



CAPITALISER SUR LA VALEUR DE L'IOT COMMENT DÉMARRER SA TRANSFORMATION NUMÉRIQUE

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400 CEOs

Asia, Europe, and the US

x

Execuational Excellence

x

was the number one challenge

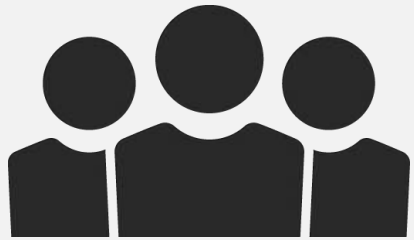
Up to

75%

struggle to implement
their strategies

Out of 80+ issues, including
innovation, geopolitical instability,
and top-line growth

IOT CREATES ENORMOUS BUSINESS OPPORTUNITY



IMPROVE CUSTOMER EXPERIENCE

Leverage data from connected products for improved service, support and usability



OPTIMIZE BUSINESS PROCESSES

Combine real-time data with existing systems to increase efficiency



DIFFERENTIATE OFFERING

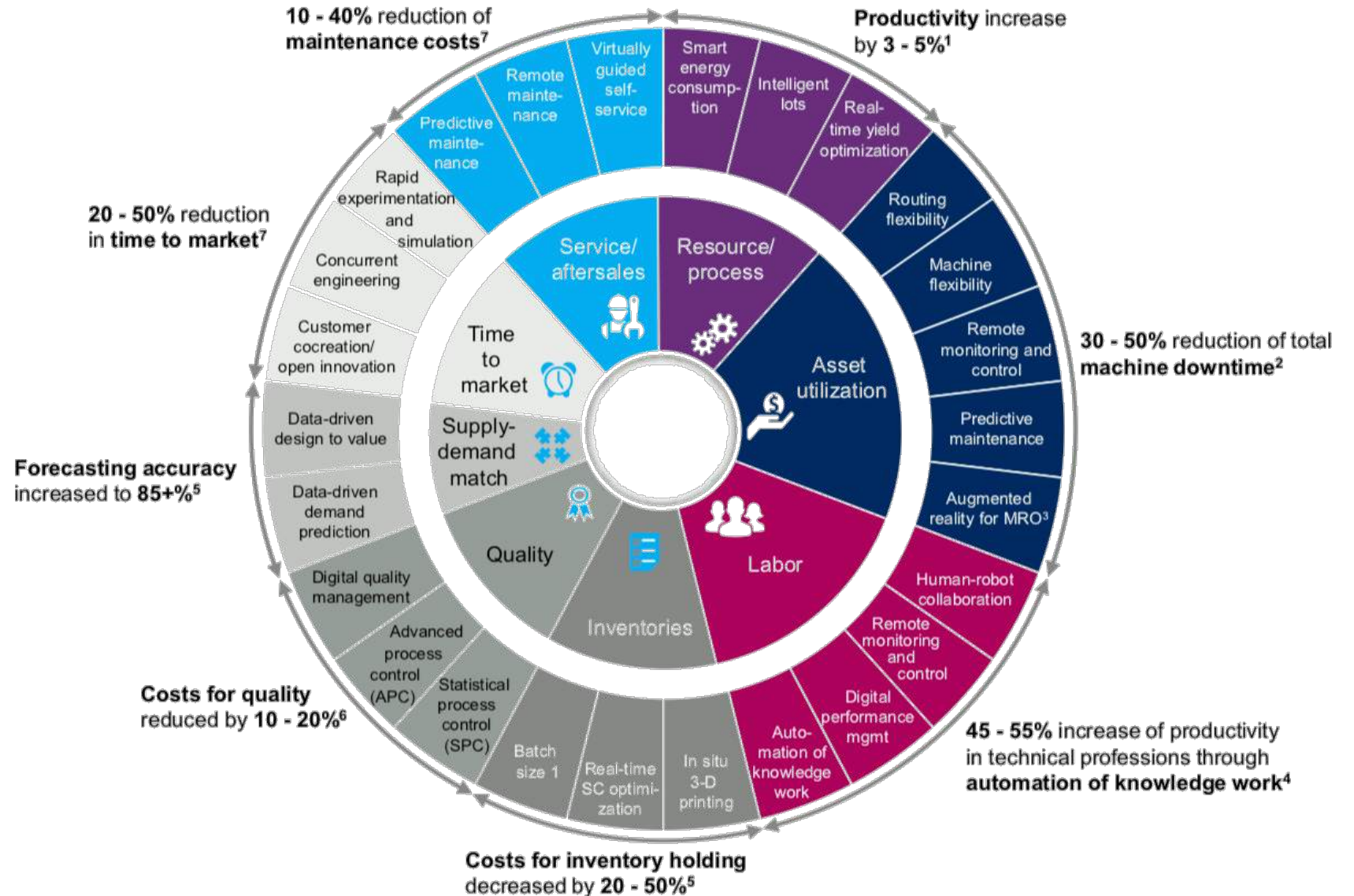
Increase pace of product and service innovation



DRIVE NEW REVENUE STREAMS

Unlock new business models and realize new value-add opportunities

INDUSTRIE 4.0 DIGITAL COMPASS



SOURCE: McKinsey

1 Client experience
 2 McKinsey analysis
 3 Maintenance, repair, and operations

4 Cf. McKinsey Global Institute: Disruptive technologies
 5 McKinsey analysis
 6 Cf. T. Bauernhansl, M. ten Hompel, B. Vogel-Heuser (Ed.): Industrie 4.0 in Produktion, Automatisierung und Logistik (2014)
 7 Cf. McKinsey Global Institute: Big data: The next frontier for innovation, competition, and productivity

THE TIME TO TRANSFORM IS NOW



Digital Transformation is the means by which industrial companies capitalize on **PHYSICAL DIGITAL** convergence

TRANSFORM TO ACHIEVE BUSINESS OUTCOMES

Smart Connected Products Drive Critical Product and Service Differentiation



Smart Connected Processes Enable Breakthroughs in Operational Effectiveness

Smart Connected People
Makes Workforce
Productivity and Quality Soar

UNLEASH OPPORTUNITIES ACROSS THE ENTERPRISE



Service Optimization

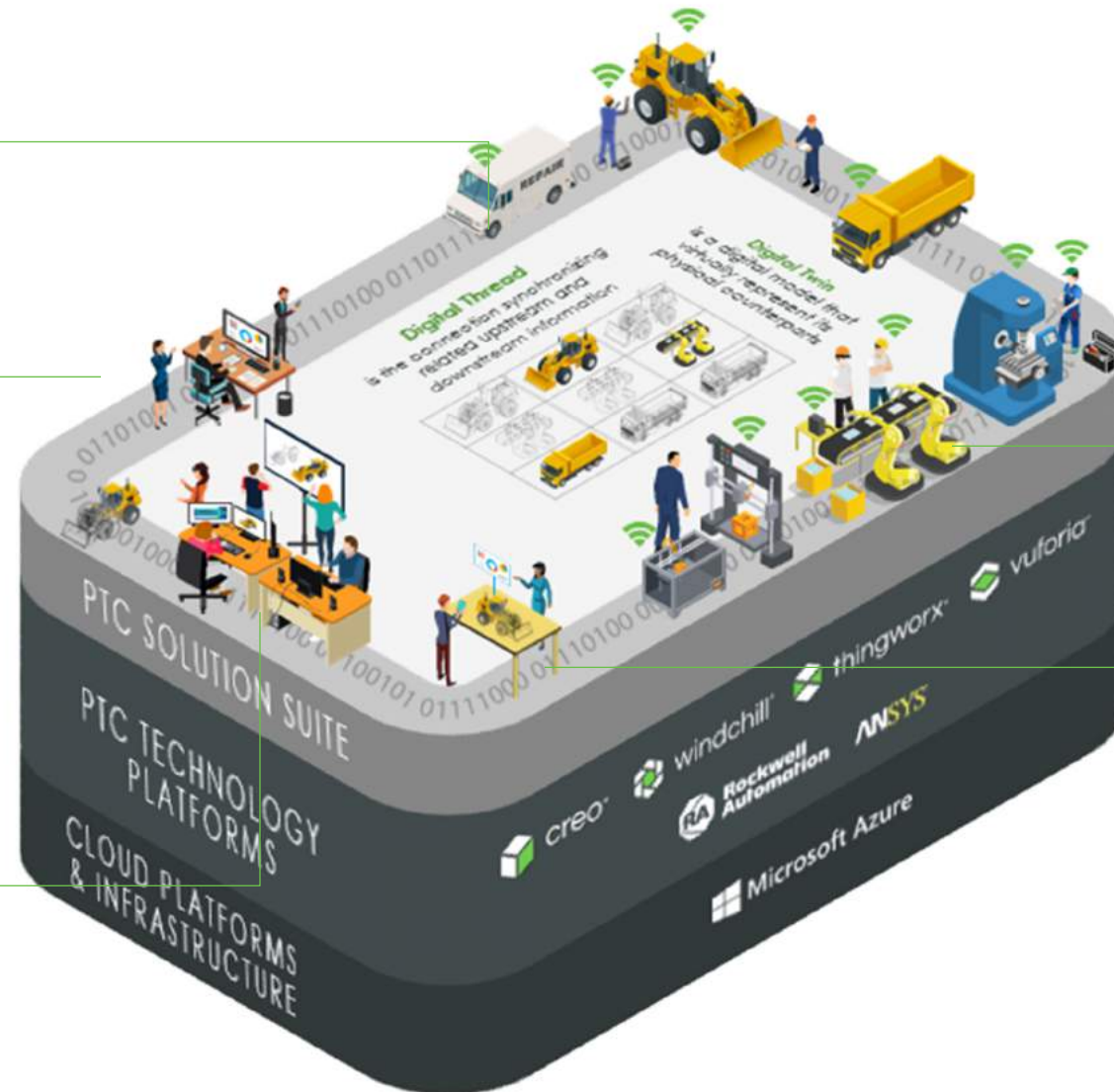
Solutions to empower service teams with advanced knowledge, remote service capabilities, and augmented intelligence to improve productivity, quality and compliance

