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GLOBAL WEBINAR

Strategic Approaches to Data Management, Analytics, and IT/OT Convergence

Featuring:

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Industry Principal, Global Power Generation - OSIsoft

Executive Summary

1. Identifying Key Business Drivers for IT/OT Data Management
2. Data Supporting Transformative Ambitions
3. Data Driven Use-Cases: IT/OT & Data Science are unavoidable
4. Guidance for the Digital OT Leader

Definitions in a Transformed World

Process-centric – Data used for optimizing and operating near real-time processes

Information-centric – Data movement for reporting and discrete decision-making

Converged data – Areas where transaction information must meet time-series data to complete the information needs of a process

Converged IT/OT Technology – A technology area that focuses on devices and appliances that can operate in both IT and OT realms

Operational Edge – Translate and automate the flow of information between IT and OT

Device Edge – Manages the devices at the point of activity and can execute specific automated tasks

Process Edge – Executes real-time instructions at the detailed operational level

Overall Market Drivers

Technology evolution

Digital-centric technologies make new **automation archetypes increasingly affordable, transparent and contextually intelligent.**

Technology convergence

Digital technologies converge to create digital twins that unleash previously **unforeseen use cases in the physical world.**

Applications expansion

The fast expansion of use cases accelerates needs for **scalability beyond the traditional operational realm.**

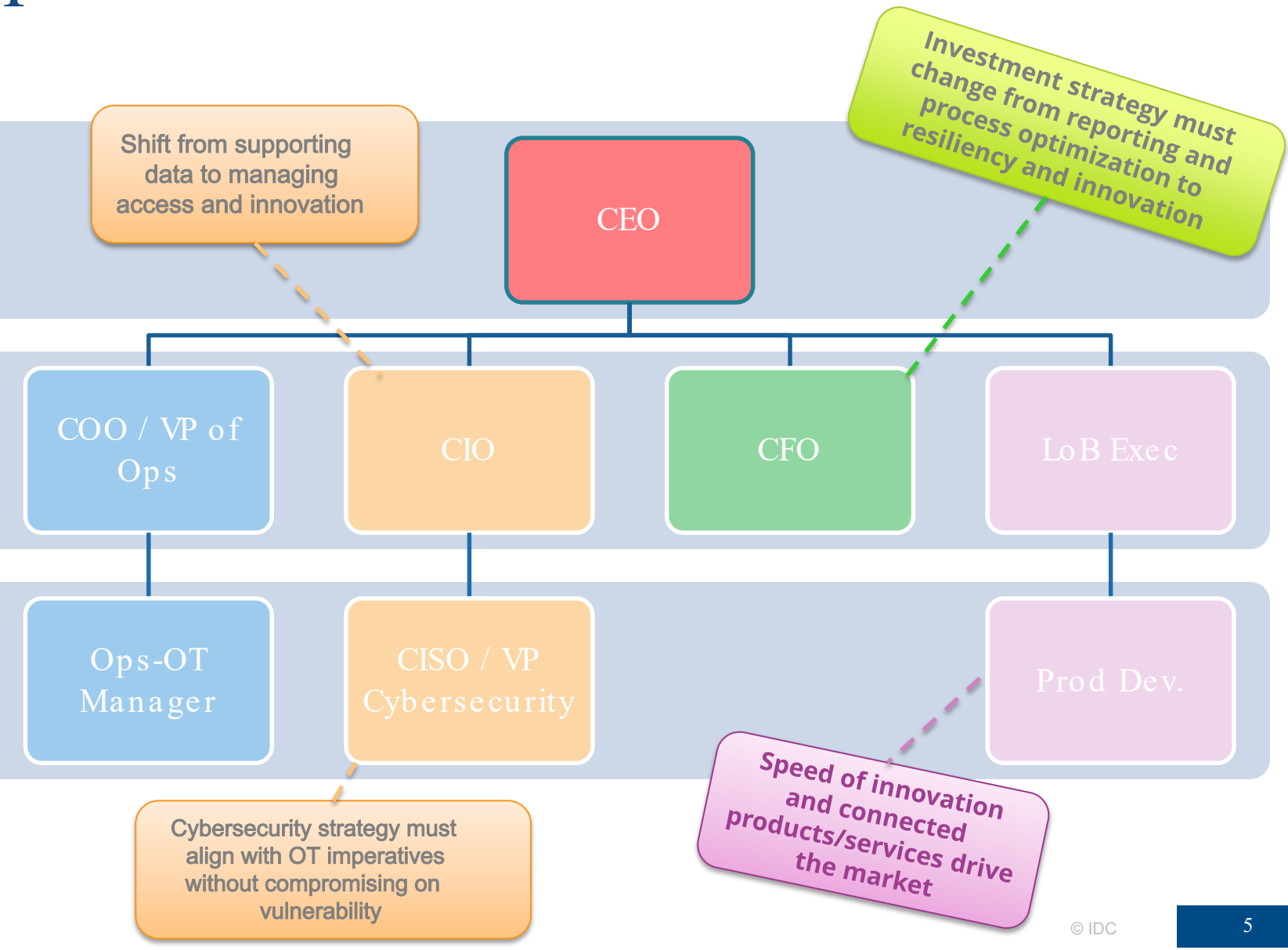
Business model disruption

Digital transformation (DX) shifts the competition from scale of integrated processes to **ability to leverage data and its value.**

