



**Rockwell
Automation**

Scalable Analytics & AI Solution

9 • 11 • 2019

Dr. Anukoon Asawachatroj

Product Manager, South East Asia

Rockwell Automation

— Digital Initiatives is **Everywhere !!**

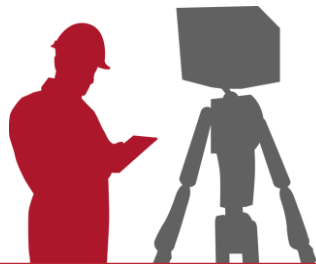


DIGITIZATION

50B



NUMBER OF
DEVICES ON THE
INTERNET BY 2020



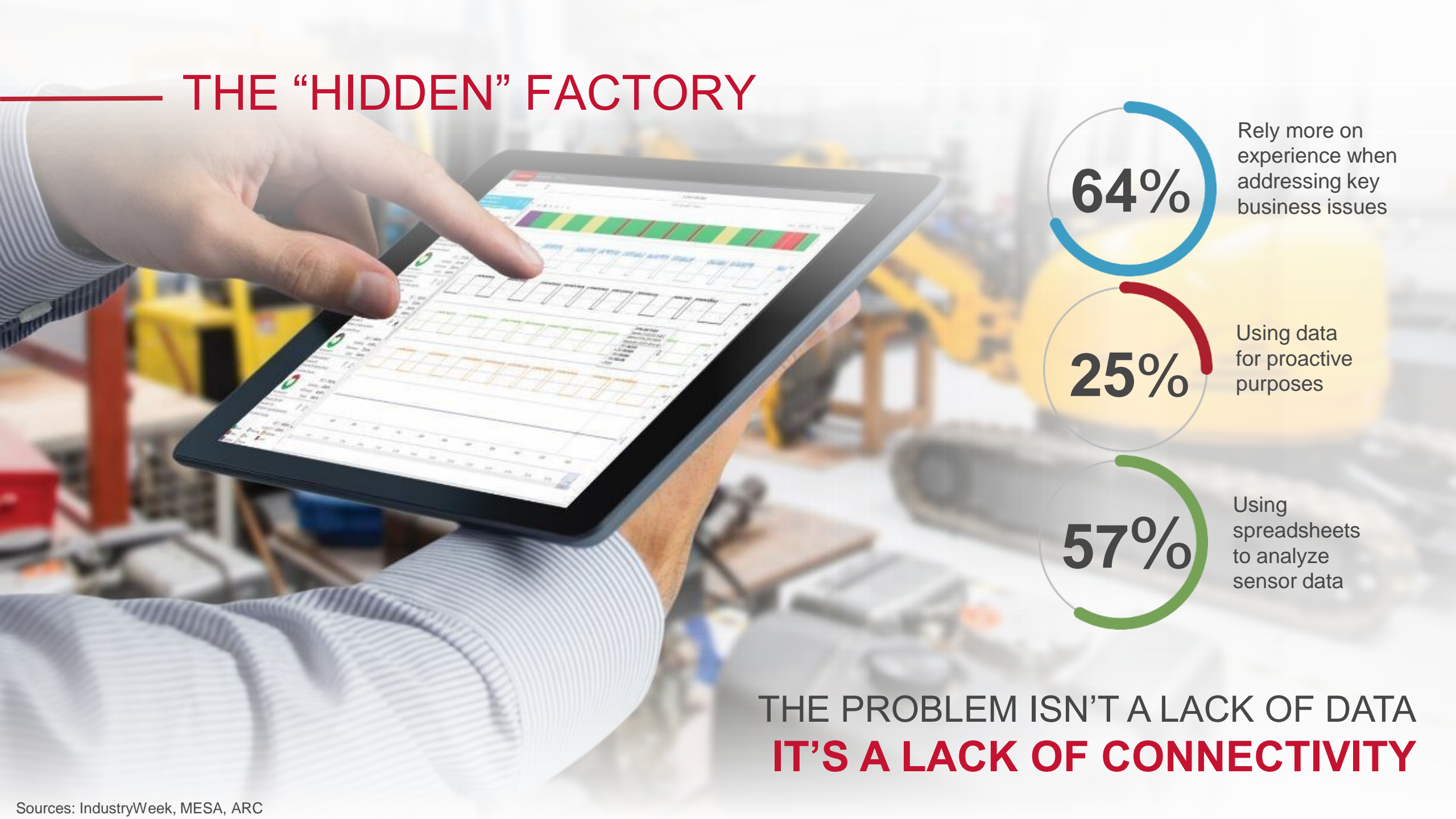
SAFE &
COLLABORATIVE
ROBOTS



AI & MACHINE LEARNING
CPS, PREDICT FAILURES
AND REDUCE DOWNTIME

WEARABLES & MOBILE
DEVICES TRANSFORM
WORK FLOWS

THE "HIDDEN" FACTORY



Rely more on experience when addressing key business issues



Using data for proactive purposes

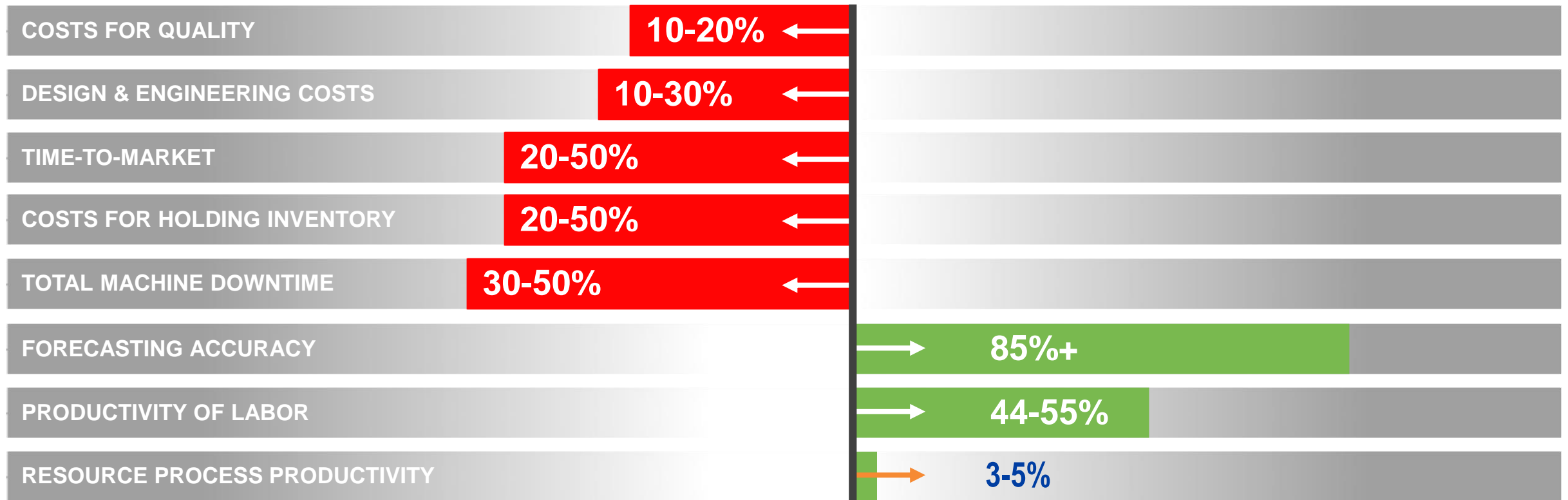


Using spreadsheets to analyze sensor data

THE PROBLEM ISN'T A LACK OF DATA
IT'S A LACK OF CONNECTIVITY

Sources: IndustryWeek, MESA, ARC

DIGITALTRANSFORMATION OPPORTUNITIES



SOURCE: McKinsey

Rockwell Automation at a glance

Our strategy is to bring The Connected Enterprise to life.
We integrate control and information across the enterprise to help industrial companies and their people be more productive.

