EMPOWERING Manufacturing

Beyond the Digital Twin

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Microsoft Worldwide Manufacturing & Resources

Microsoft

Digital transformation: Imperative

40%

of operational processes will be self-healing and self-learning by 2022[2]

70%

of manufacturers will put operations at the forefront of digital transformation projects by 2020[1]

Industry 4.0 Digital First Movers **simultaneously** achieve new revenue and cost reduction

30% revenue

30% Operational cost

Only 4% of digital first movers that integrate vertically, horizontally and with Customers; while the average company improves 2.9% and 3.6% p.a.[3]

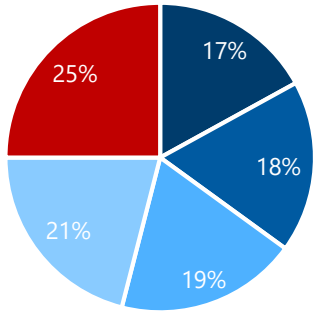
Mastering digital

up to **15% revenue increase** and simultaneous **reduction in cost to serve of more than 20%**[4]

48%

manufacturers are ready for new forms of human-machine interaction[5]

Chief obstacles for digital adoption



- **Realigning the organization to make the best use of digital rechnologies**
- **Reengineering business processes to accommodate / capitalize on digital technologies**
- **Developing the necessary skills for using digital technologies effectively**
- **Managing the deployment of digital technologies**
- **Resolving technical issues in implementing / integrating digtial technologies with existing technical infrastructure**

Forces driving digital manufacturing

- Digital Twin: virtual representation of a product, process or service
- Industry 4.0: vertical and horizonal integration | end-to-end engineering

This infographic is based on Microsoft analysis of third-party data. Sources include: 1. IDC FutureScape: Worldwide Operations Technology 2017 Predictions Jan 2017 Doc # US42261017 Web Conference By: Lorenzo Veronesi, Marc Van Herreweghe. 2. IDC FutureScape: Worldwide Digital Transformation 2017 Predictions Jan 2017 Doc # US42259317 Web Conference By: Michael Versace. 3 PWC 2016 Global Industry 4.0 Survey; Dr. Reinhard Geissbauer, Jesper Vedso and Stefan Schrauf. 4. McKinsey&Company Mastering the digital advantage in transforming customer experience, May 2017; Oliver Ehrlich, Harald Fanderl and Christian Habrich. 5. Cornelius Baur et al. Manufacturing's Next Act, McKinsey, June 1, 2015 6. Accenture Strategy Digital Factory Cracking the code to success Russ Rasmus and Jason Nichols, 2016

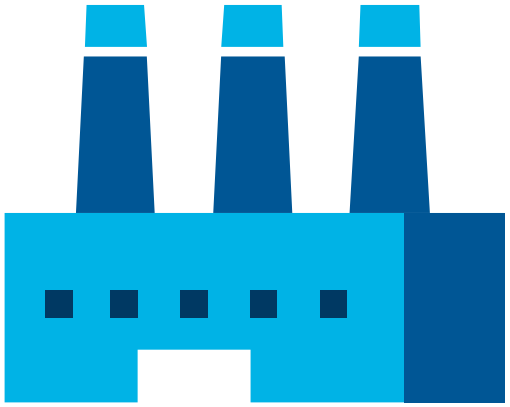
Digitalization is redefining manufacturing

Challenges → Digital Transformation ← **Opportunities**

Legacy assets and systems

Global footprint with varying connectivity

Fragmented, unused data



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Real time feedback from smart connected products

Gain insights across plants

New business models

Modern manufacturers are embracing customer centricity, innovating faster and becoming more agile

Leaders are still focused on…

A new class of digital twin

NEW SERVICES DRIVEN BUSINESS MODELS

MANUFACTURING OPERATIONS, SERVICES

R&D & ENGINEERING

Information mirroring* model

- Powerful modeling and analysis
- R&D and engineering focus

Simulation and 3D printing

- Digital design, virtual assembly, and simulation
- 3D printing mainstream

Connected IoT services

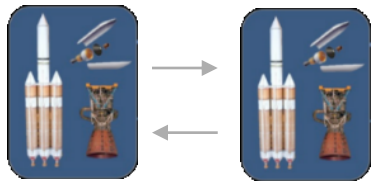
- Unified physical and virtual data
- Rapid feedback across design, manufacturing, and operations

End-to-end innovation

- Mixed reality visualizations
- Cognitive services
- Humans and device collaboration

Digital Twin evolution

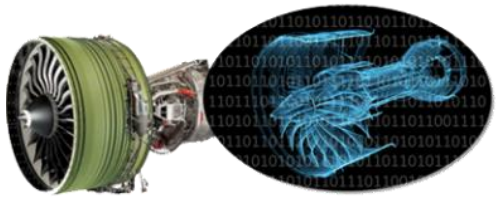
1985-2002 (18 years)



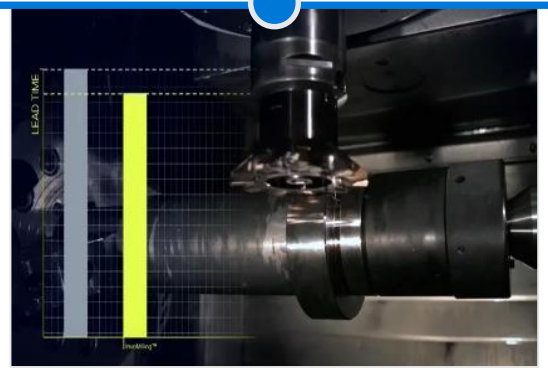
Real space

Virtual space

2003–2014 (12 years)



2014–2016 (3 years)



2017

Dr. Michael Grieves and John Vickers – University of Michigan

"This is how we take the global expertise that we have available somewhere in Tetra Pak and bring it to the fingertips of the engineer in the countryside in Chile or Pakistan."