Sales & Marketing Experiences

Virtual product demonstrations, product companions, "voice of the product" feedback, and augmented brand experiences

Engineering Excellence

Seamless data and model centric workflow that enables data-driven decisions to be made throughout the design and manufacturing process



Manufacturing Efficiency

Improve operational efficiency, reduce manufacturing costs, improve worker safety, accelerate time to market, and ensure quality & compliance

Product Innovation

Develop new products, services, and business models leveraging the digital feedback loop

QUANTIFIED OUTCOMES

5-12%

Reduction in operational costs

5-60%

Increase in operator productivity

10-50%

Reduction in scrap

2-15%

Reduction in energy costs

10-20%

Reduction in cost of quality

Solution Areas

- **Digital Workforce Productivity** increases workforce efficiency and improves quality
- **Enterprise Operational Intelligence** increases production efficiency and lowers costs
- **Intelligent Asset Optimization** maximizes throughput and asset utilization

How We Do It

- Empowering workers to increase productivity without sacrificing quality
- Creating real-time visibility and actionable insights
- Monitoring asset health to identify abnormal conditions
- Optimizing energy and resource utilization

CUSTOMER SUCCESS STORIES



BAE SYSTEMS



ENTERPRISE OPERATIONAL INTELLIGENCE



HOW WE DO IT

Understand real-time operational performance with flexible KPIs that unify data from existing heterogeneous devices, assets and systems across the enterprise.

Value

Wrap

- Real-time Production Performance Monitoring
- Asset Health Monitoring
- Real-time Workforce Performance Monitoring
- Energy Monitoring And Management

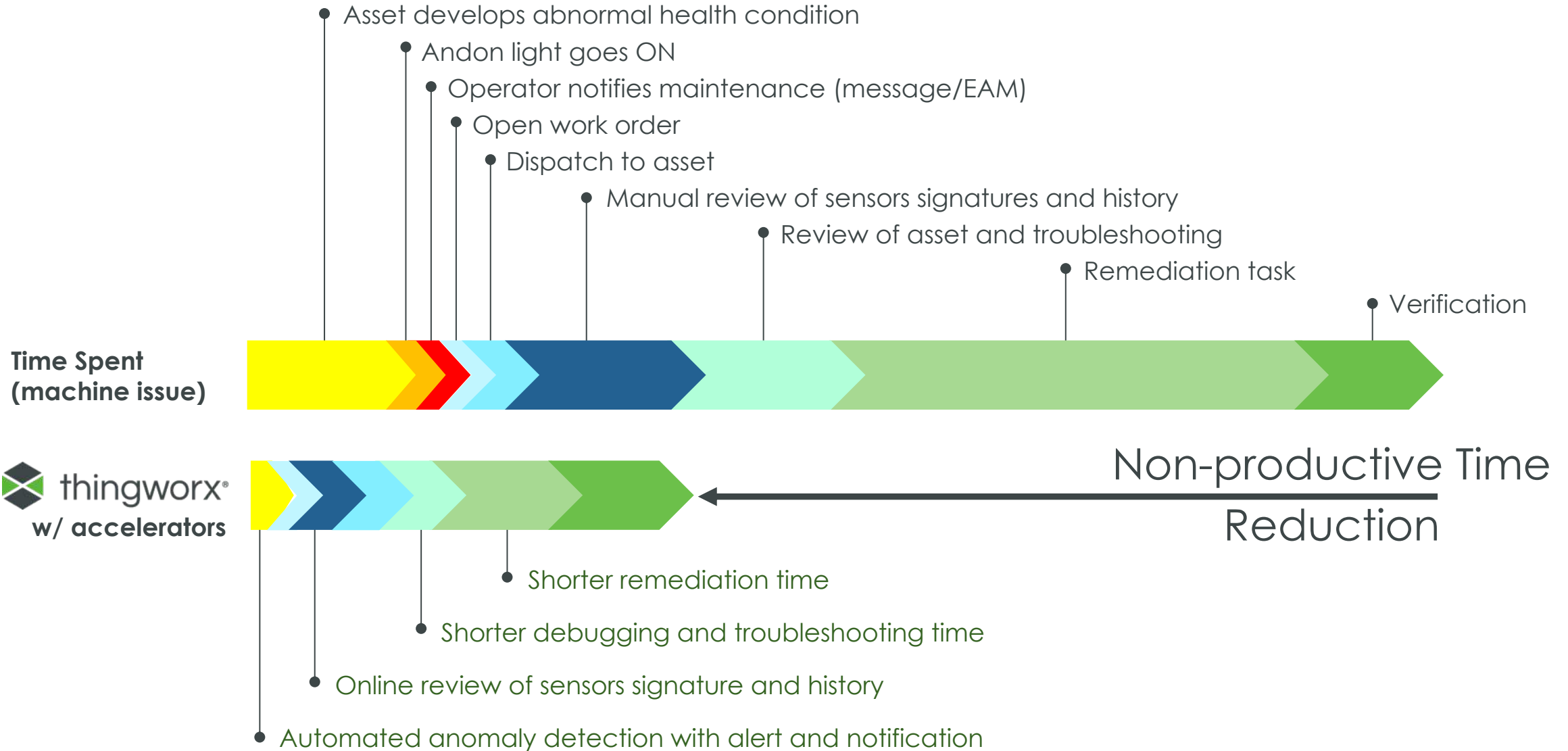
Extend

- Enterprise Plant Benchmarking
- Real-time Order Tracking
- Predictive Performance Analytics

Transform

- AR Identification Of Processes To Automate
- Production Performance Optimization
- Customer Self Service Visibility Into Order Fulfillment

CROSS DOMAIN EXECUTIONAL EXCELLENCE





thingworx®

INDUSTRIAL INNOVATION PLATFORM

PLATFORM + APPS + ECOSYSTEM

THINGWORX INDUSTRIAL IOT PLATFORM

Jumpstart your digital transformation journey

<p>ThingWorx Controls Advisor</p> <p> Controls Engineer</p>	<p>ThingWorx Asset Advisor</p> <p> Maintenance</p>	<p>Partner Apps</p>	<p>Customer Apps</p>
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THINGWORX APPS

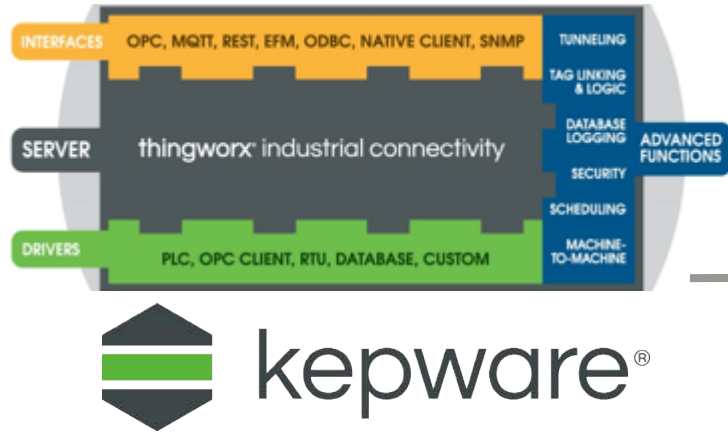
<p>Integrations</p> <ul style="list-style-type: none"> MES Quality ERP Smart Tools 	<p>ThingModels</p> <ul style="list-style-type: none"> Job Order Assets Crew Shift 	<p>Business Logic</p> <ul style="list-style-type: none"> KPIs SPC Re-order APM 	<p>Widgets</p> <ul style="list-style-type: none"> OEE Trending Work instr. Asset view
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THINGWORX ACCELERATORS

/ SOURCE /
CONTEXTUALIZE /
SYNTHESIZE /
ORCHESTRATE /
ENGAGE /

THINGWORX FOUNDATION

THINGWORX CONNECTIVITY TO DEVICES



ThingWorx Edge SDK's

- Build robust, secure, full-featured edge integrations and gateways for any platform.