The Digital Operations Mess

=> Your industry is being transformed from shifting market expectations
=> You need a technology foundation at the edge

- You have to adopt the tech discipline of IT, but with operational resiliency
- You must converge your OT with IT capabilities



Pressure for DX in the E&U Sector

- Innovation – The pressure to innovate in procedures and process
- Unconventional – Squeezing more commodity using technology
- Cloud – The biggest technology change in 40 years
- AI – The potential for AI is huge, but still embryonic
- Mobile – Access to data and information anywhere
- Connectivity – Increasingly ubiquitous enables much of the above

The Data & Analytics Controversy

- Decision makers at all levels want to disrupt the status quo, to ask new questions, to have instant access, anywhere to actionable information; to be free of mundane data preparation tasks

In the past 12-24 months 65% of organizations began to track and measure new KPIs

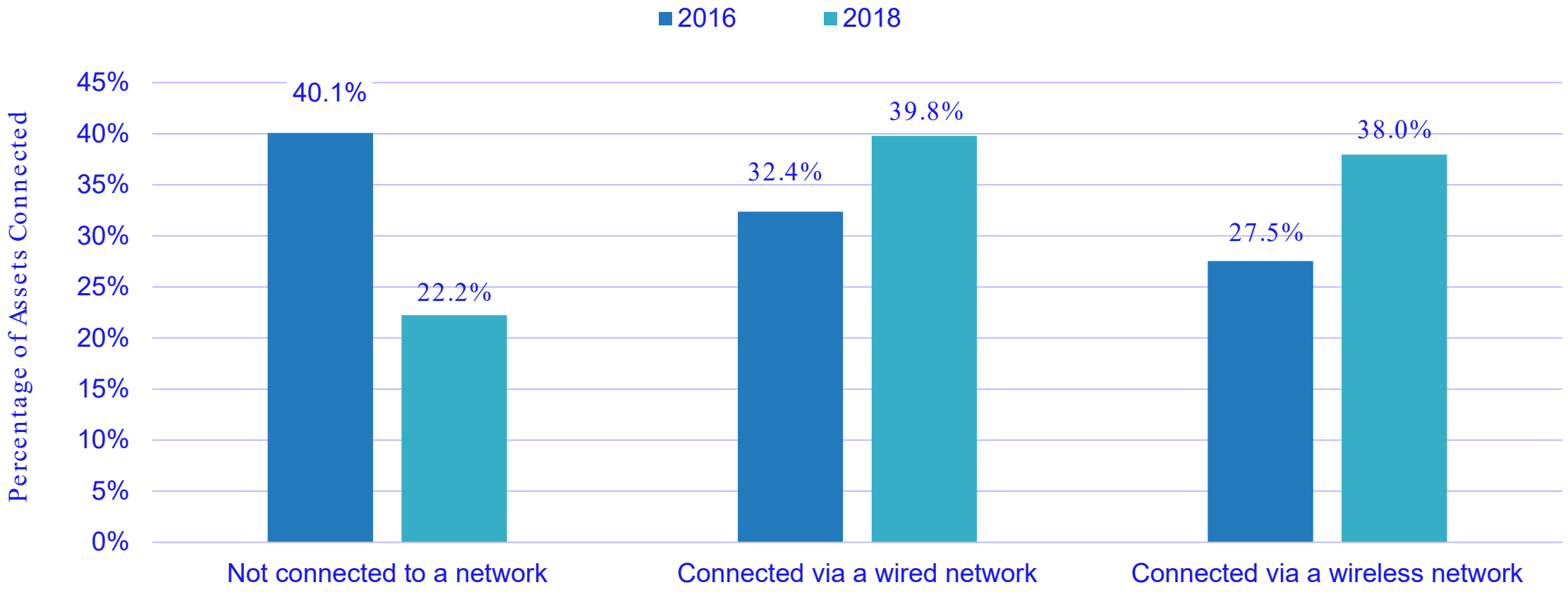
- Only 26% of Sr. executive at ops-intense companies completely agree that the speed of their IT group's response to users' analytics/BI requests meets end-user expectations

IT is not keeping up with demands from the business

- 91% of organizations rank data and analytics as a competitive advantage or differentiator but **only 24%** have been able to extract maximum available value from data.

