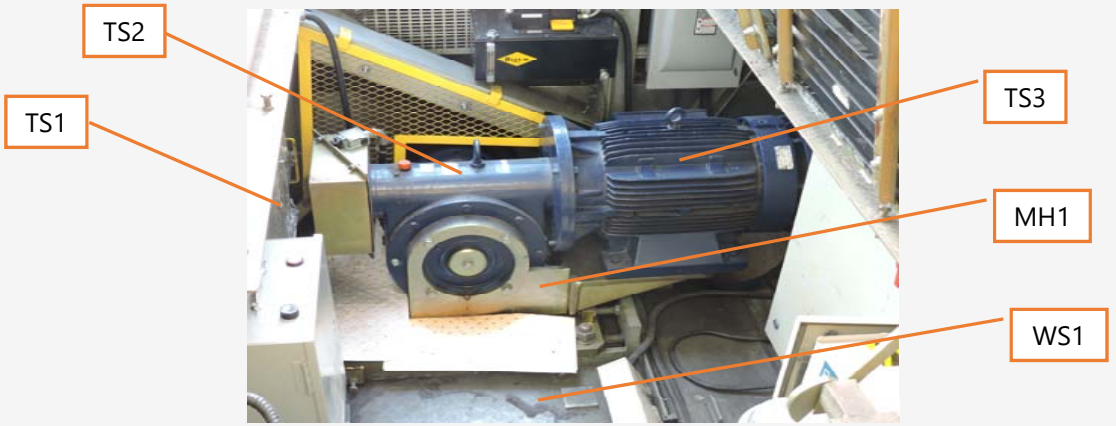
- Converting Data to Information using Rule Based Analytics



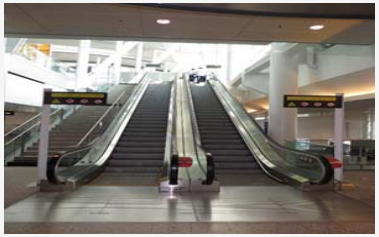
Implementation (Moving Walk – Sensors & Communication)

Device	Description	Qty
GW1	Gateway	1
TS1	Ambient Temperature	1
TS2	Gearbox Temperature	1
TS3	Motor Temperature	1
MH1	Motor Vibration/Acoustic	1
WS1	Fluid Leakage	1
ENC1	IP-66 Enclosure	1
PS1	DIN Rail Power Supply	1





Implementation (Escalator – Sensors & Communication)



Device	Description	Qty
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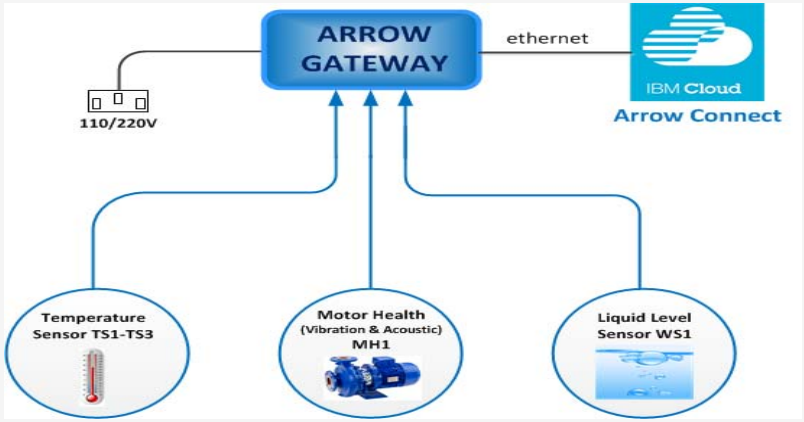
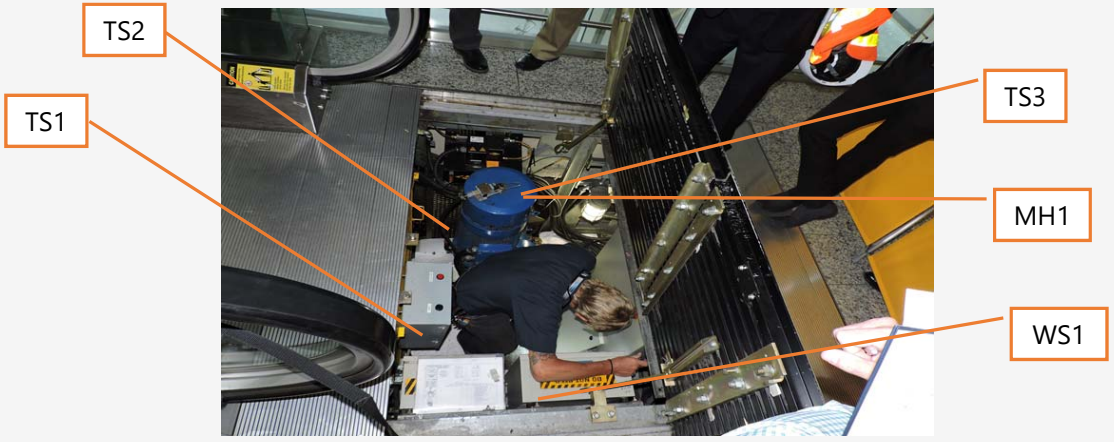
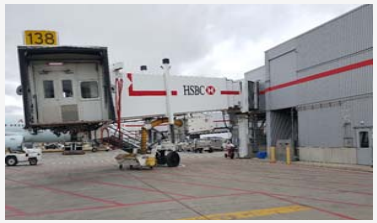
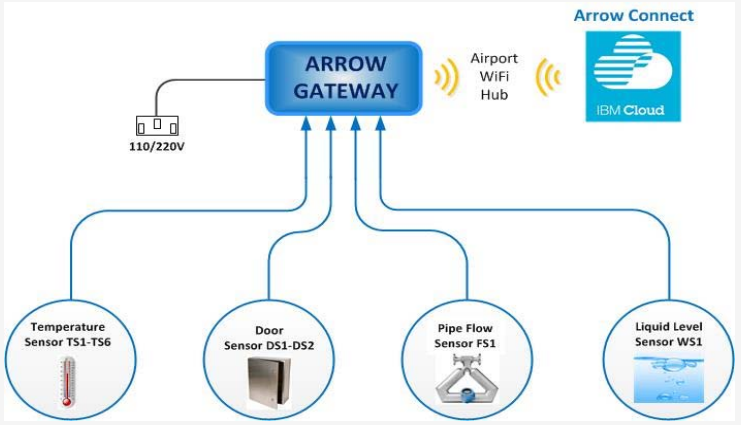