ThingWorx Edge MicroServer

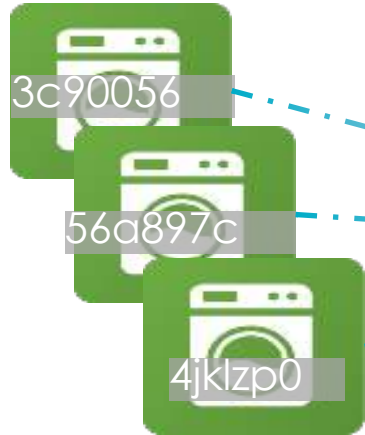
- Pre-built lightweight IoT Gateway for easily connecting your Windows, Linux, or Linux ARM devices.
- Runs on device or on a gateway connected to multiple devices.
- Rapidly integrate data sources via simple Lua scripts.

ThingWorx REST API

- Bring the power of the ThingWorx platform to even the smallest of devices.

ENTITIES AS APPLICATION BUILDING BLOCKS

Things



Thing Template



- Properties
 - Running hours
 - Average temp
 - Warranty
 - Load Size

- Services
 - Check Wash
 - Update firmware
 - Report Failure

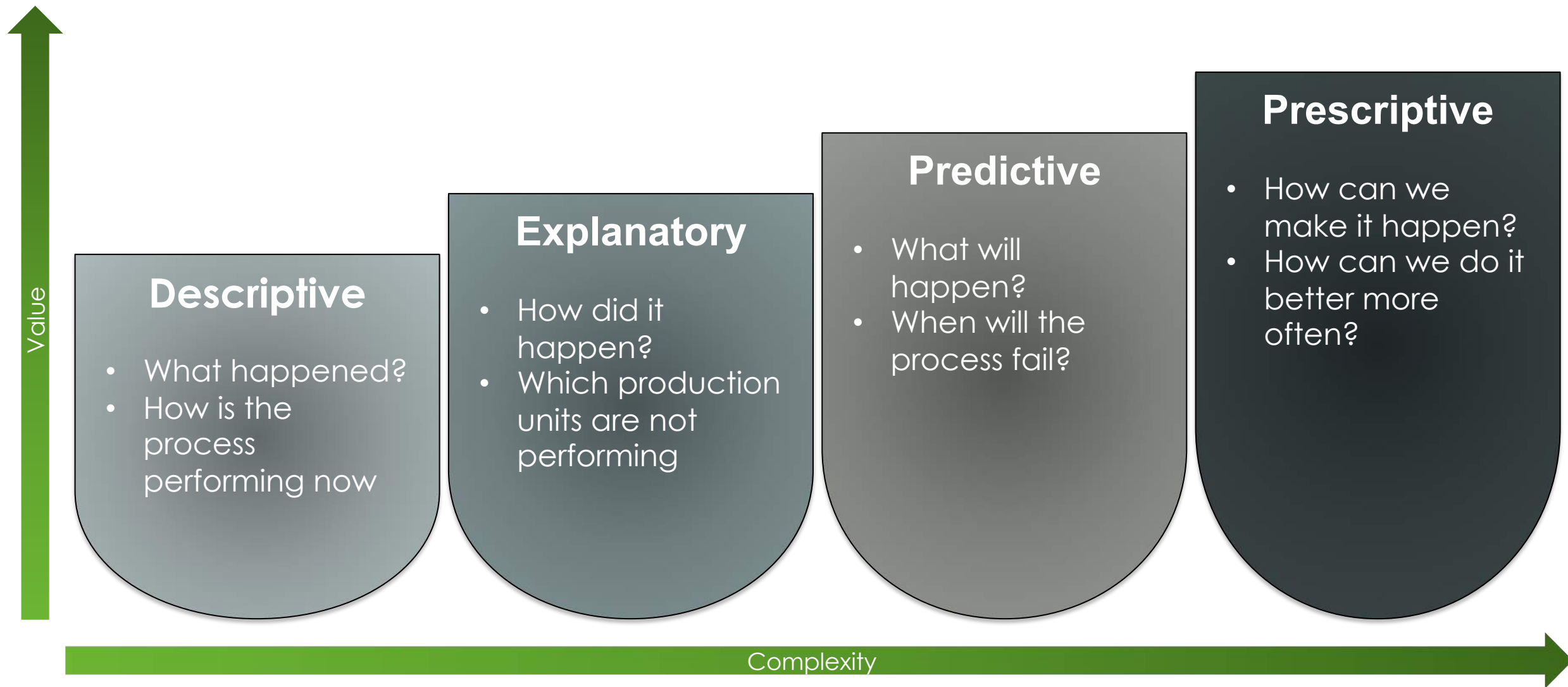
- Events
 - Wash Complete
 - Wash Started
 - Malfunction

- Subscriptions
 - Clothes ready
 - Detergent available

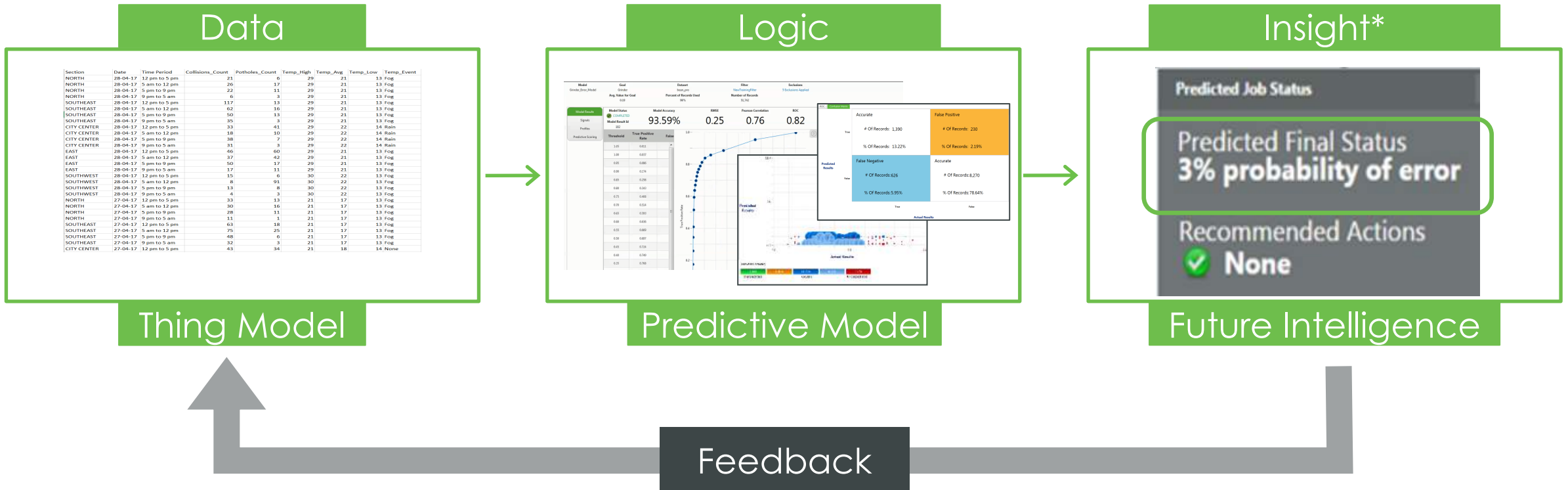
Enterprise Systems



ANALYTICS MATURITY MODEL



PREDICTIVE ANALYTICS



- Applies machine learning to historical data to make predictions about future outcomes
- Example Use Cases
 - Predict failures
 - Predict quality
 - Determine when service is needed
 - Predict sales, risk of churn

* Une perception clair et profond

Asset Risk Profile

Asset Detail Remediate Recalibrate Simulation

Performance Monitoring

Bearing Risk

10 days to failure

Service Status:

Mechanical Seal Risk

11 days to failure

Service Status:

Impeller Risk

305 days to failure

Service Status:

Name: PTC.CSLM.PS.Demo.Assets.Pump1 Customer: Acme Pump Unit: Power Lab A
 Equipment: CPXN Serial: C937KH013 Site: Demo Site Country: USA

