



# Digital Transformation

The 4<sup>th</sup> industrial revolution

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What is Digital Transformation?

# Digital Disruption and the 4th Industrial Revolution

Mechanized  
production



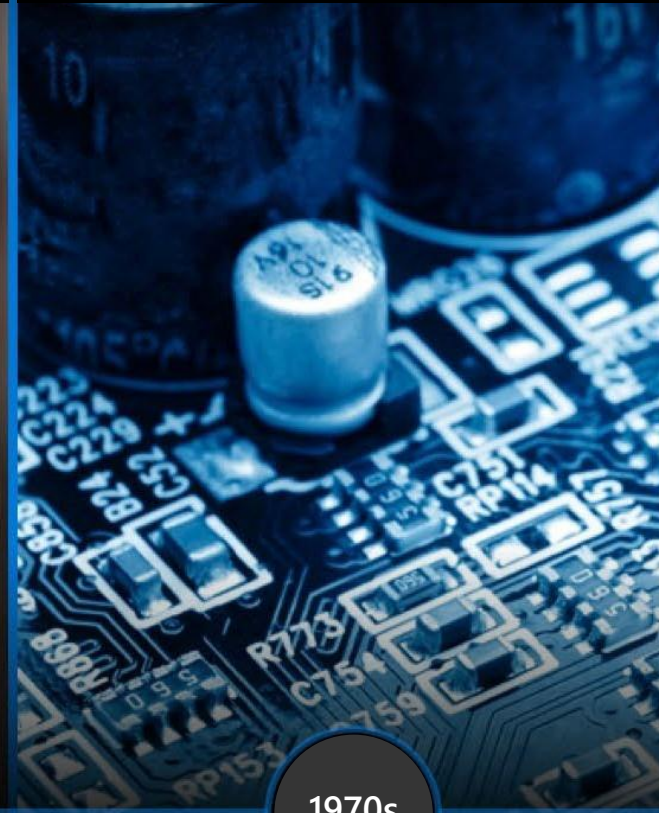
1780s

Mass  
production



1870s

Automated  
production

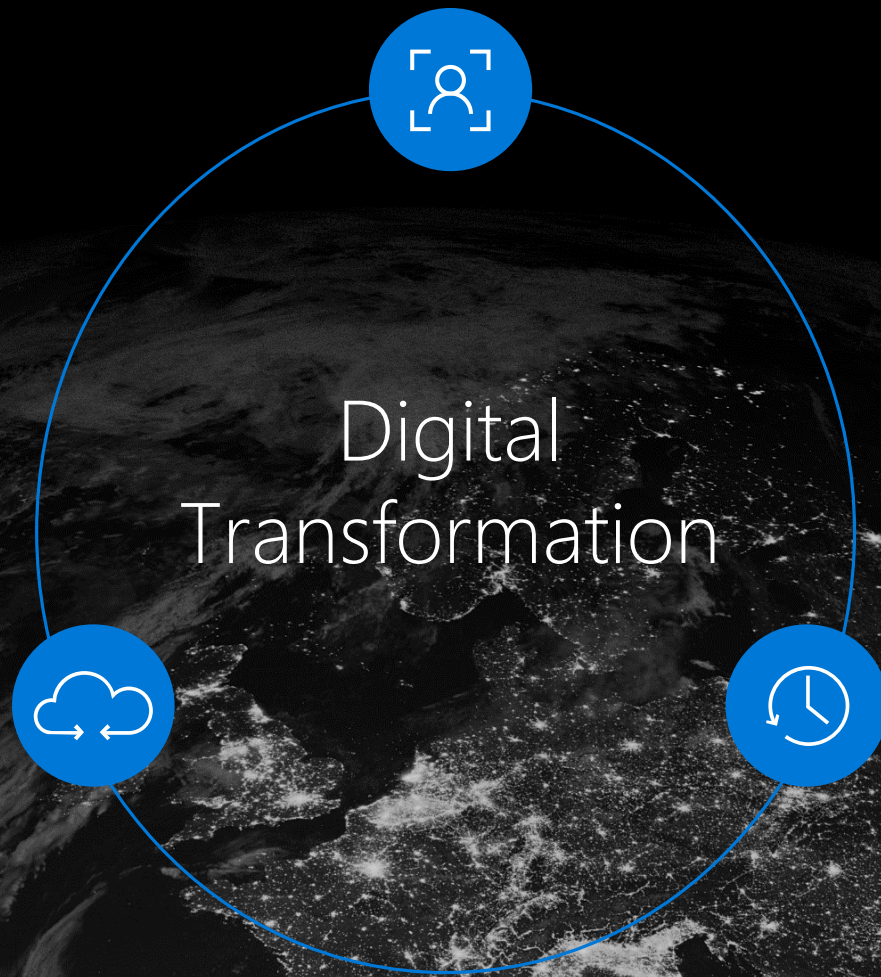


1970s

Digitized  
production



2015+



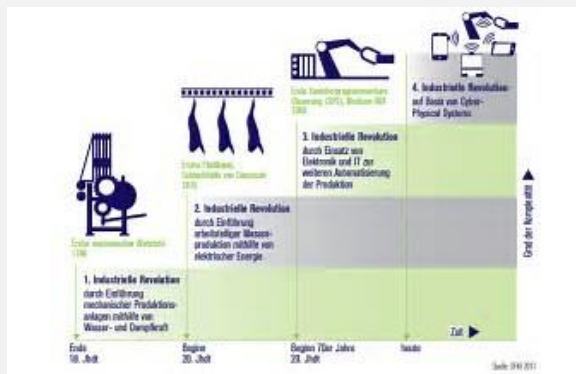
How is your business being digitally transformed?

How is your business model being digitally transformed?