\$6.7B

FISCAL 2017 SALES

23,000

EMPLOYEES

80+

COUNTRIES

ABOVE-MARKET GROWTH | PRODUCTIVITY | INTELLECTUAL CAPITAL > VALUE CREATION

THE CONNECTED ENTERPRISE

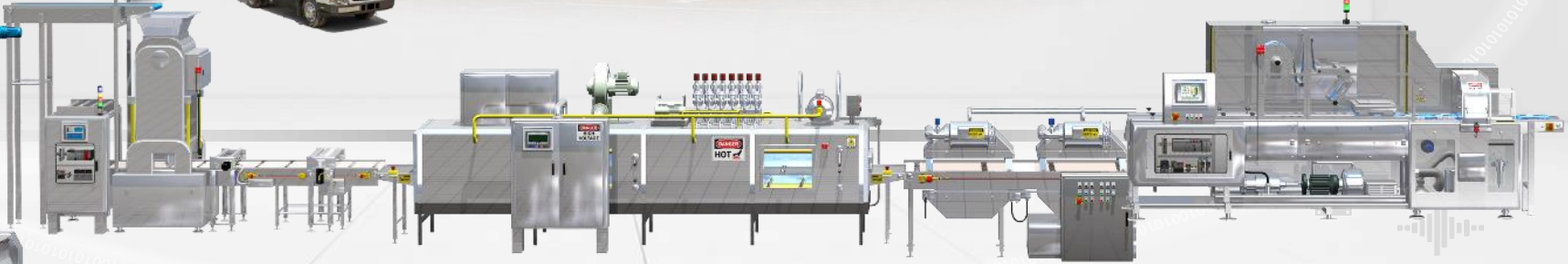
ROCKWELL AUTOMATION'S VISION FOR SMART MANUFACTURING



**SMART
PLANTS**



**SMART
MACHINES**



**SMART
DEVICES**



Sensors



Actuators



Intelligent Motor Control



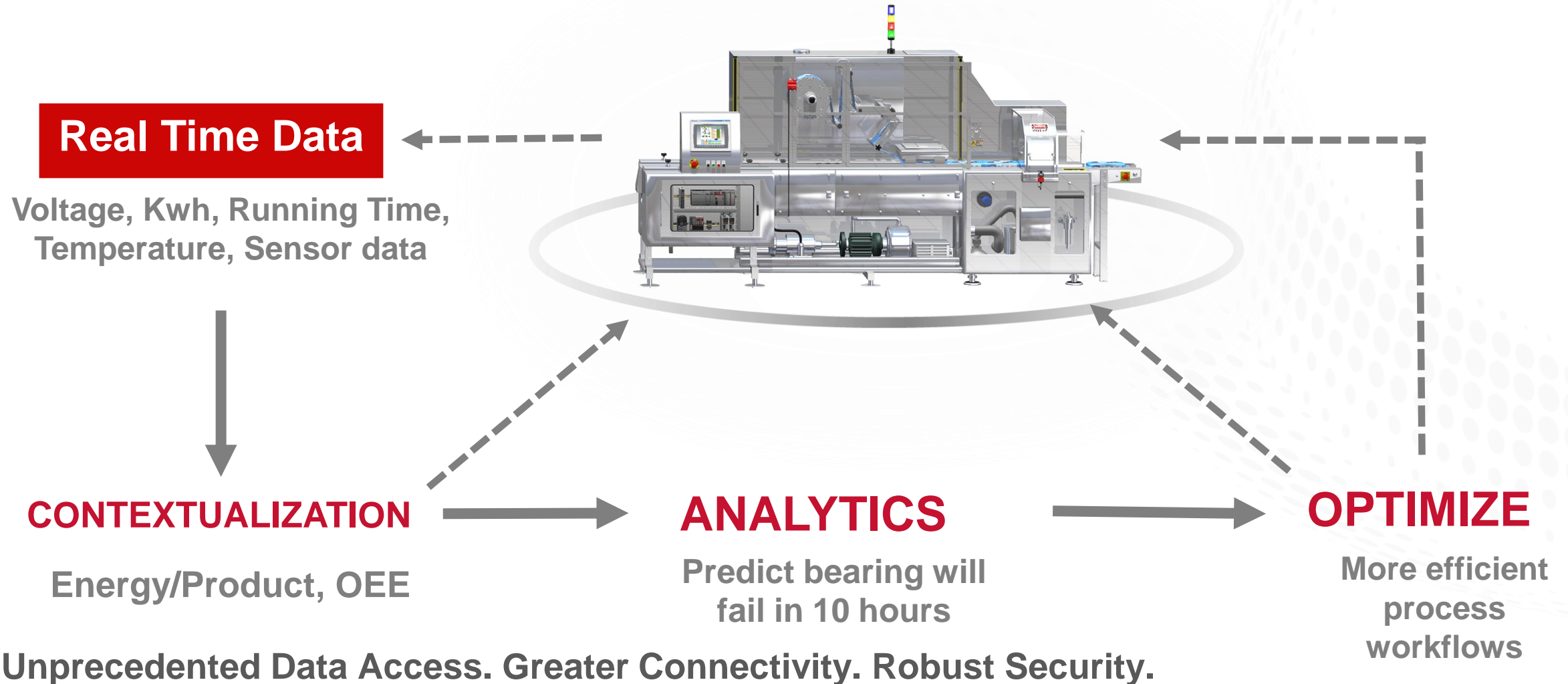
Automation Control



Terminals

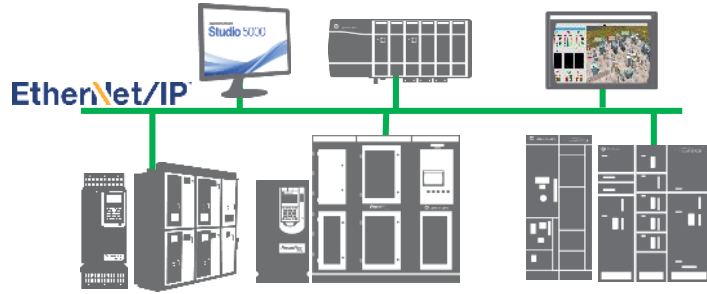
What is a **Smart Machine**?

Turning Data Into Action. In Real Time



Integrated Architecture

Delivers Increased Value When Combining:



FT Innovation Suite



Studio 5000 Software



Logix Controllers



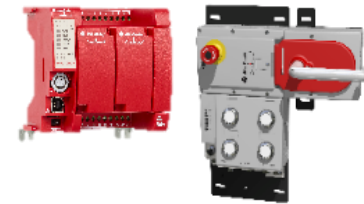
Smart Sensors



Network Infrastructure &
Security



Smart Motor Control



Smart Safety

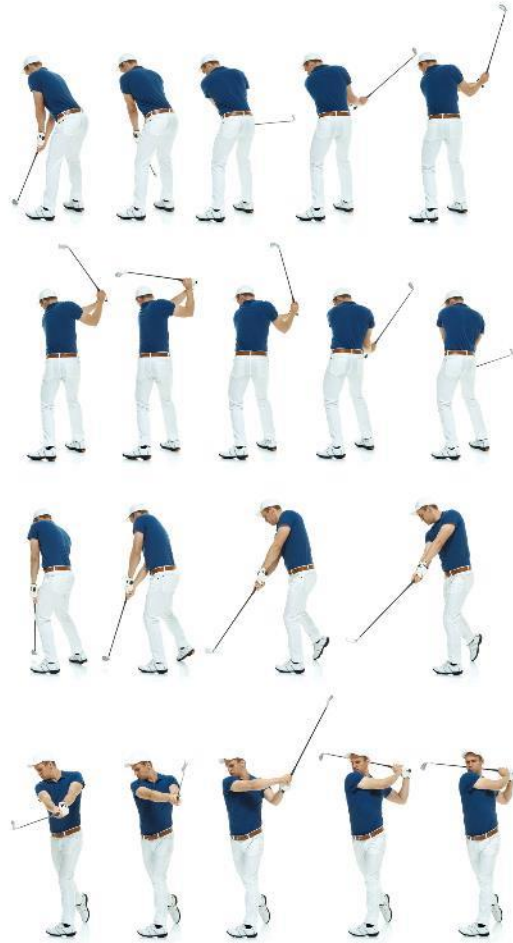


FT Operation Suite

FT View ME
FT View SE

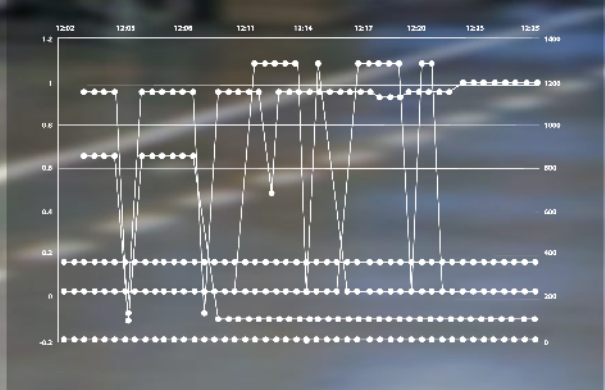
Everyday Analytic

Looking for Patterns in Data



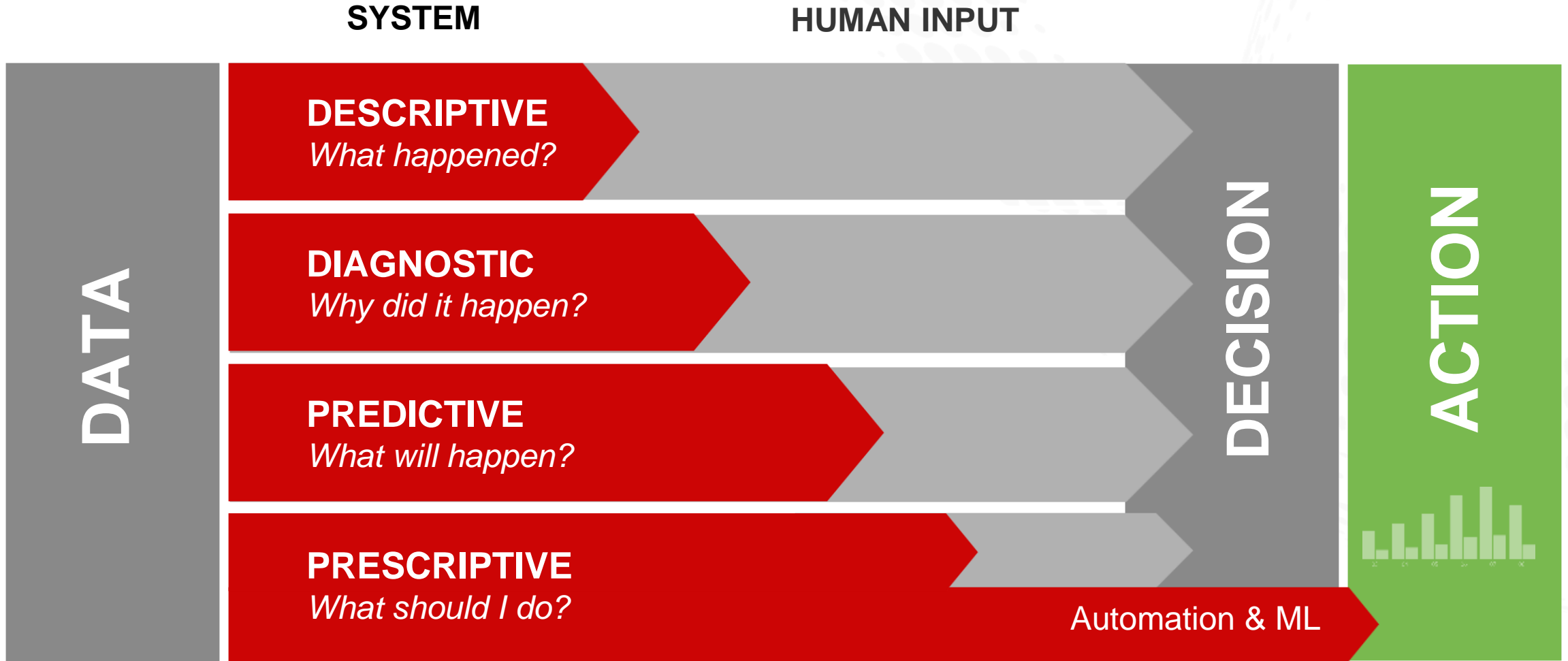


12:04:42 PM	55	876	899	1141	17	FALSE	FALSE
12:04:59 PM	56	876	888	1142	17	FALSE	FALSE
12:05:17 PM	54	878	899	1142	17	FALSE	FALSE
12:05:34 PM	53	876	899	1143	17	FALSE	FALSE
12:05:50 PM	53	873	888	1142	17	FALSE	FALSE
12:06:09 PM	51	85	841	126	18	FALSE	FALSE
12:06:26 PM	51	876	899	1142	17	FALSE	FALSE
12:06:44 PM	50	876	888	1142	17	FALSE	FALSE
12:07:00 PM	50	874	888	1141	16	FALSE	FALSE
12:07:16 PM	50	875	888	1141	17	FALSE	FALSE
12:07:33 PM	50	877	888	1145	17	FALSE	FALSE
12:07:51 PM	50	872	888	1135	17	FALSE	FALSE
12:08:09 PM	50	875	888	1141	17	FALSE	FALSE
12:08:27 PM	50	874	888	1142	17	FALSE	FALSE
12:08:43 PM	29	873	888	1139	17	FALSE	FALSE
12:08:59 PM	29	85	840	147	24	FALSE	FALSE
12:09:16 PM	29	85	858	1145	17	FALSE	FALSE
12:09:36 PM	29	85	888	1144	17	FALSE	FALSE
12:09:53 PM	29	85	888	1146	17	FALSE	FALSE
12:10:11 PM	29	85	899	1130	17	FALSE	FALSE
12:10:29 PM	29	85	899	1142	17	FALSE	FALSE
12:10:45 PM	29	85	899	1139	17	TRUE	FALSE
12:11:02 PM	29	85	888	1130	17	TRUE	FALSE
12:11:22 PM	29	85	840	646	14	TRUE	FALSE
12:11:38 PM	29	85	888	1140	17	TRUE	FALSE
12:11:50 PM	29	85	888	1140	17	TRUE	FALSE
12:12:13 PM	29	85	888	1138	17	TRUE	FALSE
12:12:38 PM	29	85	888	1142	17	FALSE	FALSE
12:12:48 PM	29	85	899	1145	17	TRUE	FALSE



SCALABLE ANALYTICS

VARYING DEGREES OF HUMAN INTERACTION.



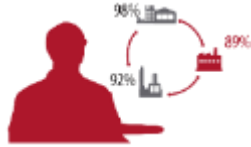
Scalable Analytics Landscape

	DESCRIPTIVE	DIAGNOSTIC	PREDICTIVE	PRESCRIPTIVE
ENTERPRISE	 <p>Which facility performed the best?</p>	 <p>Why is Site A throughput behind plan?</p>	 <p>I predict that Site A will be behind plan soon.</p>	 <p>What action should I take to avoid Site A from falling behind plan?</p>
SYSTEM	 <p>Is Line 1 running ok?</p>	 <p>Why is Line 1 quality poor?</p>	 <p>I predict that Line 1 quality is moving out of tolerance.</p>	 <p>What action should the operator take to avoid poor quality?</p>
DEVICE	 <p>Am I running ok?</p>	 <p>Why did a fault happen?</p>	 <p>I predict a fault will happen soon.</p>	 <p>What action should be taken to avoid the fault?</p>

Scalable Analytics Landscape

ENTERPRISE

DESCRIPTIVE



Which facility performed the best?