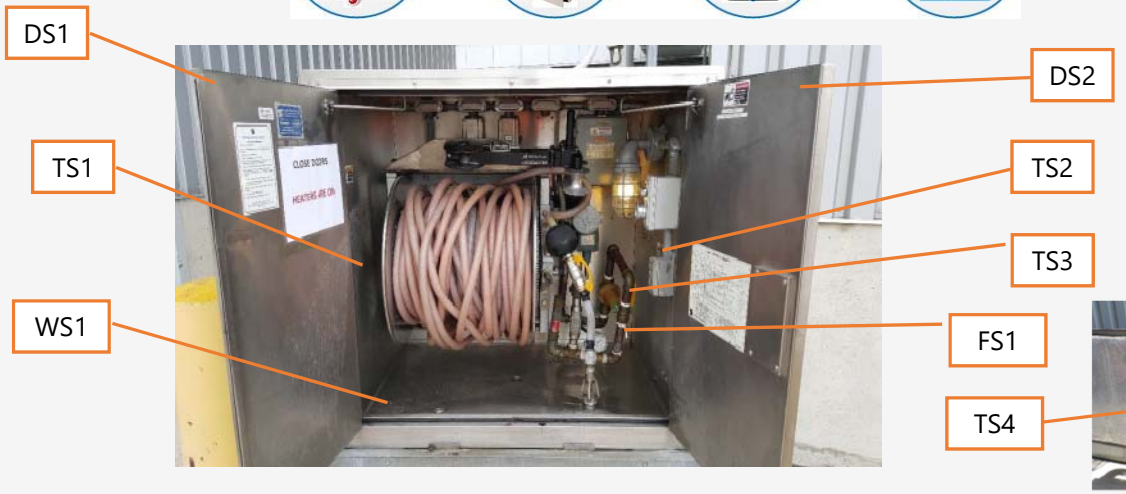


Implementation (PWC – Sensors & Communication)