# Key initiatives driving Manufacturing

## 14.0 Design Principles

- Vertical integration
- Horizontal integration
- End-to-end engineering



## Factory of the Future

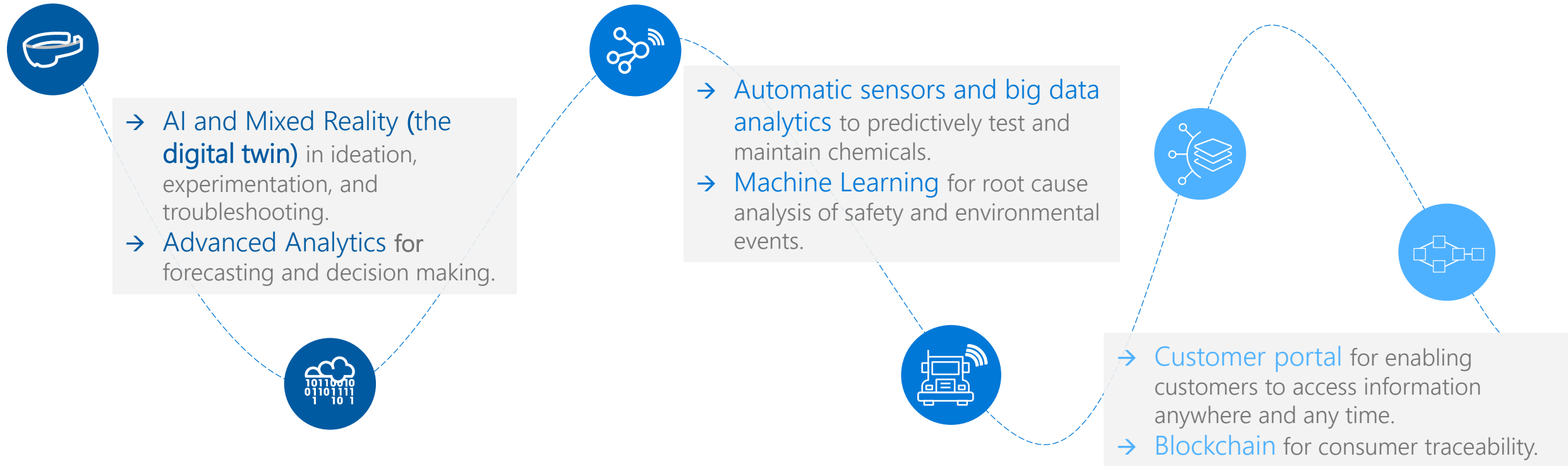
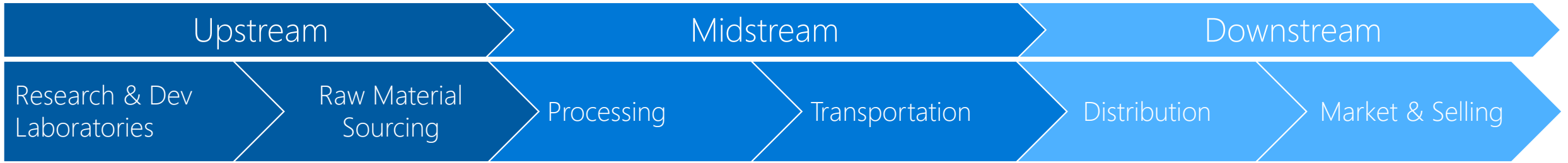
- Virtual Ecosystem
- Human-Machine
- Collaborative Robots (CoBots)

## Digital Twin

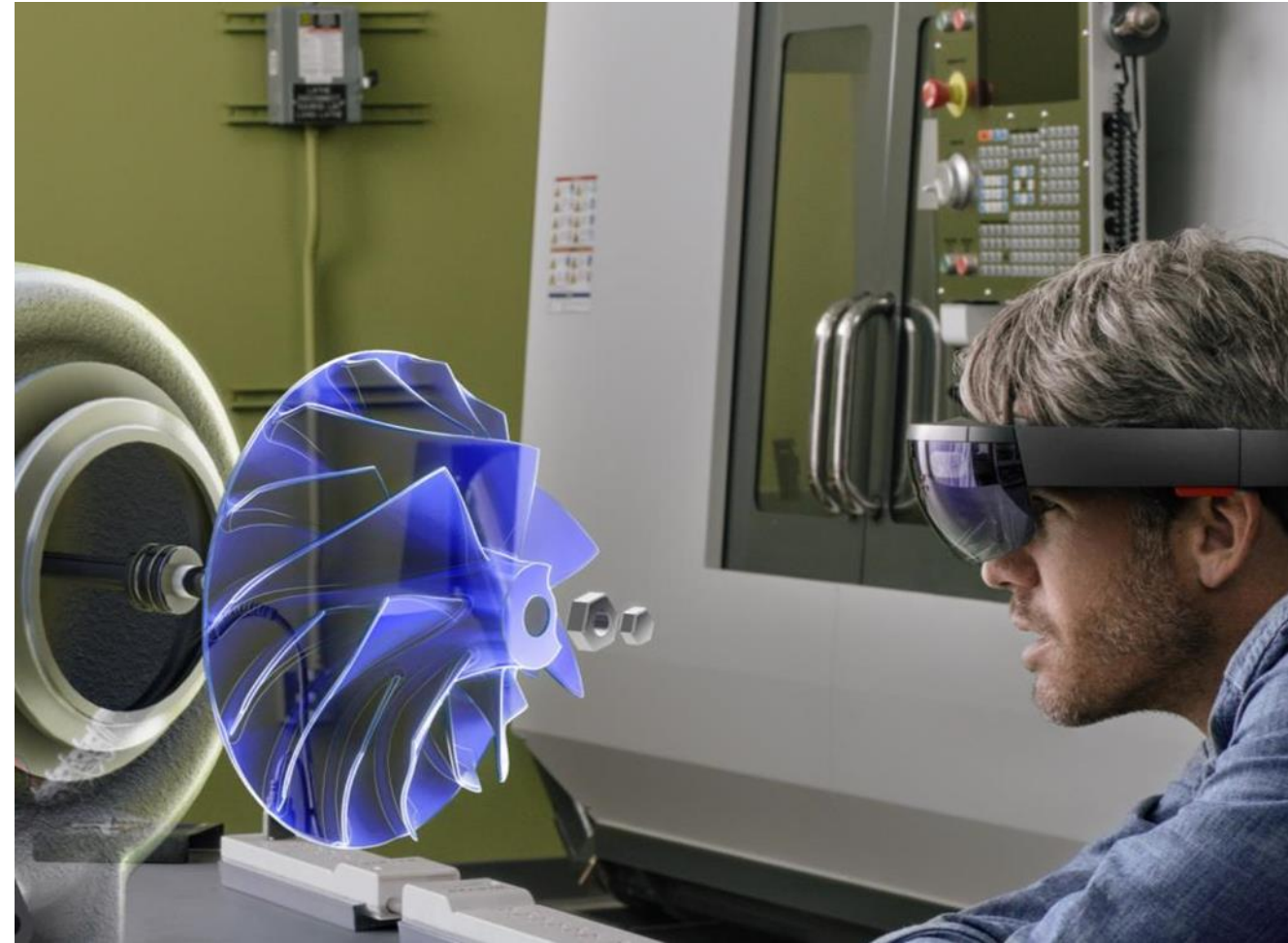
- Virtual representation of equipment or manufacturing process



# How companies are digitally transforming their supply chains

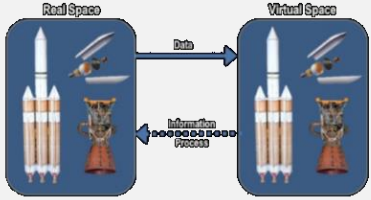

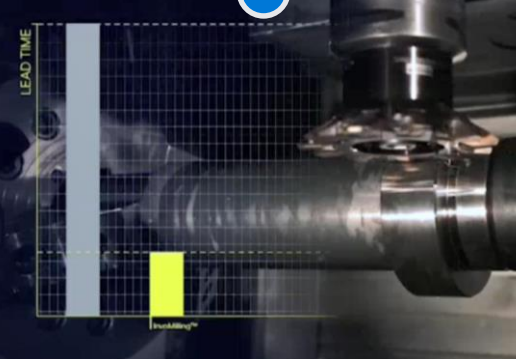



# The Digital Twin



# New Class of Digital Twin

Digital Twin evolution

Information Mirroring* Model	Digital Simulations, 3D Printing	Intelligent & Connected IoT Services	Mixed Reality, Cognitive and AI
<p>Digital Twin as concept R&amp;D &amp; engineering focused Dedicated workstations and servers</p> <p><b>1985-2002</b> (18 years)</p>	<p>Collaboration, simulation and workflow across global enterprise Browser and web access</p> <p><b>2003-2014</b> (12 years)</p>	<p>Connected devices - Data unification between physical and virtual worlds IoT, big data analytics, cloud</p> <p><b>2014-2016</b> (3 years)</p>	<p>Holographics and AR/VR Cognitive services Artificial Intelligence</p> <p><b>2017</b></p>
			