DIAGNOSTIC



Why is Site A throughput behind plan?

PREDICTIVE



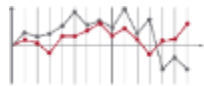
I predict that Site A will be behind plan soon.

PRESCRIPTIVE

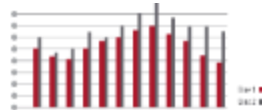


What action should I take to avoid Site A from falling behind plan?

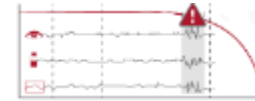
SYSTEM



Is Line 1 running ok?



Why is Line 1 quality poor?

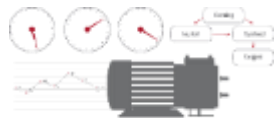


I predict that Line 1 quality is moving out of tolerance.



What action should the operator take to avoid poor quality?

DEVICE



Am I running ok?



Why did a fault happen?

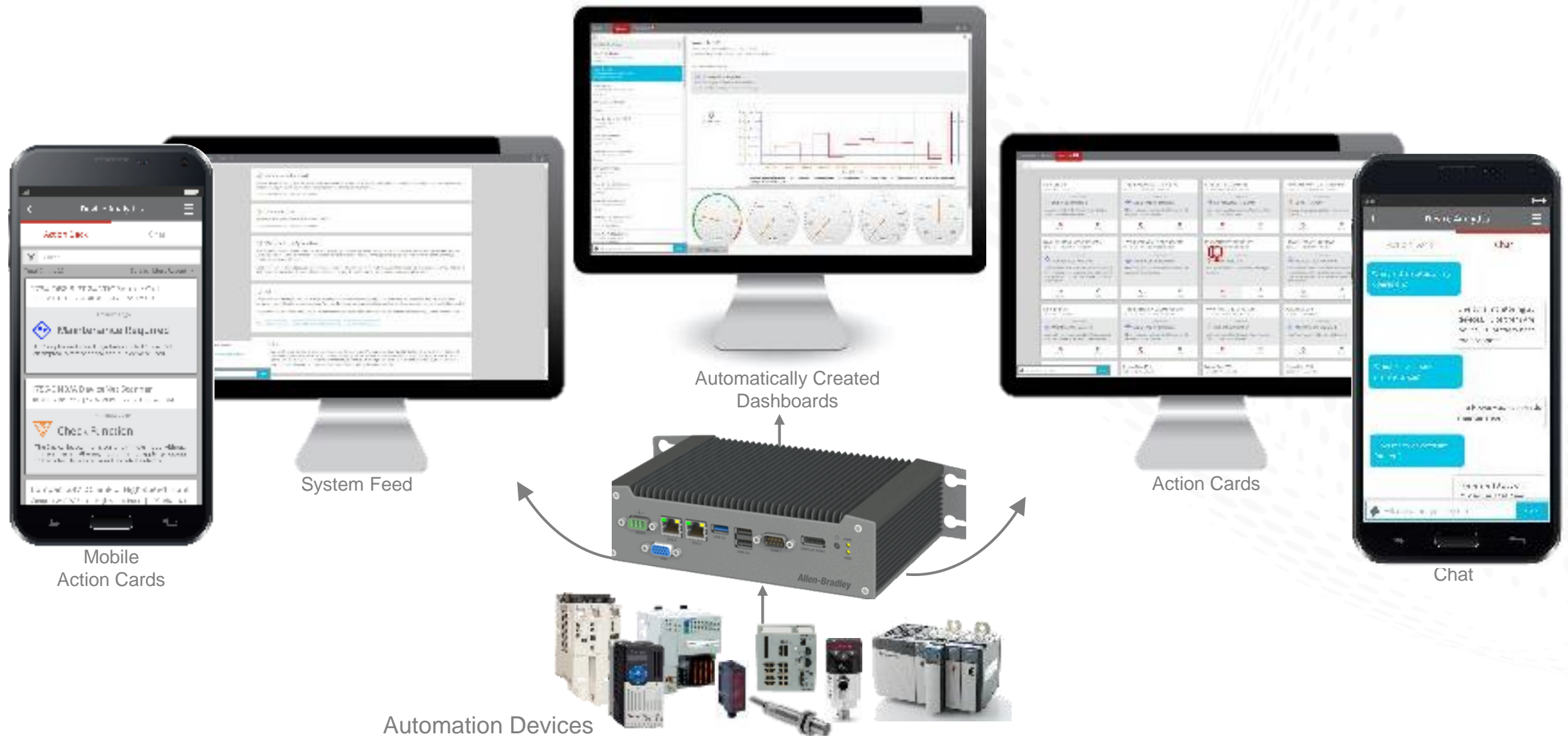


I predict a fault will happen soon.

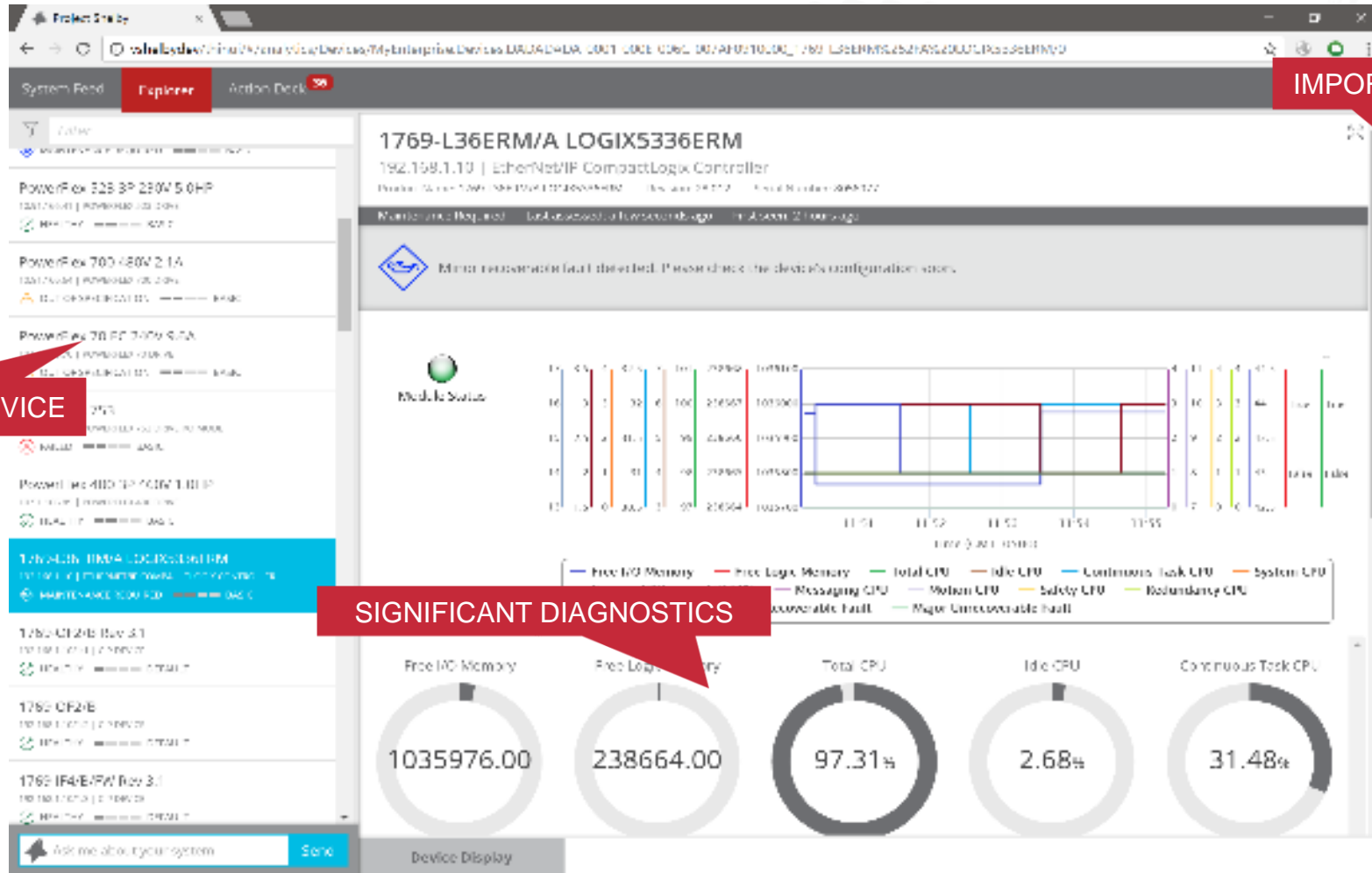


What action should be taken to avoid the fault?

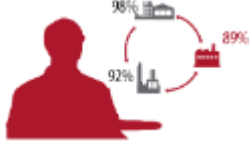



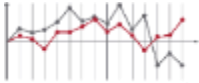
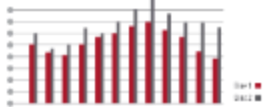
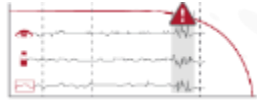

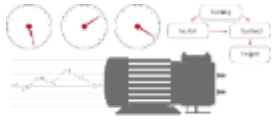



FactoryTalk Analytics for Devices



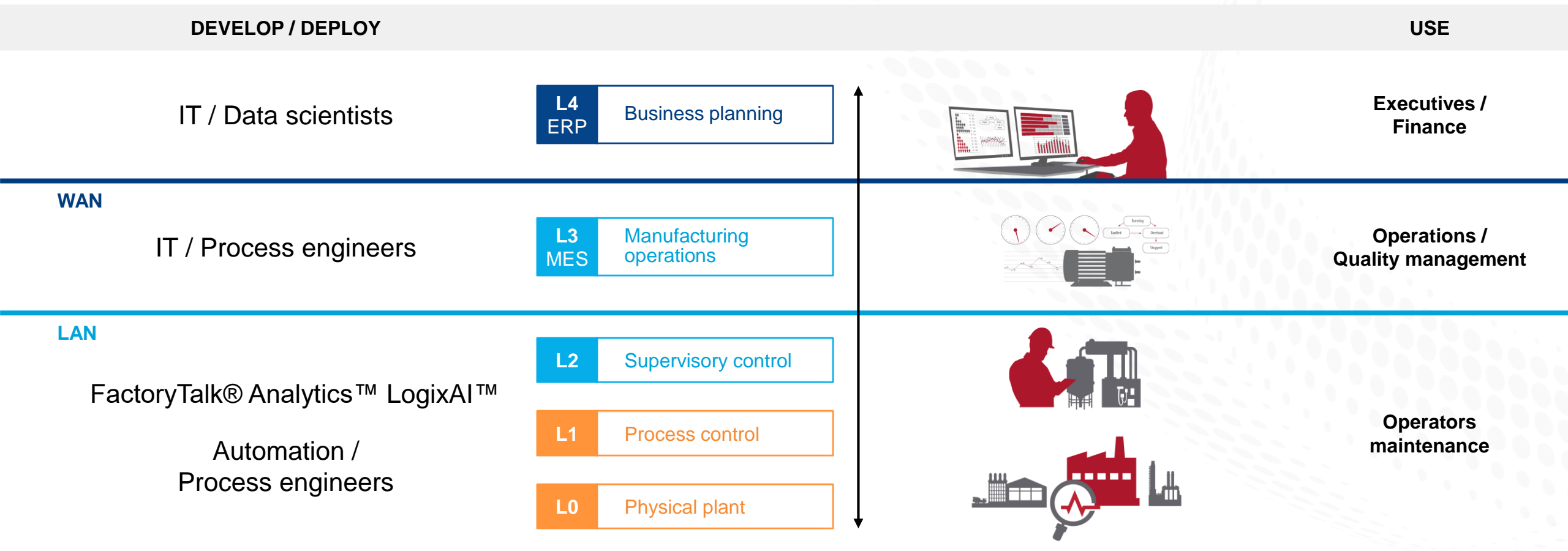
Dashboard Generated in Explorer View



Scalable Analytics Landscape

	DESCRIPTIVE	DIAGNOSTIC	PREDICTIVE	PRESCRIPTIVE
ENTERPRISE	 <p>Which facility performed the best?</p>	 <p>Why is Site A throughput behind plan?</p>	 <p>I predict that Site A will be behind plan soon.</p>	 <p>What action should I take to avoid Site A from falling behind plan?</p>
SYSTEM	 <p>Is Line 1 running ok?</p>	 <p>Why is Line 1 quality poor?</p>	 <p>I predict that Line 1 quality is moving out of tolerance.</p>	 <p>What action should the operator take to avoid poor quality?</p>
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Developing and using analytics