Flow Rate
6.77 gpm

Discharge Temp
N/A

SC Pressure
N/A

Discharge Pressure
33.03 psi

Delta Pressure
16.91 psi

Suction Pressure
16.12 psi

Efficiency
11%

Vibration
OK

Vibration Bearing
-0.31 mA/g

Vibration X
-0.04 mA/g

Vibration Y
-0.16 mA/g

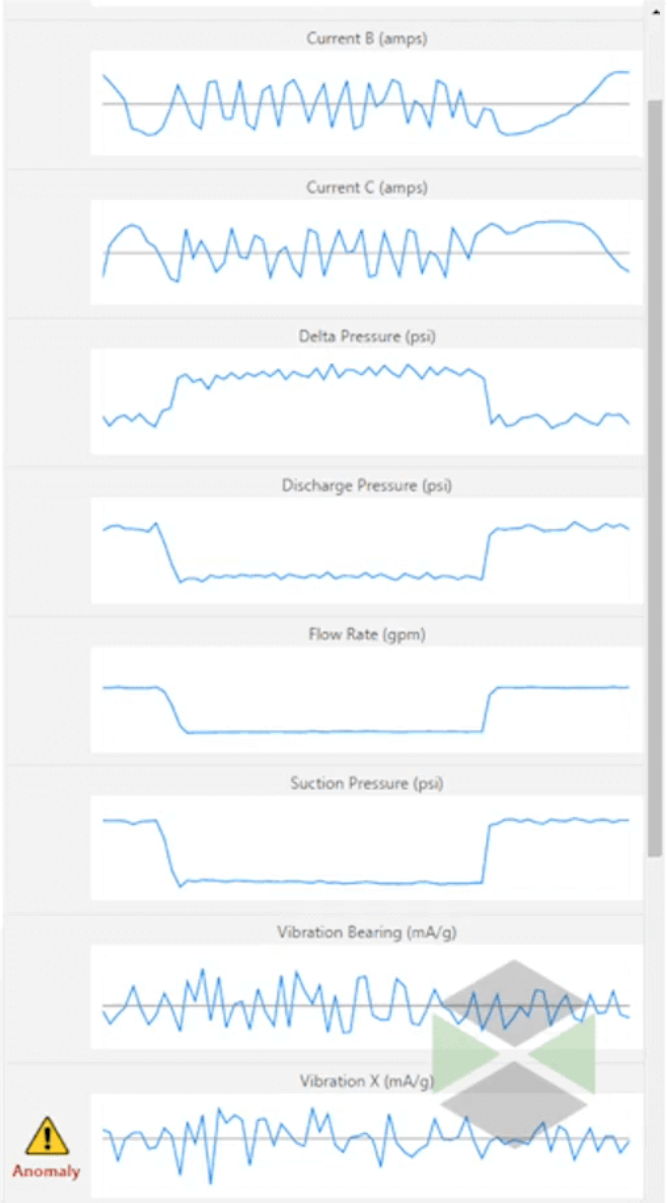
Discharge Pressure
Anomaly

Delta Pressure
Anomaly

Suction Pressure
Anomaly

Voltage
36.27 V
77.09 V
-66.59 V

Current
-1.98 amps
5.59 amps
-3.63 amps

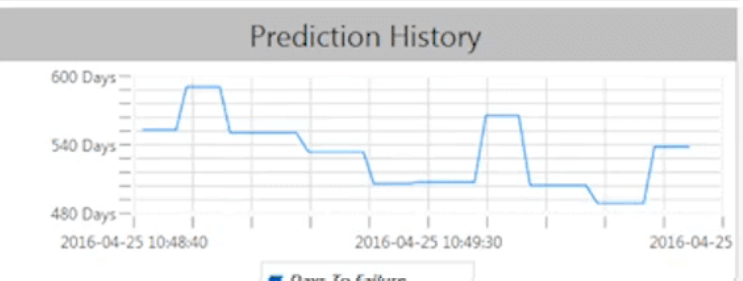


Contributing Factors

Name	Value	Weight
Vibration X	0.26 mA/g	21%
Suction Pressure	16.07 psi	14%

Prediction Accuracy

Accuracy	98%
Root Mean Square Error (RMSE)	13.12
Pearson Correlation	0.97
Validation	10,321



Anomaly

View Detail Remediate **Asset Risk Analysis**


High Risk
9

⚠️ 6 days to failure

Service Status:

Current B	44.63 amps
Voltage C	2 V
Voltage B	107.18 V

PTC.CSLM.PS.Demo.Assets.Pump10

	Model CPXN	Risk Summary	Service Information
	Serial # C937KH022	Voltage A 66.52 V	MTBF 278 Days
	Location Houston, TX	Voltage B 131.77 V	Last Service 43 Days
		Voltage C 1.37 V	Contracted Service 98% availability
		Current B 33.01 amps	
		Current A 80.23 amps	
		Current C 89.64 amps	

Service Status:

Low Risk
0

⚠️ 3 days to failure

Service Status:

Model CPXN	Risk Summary	Service Information
Serial # C937KH017	Voltage A 84.35 V	MTBF 278 Days
Location Graysville, GA	Current A 44.56 amps	Last Service 43 Days
	Current C 87.56 amps	Contracted Service 98% availability
	Current B 77.49 amps	
	Voltage B 194.64 V	
	Voltage C 0.65 V	

Service Status:

Normal Operation
1

⚠️ 4 days to failure

Service Status:

Model CPXN	Risk Summary	Service Information
Serial # C937KH019	Voltage A 57.5 V	MTBF 278 Days
Location Evansville, IN	Voltage B 105.99 V	Last Service 43 Days
	Current B 73.45 amps	Contracted Service 98% availability
	Current C 33.04 amps	
	Voltage C 0.54 V	
	Current A 41.89 amps	

Service Status:

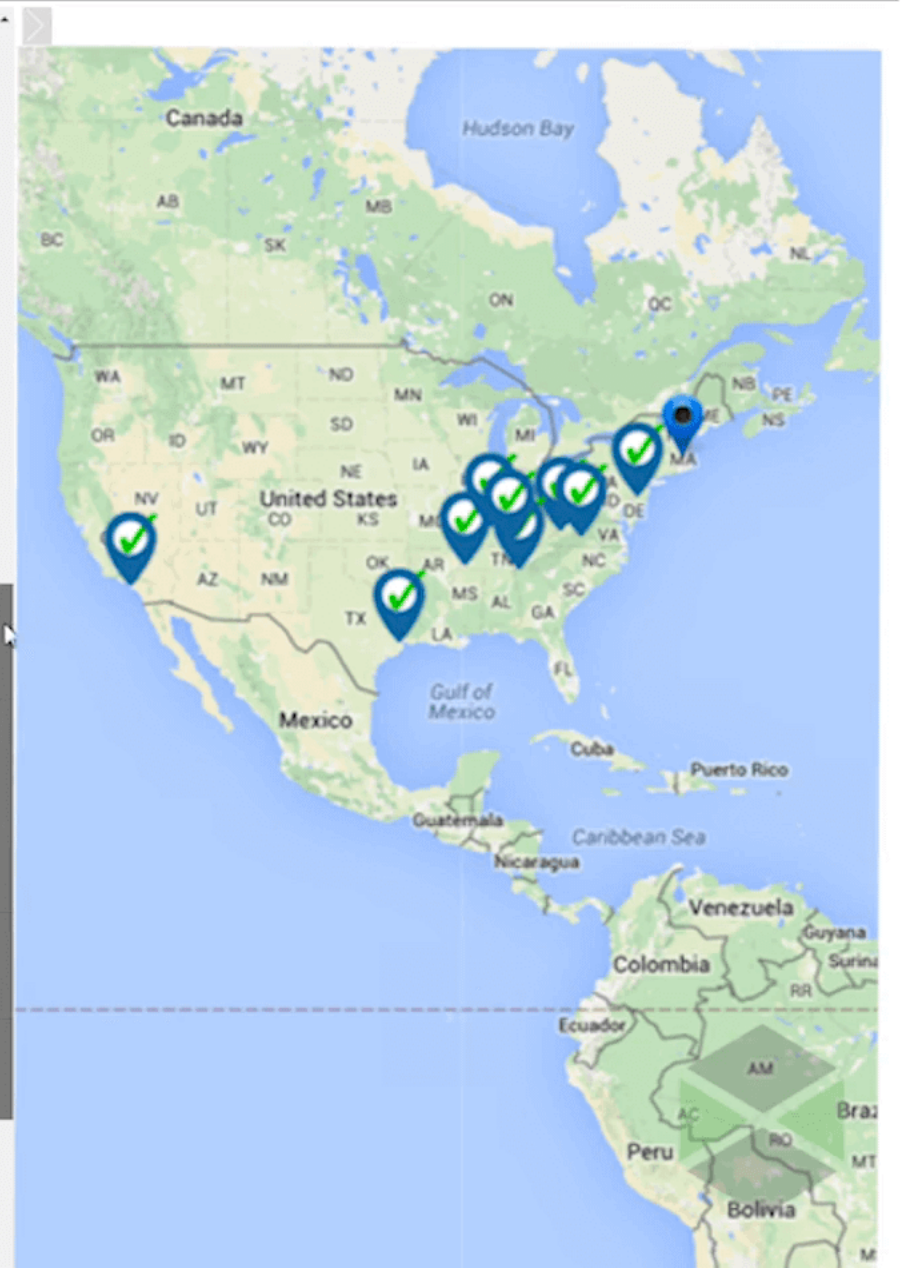
Disconnected
0

⚠️ 5 days to failure

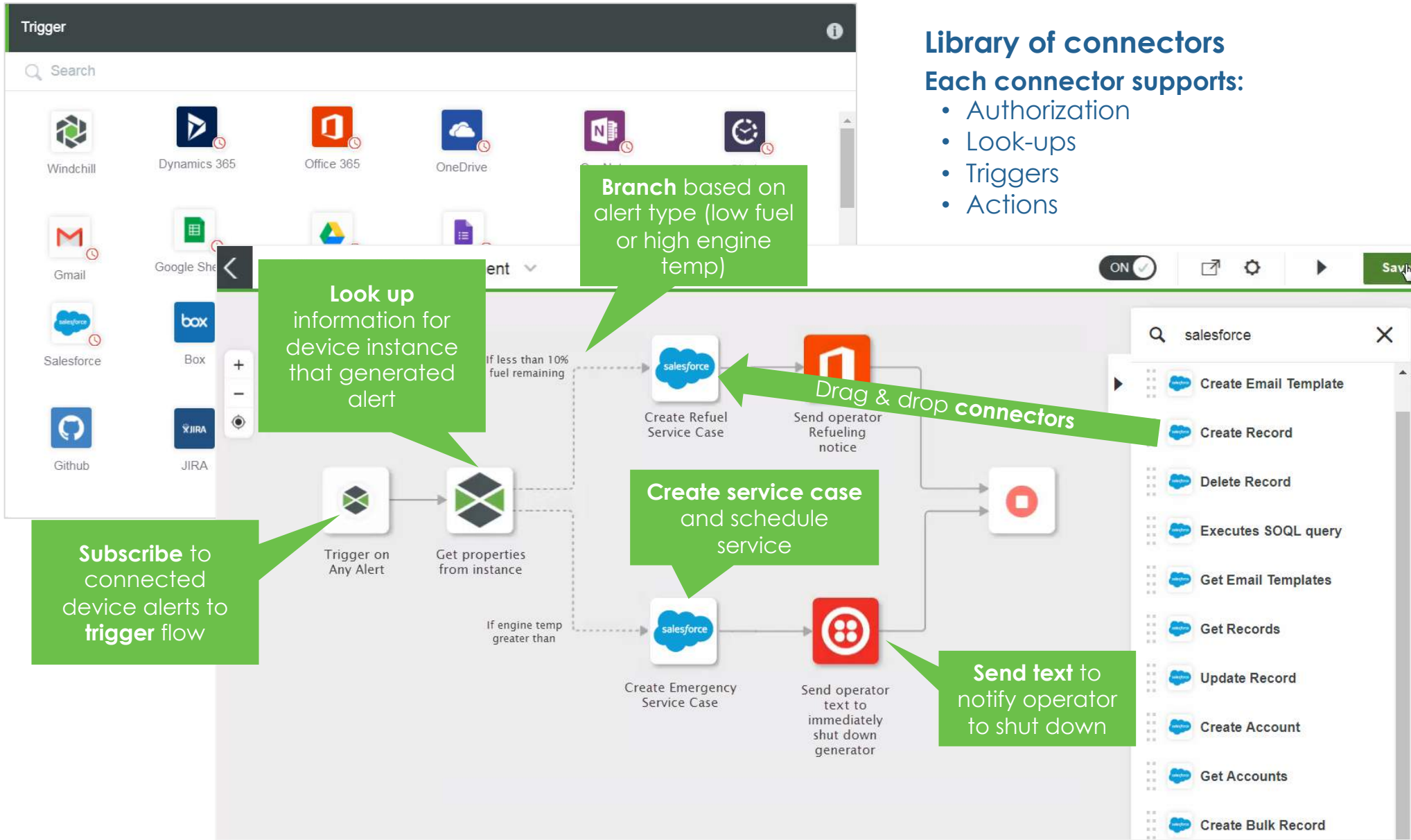
Service Status:

Model CPXN	Risk Summary	Service Information
Serial # C937KH020	Voltage A 70.5 V	MTBF 278 Days
Location Austin, KY	Current C 48.13 amps	Last Service 43 Days
	Voltage B 109.71 V	Contracted Service 98% availability
	Current A 82.64 amps	
	Voltage C 0.05 V	

Service Status:



INTEGRATION & ORCHESTRATION FRAMEWORK



RefrigeratedBeerTruck BeerTruck_09 New Mashup - 2

New Mashup Mashup Design Info Save Cancel Edit More

Widgets Mashups Workspace

Category All

Line Chart Link List Range Slider Slider Validator Vertical Slider

Mashup Filter Properties

Name	Value
-T- Id	mashup-root
-T- Type	Mashup
-T- DisplayName	Mashup
-T- Description	
Master	Search Mashups

Connections To-Do

Mashup

Name Value

Drag & Drop 60+ Widgets and arrange as desired

Add Data

Select Entity All Dynamic

Selected Services

Entity Type	Entity Name	Service	Mashup Loaded?	Remove
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Cancel Done

Add contextualized data, regardless of its source

RefrigeratedBeerTruck | BeerTruck_09 | New Mashup - 2

New Mashup | Mashup | Design | Info | Save | Cancel Edit

Widgets | Mashups | Workspace

Category: All

grid

Grid

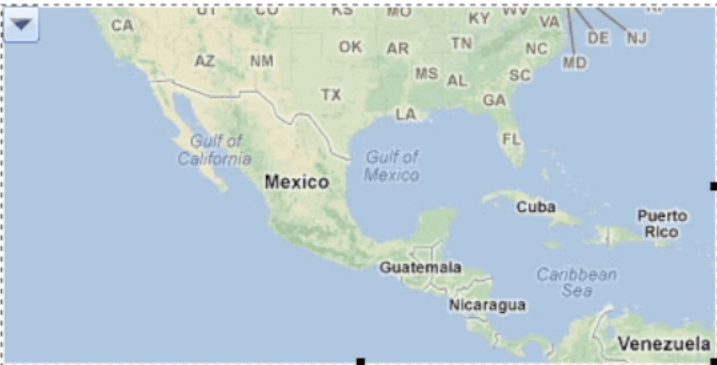
Item

Item

Selected

Item

Item



Must Be Bound To Data

GoogleMap-2

Filter Properties

- # Zoom
- T AutoZoomBehavior: AutoZoom every
- MarkerFormatting: State Formatting
- MarkerStyle
- SelectedMarkerSty...
- SelectionMarkerSt...
- Start
- Env
- P
- RouteStyle

Connections | 4 To-Do

GoogleMap-2

ThingTemplates_RefrigeratedBeerTruck

- QueryImplementingThingsWithData
- Parameters
- Returned Data
- All Data
- Selected Row(s)

Name	Value
------	-------

Bind the data model to relevant Widgets

RefrigeratedBeerTruck BeerTruck_09 New Mashup - 2

New Mashup Mashup Design Info Save Cancel Edit


Widgets Mashups Workspace

Category All

grid

Grid

Item Item Selected Item Item



BillOfLading BillOfLadingItems Cargo CurrentSpeed Description DriverNa

Grid-3

Name	Value
-T- Id	Grid-3
-T- Type	Grid
-T- DisplayName	Grid-3
-T- Description	
RowFormat	State Formatting

Connections To-Do

ThingTemplates_RefrigeratedBe... QueryImplementingThingsWith... All Data Data Grid-3

ThingTemplates_RefrigeratedBeerTruck QueryImplementingThingsWithData Parameters Returned Data All Data Selected Row(s)

Name	Value
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Configure Widgets to display pertinent information