<p>Powerful 3D modeling and analysis Remote programming CNCs, robots...</p>	<p>Digital design, virtual assembly, and simulation before physical commitment 3D printing goes mainstream</p>	<p>Rapid feedback across design, manufacturing, operation Products augmented with digital services</p>	<p>Guided interactions Blended human-machine collaboration Autonomous and self healing</p>

\*Dr. Michael Grieves and John Vickers – University of Michigan



Press **esc** to exit full screen



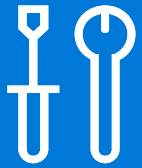
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## EMPOWER YOUR EMPLOYEES with new gen digital twin

### **BUILD**

advanced analytics capabilities for improved insights

### **DELIVER**

rich marketing content globally and adapt processes with scalable infrastructure

### **INCREASE**

employee effectiveness through greater collaboration

### **ENABLE**

better and faster decision making through mobile connectivity



# thyssenkrupp



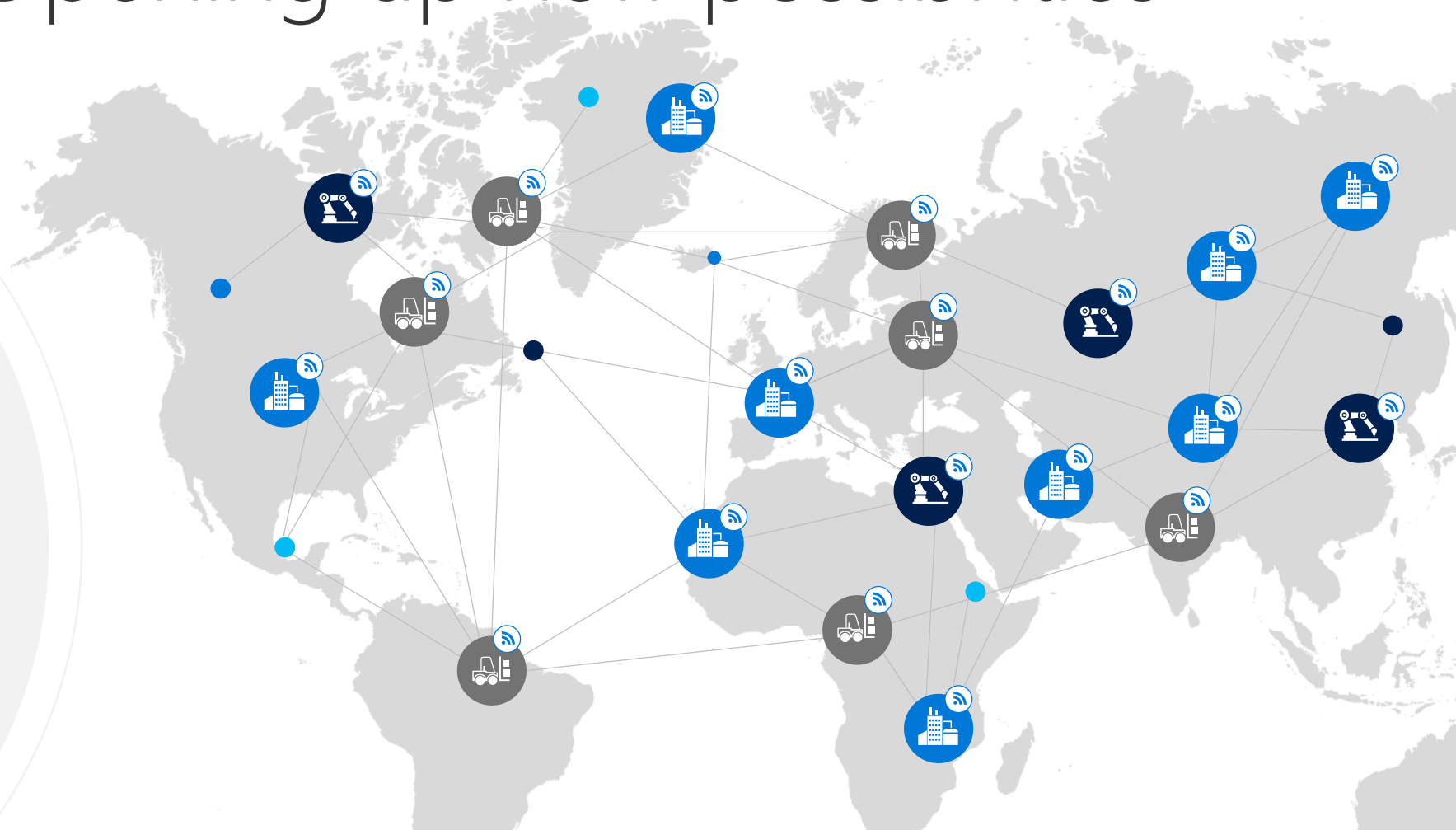
# Connected Factories



# Industry 4.0 - Opening up new possibilities

## Factory of the future:

A complex ecosystem of self-regulating machines and sites, able to customize output, optimally allocate resources, and offer a seamless interface between the physical and virtual worlds of construction, assembly and production.