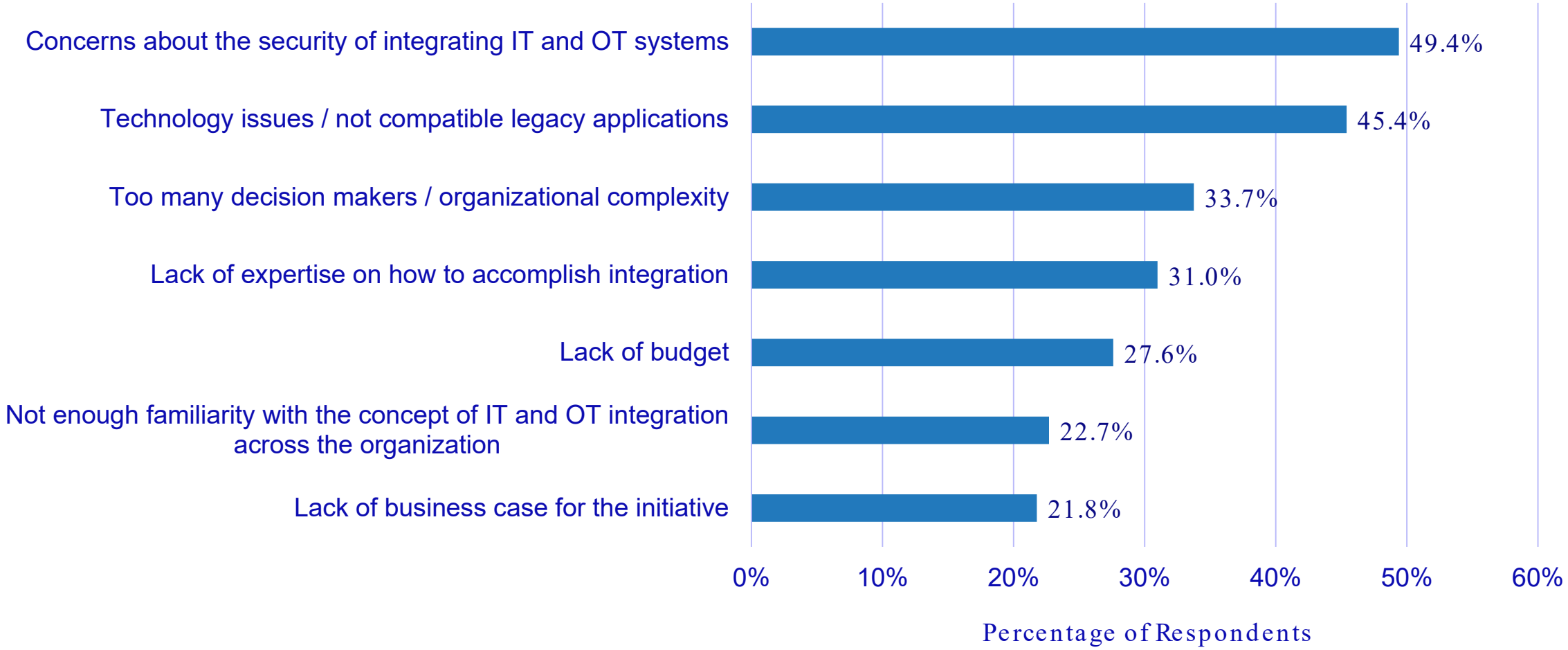
Data is the resource that companies have, but struggle extracting value from