- Johan Nilsson, Vice President of Tetra Pak Services

Devices

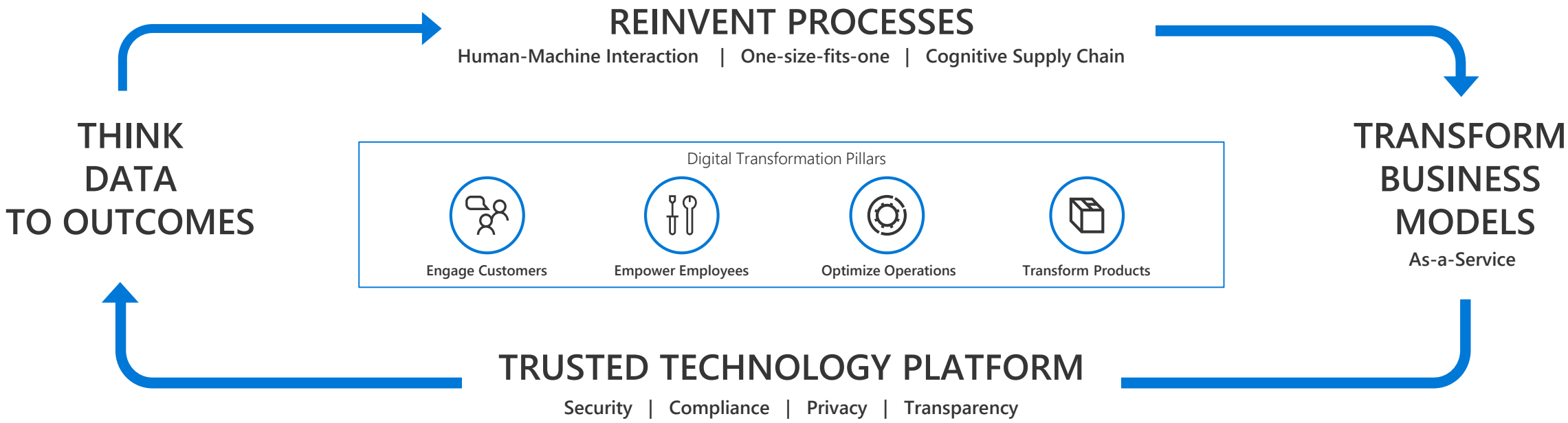
Big Compute

3D Printing Facilitation

IoT, Analytics, and CRM

Cognitive Services

Framework for manufacturing transformation



Achieve digital excellence with connected products and services

Connected product innovation

Plants and supply chains of the future

Connected marketing, sales, and services

IoT enabling rich connected consumer experiences

Pervasive connectivity enabling new offerings and revenue

CONNECTED VALUE NETWORKS

Transforming how products are designed, manufactured, and sold

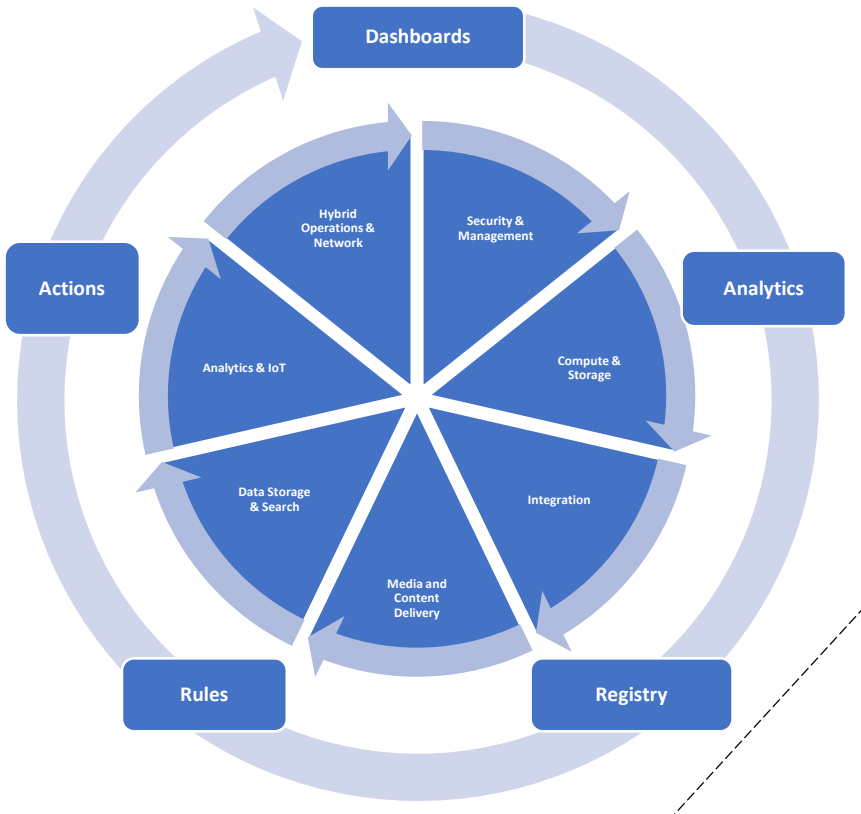
CONNECTED SERVICES AND EXPERIENCES

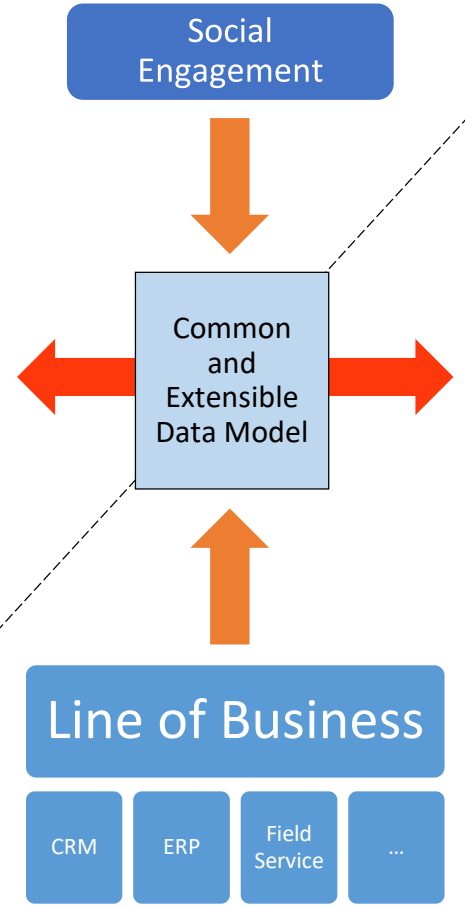
Creating new business models as a service provider

Connected product innovation

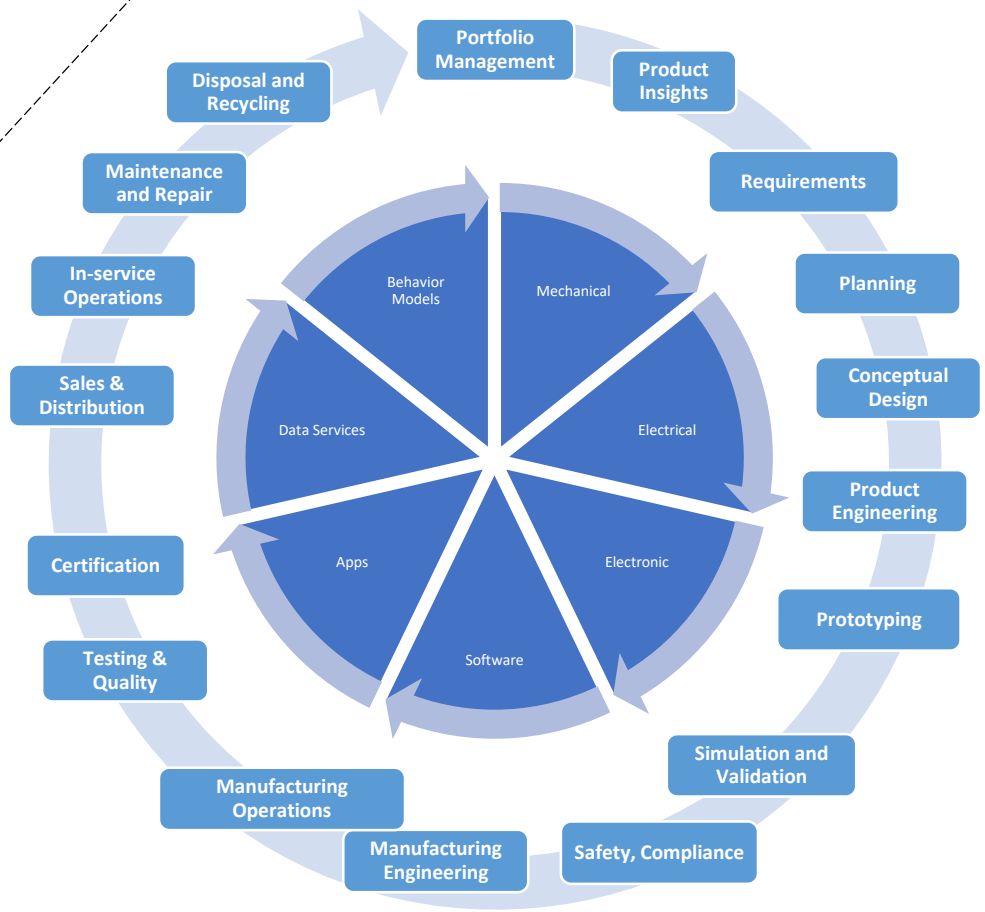
Systems of Intelligence inform Systems of Record

Systems of intelligence





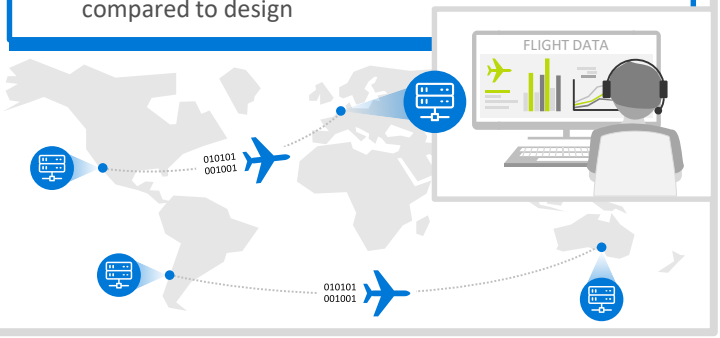
Systems of record



Connected product innovation

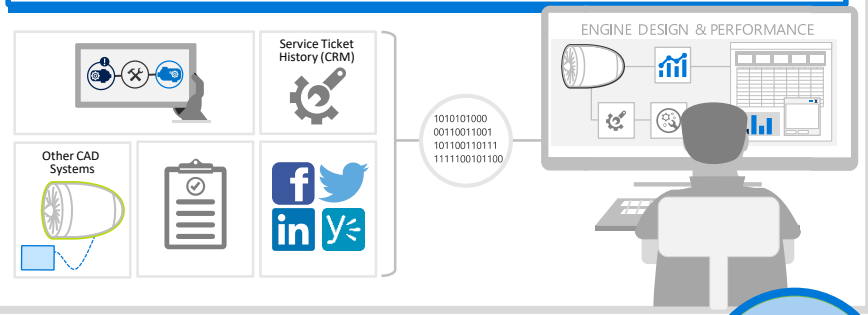
1 Understand exactly how products are performing in the field

- Know how frequently the product is being used
- Find usage and failure rates for specific parts or features
- Discover 360° view of product performance compared to design



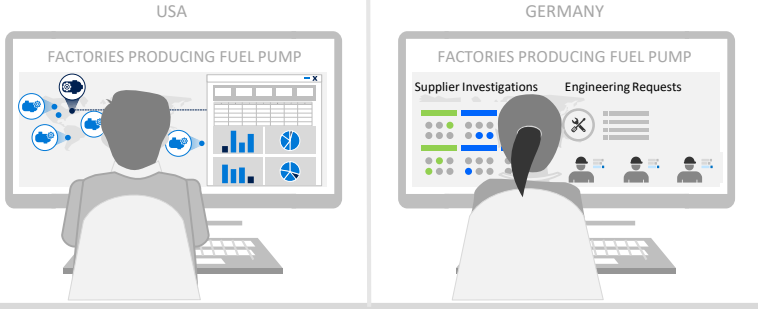
2 Combine product data across all relevant sources