Open  
value chain



Flexible  
production

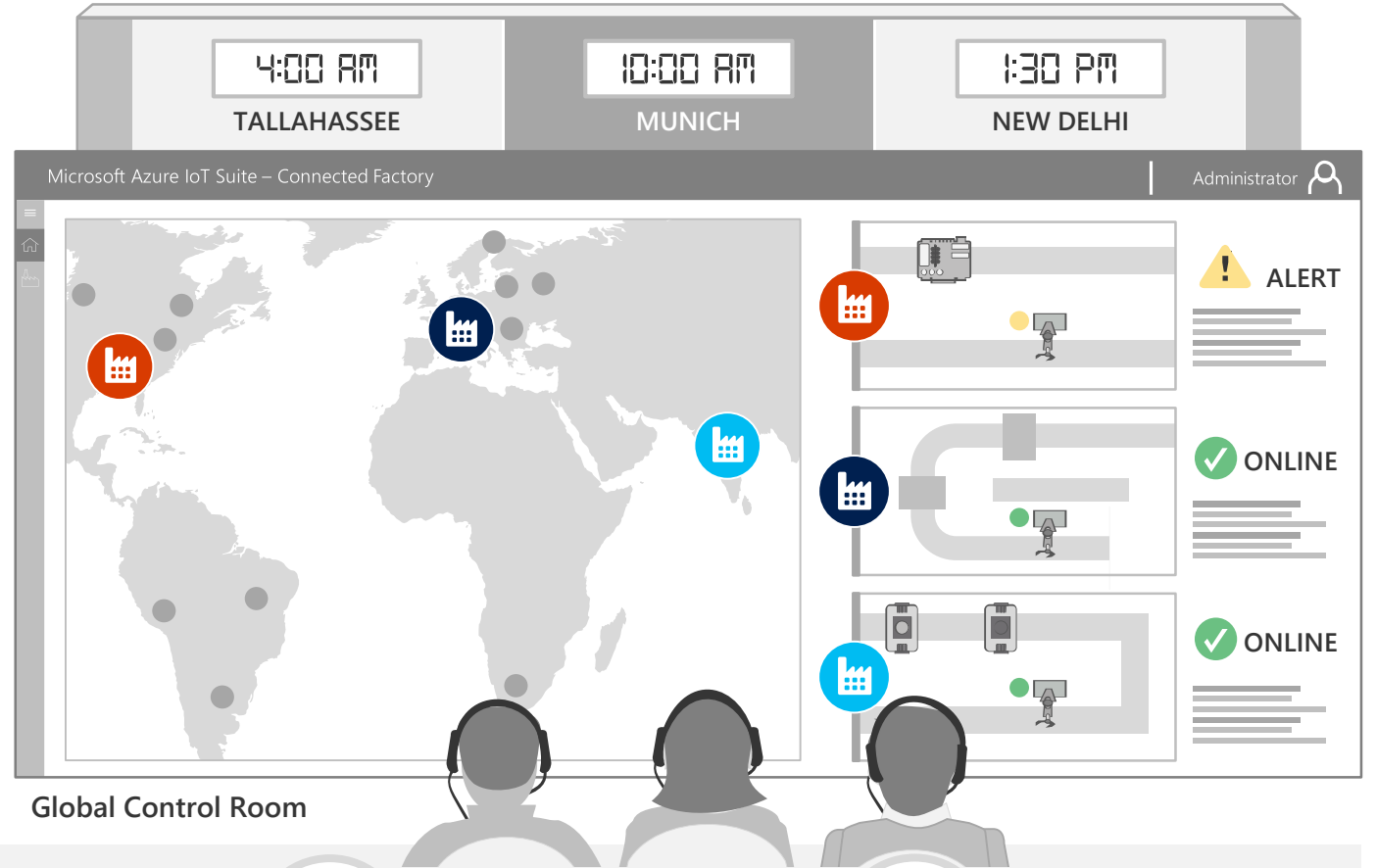
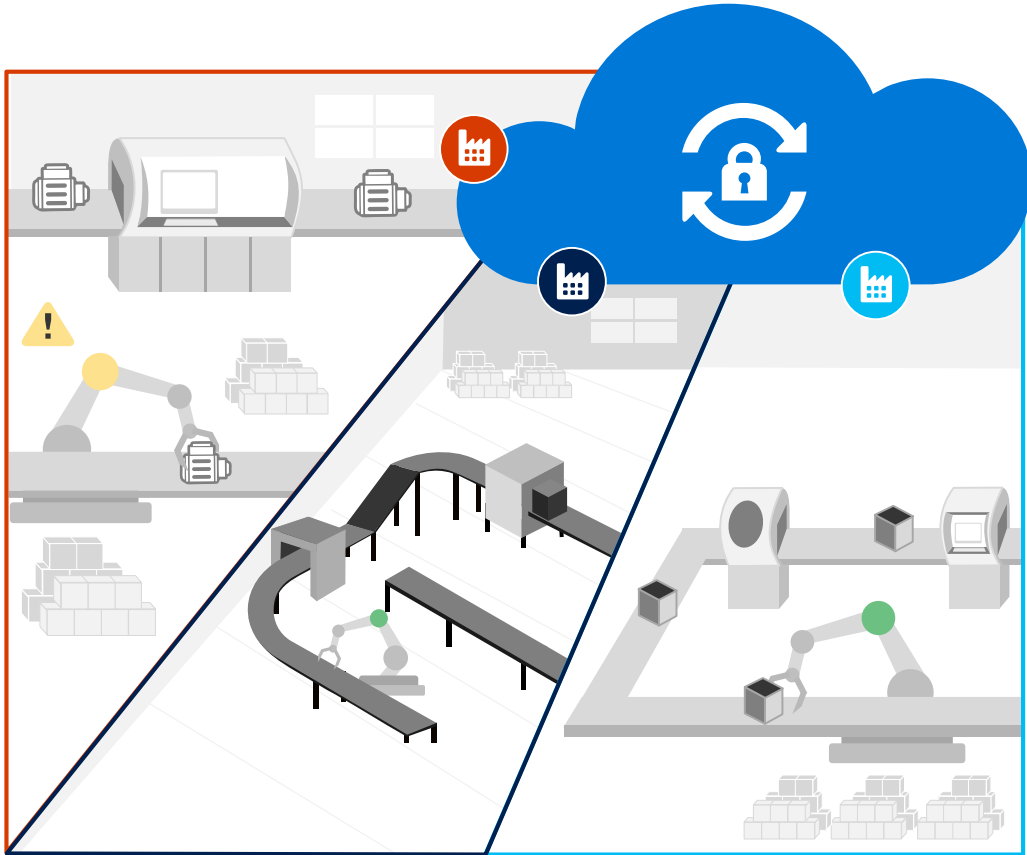