The Reality of Connected Operational Equipment



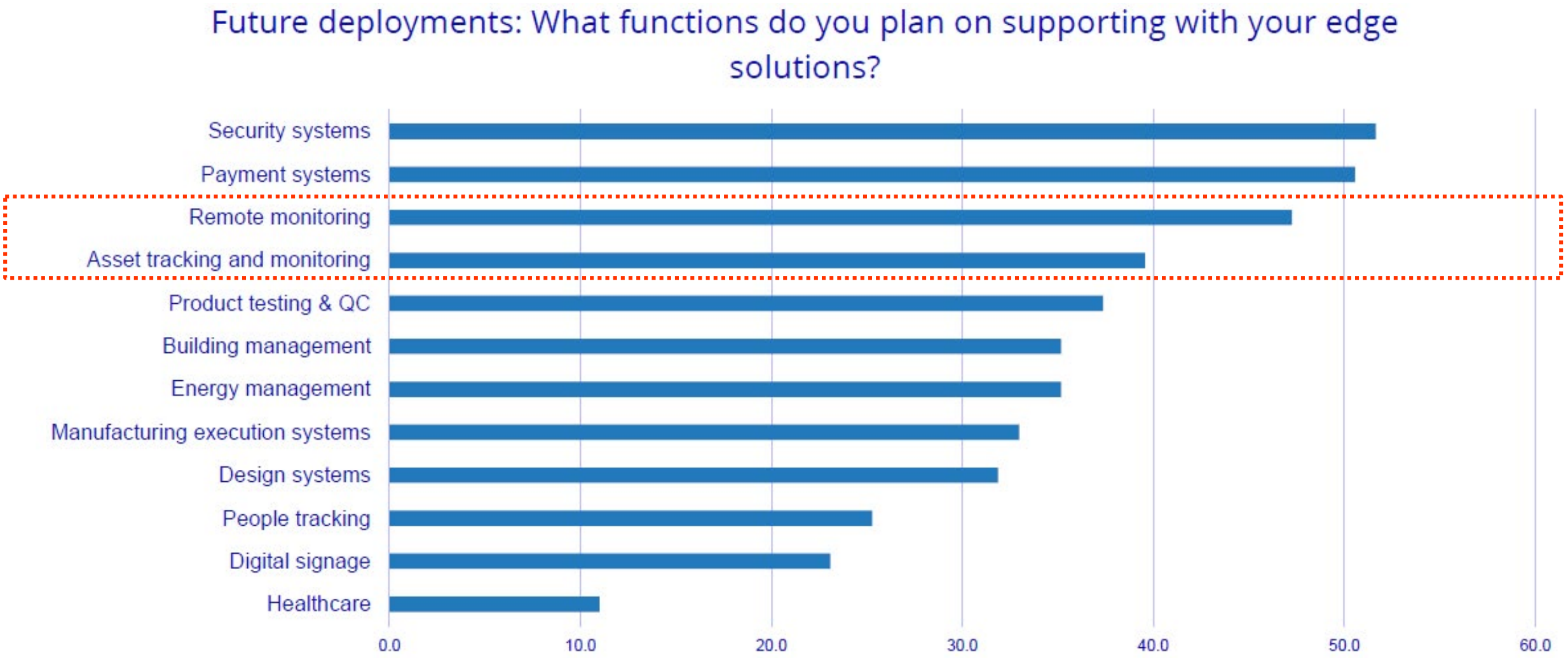
Source: IDC IT/OT Convergence Survey, June 2018 (2016 N=794, 2018 N=905)

Top Barriers to IT/OT integration in 2018



Source: IDC IT/OT Convergence Survey, June 2018 (2018 N=905)