WAN

LAN

FactoryTalk® Analytics™ LogixAI™

Control networks

Industrial AI Use Case

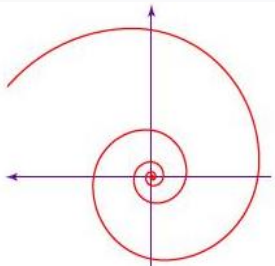
Automated modeling example

$$r = ae^{\theta \cot b}$$

- Data modeling is different than object modeling
- LogixAI models operational behavior by creating a mathematical equation
- Other algorithms may build models based upon clusters, regression, etc.
- Applications that follow the laws of physics can be modeled by LogixAI
- Example: winder applications

A spiral is a plane curve that, in general, winds around a point while moving ever farther from the point.

<https://www.britannica.com/science/spiral-mathematics>



Anomaly Detection

Learn what's normal, find deviations from normal.

Anomalous behavior that is not understood and cannot be alarmed upon through typical automation system capabilities can cause scrap, defects, poor quality or undesirable operations.

A predictive model can be utilized to support understanding if an output variable could exceed acceptable operational boundaries.

Pinpointing slow changing deviations that cannot be detected by other means enables proactive thinking to address conditions before production is impacted.

Modes of operation

Virtual Sensor

Estimate values from incomplete data.

A predictive model can act as a virtual sensor (aka soft sensor) by estimating output values.

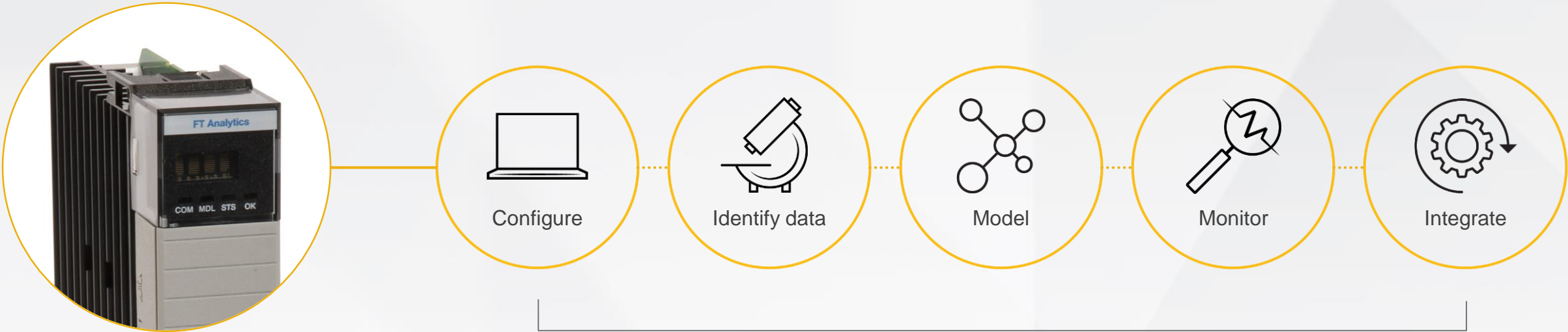
Having a predicted, estimated output value reduces the need for manual effort required to capture and record readings.

A virtual sensor can:

- reduce the need to instrument the operation with expensive or difficult to implement instruments or sensors.
- check the reliability of a physical sensing device where environmental conditions may cause degradation of the physical sensor reading ability (i.e. caused by heat, humidity, debris).
- enable tight control or proactive deployment of resources when the estimated output variable is expected to reach an out-of-specification condition.

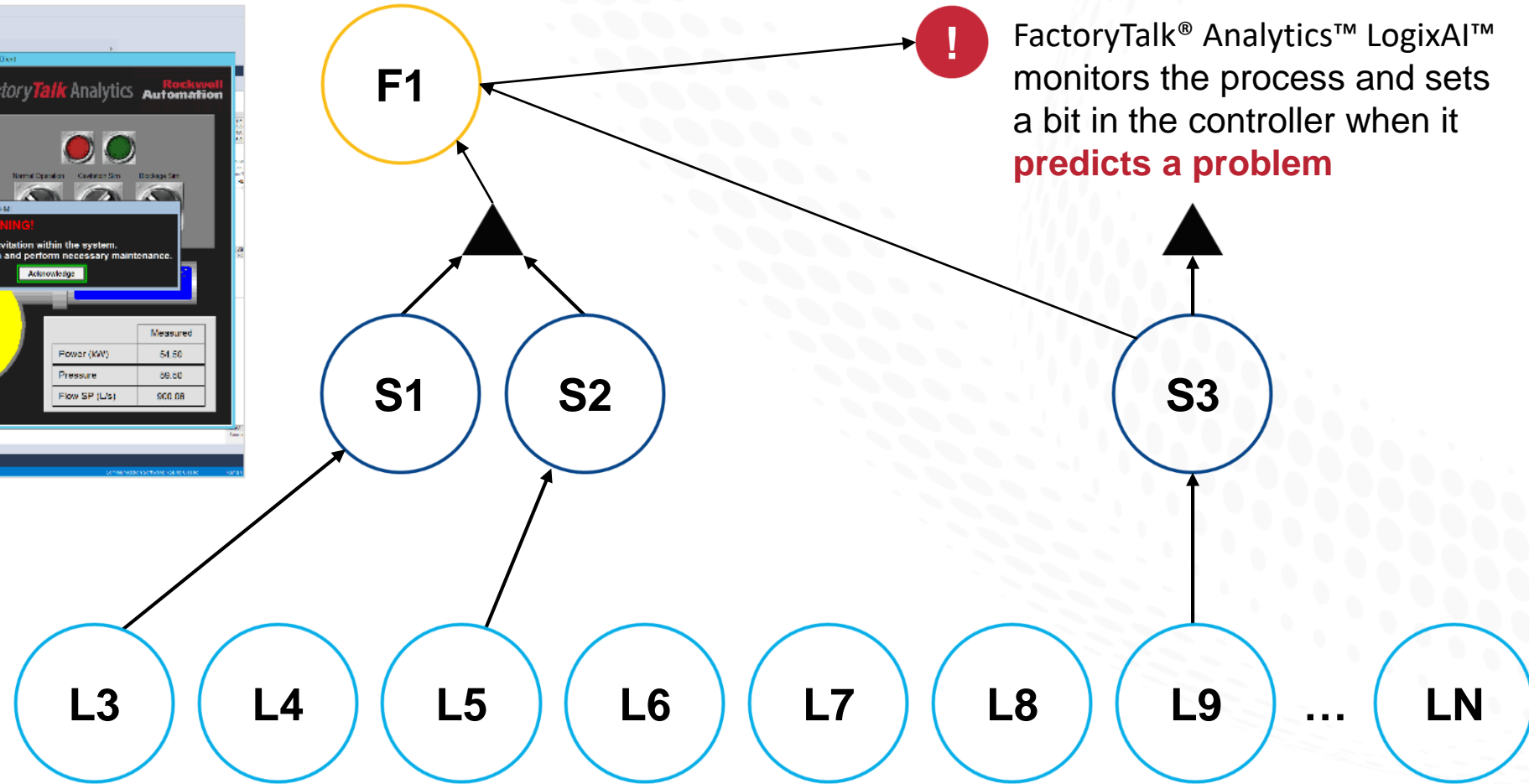
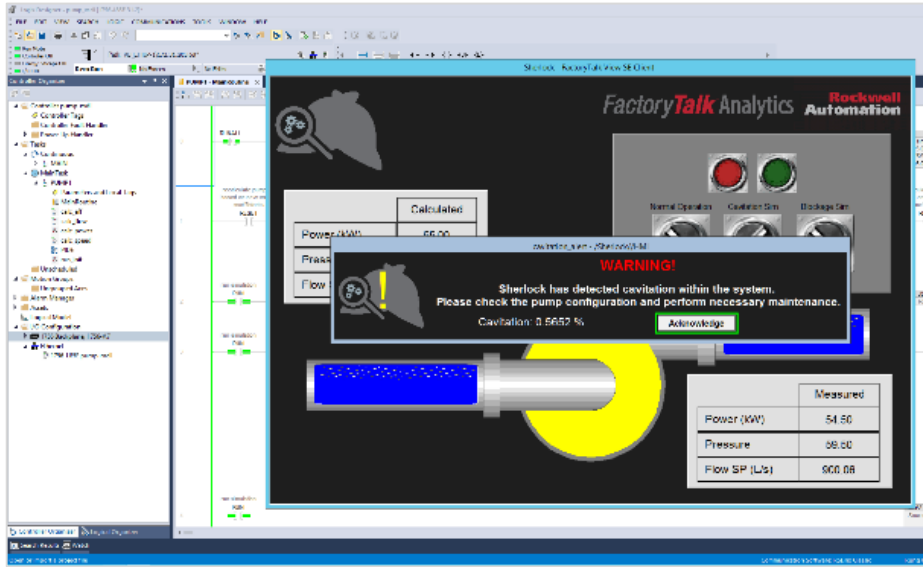
FactoryTalk® Analytics™ LogixAI™