Human-centered  
manufacturing



Innovative  
business models

# Connected Factories



Global Control Room



Connect your machines



Monitor and adjust

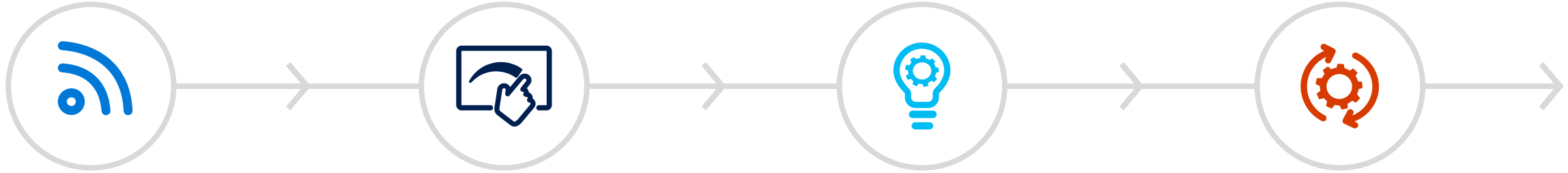


Automate insights and optimize



Transform business processes

# Starting your journey



## Connect your machines

Connect equipment without disrupting production

Bring more equipment online at your own pace

Collect operational data that was previously out of reach

## Monitor and adjust

Enable near-real-time visibility

Empower employees with easy-to-glean insights

Detect anomalies earlier to adjust before equipment fails

## Automate insights and optimize

Minimize downtime using predictive insights

Optimize your production and reduce process costs

Scale to gain visibility across multiple sites

Make operational changes based on real data

## Transform business processes

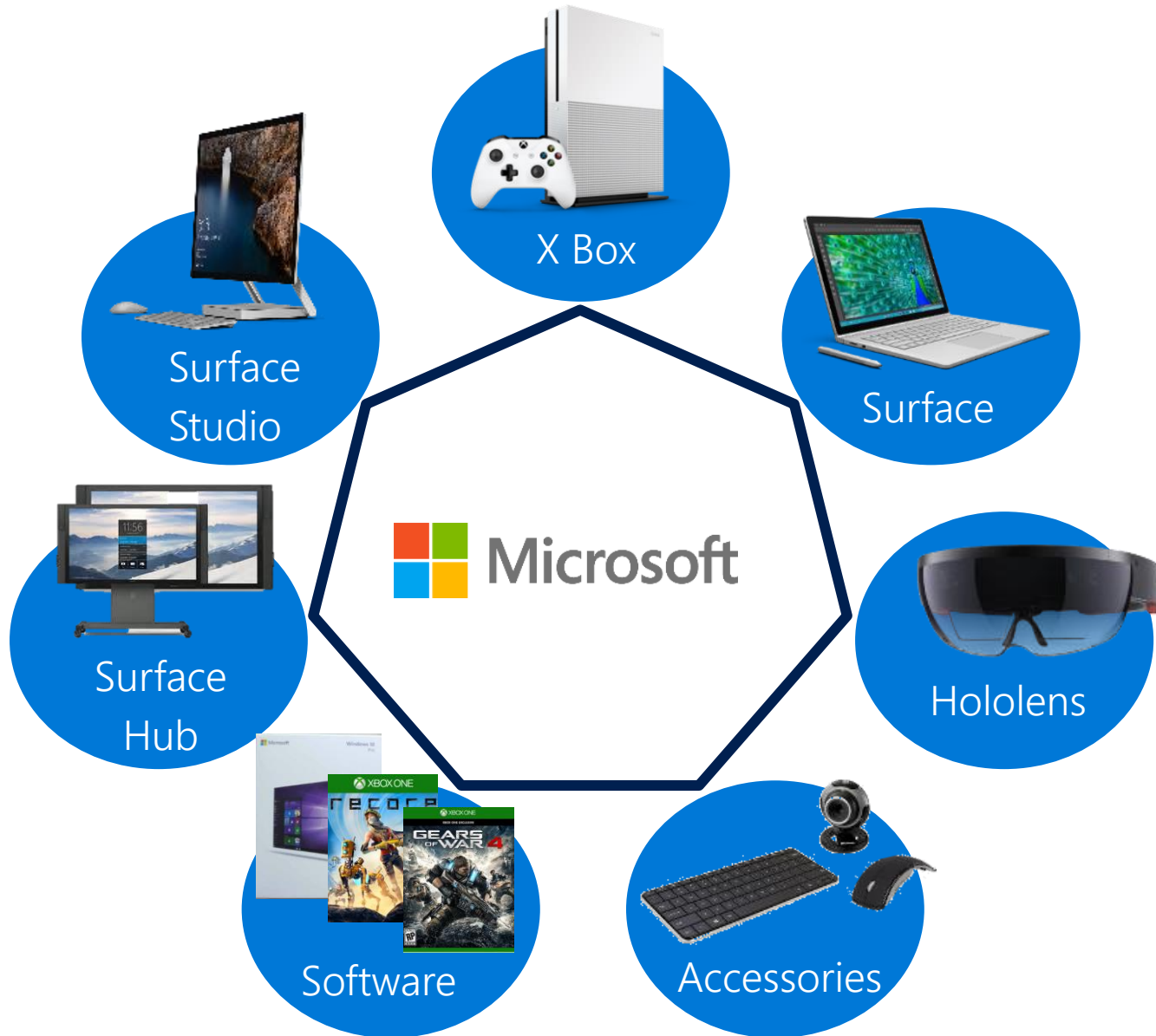
Achieve better integration of your value chain

Adapt to shorter product life-cycles with flexible production

Improve productivity with human-centered manufacturing

Enable innovative business models like PaaS

# Our Own Transformation Story



>77M

Units Manufactured & Shipped

>42,000

Number of Active SKU's

30K

Ship To Locations

>400

Number of Suppliers  
(includes component suppliers)

107

Countries Serve

33

Number of Mfg & Distributon  
Locations





# One Digital Supply Chain: Transformation Journey

## Wave 3: Cognitive

Amplify with algorithmic decision making and automated execution.  
*Intelligent. Empowered*

## Wave 2: Predictive

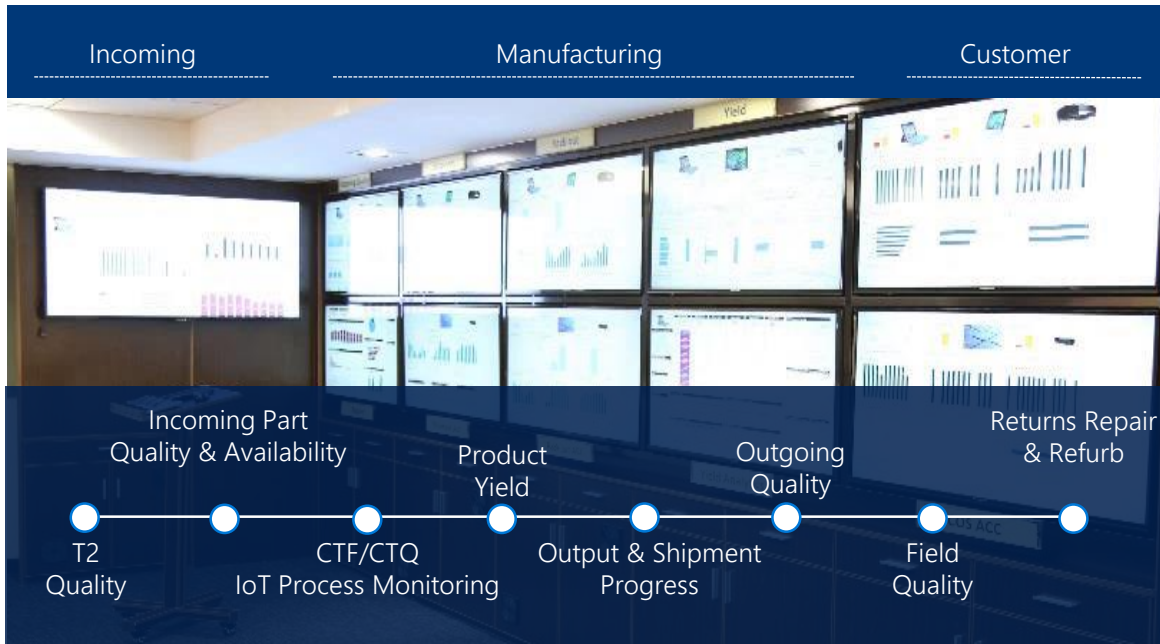
Move from Reactive to Predictive with big data, machine learning, IoT.  
*Smarter. Faster*

## Wave 1: Connected

Leverage the cloud to connect, automate, visualize E2E view of business.  
*Interconnected. Aligned*