- Aggregate data from silos such as maintenance records, design specifications, and diagnostics
- Analyze data across vendors, part specifications, and other external sources
- Integrate stakeholder feedback on existing and suggested features for 360° view of customer

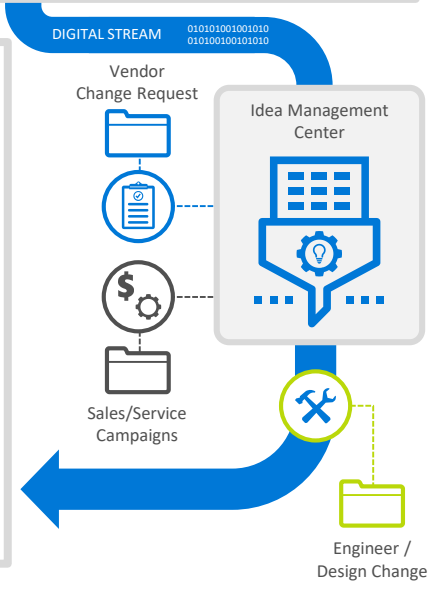


3 Predict disruptive events and identify opportunities

- Collaborate across teams and geographies with product-focused tools
- Determine if products meet design benchmarks
- Compare quality of variants using data-driven analysis to guide design changes

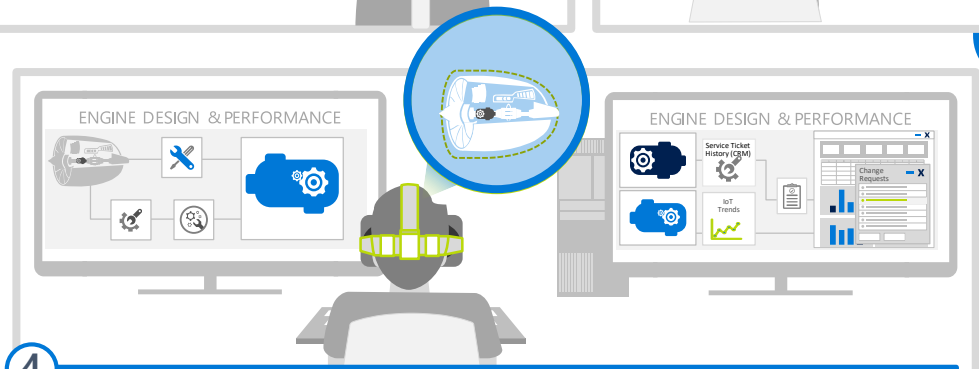


DIGITAL STREAM



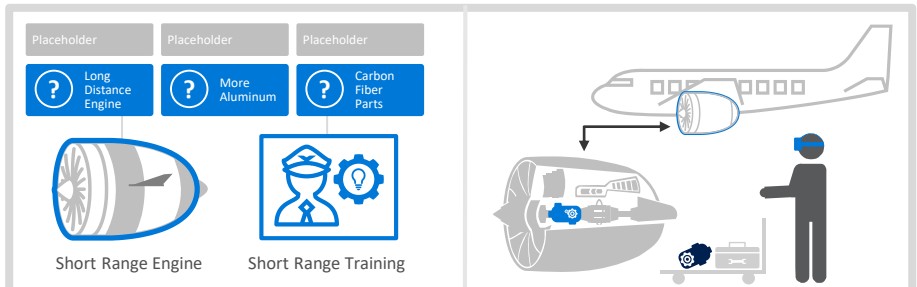
4 Investigate issues and redesign as necessary

- Resolve instances of over- and under-engineering to optimize product performance/cost ratio
- Design different product configurations to better fit usage patterns
- Support redesign of areas with regular failures
- Manage vendor lists and track standard performance across suppliers



5 Anticipate new use cases and optimize product performance

- Save time and money by combining preventative maintenance with replacement of redesigned parts
- Refine products to fit stakeholder needs at product launch and throughout the product lifecycle
- Design new products lines and offer new services, like training, based on product insights

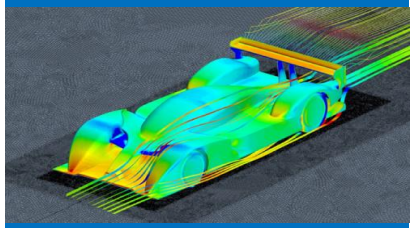


DIGITAL STREAM

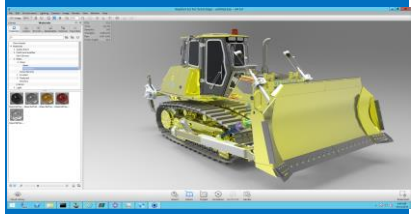
Advancing portfolio to transform products