Descriptive | Diagnostic | Predictive | Prescriptive

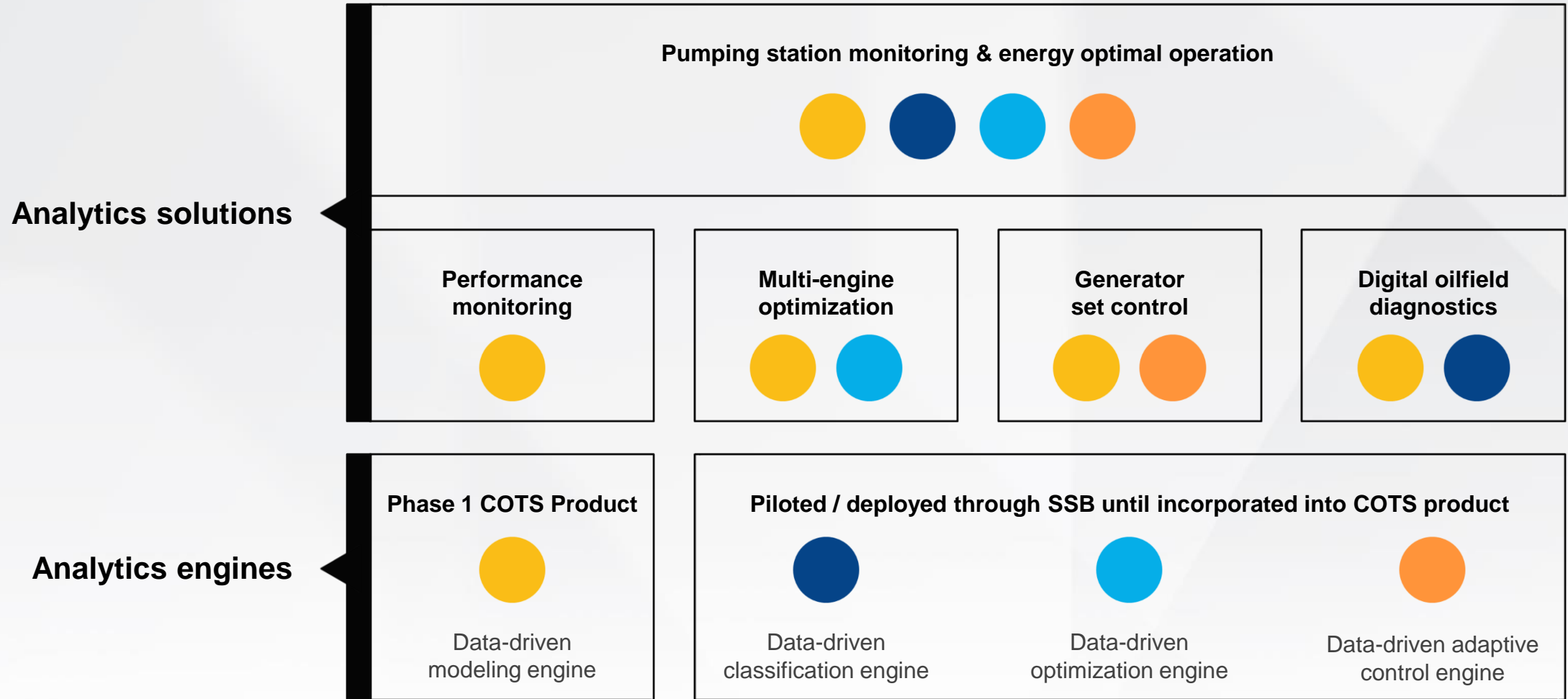


NO DATA SCIENTIST REQUIRED

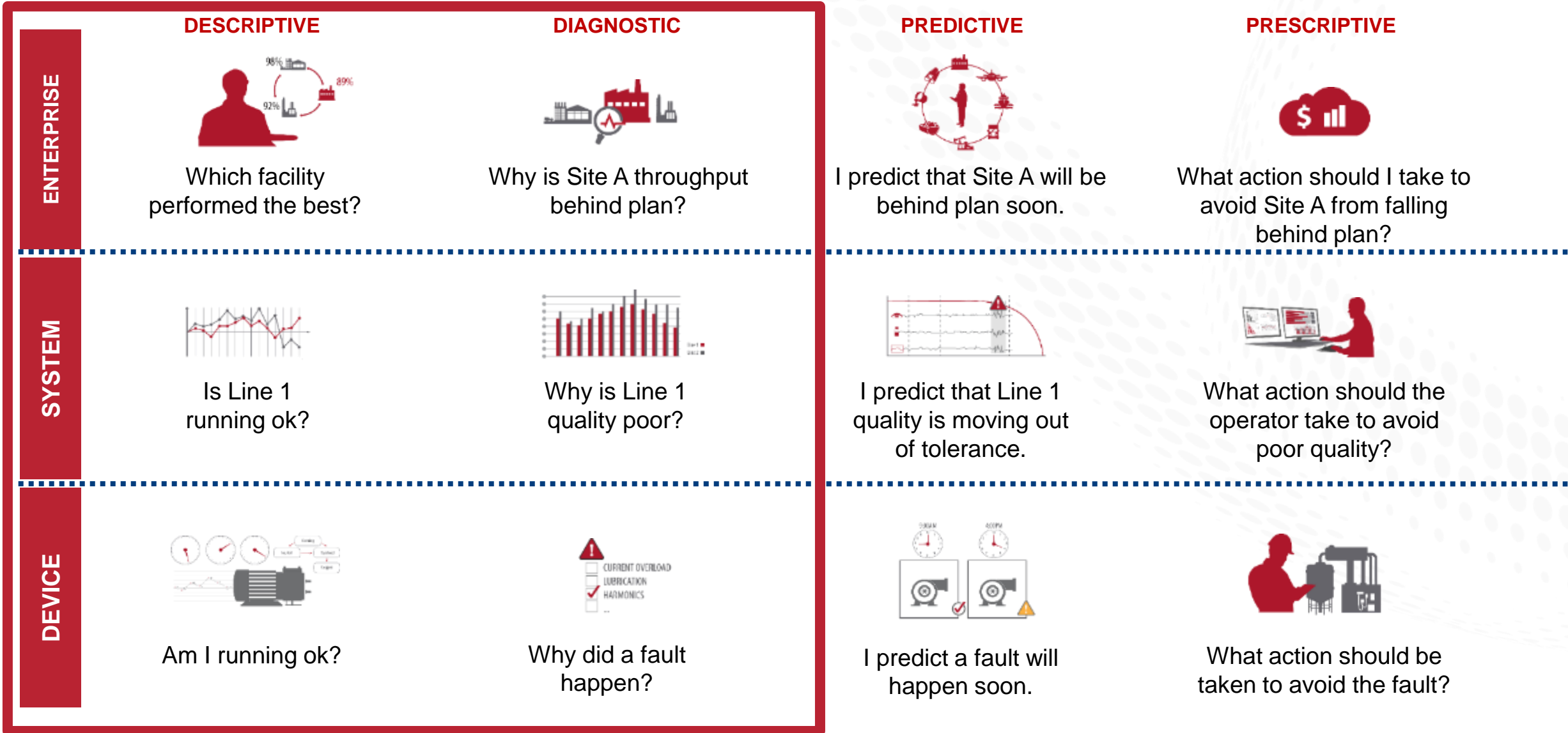
How FactoryTalk® Analytics™ LogixAI™ works