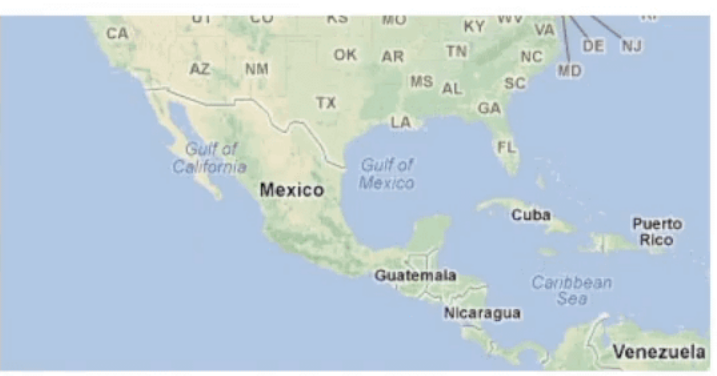
Widgets Mashups Workspace

Category All

grid

Grid

Default Language



Item
Item
Selected
Item
Item

CurrentSpeed	EngineRunTime	Name	TrailerHumidity	TrailerTemperature

Data Session User

ThingTemplates_RefrigeratedBeerTruck

QueryImplementingThingsWithData

Parameters

Returned Data

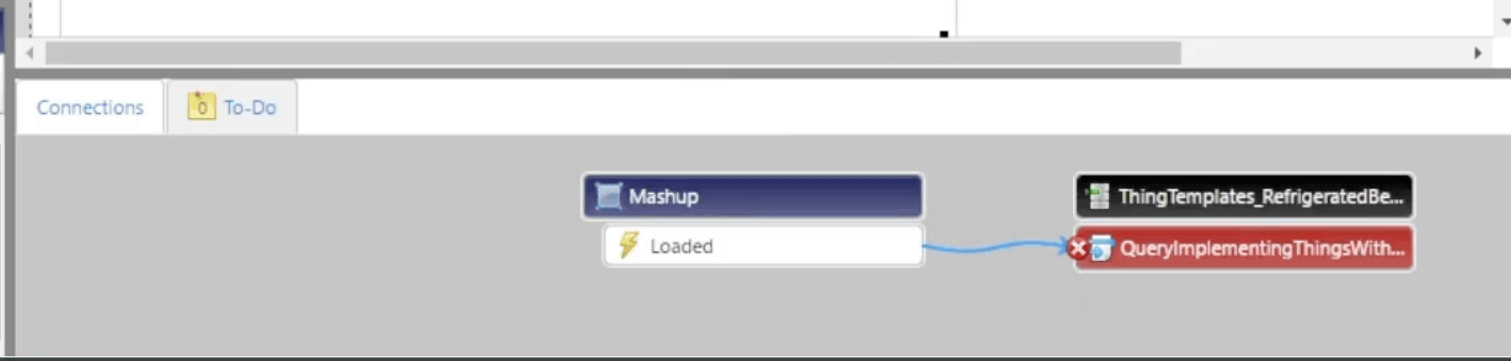
All Data

- avatar
- BillOfLading
- BillOfLadingItems
- Cargo
- CurrentSpeed
- description
- DriverName
- DriverPhoneNumber
- DriverPhoto
- EngineRunTime
- EquipmentFault

Name	Value

Mashup Filter Properties

Name	Value
-T- Id	mashup-root
-T- Type	Mashup
-T- DisplayName	Mashup
-T- Description	
Master	Search Mashups



Quickly test interface design and operation



Asset Model

Filter By Site: Needham Factory

- 1-1_SinkingEDM**
 Status: Running
 No Predicted Failures
- 1-3_CNCMill**
 Status: Running
 1 Predicted Failures
- Proto_WaterCutter**
 Status: Running
 No Predicted Failures
- 1-1_WireEDM**
 Status: Running
 No Predicted Failures
- 1-2_GantryRobot**
 Status: Running
 No Predicted Failures
- 1-2_WeldingRobot**
 Status: Running
 No Predicted Failures

Asset Detail

Model Number: SNKEDM-9X8
 Serial Number: SNKEDM9X873212
 Location: Boston, MA
 Related Lines: 1-1_Line
 Related Site: Needham Factory

Info

Current: 1.16
 Voltage: 16.09
 Temperature: 42.85

Operation

Remote Connect

Schedule Event

Alert Setting

Find Recipient

--Select a recipient-- Add/Edit Recipient

Alert Recipients	
Username	Role
Rob	Engineer
Mike	Manager

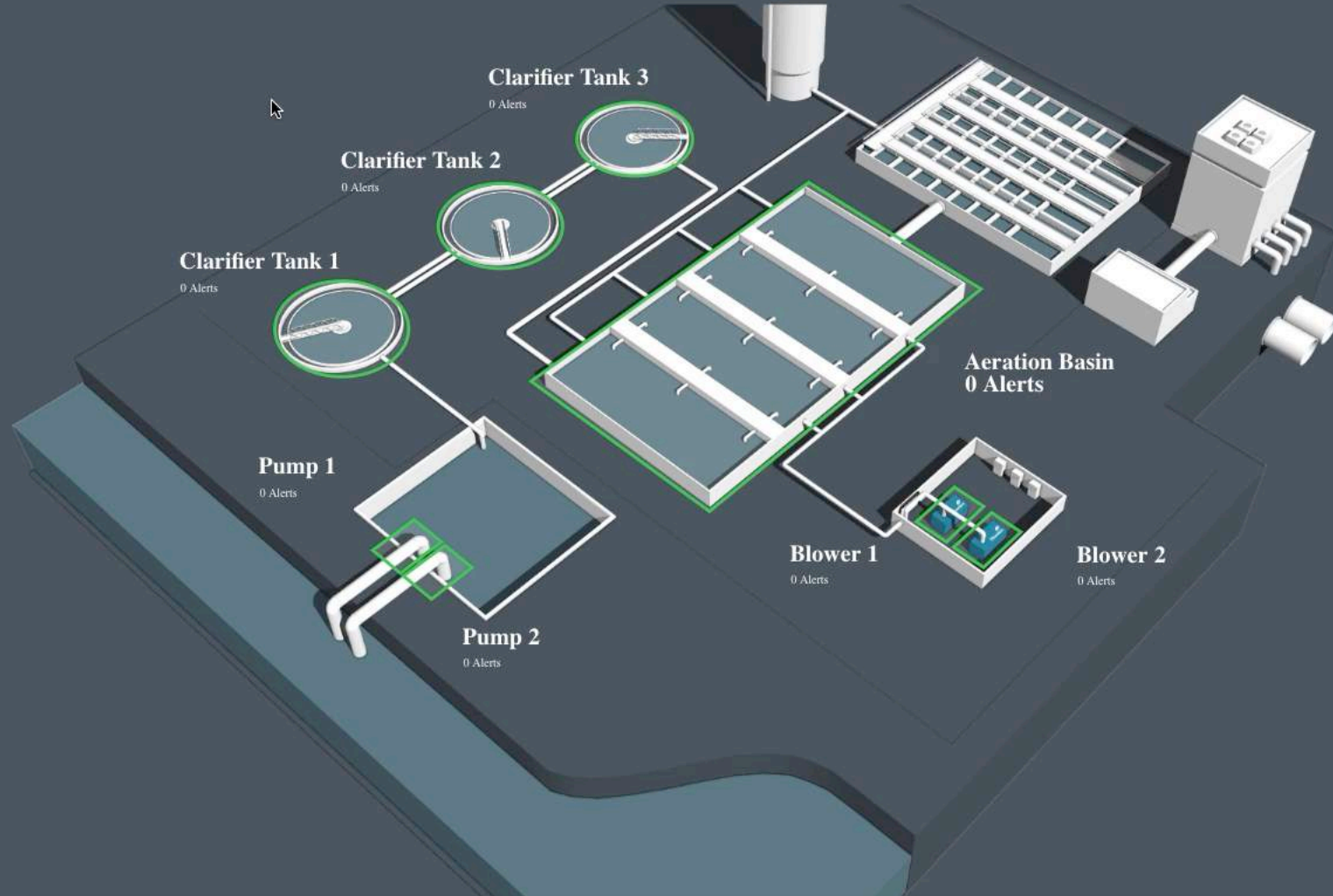
Alert Service Tickets

Alert Service Tickets

Analytics

Avg Vibration Peak

Failure Type: Drawbar		Failure Type: Vibration	
ESTIMATED MODEL ACCURACY		CONTRIBUTING RISK FACTORS	
98.3%		VERY LOW RISK	
RMSE	0.13	Avg Maintenance Time 3 Months Ago:	1.50
Pearson Correlation	0.50	Mechanical Alert Codes Prior Month:	0.50
Avg Vibration Peak From Last Month:		1.13	



Howden Diaphragm 1

Model Number:	D101010
Serial Number:	527801
Description:	Howden Diaphragm 1
Location:	Barcelona

Running: 24 days 18 hrs

Alerts: No active
Weekly total: 0

Howden Diaphragm 2

Model Number:	D101010
Serial Number:	527802
Description:	Howden Diaphragm 2
Location:	Barcelona

Planned Downtime: 3 mins 33 secs

Alerts: No active
Weekly total: 0

Howden Diaphragm 3

Model Number:	D101010
Serial Number:	527803
Description:	Howden Diaphragm 3
Location:	Barcelona

Running: 24 days 18 hrs

Leverage technology platforms for fast results & evolution

IMPROVING OVERALL EQUIPMENT EFFECTIVENESS... AT ENTERPRISE SCALE



PROBLEM

Carlsberg needed a better solution for measuring OEE of different types of aging assets at more than 250 packaging lines across the world.