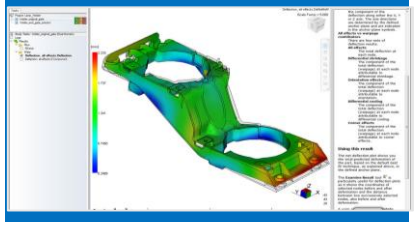
Devices for 3D

CAE in the Cloud

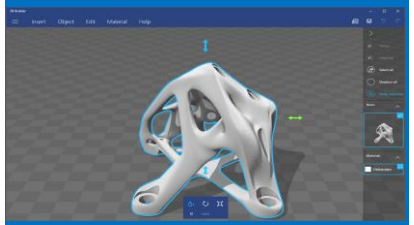


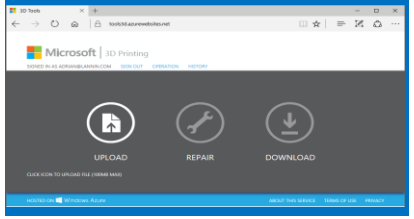
CAD in the Cloud





3D Printing

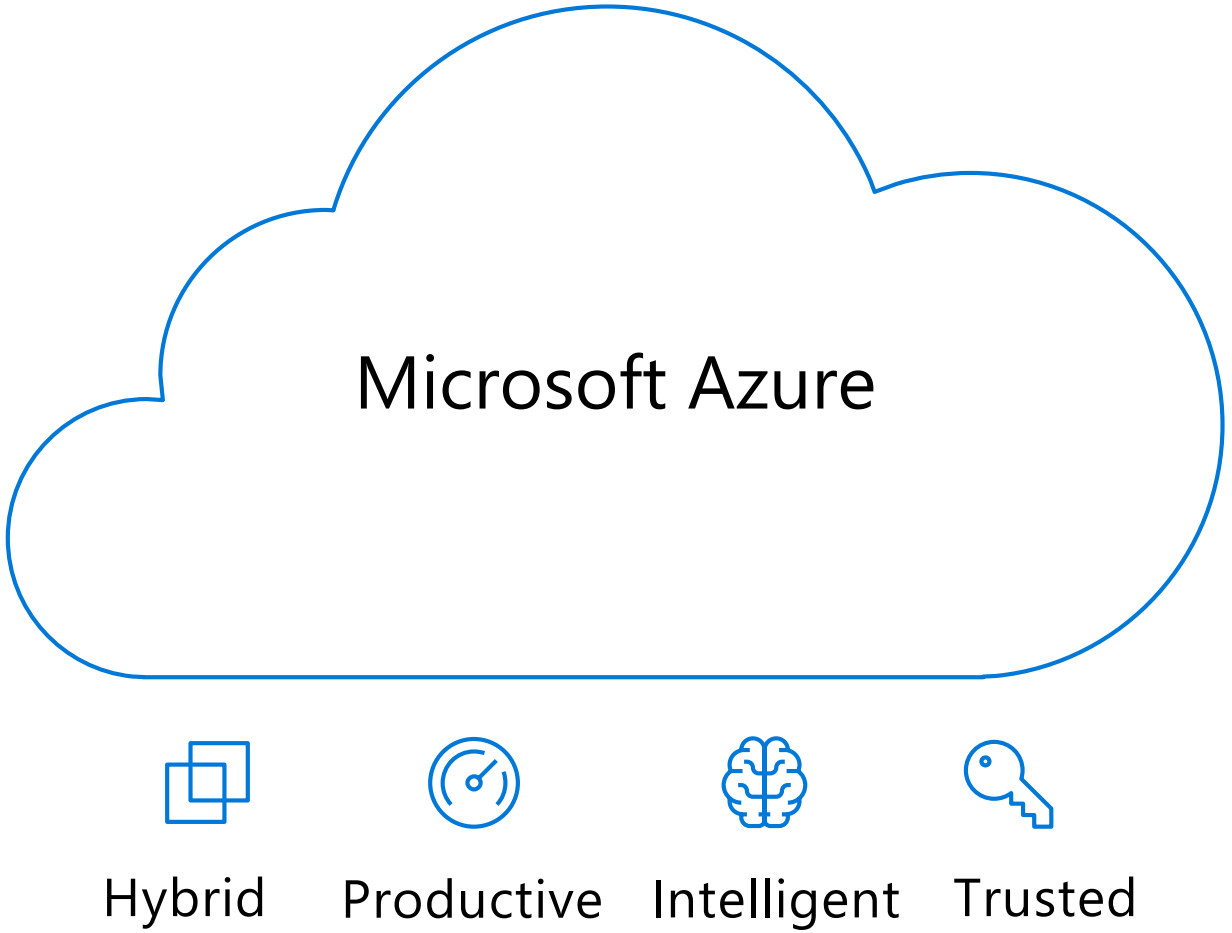




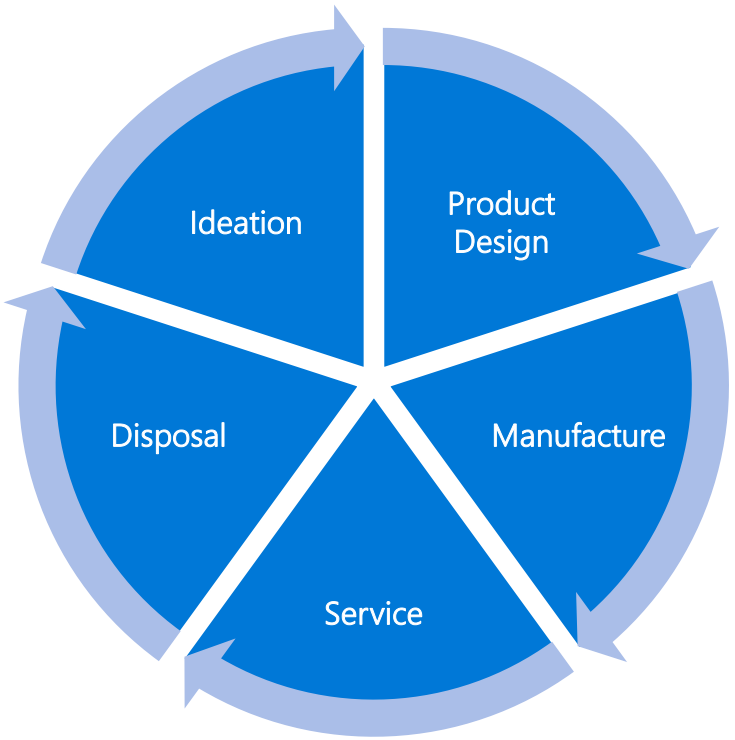
IoT

- HDInsight
- Machine Learning
- Stream Analytics
- DataLake
- Data Catalog
- Data Factory
- Event Hubs
- IoT Hub
- Mobile Engagement

Transformation with Cloud Capabilities



Microsoft Strategy in PLM for Manufacturing



Product Lifecycle

Cloudify

Move workloads to cloud and help scale and reduce costs

Integrate

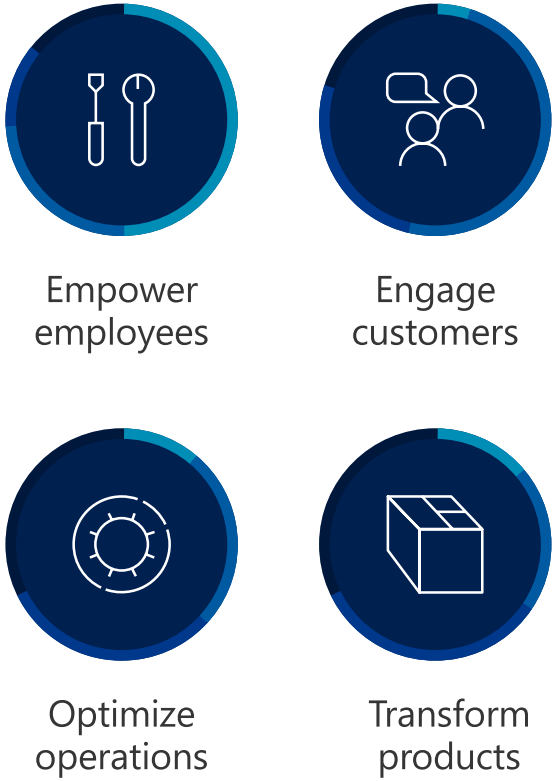
Connect PLM systems with CRM, ERP, MES, SLM and other systems

Advance

Deepen and broaden the existing PLM investment by enabling augmented reality, cognitive/AI, simulation, 3D printing and other scenarios

HPC/Simulation

Finite Element Analysis, Computational Fluid Dynamics and other High Performance Computing and Simulation



Empower employees

Engage customers

Optimize operations

Transform products

SIEMENS DASSAULT SYSTEMES ptc AUTODESK SOGETI Capgemini aras corp ANSYS Altair

Microsoft aras corp

Engineering, design and manufacturing

- Xbox, Surface, Surface Hub, HoloLens
- Datacenter servers and networking hardware
- 2,000+ internal and external users
- 15+ external Tier 1 and 2 partners

Benefits

- Reduced IT costs
- Reduced architectural complexity
- Increased scalability
- Disaster recovery and failure analysis

Paccar

Data visualization

Challenge Increase Paccar's full-scale modeling process with 3D holograms, decreasing turnaround time and beating competitors to market

Solution Paccar and partner Finger Food Studios developed a full-scale truck hologram to envision the truck design process

Benefits 3D model visualization and data integration. Immediate realization of design changes

PACCAR

> "Each mistake really adds up because they're compounded on such a phenomenal scale; catching them saves a lot of money. So even if the initial investment in the technology can seem high, it's offset against those savings and definitely starts to look like a much more viable proposition."

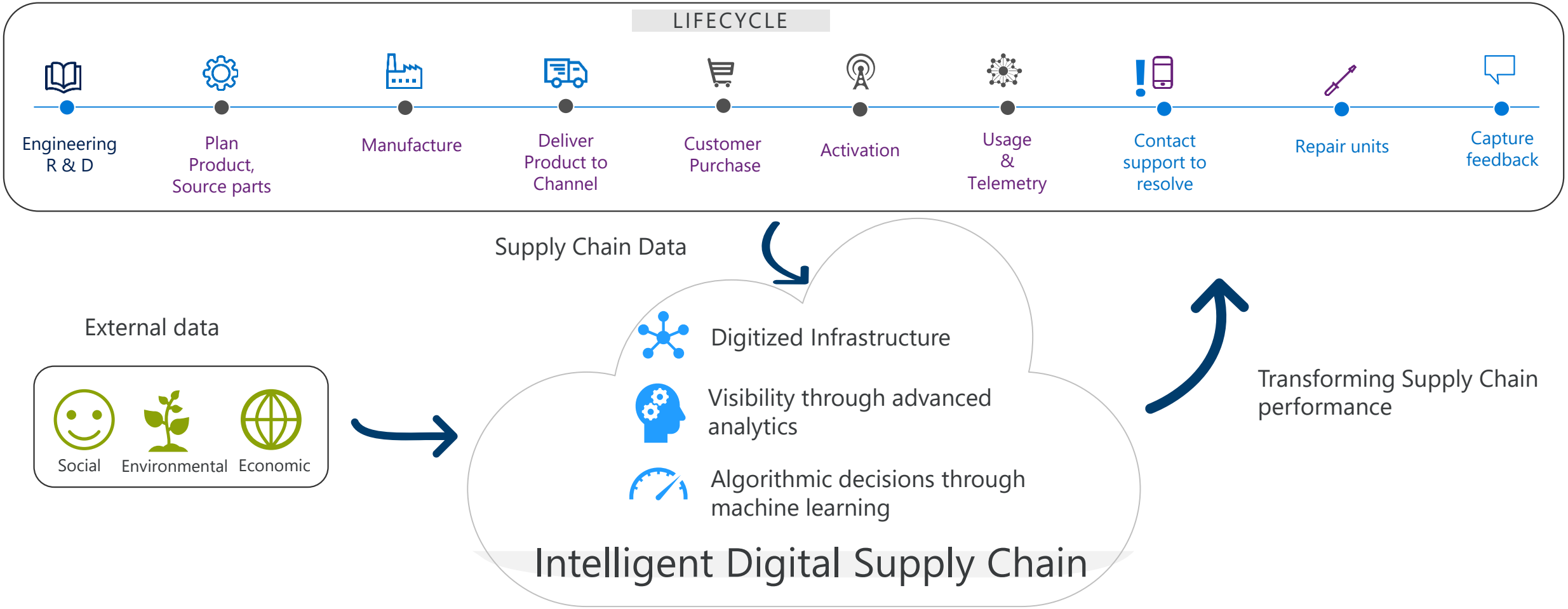
— Chris Waind
Finger Food Studios Creative Director