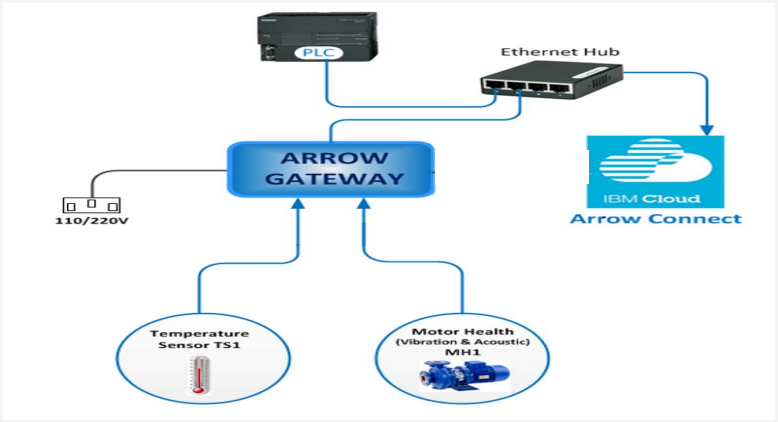
Device	Description	Qty
TS1, TS2	Heating Pad Temperature	2
TS3	Pipe Temperature	1
TS4	Backflow Cabinet Ambient	1
TS5	Cabinet Ambient	1
WS1	Drain Leak Detection	1
FS1	Water Flow Detection	1
DS1..DS2	Door Open Sensors x2 (Left, Right)	
GW1	SBC/Sensor Gateway	1
ENC1	IP-66 Enclosure	1
PS1	DIN Rail Power Supply	1



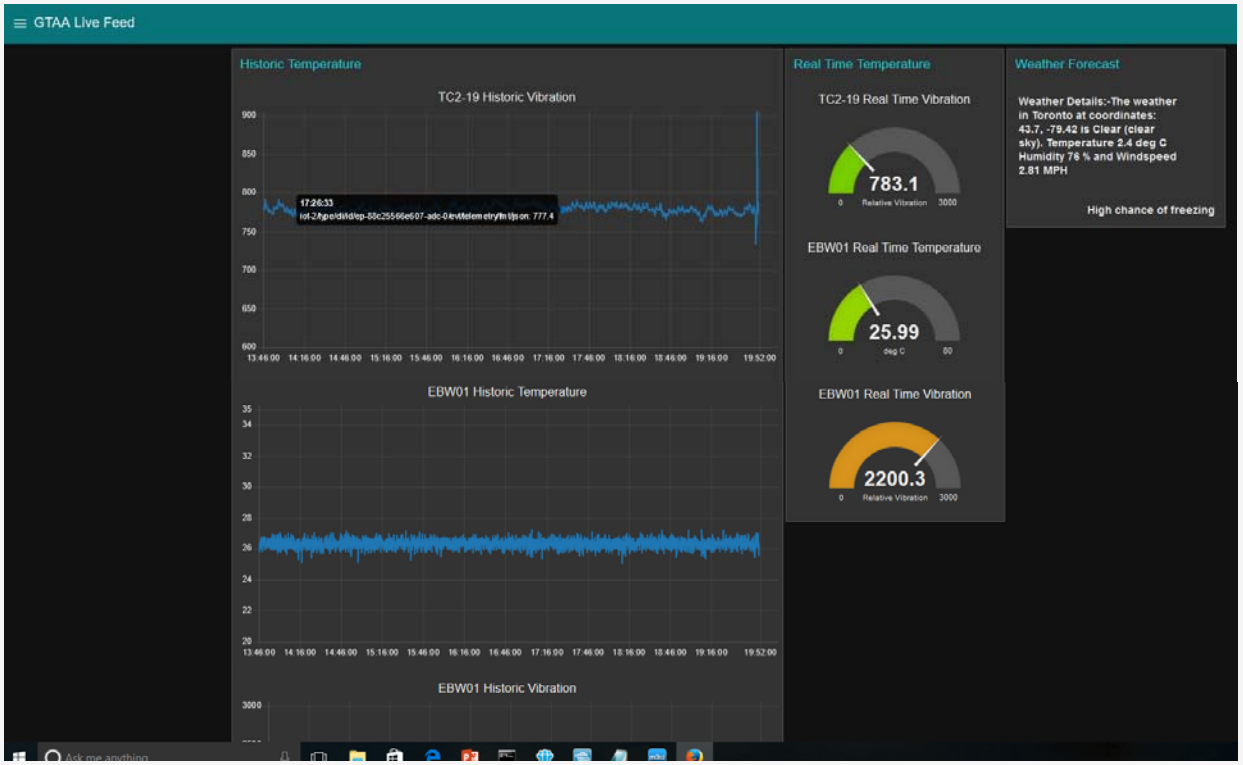


Implementation (BHS – Sensors & Communication)

Device	Description	Qty
GW1	Gateway	1
TS1	Motor Temperature	1
MH1	Motor Vibration Acoustic	1
ENC1	IP-66 Enclosure	1
PS1	DIN Rail Power Supply	1



Current Status



- Sensors have been installed and tested on the BHS, PWC, two PMD's
- Sensor data is being published to the IBM IoT Platform (Bluemix)
- Dashboards present real-time and historic views of the data
- Rules defined to automate the generation of work orders in Maximo and alerts via email

Next Steps

Gathering Data

IoT is not just about collecting lots of data and doing 'corrective maintenance' – it's more about getting the right data that will yield long term historical analytics.