# Standardized visualization, proactive and real time

## E2E Visibility from Incoming to Customer



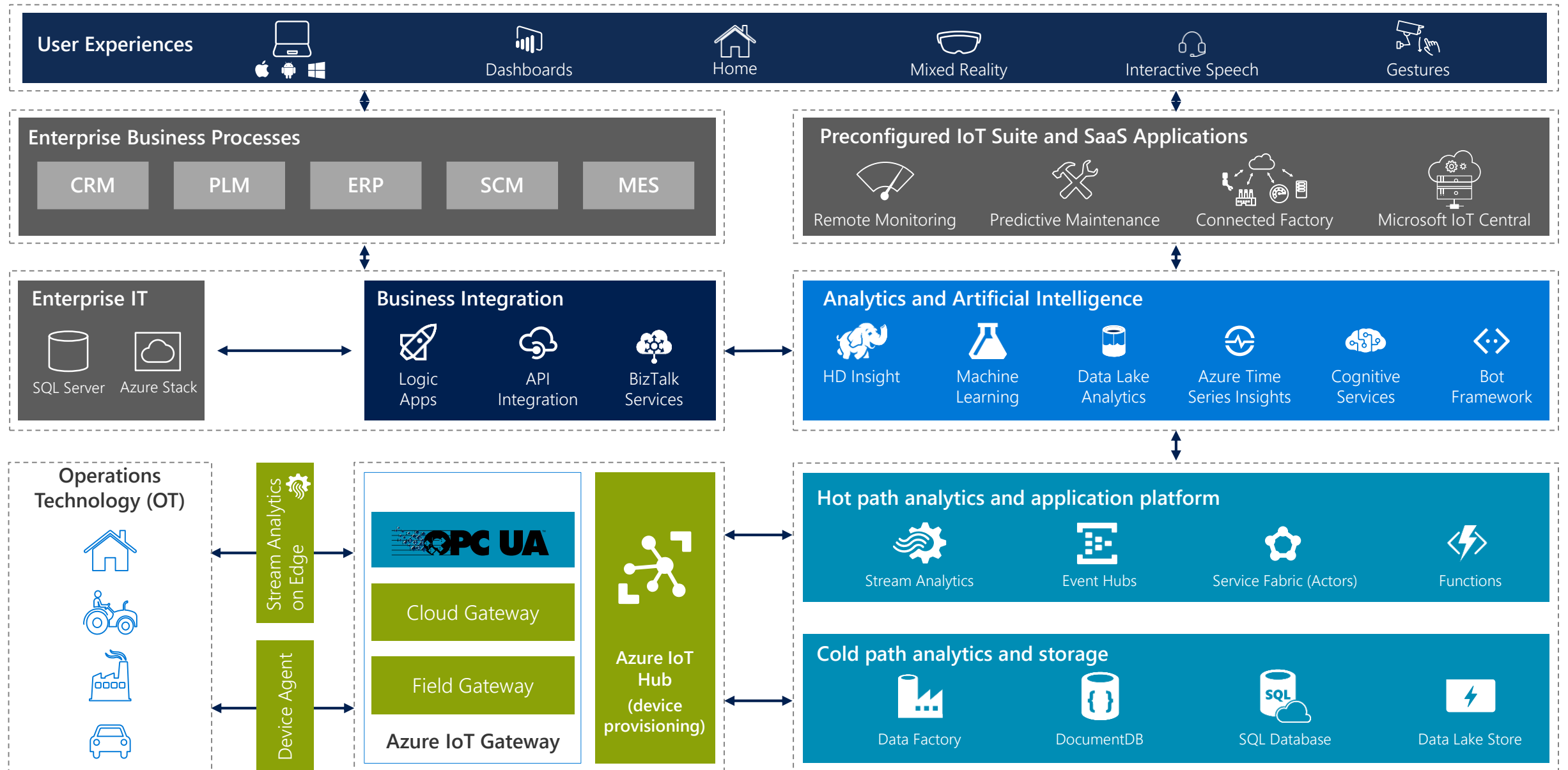
## Proactive Alerting, Real time Insights



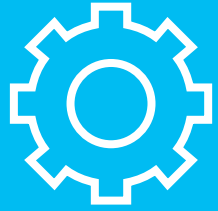
- Creating Clarity via Personalized Dashboards
- Increasing Collaboration, Connected Data Streams enable Teamwork
- Improving Factory Productivity/Optimization

- Big Data insight and Machine Learning
- Proactive Alerting
- Predictive Analytics