Microsoft in Manufacturing

Manufacturing and supply chain

>77M Units Manufactured & Shipped	>42,000 Number of Active SKU's
~$8B Total Amount of Annual Spend	>390 Number of Suppliers (includes component suppliers)
9 Number of Manufacturing Locations	24 Number of Distribution Centers
1.7M+ Est. FY17 Number of Retail and Commercial Sales orders	2.0M+ Est. FY17 SAP Deliveries
107 Countries Served	106 Physical Microsoft Stores

Next generation supply chain

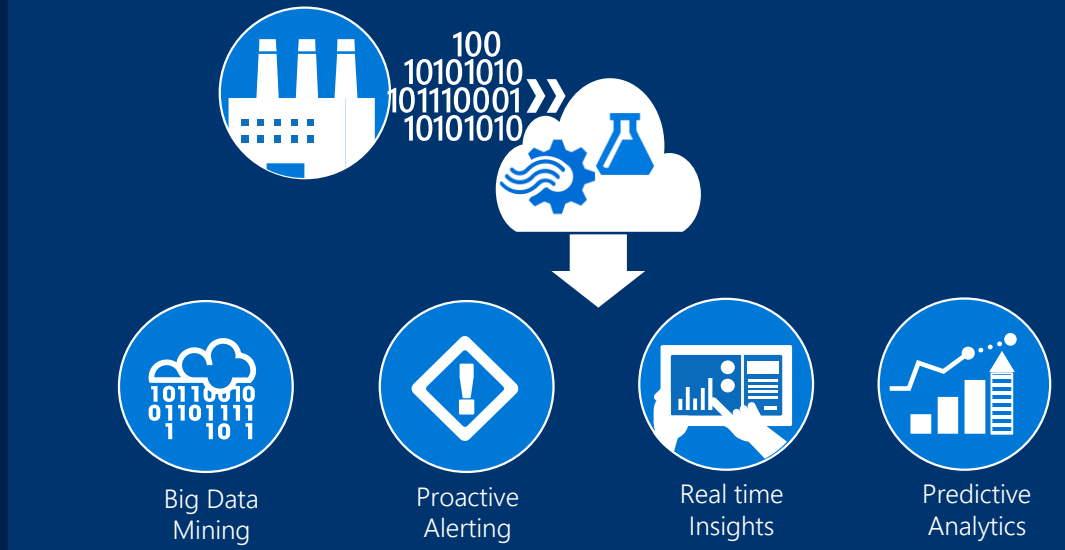


Next generation supply chain

End to End Visibility from Incoming to Customer

- Creating clarity via personalized dashboards
- Increasing collaboration, connected data streams enable teamwork
- Improving factory productivity/optimization

Proactive Alerting, Real time Insights

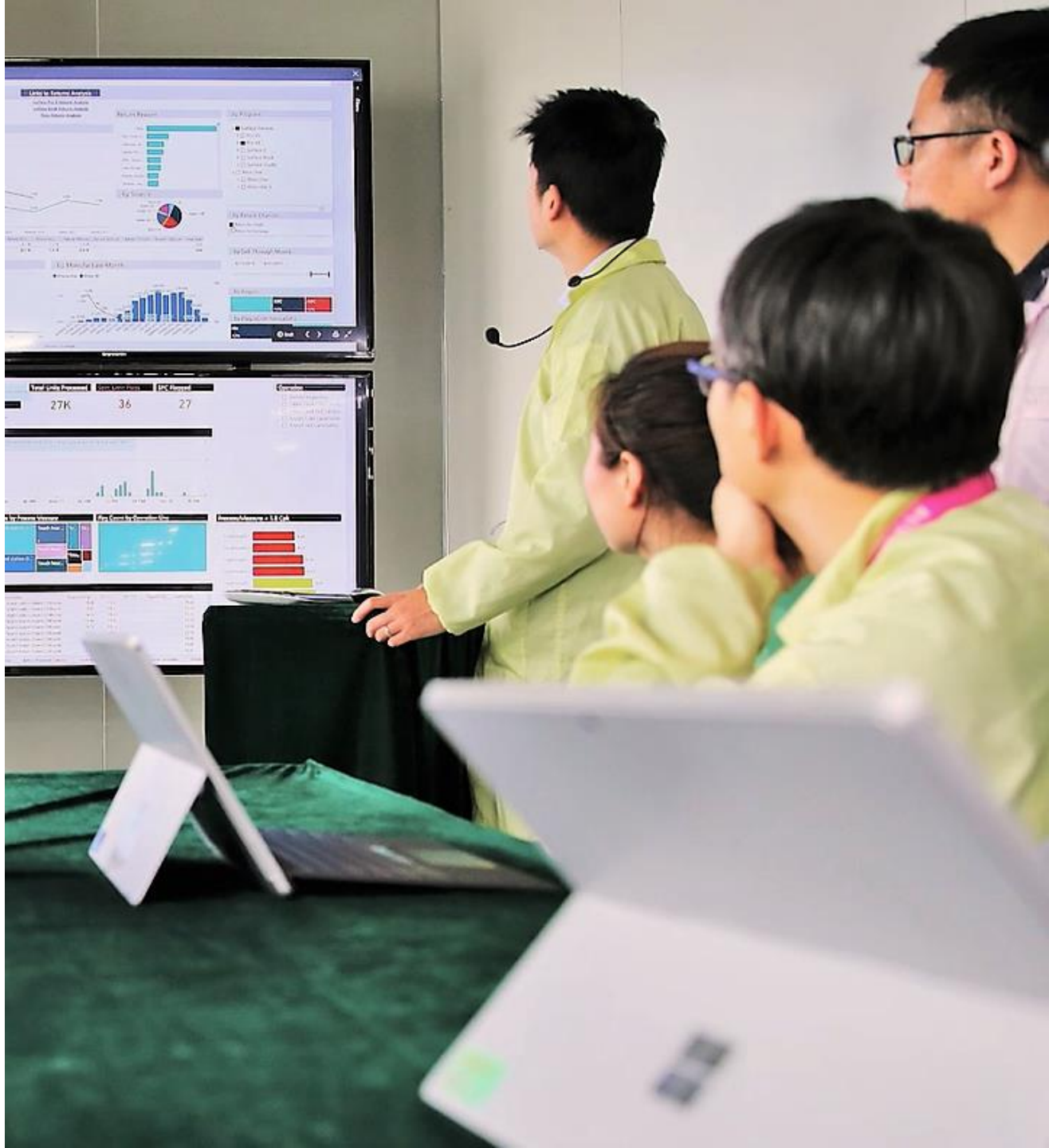


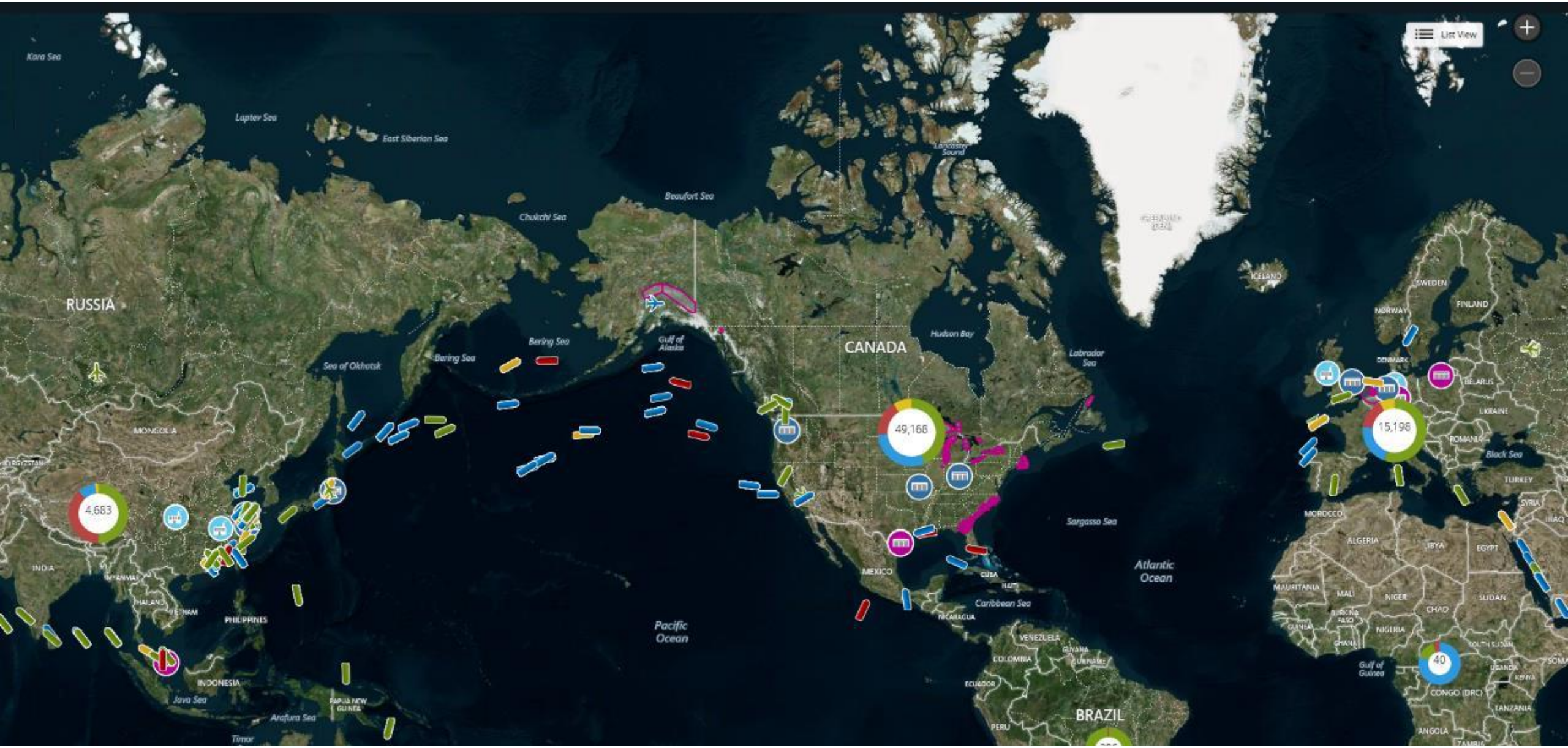
- Big data insight and machine learning
- Proactive alerting
- Predictive analytics