PMQ

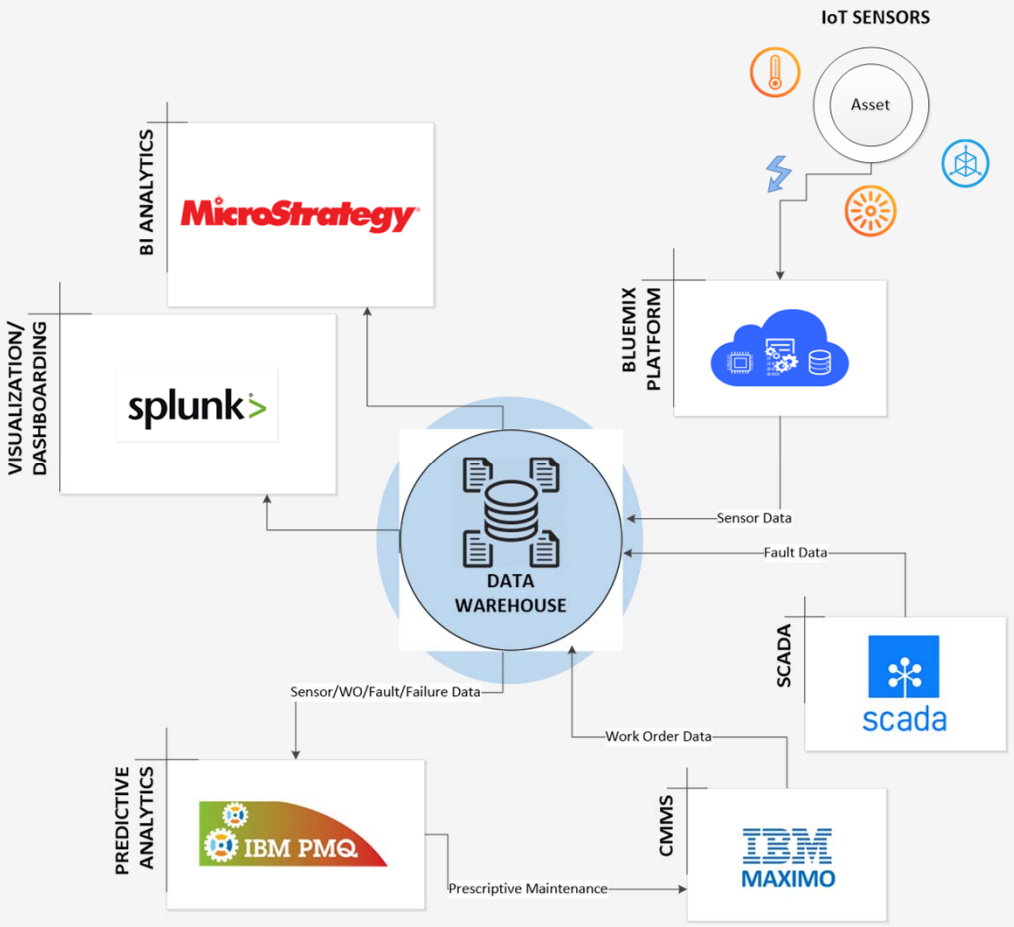
If you have the right data (and we do!) we can enrich that data with all other data sources to move towards predictive analytics.

Predictive Maintenance

Our goal is to significantly reduce breakdowns and unplanned maintenance and move to a more condition based and predictive based maintenance paradigm.

Feasibility Study

Finally. need to determine what areas will return highest return on investment. Study needs to compare current failure rate and the impact/risk to the operation to support investment. Questions to be answered; will this become an overlay to current system or a requirement for systems moving forward?



Lessons Learned

- An IoT project spans the line of business and the IT departments – it is essential that you collaborate with all parts of the business – in our case, this included EDI, Arrow, GTAA IT and GTAA Maintenance (and IBM). If you don't collaborate you will hit multiple brick walls.
- Choosing the right sensor is very important and took a lot longer than we initially thought it would
- Consider the total IT infrastructure – organisations like an Airport run very secure networks with multiple firewalls and restrict anything that is not business critical. Watson IoT requires certain ports to be opened that are not standard – make sure you take this into account
- Never assume that, just because there is an Ethernet cable close by, it is connected to a gateway

Thank You

Questions & Discussions