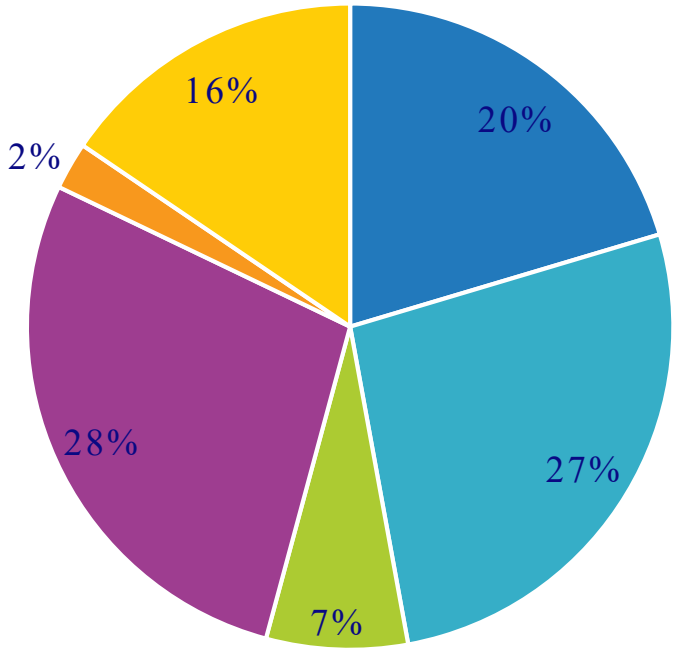
Functions where Edge will be Deployed



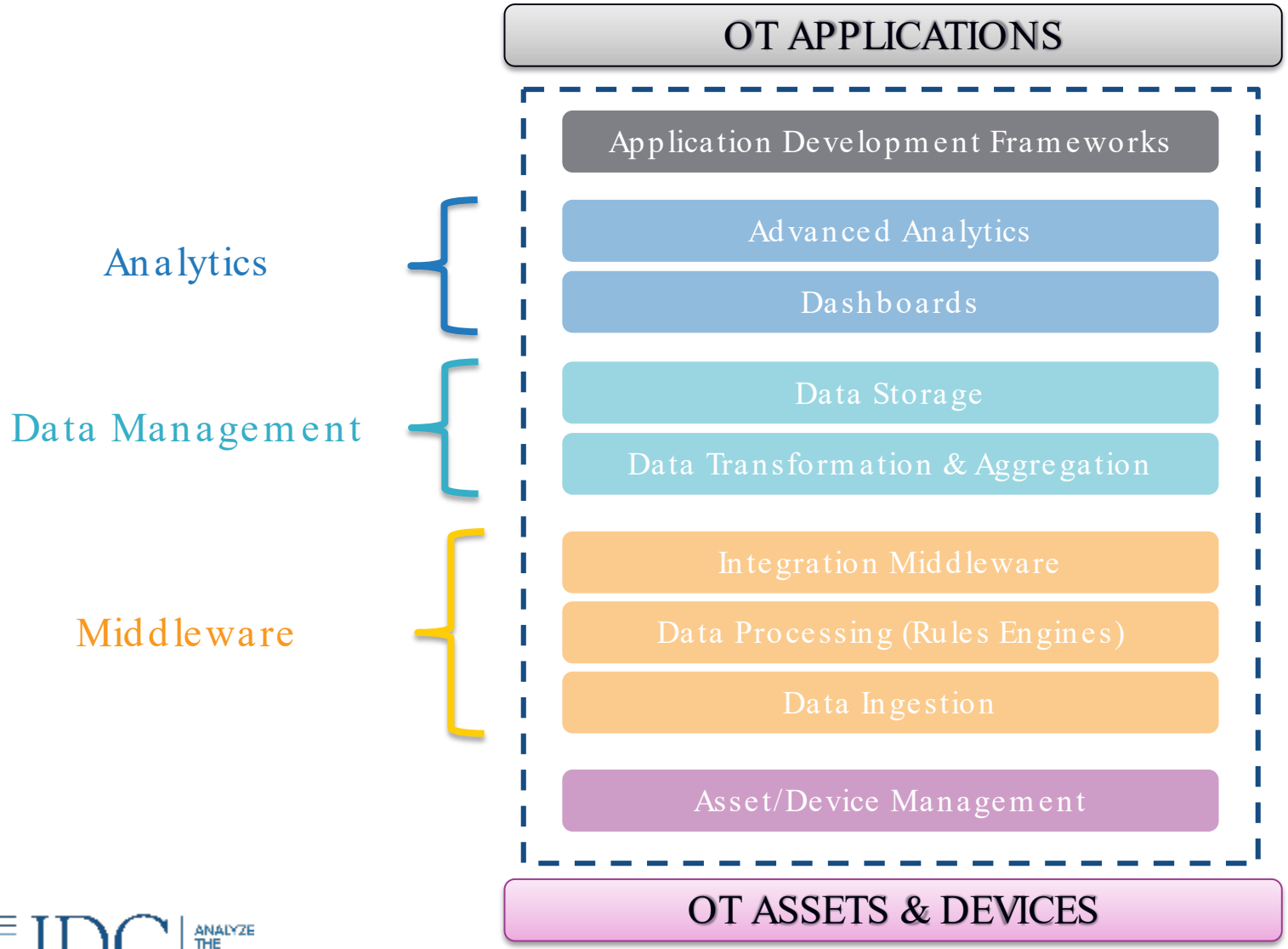
IDC's Enterprise Datacenter Edge Survey, March 2018;