> This digital transformation will allow us to spend more of our time on the complex problems and let the computers take care of the easy problems. It's making us smarter, faster, more collaborative, and connected."

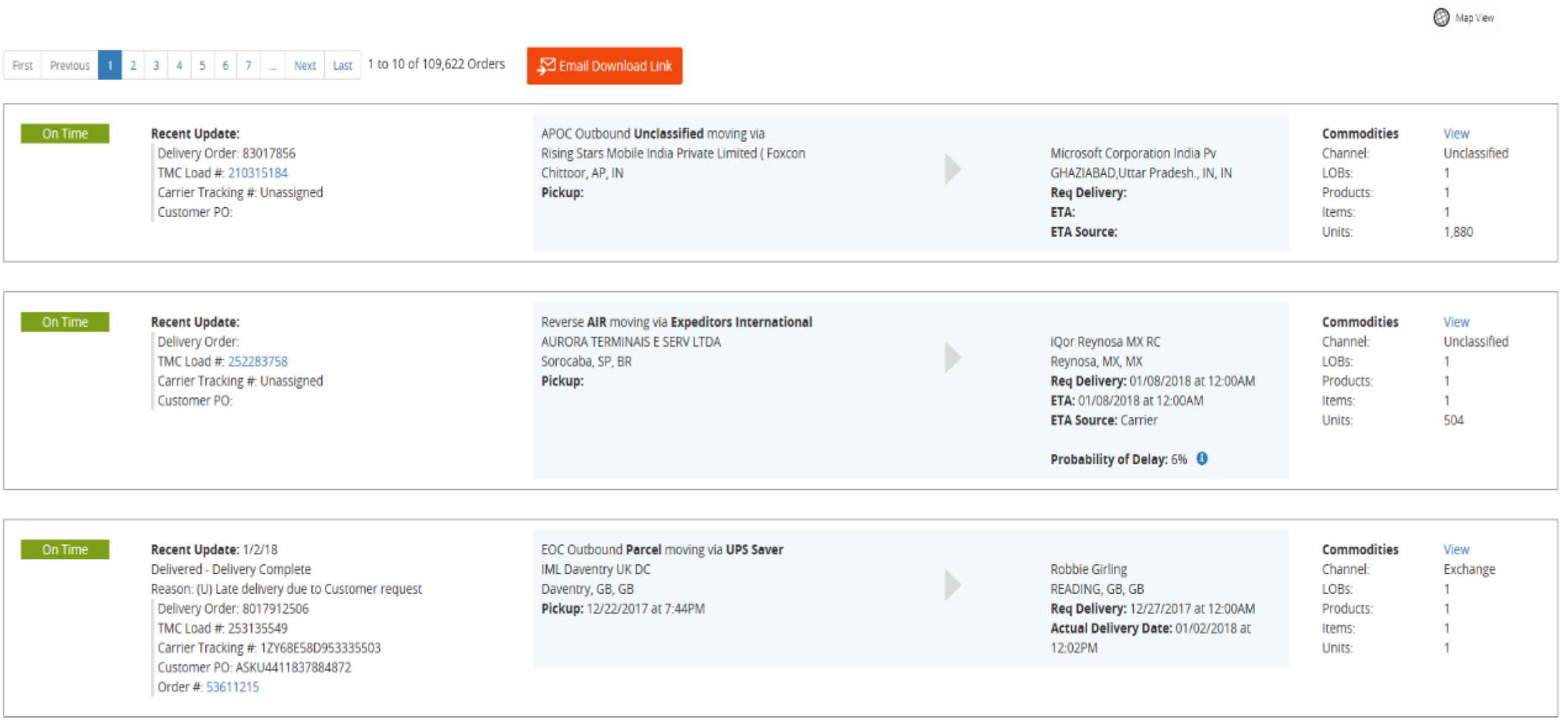
— **Jerry Knoben,** CVP Manufacturing, Microsoft