Potential Use Cases for Analytics™ LogixAI™

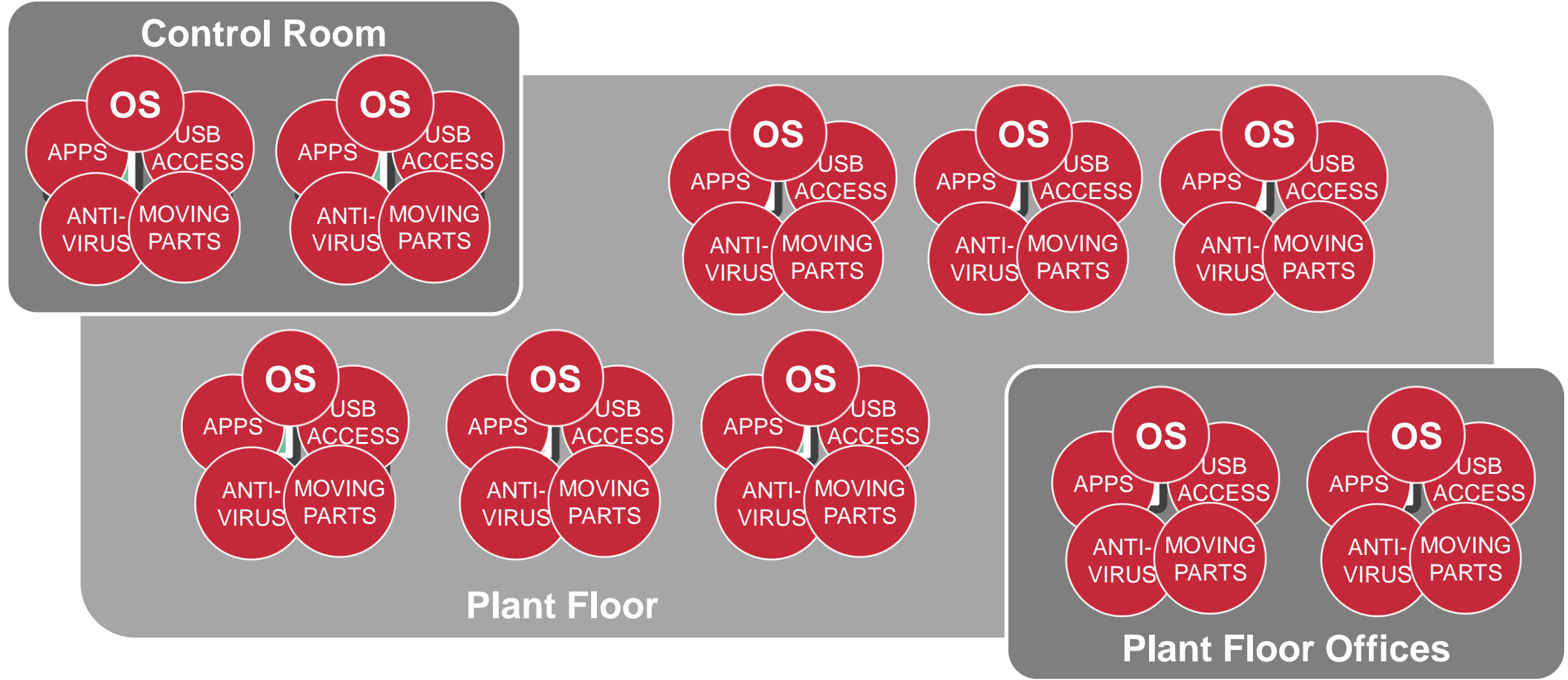


Scalable Analytics Landscape



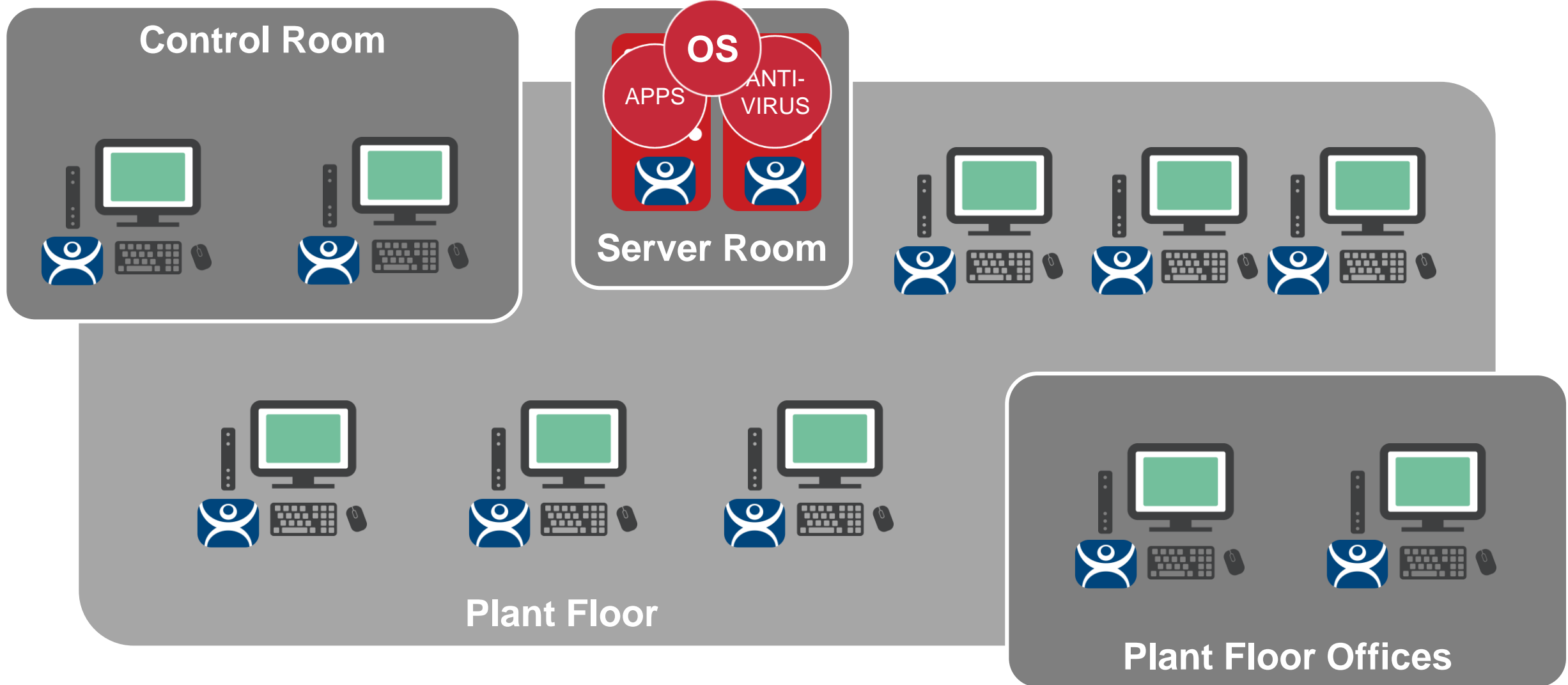
Traditional Automation Network

Dedicated PCs for Dedicated Applications

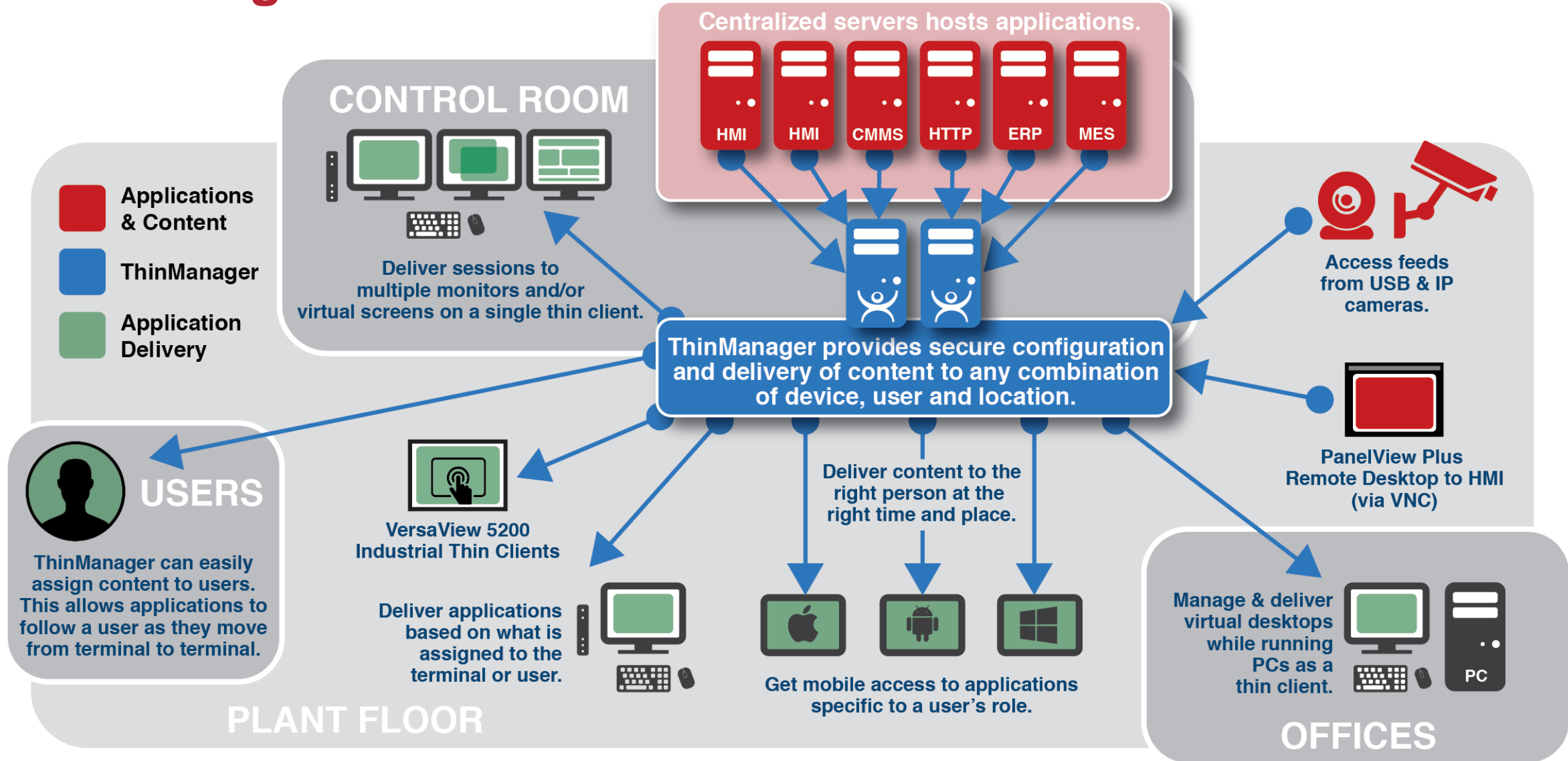


ThinManager Solution

Replace PCs with Thin Clients and Manage Centrally

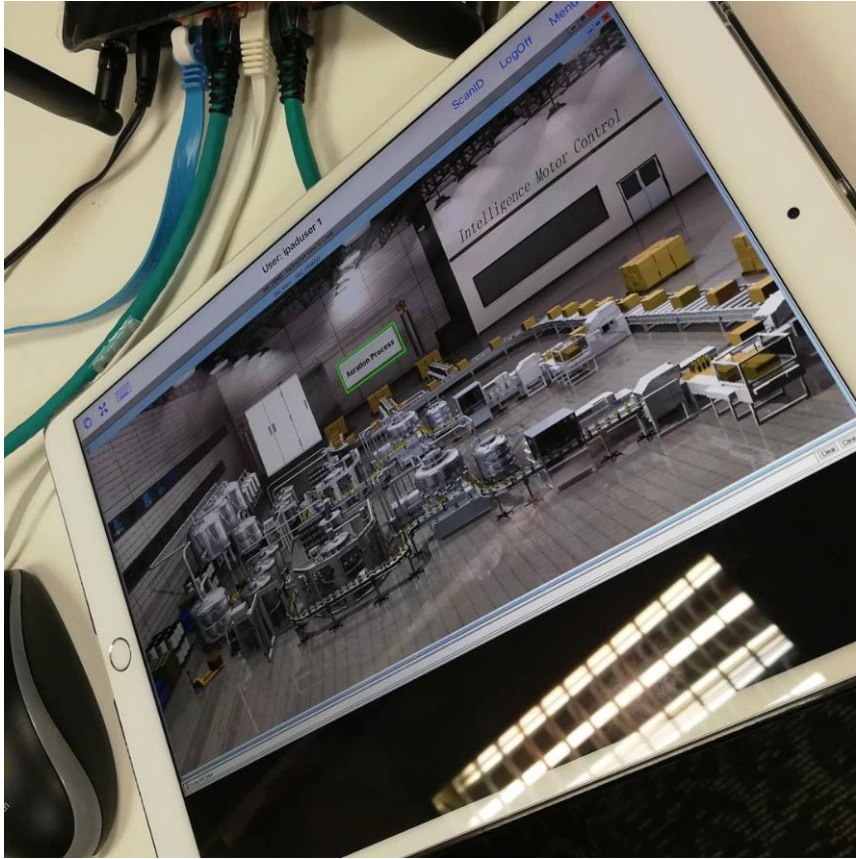


ThinManager Solution



Replace PCs with Thin Clients and Manage Deployment Centrally with ThinManager

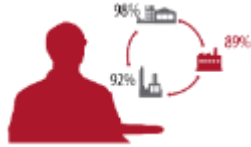
ThinManager Multiple Contents Deliverable



Scalable Analytics Landscape

ENTERPRISE

DESCRIPTIVE



Which facility performed the best?

DIAGNOSTIC



Why is Site A throughput behind plan?

PREDICTIVE



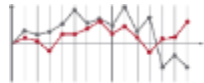
I predict that Site A will be behind plan soon.

PRESCRIPTIVE

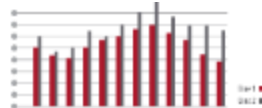


What action should I take to avoid Site A from falling behind plan?

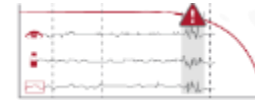
SYSTEM



Is Line 1 running ok?



Why is Line 1 quality poor?

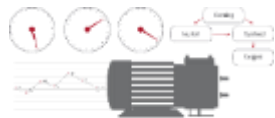


I predict that Line 1 quality is moving out of tolerance.



What action should the operator take to avoid poor quality?

DEVICE



Am I running ok?



Why did a fault happen?



I predict a fault will happen soon.



What action should be taken to avoid the fault?

Industry and Technology Alignment

Recipe for Industrial IoT Success



+



Perfectly Aligned Focus

SMART CONNECTED OPERATIONS

CONNECTED ENTERPRISE OPERATIONS

Complementary Expertise



Tech Expertise

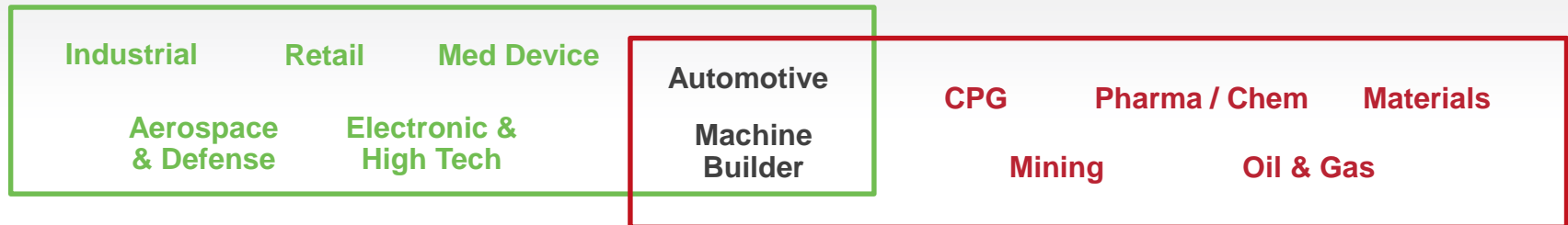


Domain Expertise



Brand Recognition

Complementary Segments



Complementary Products



What is PTC ThingWorx?