Performance Tracking of Monitored Assets is not a Mature Discipline yet

- IIoT Deployment is uneven
- Scaling is often a world away



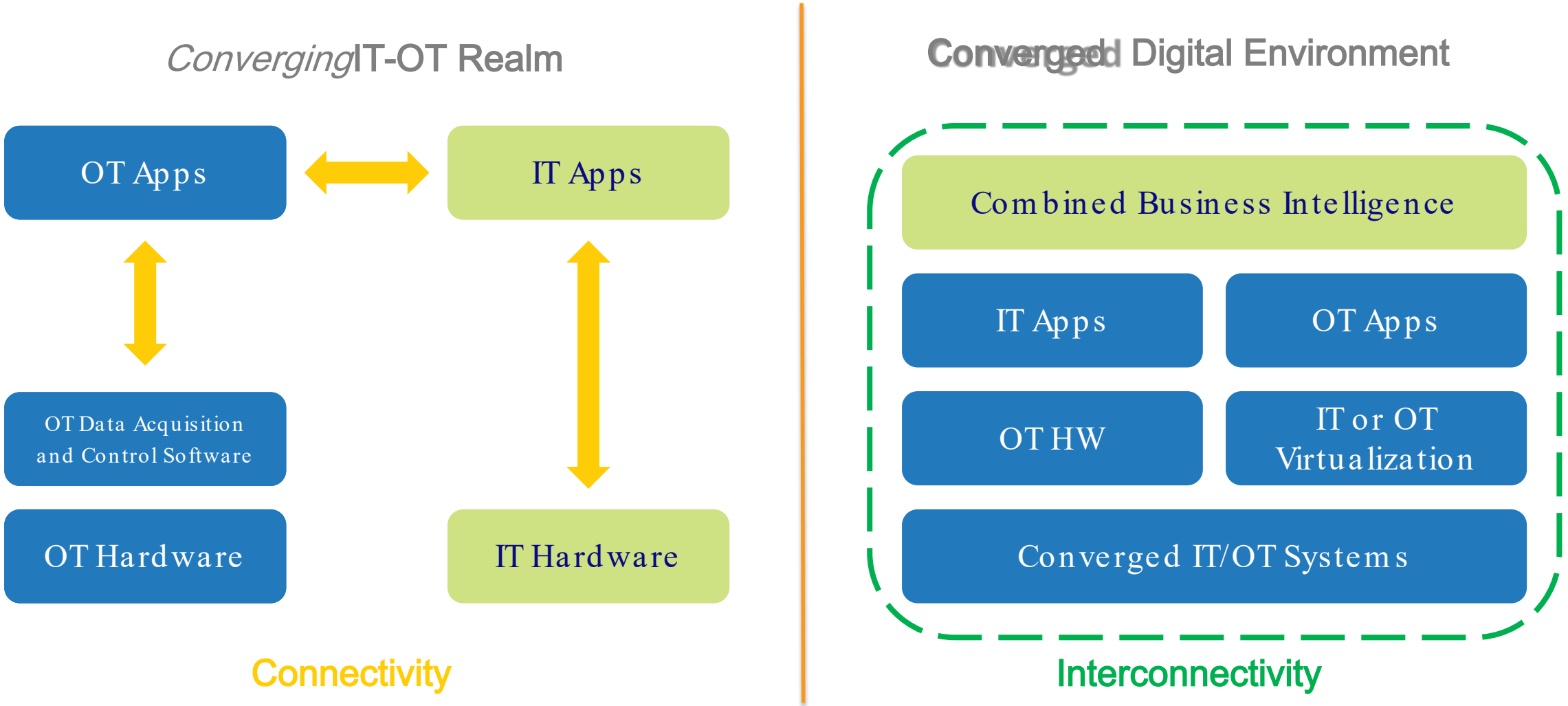
Traditional OT Stack – Digitizing OT



- Digitizing the traditional OT model creates better, more flexible OT Applications
- However the OT silo is encouraged

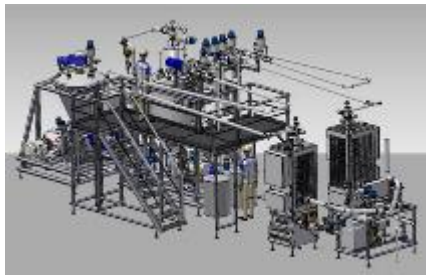
=> Even if Ops effectiveness increases upon Ops metrics, reflecting the positives on an entire business ecosystem will remain as intangible as it is today.

Connectivity is Only a Step in the Journey

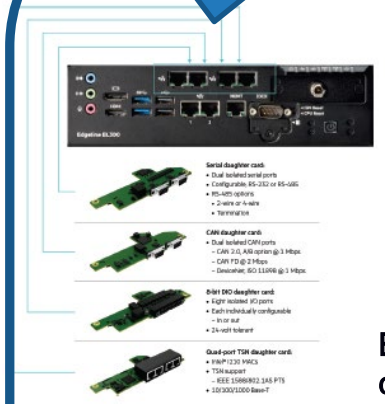


Digitalization and Instrumentation in a Box for legacy assets

- **Intelligent Edge**
  - Serial Comms
  - A/D I/O
  - Wireless
- **Process Historian**
- **Cloud Account**
  - IoT management in cloud
  - Analytics & ML in cloud



Physical world



Edge system that connects analog, legacy digital, and IoT sources to IT/OT infrastructure