Microsoft



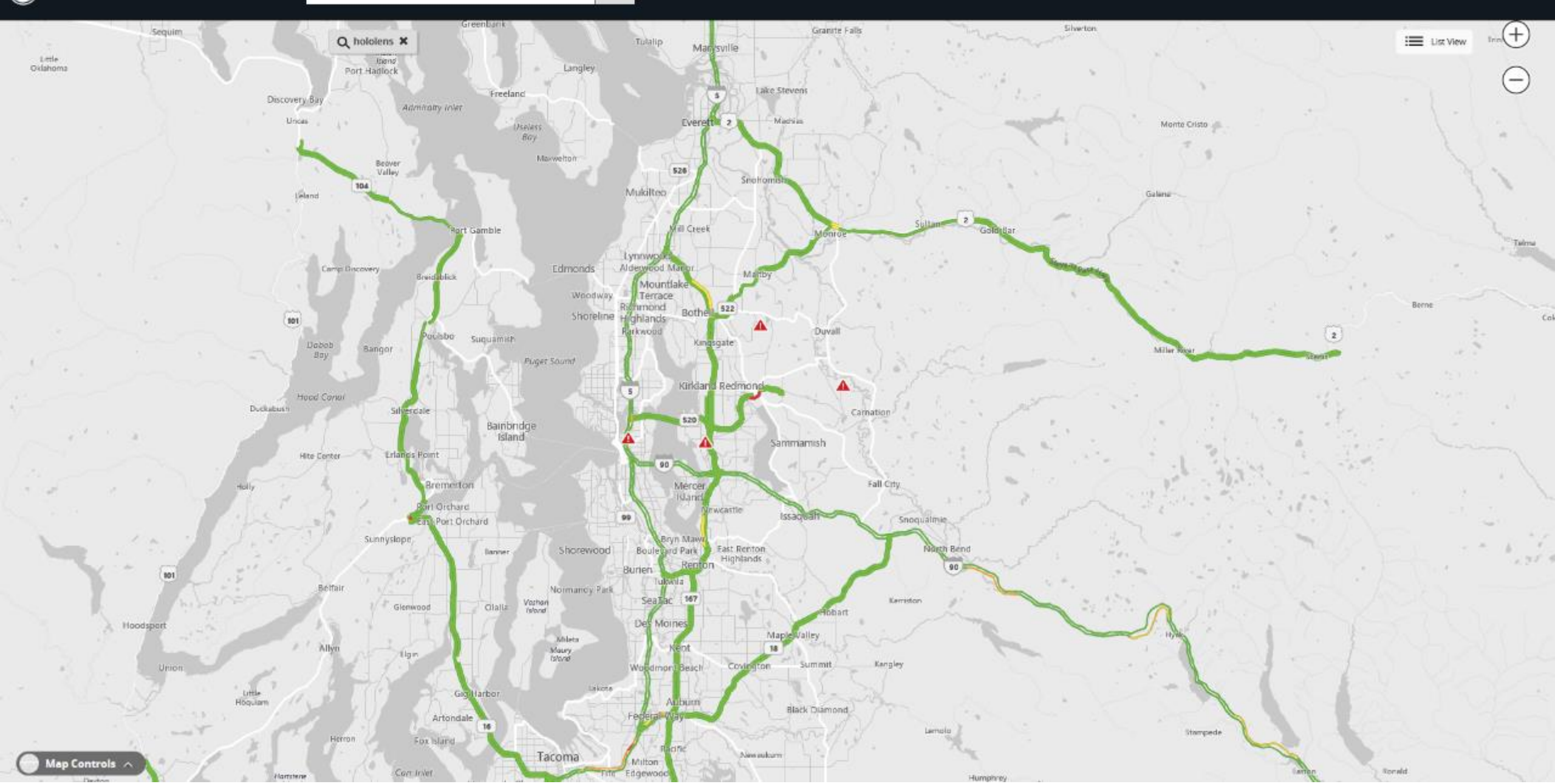


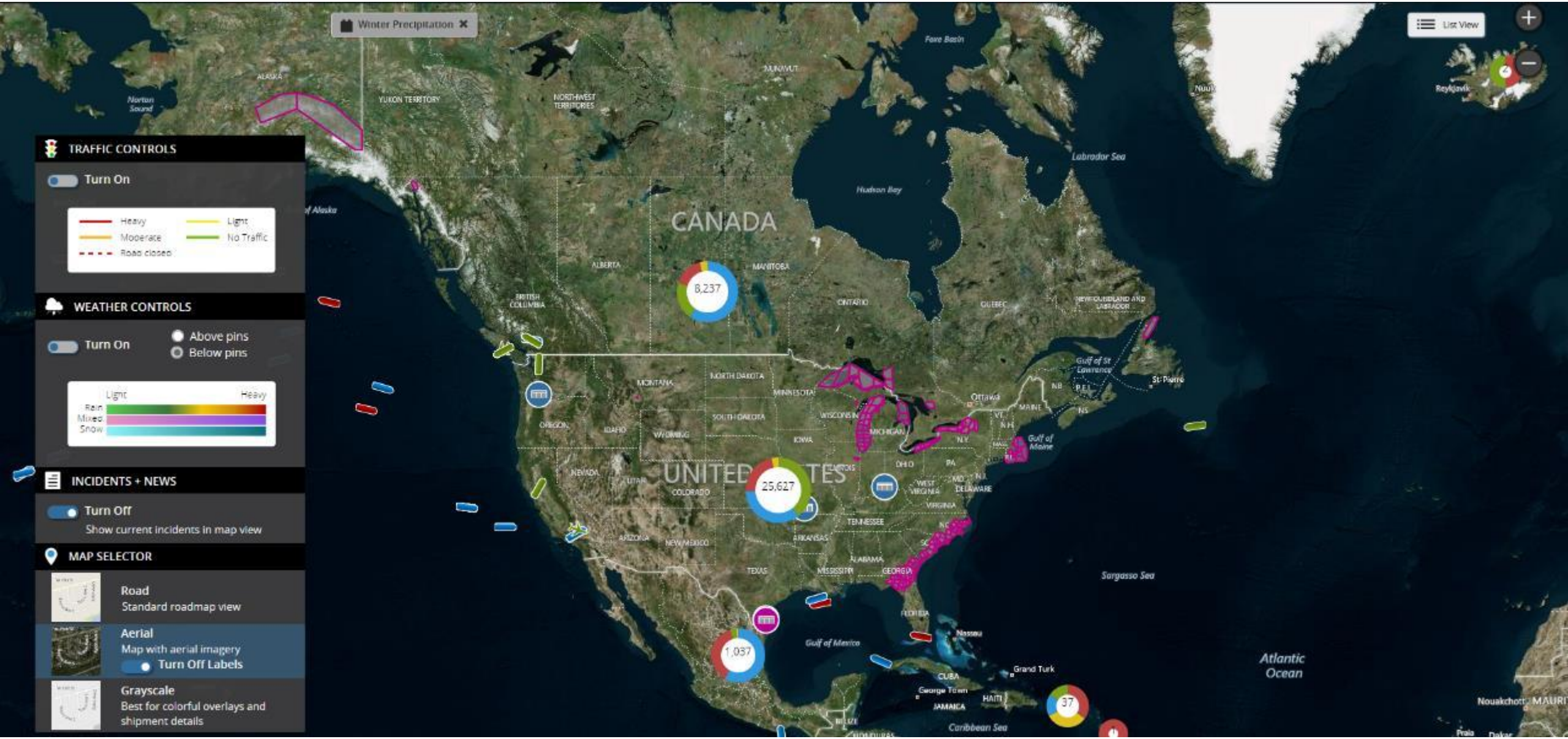
Breadth of Supply Chain: Global View of Microsoft Supply Chain's in Real-Time



Depth of Supply Chain: SKU-level visibility of Microsoft Supply Chain's in Real-Time

Impact to Supply Chain Disruptions: Weather Patterns visualized Globally


hololens
List View
Map Controls
Everett
Mukilteo
Edmonds
Lynnwood
Mountlake Terrace
Shoreline
Bothell
Kirkland
Redmond
Bainbridge Island
Bremerton
Port Orchard
Poulsbo
Port Gamble
Sammamish
Issaquah
Renton
Tukwila
SeaTac
Des Moines
Kent
Auburn
Federal Way
Tacoma
Puget Sound
Monroe
Snohomish
Marysville
Lake Stevens
Duvall
Carnation
Fall City
Snoqualmie
North Bend
Maple Valley
Black Diamond
Enumclaw
Burien
Shorewood
Mercer Island
Newcastle
Sequim
Port Hadlock
Langley
Freeland
Coupeville
Oak Harbor
Granite Falls
Silverton
Monte Cristo
Sultan
Gold Bar
Index
Startup
Supply Chain Disruptions: Impact of Traffic Events visualized in any area globally

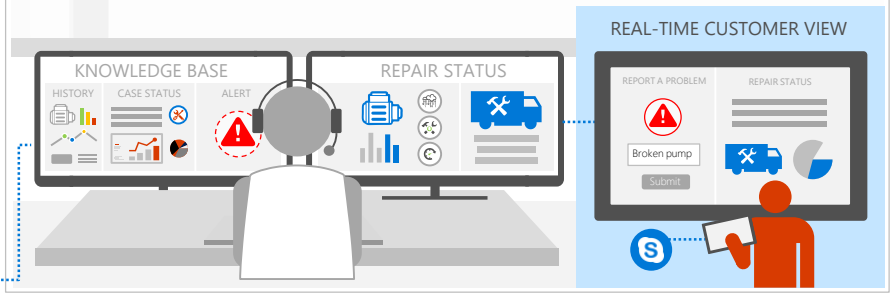


Impact to Supply Chain Disruptions: Specific Weather event visualized in areas affected

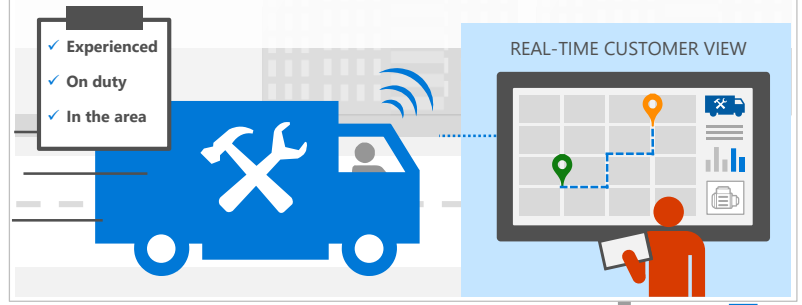
Connected Field Service

1 **Reduce downtime with proactive alerts from connected devices.**

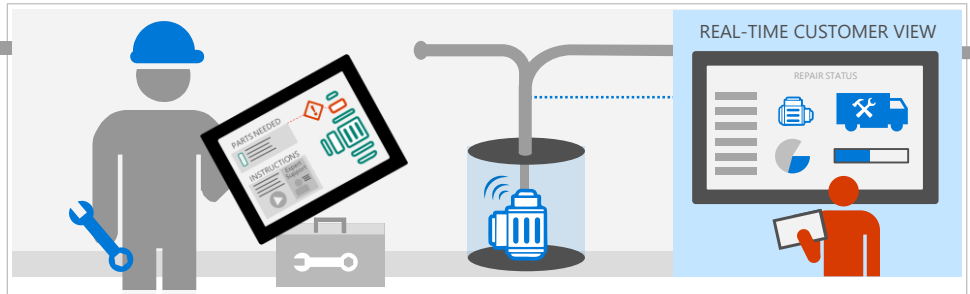
2 **Address issues faster by remotely monitoring devices and keeping customers in the loop.**



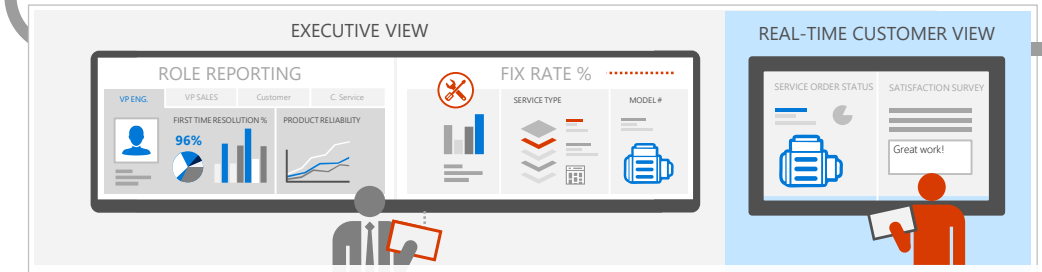
3 **Reduce maintenance costs by dispatching the right technician only when needed.**



4 **Ensure your service techs are fully equipped to deliver a first-time fix.**



5 **Gain enhanced visibility into product, service, company performance and customer satisfaction.**



Back to home

thyssenkrupp elevator

Developing a world-class service arm

Challenge ThyssenKrupp wanted to offer dramatically increased uptime, predictive and even preemptive service to its customers

Solution Microsoft technology enabled ThyssenKrupp to monitor products via a real-time dashboard and instruct technicians on optimal maintenance activities

Benefits

- Increased elevator uptime
- Reduced costs for ThyssenKrupp and its customers
- Developed real-time data visualization and awareness of issues

thyssenkrupp

"We wanted to go beyond the industry standard of preventative maintenance, to offer predictive and even preemptive maintenance."