# Manufacturing Industry Framework



# Digital supply chain: Rethinking how to optimize operations



## OPTIMIZING OPERATIONS



Harnessing  
technology for next  
level of efficiency



Leveraging digital  
platforms to  
reduce delivery  
timeframes



Testing new  
products  
and services at a  
fraction of the cost

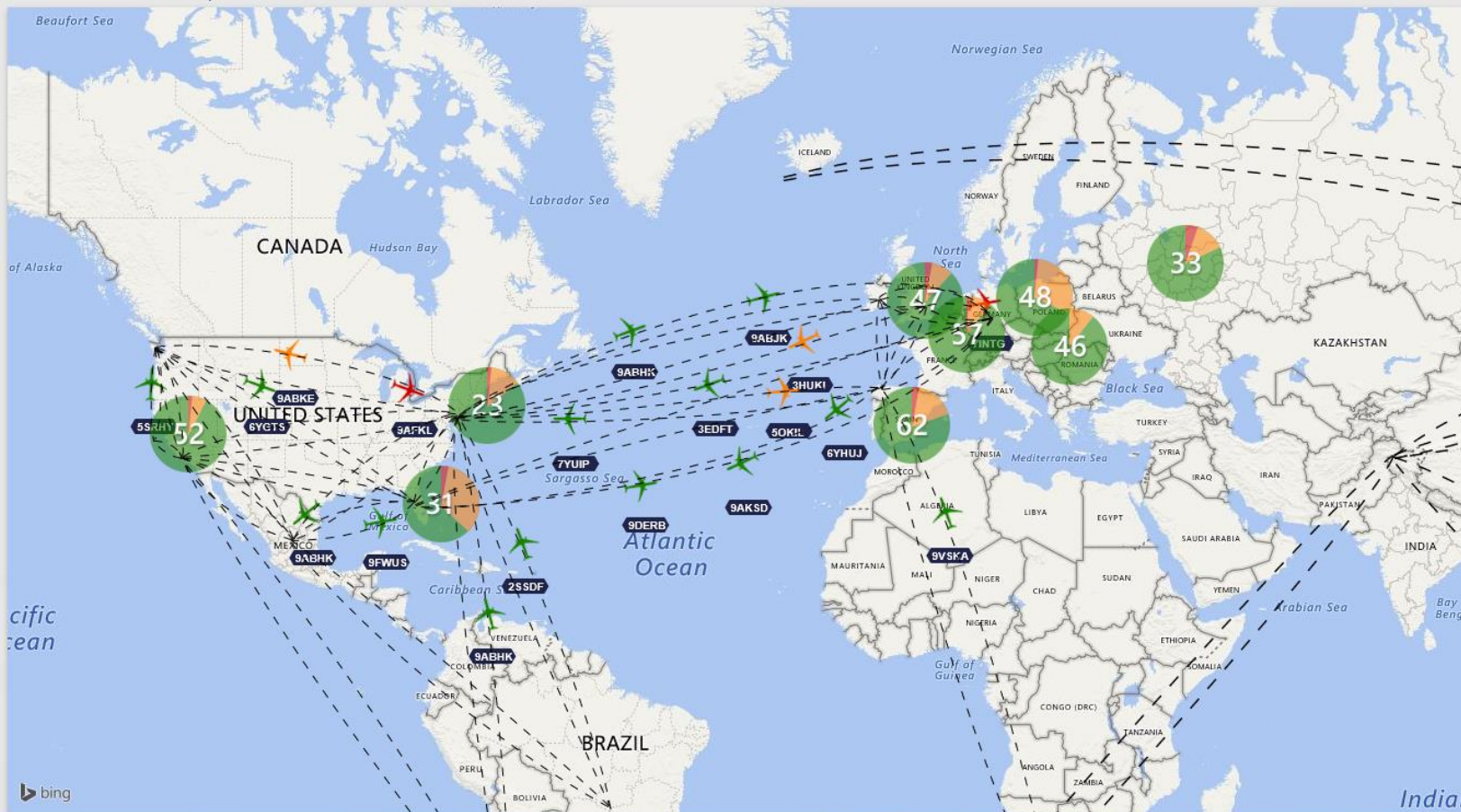


Anticipating and  
solving customer  
issues before they  
become issues





### Fleet Location Map



### Operating KPI's

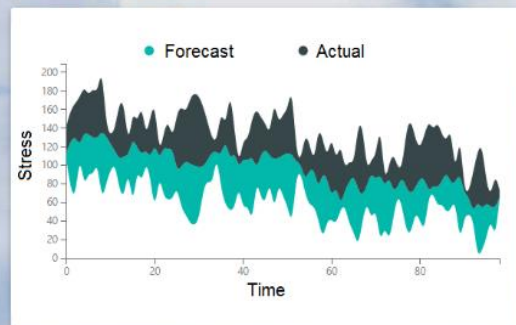
NORMALIZED FUEL EFFICIENCY

89%

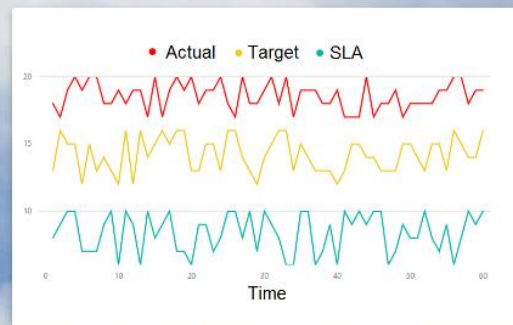
FLEET UTILIZATION

91%

### Schedule Stress



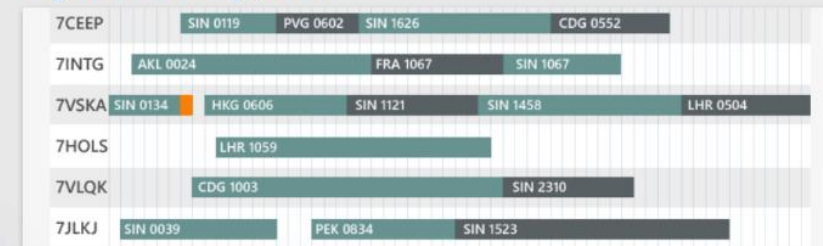
### On-time Performance



### Fleet Status

STATUS	TAIL ID#	TYPE	DEST	TIME REM	ADVISORY
<b>Early Watch List</b>					
🔴	7INTG	A350	LHR	3:45 (hr)	Primary Fuel Pump
🟠	7IALK	787	FRA	7:16 (hr)	Hydraulic System
🟠	7TJWB	A350	KEF	0:18 (hr)	Control Surface
🟠	7CEEP	A380	DFW	2:11 (hr)	Main Door Seal
🟠	7JLJW	787	CDG	0:45 (hr)	Engine Bleed Air
🟠	7VSKA	777	GVA	12:18 (hr)	Oxygen System
🟠	7HOLS	A320	DTW	2:10 (hr)	Scheduled Maintenance
🟠	7VLQK	757	LAX	0:06 (hr)	Landing Gear

### Flight Scheduling (UTC)



### Maintenance Scheduling

TAIL ID#	TYPE	LOC	TIME REM	SYSTEM	Service
7SKAJ	A380	FRA	16 hrs	Engine	Engine Wash Service
7ASKO	A320	LHR	2 hrs	Fuel Pump	Preventative Maintenance
7MNWL	777	FRA	2 days	ALL	Scheduled Service
7XOWK	787	FRA	2 days	Engine	Engine Overhaul
7PLKA	A350	CDG	6 hrs	Hydraulic System	Preventative Maintenance
7WKAL	747	FRA	5 days	ALL	Scheduled Service
7UOSL	A340	CDG	1.5 hrs	Fuel Pump	Preventative Maintenance
7QKAO	737	FRA	18 hrs	Engine	Engine Wash Service



### Engine Details

TAIL NUMBER	7INTG
TYPE	Airbus A350
ENGINE	TRENT XWB
SERIAL#	21001
LAST SERVICE DATE	02/15/2016
CYCLES SINCE LAST SERVICE	3,100
NEXT WASH DATE	07/24/2016

Performance

92%

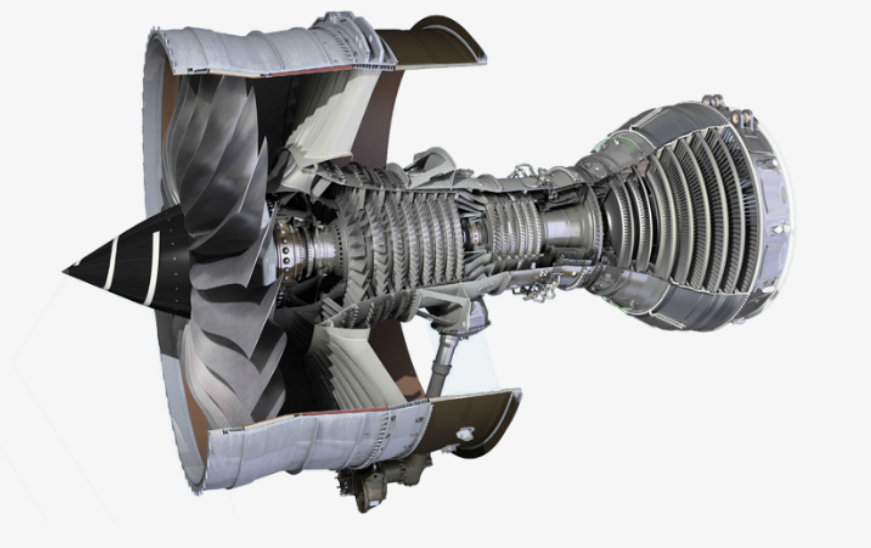


### Aircraft Service Notes

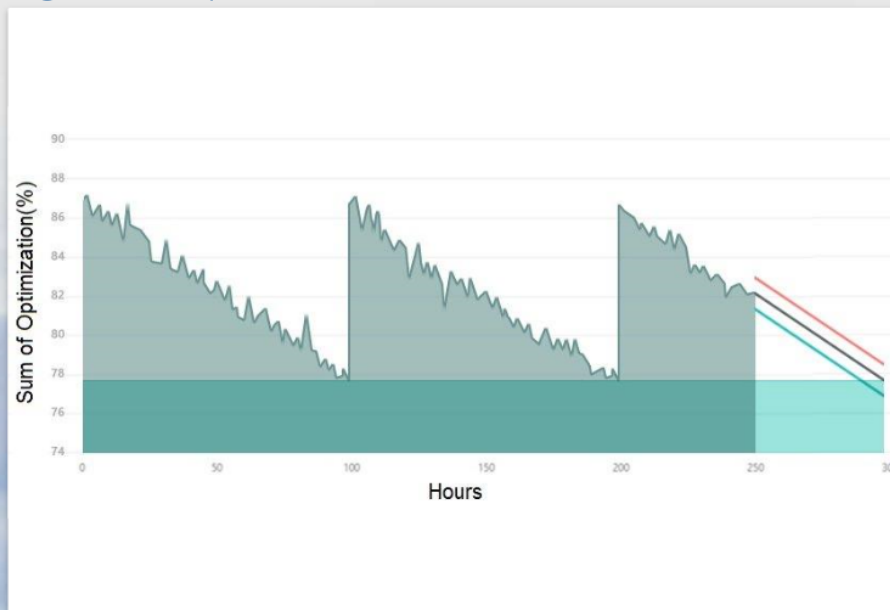
DATE	TECHNICIAN	LOC	SERVICE
1/5/2015	Joe Healy	FRA	Full Inspection
1/31/2015	Chen Yang	LHR	Engine Wash
2/6/2015	Lola Jacobsen	FRA	Landing Gear Repair
2/15/2015	Katie Jordan	DTW	Door Seal Repair
2/17/2015	Hamish Hill	LGA	Full Inspection
2/25/2015	Jiri Karpeta	FRA	Bleed Air Valve Repair
3/1/2015	Christian Kemp	HAJ	Light Replacement
3/15/2015	Jim Kim	FRA	Control Surface Repair
3/21/2015	Manuel Machado	LGA	Engine Wash
3/1/3015	Jacek Maśliński	FRA	Full Inspection
4/15/2015	Arnie Mondloch	FRA	Blade Replacement