Advanced analytics and machine learning results

Real-time Data

Cloud w/ IoT Hub, Analytics, and Machine Learning

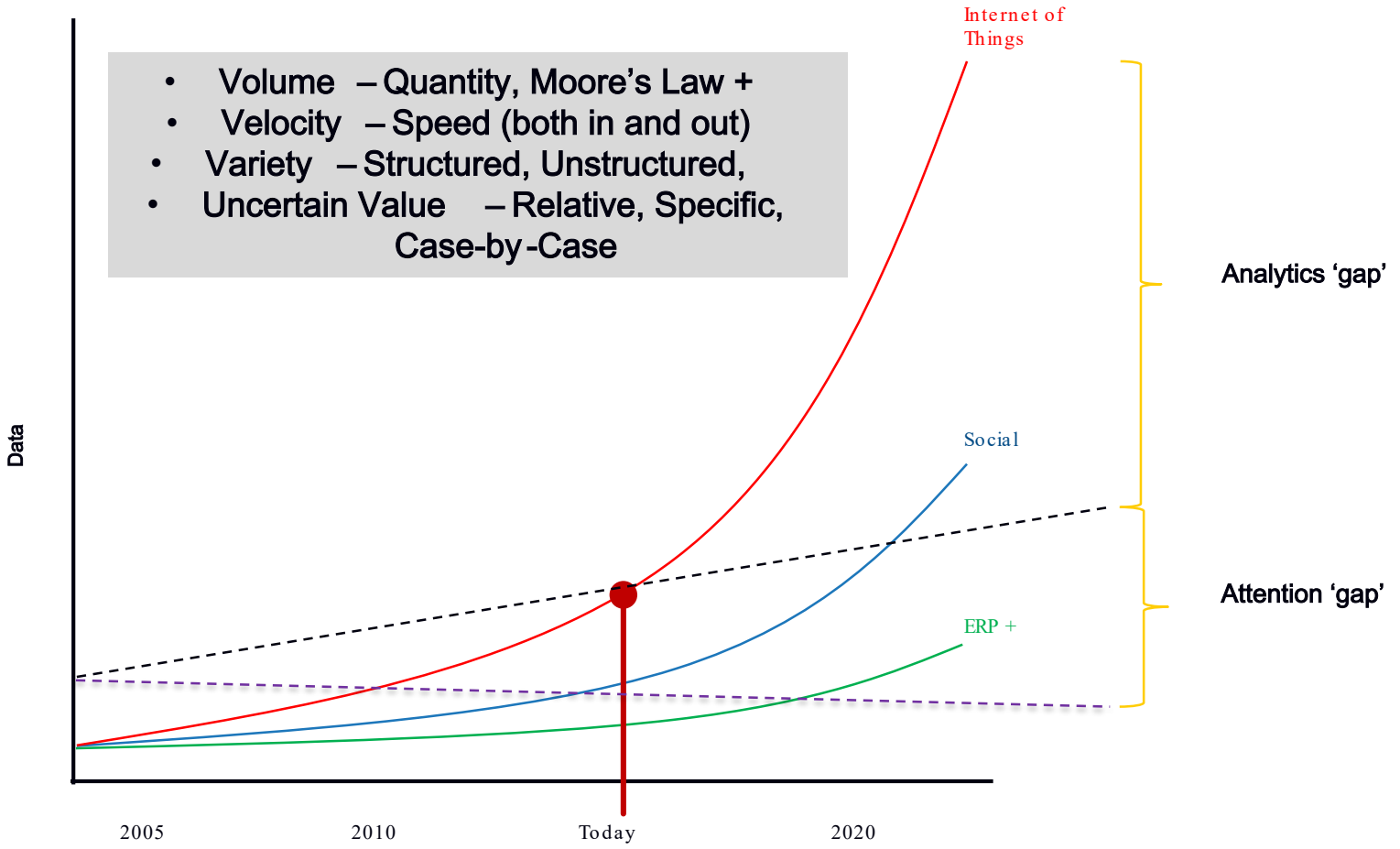
Data and Analytical results exchanged

Real-time Data

Process Data Historian

Real-time analytical results

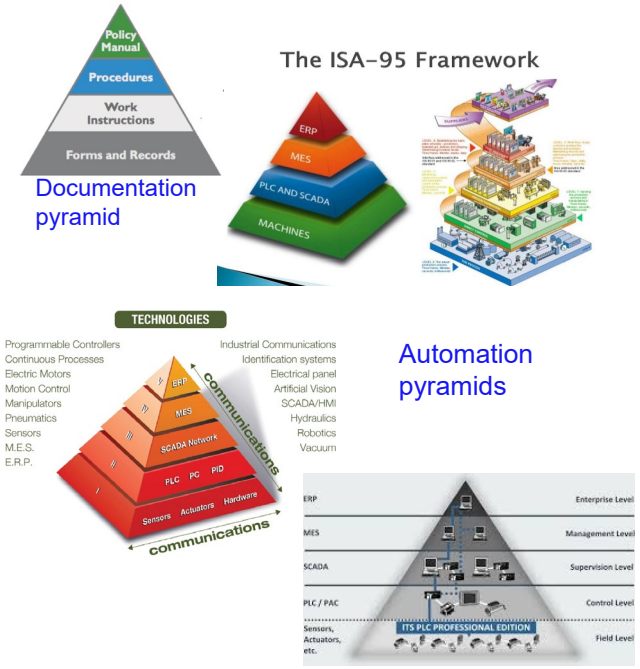
Mind the Data Gaps



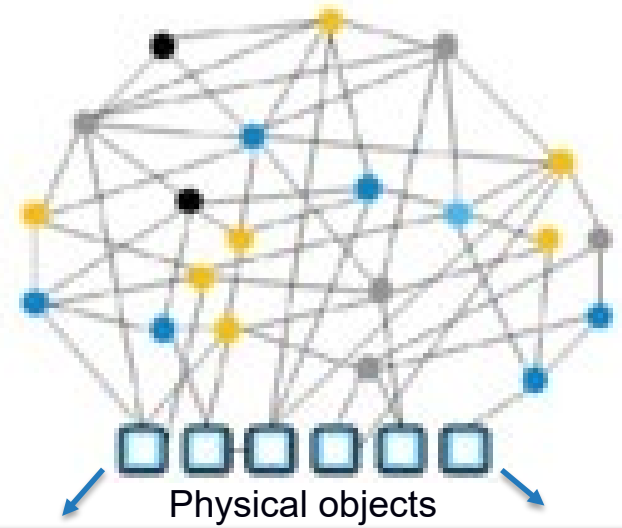