— Andreas Schierenbeck,
CEO, ThyssenKrupp Elevator

Back to home

thyssenkrupp

Transforming home mobility solutions

Challenge thyssenkrupp wanted to make it easier for customers to visualize their custom staircase solutions, while simplifying the complex manufacturing process

Solution thyssenkrupp used mixed reality headsets to quickly scan staircases and automatically share data in real-time with sales, design, and manufacturing teams

Benefits

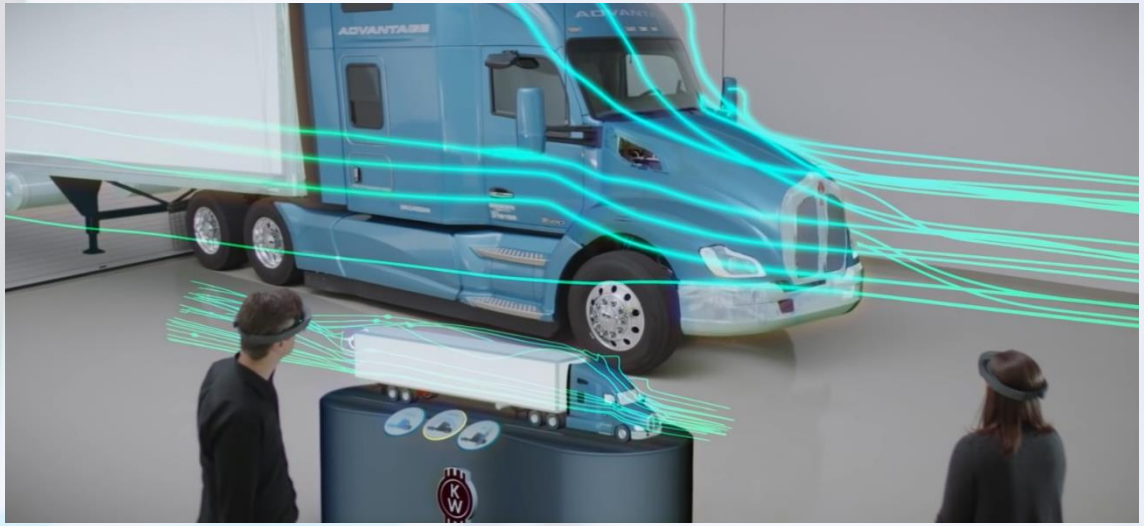
- Delivered products up to four times faster
- Improved customer satisfaction with in-home visualizations
- Enhanced collaboration and efficiency with instant data sharing and near real-time design approval

thyssenkrupp

"With this partnership with Microsoft, thyssenkrupp will transform homes to make life better. That is a game changer."

— Thomas Felis,
Vice President of Innovation, thyssenkrupp

Introducing a whole new class of Digital Twin



2017

End-to-end innovation and collaboration

- Powerful, advanced, and immersive visualization
- Intelligent interaction with cognitive services and autonomous capabilities
- In-process collaboration between humans and equipment

2014

Connected IoT services

- Data unification across physical and virtual
- Rapid feedback across design, manufacturing, operation
- New services, like remote monitoring or predictive maintenance

2003

Digital simulation and 3D printing

- Digital design, virtual assembly and simulation before physical commitment
- 3D printing mainstream
- No direct feedback

1985-2002

Information Mirroring* model

- Powerful modeling and analysis
- R&D and engineering focused

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

Advanced and immersive visualization

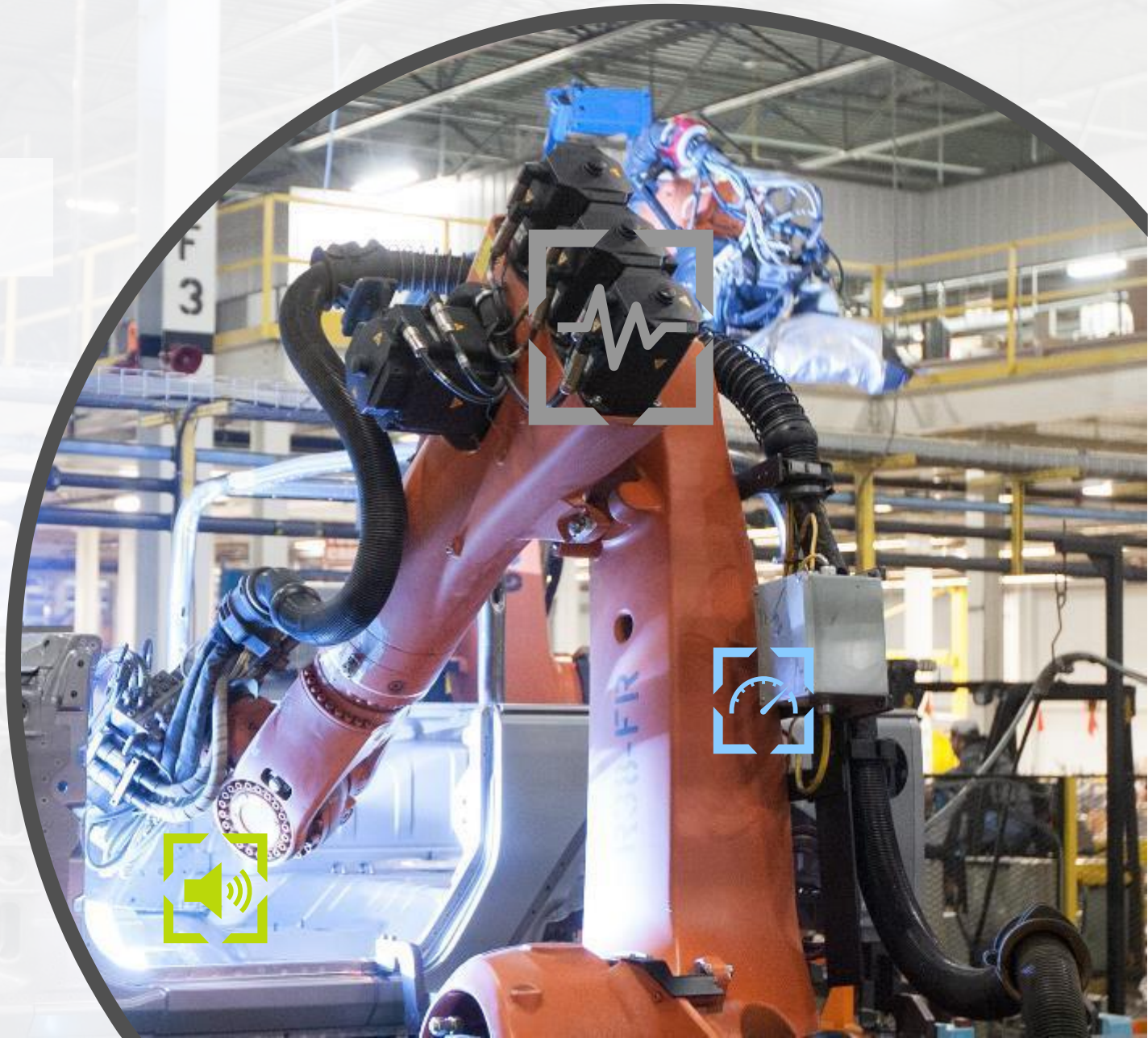
- Project a digital image of a real-world device in two-dimensional or three-dimensional space
- Overlay real-time data visualization on physical devices
- See into the past by replaying events from the digital record

Example scenario:

Technicians replay Digital Twin telemetry recording of plant floor devices to determine root cause of faults in the latest product batch.

Intelligent interaction

- Enable speech, audio, and visual recognition and processing
- Automate baseline tasks
- Simulate outcomes of new procedures digitally



Example scenario:

Digital Twin solution processes a video recording of a fault-creation to develop a recommendation for a fix and adds notes to the digital record for that component.

In-process collaboration

- Empower remote experts to work with on-site technicians
- Get recommendations from devices to improve decisions
- Enable hands-free context with real-time feedback

Example scenario:

Digital Twin solution walks service technicians in the field through a repair with instructions augmented over a physical device.

Microsoft

Thank you

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