### Engine Overview

TRENT XWB



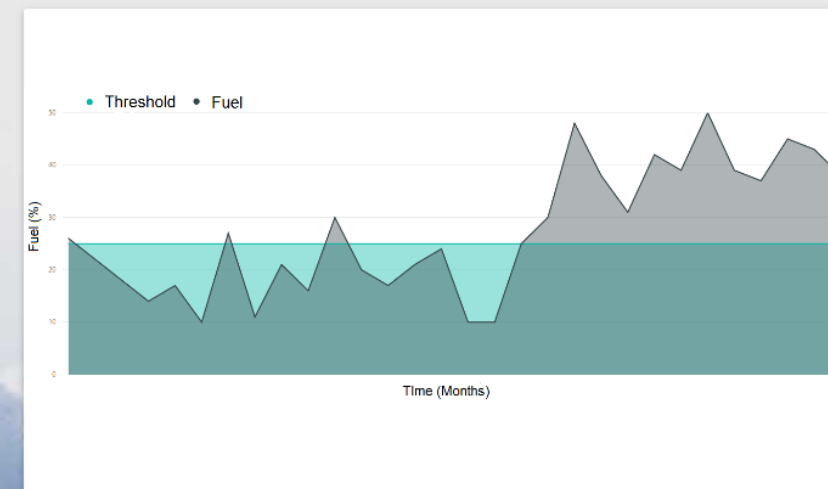
### Engine Wash Optimization



### Engine Systems

STATUS	ATA CODE	COMPONENT	RUL
WARNING	ATA 28	PRIMARY FUEL PUMP	
OK	ATA 71	POWER PLANT	
OK	ATA 74	IGNITION	
OK	ATA 75	BLEED AIR SYSTEM	
OK	ATA 76	ENGINE CONTROLS	
OK	ATA 78	EXHAUST	
OK	ATA 79	OIL SYSTEM	
OK	ATA 82	WATER INJECTION	
OK	ATA 83	ACCESSORY GEARBOX	

### Normalized Fuel Burn



### Engine Lead Indicators

TGT Margin

88%

RUL

52%

RESOURCE SCHEDULING VIEW | INITIAL PUBLIC VIEW

### Filter & Map View

**FILTER** | **MAP VIEW**

MAP VIEW SETTINGS | WO NUMBER:

MAP CONTROLS: [North Arrow] [Zoom In] [Zoom Out] | Road | Legend

Scale: 2500 feet | 1 km

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RESOURCE	7/11/2016											
	10 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM
<b>Carlos Grilo</b> 9:00   90%	Work Order: 00457 Account: <b>Rolls Royce - Frankfurt DE</b>		Work Order: 00236 Account: <b>Rolls Royce - Frankfurt DE</b>			Work Order: 00417 Account: <b>Rolls Royce -</b>						
<b>David So</b> 8:15   83%	Work Order: 00432 Account: <b>Rolls Royce -</b>		Work Order: 00413 Account: <b>Rolls Royce - Frankfurt DE</b>			Work Order: 00375 Account: <b>Rolls Royce -</b>		Wo... Accou				
<b>Diane Prescott</b> 7:45   78%	Work Order: 00373 Account: <b>Rolls Royce - Frankfurt DE</b>			Wo... Accou		Work Order: 00376 Account: <b>Rolls Royce - Frankfurt DE</b>						
<b>Jamie Reding</b> 4:30   45%	Wo... Accou	Work Order: 00403 Account: <b>Rolls Royce -</b>		Work... Account:		Wo... Accou						
<b>Ty Carlson</b> 9:00   90%	Work Order: 00399 Account: <b>Rolls Royce -</b>		Wo... Accou	Wo... Accou	Work Order: 00371 Account: <b>Rolls Royce -</b>		Work Order: 00434 Account: <b>Rolls Royce - Frankfurt DE</b>					

### Unscheduled Work Orders

WORK ORDER NUMBER	PRIMARY INCIDENT DESCRIPTION	WORK ORDER TYPE	PRIMARY INCIDENT TYPE	PRIORITY	PRIMARY INCIDENT ESTIMATED DURATION	SERVICE TERRITORY	PREFERRED RESOURCE
00471	Replace Primary Fuel Pump (ID: 845D7889) on Engine 1, A...	<a href="#">Service Call</a>	<a href="#">Fuel Pump Replacement</a>	<a href="#">Critical</a>	210	<a href="#">DE</a>	<a href="#">Jamie Reding</a>
00465	Landing light on left side Airbus A350 is completely burne...	<a href="#">Service Call</a>	<a href="#">Light Replacement</a>	<a href="#">High</a>	120	<a href="#">DE</a>	
00464	Minor repairs to landing gear. Ensure retraction is smooth...	<a href="#">Service Call</a>	<a href="#">Landing Gear Replacement</a>	<a href="#">High</a>	45	<a href="#">DE</a>	
00460	Technician noted on the service report that Bleeder valve...	<a href="#">Service Call</a>	<a href="#">Bleed Air Valve Repair</a>	<a href="#">High</a>	45	<a href="#">DE</a>	
00458	Engine 2 blades are up to be replaced due to aging parts.	<a href="#">Service Call</a>	<a href="#">Blade Replacement</a>	<a href="#">High</a>	120	<a href="#">DE</a>	
00455	Automated alert was triggered for 727 (711 MA) indicating	<a href="#">Service Call</a>	<a href="#">Bleed Air Valve Repair</a>	<a href="#">High</a>	210	<a href="#">DE</a>	





## TRANSFORMING PRODUCTS



Leveraging data to enter new markets



Revising business models to prioritize agility and emerging trends



Making customers your business partners



Connecting products to amplify and redefine their value

# Product as a Service: Rethinking how to transform products



# Summary | Empowering manufacturing

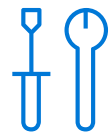
Connected business networks

Connected services and experiences



**ENGAGE YOUR CUSTOMERS**

with personalized experiences



**EMPOWER YOUR EMPLOYEES**

to make intelligent decisions



**OPTIMIZE YOUR OPERATIONS**

to ensure sustainable production



**TRANSFORM YOUR PRODUCTS**

by unlocking new opportunities