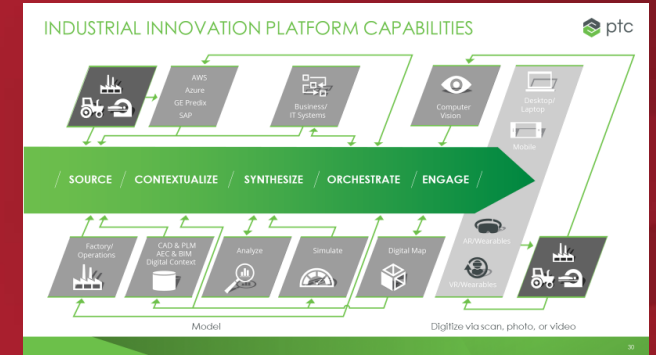
High-Level Overview

■ ThingWorx is a platform, that enables:

- Data Connectivity – live data, transactional and time series
- Computation – perform calculations on the data
- Analytics – leveraging the Analytics engine (prediction...)
- Unified Production Model Development – organize to meet customer needs
- Visualization – data shared and fused from different data sources in context
- Configure and Extend – via APIs and configurations

■ ThingWorx integrates with:

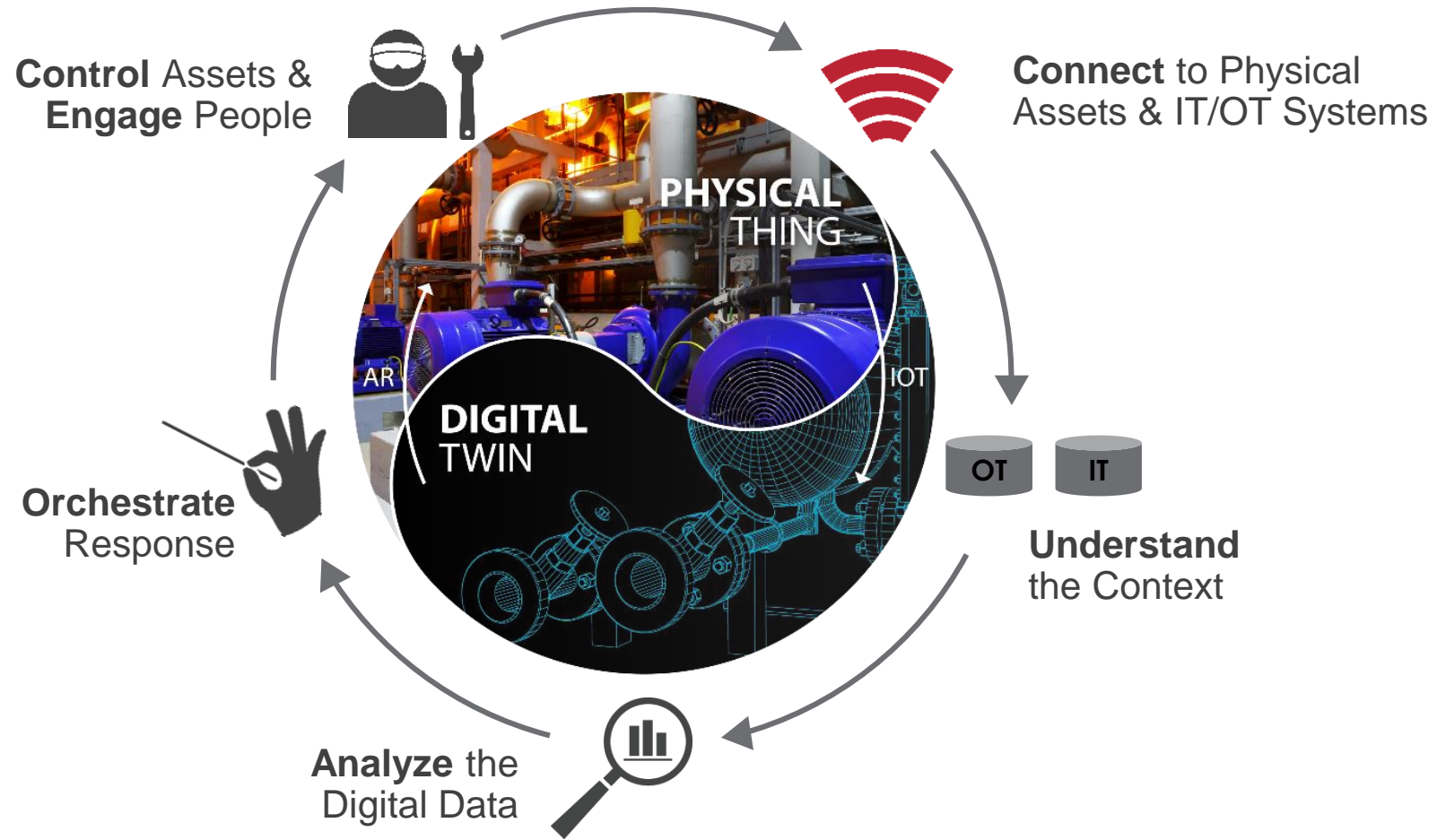
- Vuforia – for Augmented Reality
- WindChill – to surface data from PLM



A screenshot of the ThingWorx configuration interface. The interface shows a tree view on the left with categories like 'Thing', 'Thing Template', 'Data Stream', 'Resource', 'Model Tag', 'Workflow', 'Workflows', 'Data Definitions', 'Data Definitions', 'Data Definitions', and 'Data Definitions'. The main area displays a table of configurations:

Name	Description	Type	Modified
WeatherForecast_Arduino2		Thing	2018-07-25 14:50:04
V1_Arduino2	Automatically created value stream	Thing	2018-07-25 14:50:04
Arduino2	User created by the ThingWorx ACM	User	2018-07-25 14:50:04
GlobalEventProperties	Default shape for action properties	ThingShape	2018-06-11 07:11:14
mqtt_publisher		Method	2018-06-25 07:09:14
mqtt_listener		Method	2018-06-25 15:56:19
WeatherForecastBackground		Modifiability	2018-06-25 07:10:03
SendOverline		Modifiability	2018-06-25 07:10:03
mqttSubscriber		Modifiability	2018-06-25 07:10:03
ClientAppBackground		Modifiability	2018-06-25 07:10:03
ClientAppBackground		Modifiability	2018-06-25 07:10:03
ClientAppBackground		Modifiability	2018-06-25 07:10:03
ClientAppBackground		Modifiability	2018-06-25 07:10:03

Bridging the Digital and Physical



FactoryTalk[®]

thingworx[®]

vuforia[™]

Smart Manufacturing

IIoT Suite - System and Solution Business

2018-10-18 18:34:...

Map Satellite Parapel Islands Luzon

IIoT Suite - System and Solution Business

2018-10-18 18:32:...

Year: 2018

Alarm Summary Waiting for Alarm Events...

System Status

IN 0 Kg.

OUT 0 Kg.

Rockwell Automation

Rockwell Automation

Bay 05 Bay 05-0

75%

Overview

TA-05: 24780 mm, 28.50 °C

TA-06: 40000 mm, 29.20 °C

TA-15

D-702 Additive

BAY 05

BAY 06

BAY 07

Search and Select Order Number

BCU - 01	Reset	Select	Confirm	Comp. No.
Product	Preset Vol.	Qty. Loaded		
Solar	0.0	295.6	L	Command
Fame	0.0	15.3	L	
TOTAL QTY.	0.0	310.8	L	
ADDITIVE	0.0	95.0	gr	

BCU - 02	Reset	Select	Confirm	Comp. No.
Product	Preset Vol.	Qty. Loaded		
Premium	0.0	105.6	L	Command
Ethanol	0.0	5.3	L	
TOTAL QTY.	0.0	110.8	L	
ADDITIVE	0.0	35.0	gr	

BCU - 03	Reset	Select	Confirm	Comp. No.
Product	Preset Vol.	Qty. Loaded		
Pertamax	0.0	105.6	L	Command
Ethanol	0.0	5.3	L	
TOTAL QTY.	0.0	110.8	L	
ADDITIVE	0.0	35.0	gr	