SOLUTION

By deploying Enterprise Operational Intelligence solutions on top of their existing assets, Carlsberg was able to improve OEE without disrupting operations.

IMPACT

Implemented at one new factory each month since initial rollout in 2018

- Accelerated OEE improvements
- Increased operational performance
- Gained real-time visibility into factories



Microsoft Azure

INDUSTRIAL LEADER DELIVERS DATA-DRIVEN ADVANTAGE



PROBLEM

Howden, a Colfax subsidiary, wanted to use IoT and AR to enhance product functionality and provide more value to its customers and stakeholders.

SOLUTION

Howden is leveraging Service Optimization solutions to gather and analyze critical equipment data to provide customers with insights to optimize equipment performance and operational efficiencies.

IMPACT

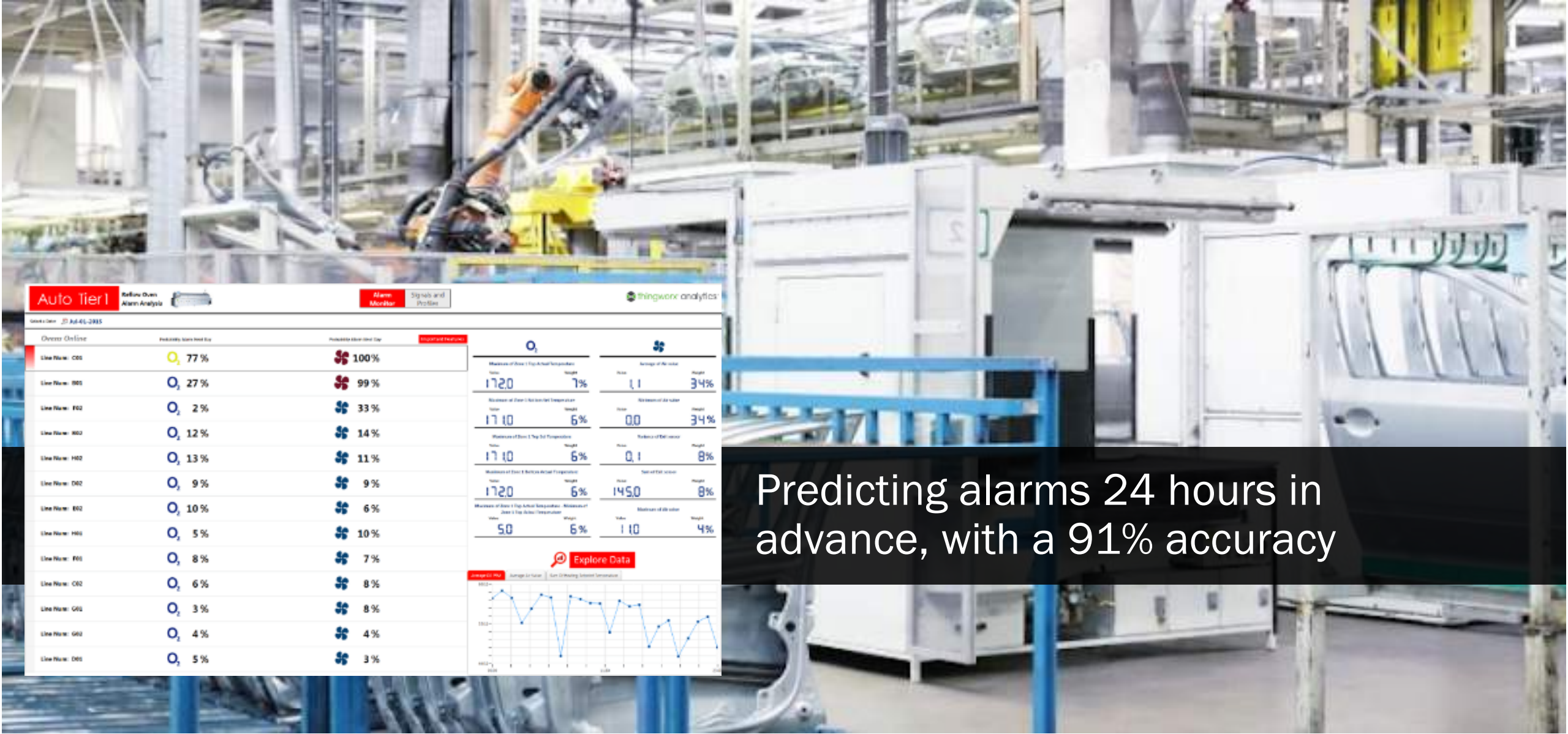
- Reduced solution roll-out time from years to months
- Enabled new visibility into manufacturing data
- Transformed customer relationships from transactional to collaborative



Microsoft Azure



PREDICTIVE MAINTENANCE TO REDUCE DOWNTIME



Auto Tier1 Return Over Alarm Analysis **Alarm Monitor** **Signals and Profiles** **thingworx analytics**

Unit: Line Ad-45-285

Process Online	Predicted Alarm Next Day	Predicted Alarm Next Day	Important Features
Line Name: C05	77%	100%	
Line Name: B05	27%	99%	
Line Name: F02	2%	33%	
Line Name: B03	12%	14%	
Line Name: H02	13%	11%	
Line Name: D02	9%	9%	
Line Name: E02	10%	6%	
Line Name: H01	5%	10%	
Line Name: F01	8%	7%	
Line Name: C02	6%	8%	
Line Name: G01	3%	8%	
Line Name: G02	4%	4%	
Line Name: D01	5%	3%	

Q₁

Maximum of Zone 1 Top Actual Temperature

Value	Weight
1720	7%

Maximum of Zone 1 Top Actual Temperature

Value	Weight
1710	6%

Maximum of Zone 1 Top Actual Temperature

Value	Weight
1710	6%

Maximum of Zone 1 Top Actual Temperature

Value	Weight
1720	6%

Maximum of Zone 1 Top Actual Temperature

Value	Weight
50	6%

Q₃

Average of All value

Value	Weight
1.1	34%

Average of All value

Value	Weight
0.0	34%

Average of All value

Value	Weight
0.1	8%

Average of All value

Value	Weight
1450	8%

Average of All value

Value	Weight
110	4%

Explore Data

Predicting alarms 24 hours in advance, with a 91% accuracy

Results

- ThingWorx Analytics created a predictive model of throughput an hour in advance
- ThingWorx Analytics output (Profiles) identified an opportunity to solve a systemic problem by better controlling conditions at two specific points on the machine
- Profiles also identified optimal performance conditions for machine throughput



PARCEL EQUIPMENT

Business Initiative

A large and historic manufacturer of parcel equipment has invested a great deal of money into building out a world-class service organization. The company's revenue model is to tier service based on extremely high SLA's. After winning a very large customer, the company is concerned that the information infrastructure and personnel are about to be overwhelmed.

Company Pain Points

- Struggling to correlate equipment performance statistics and maintenance data
- 24/7 on-site technicians ensure that critical failure happens rarely with tier 1 customers
- Performance degradation is a cause of customer satisfaction issues
- Service organization is too often reactive

Highlights

- 1. Answered service organization questions without manually inspecting large volumes of data**
- 2. Provided insights into how multiple factors combined to impacted performance**
- 3. Enabled sufficient lead time to adjust production and/or settings for optimal performance**

SIMPLIFY YOUR DIGITAL TRANSFORMATION WITH THINGWORX AND AZURE IOT



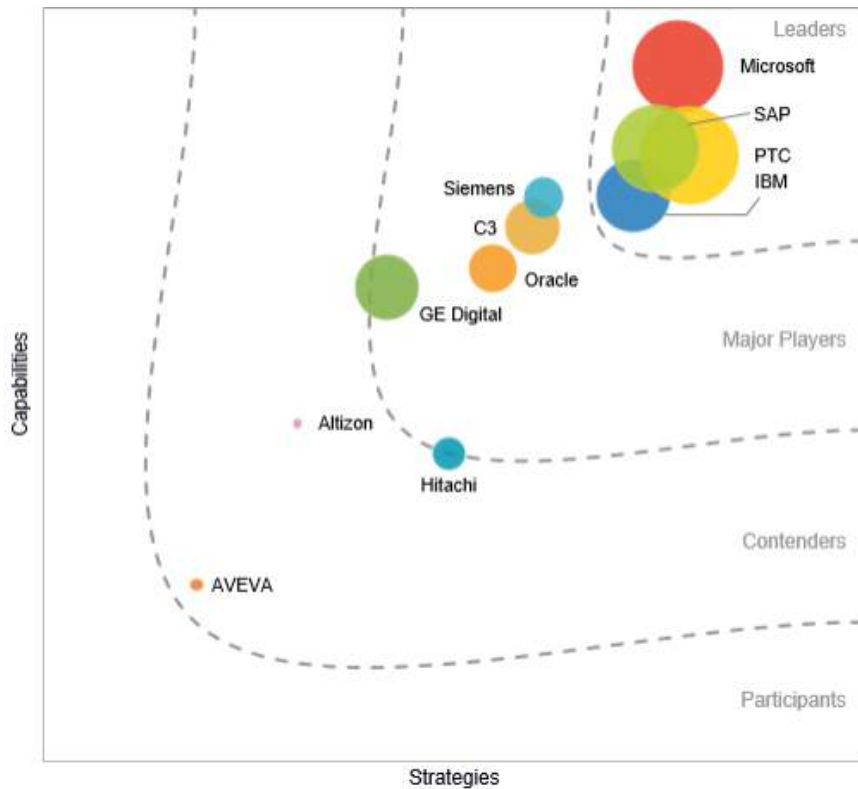
Industrial IoT Solutions Platform	thingworx® operator advisor	thingworx® asset advisor	thingworx® controls advisor	thingworx® production advisor	thingworx® navigate	thingworx® software content management
	<p>Connect</p> <p>Integration with most common enterprise systems and industrial protocol drivers</p>	<p>Build</p> <p>Digital twin modeling for data transformation and rapid development of solutions</p>	<p>Analyze</p> <p>Derive valuable insights, recommendations, and predictions from complex contextualized data</p>	<p>Manage</p> <p>Deploy and maintain solutions across multiple sites via a cloud-based portal</p>	<p>Experience</p> <p>Provide insights in relevant visual dashboards and robust AR/VR/MR experiences</p>	



Azure Security Center for IoT	Azure Services or IoT		Azure IoT Hub Device Provisioning Service Azure Digital Twins, Azure Maps Azure Time Series Insights Azure Stream Analytics	Azure Cosmos DB Azure AI Azure Cognitive Services Azure ML	Azure Logic Apps Azure Active Directory Azure Monitor Azure DevOps Power BI
	Intelligent Edge		Azure Sphere Azure IoT Edge Azure Data Box Edge Azure Stack	<u>Workloads</u> Azure Stream Analytics Azure ML Azure SQL	Azure Functions Azure Cognitive Services Azure Blob Storage

Globally available edge/private/public cloud infrastructure (IaaS)

LEADERS PARTNERING TO HELP ACCELERATE DIGITAL TRANSFORMATION



2019 IDC MarketScape -- Industrial IoT Platforms for Manufacturing ([here](#))

“These two industry leaders coming together makes perfect sense. With ThingWorx and Azure, Colfax will be able to capitalize on the opportunities inherent in the Internet of Things to quickly grow and scale its operations.”¹

Ryan Cahalane, Vice President of Digital Growth at Colfax.

“Combining PTC's platform with the speed, scalability, and intelligence of Azure will enable customers to accelerate industrial innovation.”¹

Jason Zander, Executive Vice President of Microsoft Azure.

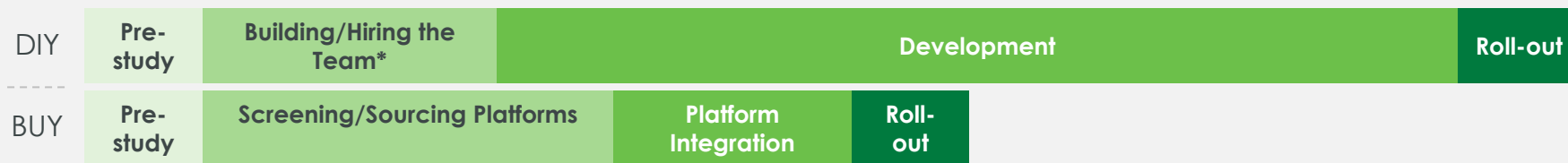
¹ PTC. “PTC Partners with Microsoft to Help Customers Accelerate Their Digital Transformations in IoT”. Press Release, JAN 2018

THE TRUTH ABOUT DIY (DO IT YOURSELF)



TIME

DIY systems may take twice as long to implement as vendor systems



Source: [IoT Analytics](#)



MONEY

Total cost of ownership (TCO) can be nearly 4x greater for DIY

5-year real cost:	DIY	BUY
	\$2.6 million	\$655,100

Source: [NetworkWorld](#) Smart factory case study



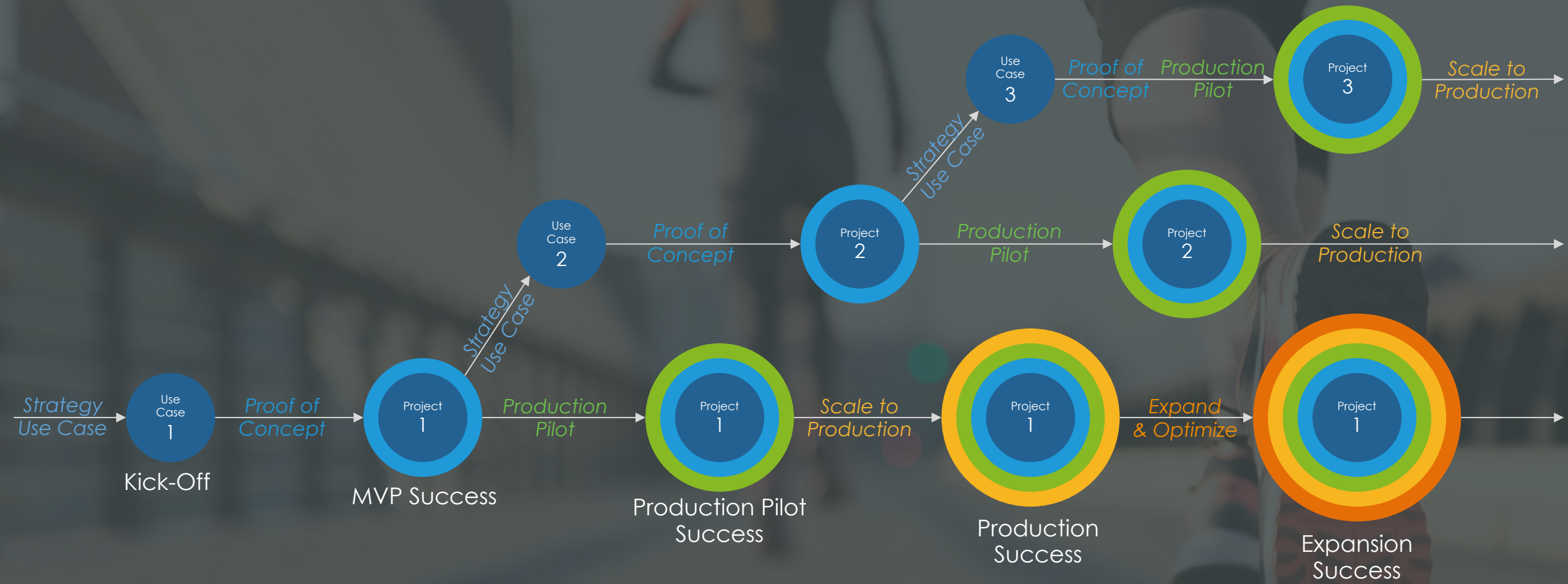
COMPETITIVE ADVANTAGE

Companies on the DIY path lose **competitive advantage** when:

- Diverting resources from their core products into IoT system development
- Competitors partner with IoT vendors, realizing value more quickly

Source: Primary research, [Softweb Solutions](#)

TRANSFORMATION FRAMEWORK



Customer Success Management

1. Know your Digital Transformation mission and purpose

- *Accountable sponsor, encompassing program, guiding principles, ...*

2. Implicate stakeholders and plan for scale from the beginning

3. Validate and prioritize use cases with lines of business

- *Build solutions to validated, quantified, and measurable business problems*
- *Technology-driven projects often fall short and don't scale well*

4. Start now and take it step-by-step

- *Use cases prioritized, business case, Proof-of-Value, Production Pilot, Industrialize*

5. Don't go it alone

- *Surround yourself with relevant partners and carefully measure DIY (Do It Yourself)*





ptc