3.4%

Google

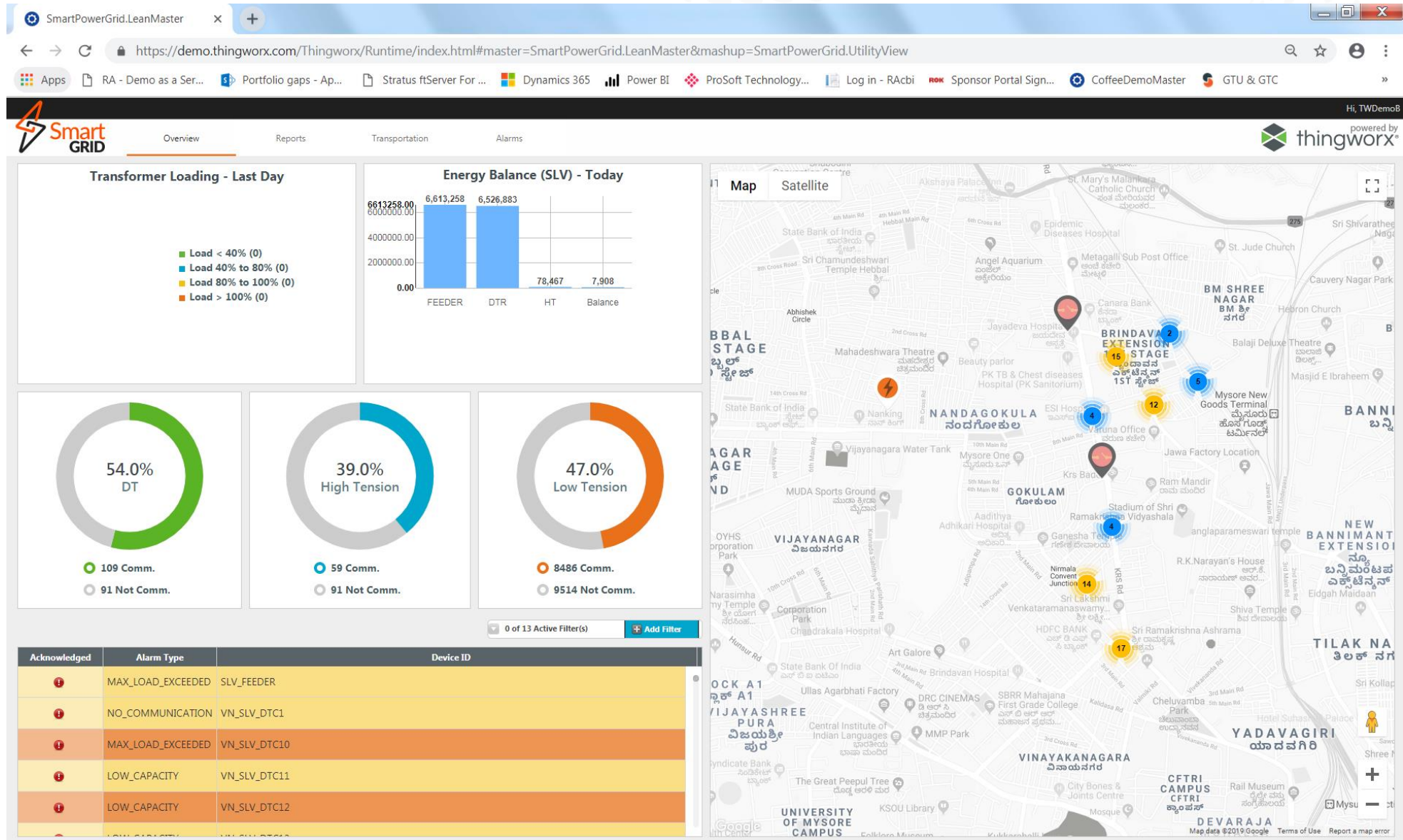
Oct 2018

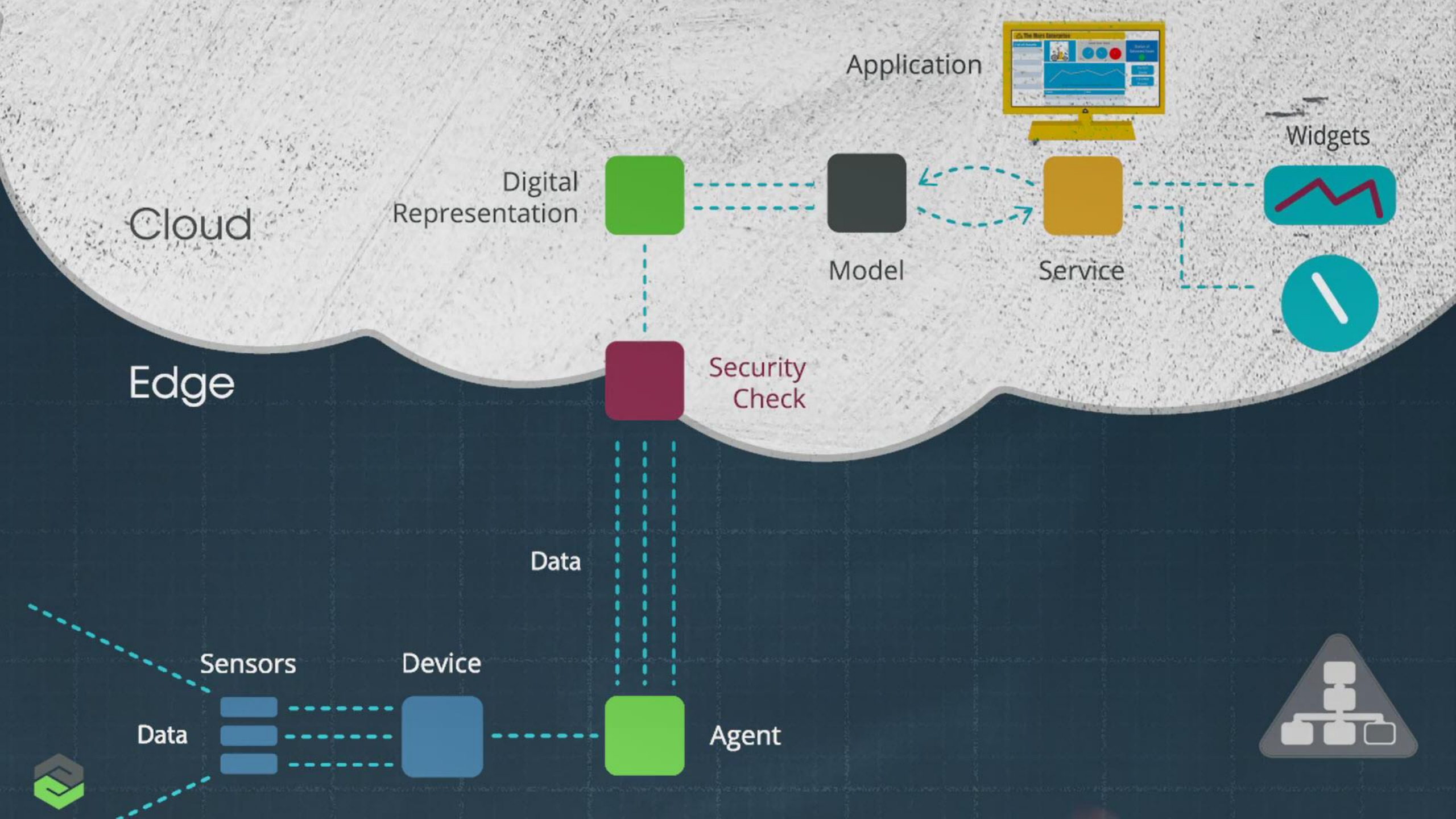
TK-TA05: 24780

TK-TA06: 40000

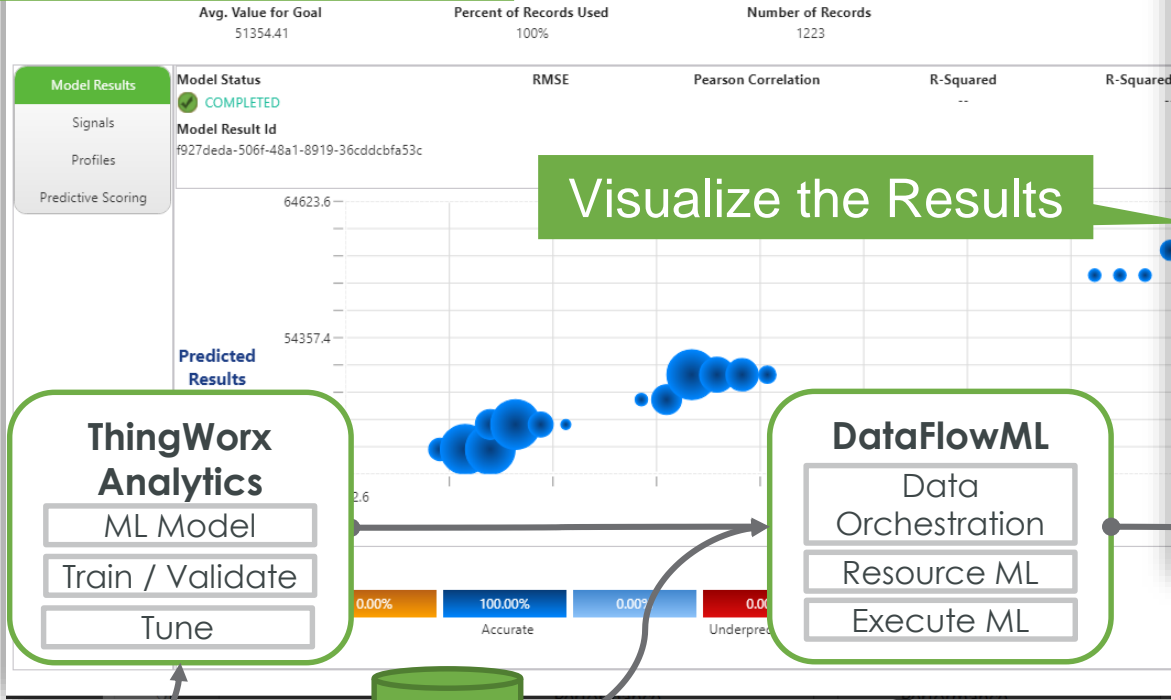
Show Tag

Smart Grid





Operationalize the ML Model – Score the Model



ThingWorx Analytics

- ML Model
- Train / Validate
- Tune

DataFlowML

- Data Orchestration
- Resource ML
- Execute ML

DataView

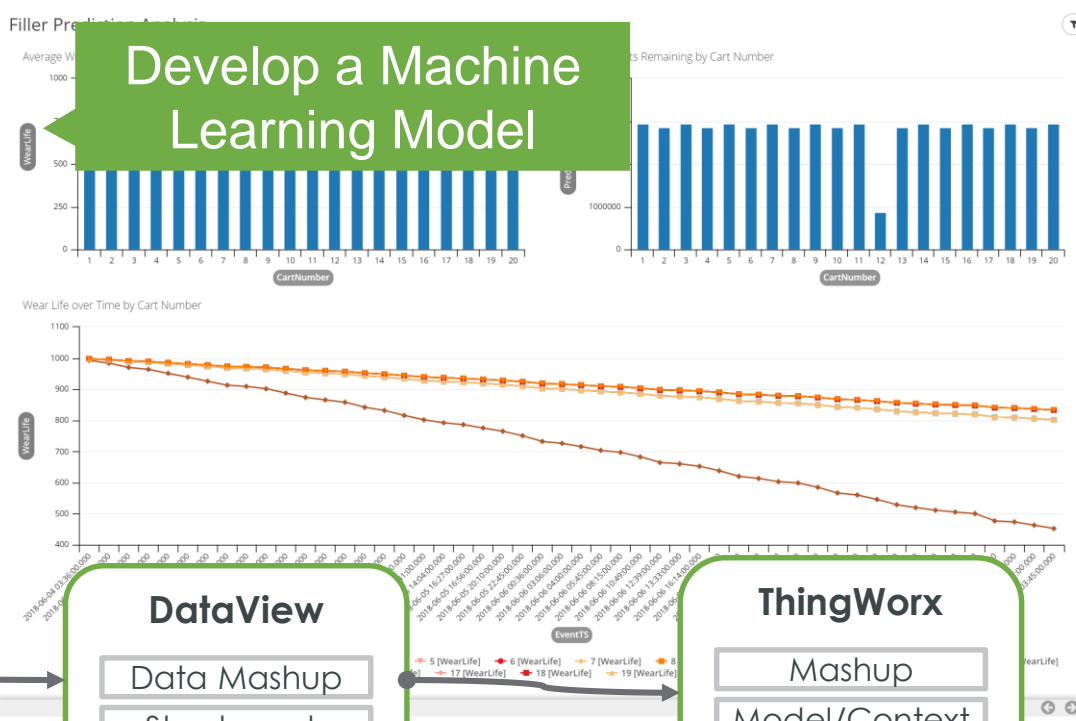
- Data Mashup
- Storyboards

ThingWorx

- Mashup
- Model/Context
- Connect

Visualize the Results

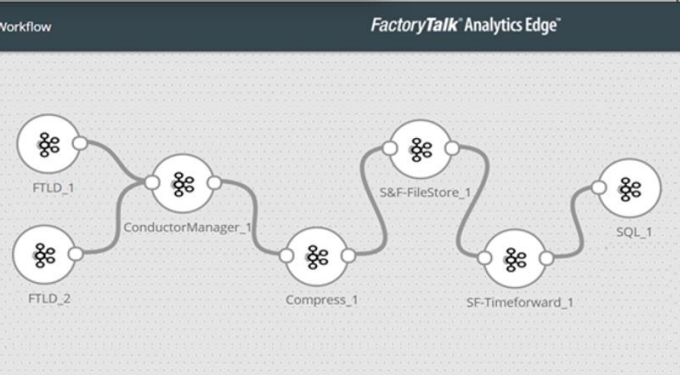
Develop a Machine Learning Model



Extract Live Data needed by the ML model

Edge Runtime

- Pipeline Exec
- Execute ML
- Data Manipulation



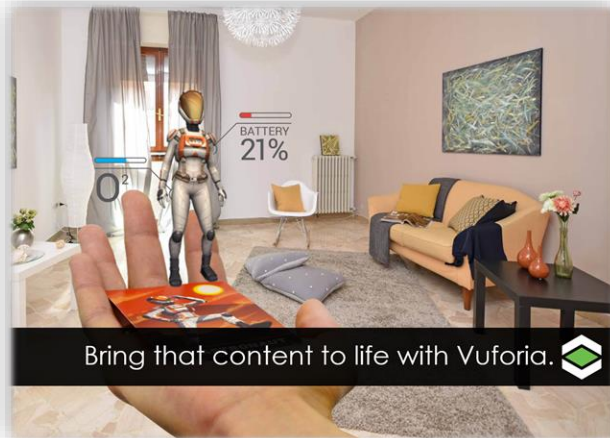


vuforia™ Augmented Reality

vuforia® engine

For Developers

- Allows Apps to “see” and puts content onto the world through environments or objects



vuforia® studio™

For Enterprise Content Creators

- Powerful AR content creation and publishing solution for industrial enterprises



vuforia® chalk™

For Remote Assistance

- Allows you to “see what I see” and annotate in a shared workspace



Assembly & Process Work Instruction



Enabling the Industrial Internet of Things (IIoT)

The Connected Enterprise Customer Outcomes



Faster Time to Market



Lower Total Cost of Ownership



Improved Asset Utilization



Enterprise Risk Management



SCALABLE EXECUTION SYSTEMS



SCALABLE ANALYTICS



MOBILITY & COLLABORATION



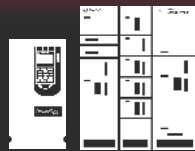
CONNECTED SERVICES

ROCKWELL AUTOMATION IIoT INFRASTRUCTURE – Integrated Architecture™

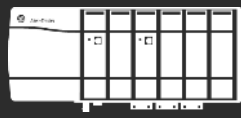
SMART CONNECTED ASSETS – EtherNet/IP Enabled Network



SENSORS & ACTUATORS



INTELLIGENT MOTOR CONTROL



CONTROLLERS



MOBILE / DISPLAYS



MACHINES & EQUIPMENT



REMOTE ASSETS



Thank you
More information:

Contact

Dr. Anukoon Asawachatroj

aasawac@ra.rockwell.com

Mobile 063-202-3425



www.rockwellautomation.com