- **Analytics gap** – available data exceeds analytics capability
- **Attention gap** – available insights from analytics exceeds people capacity to act upon in a timely manner

The Evolution: Software -Defined Automation

From traditional pyramids…



…to next-generation "extreme" automation

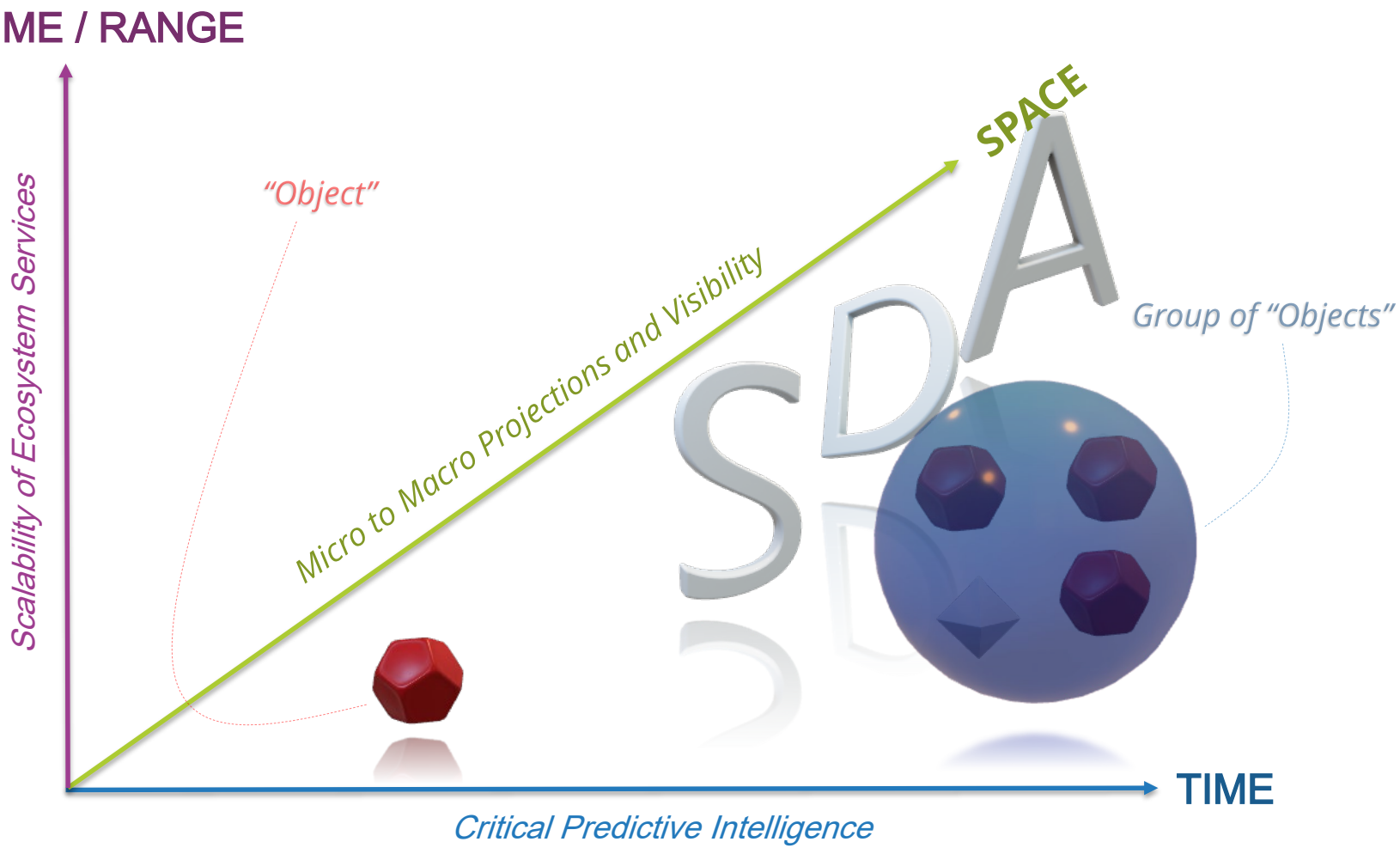


Medical devices, cars, product shelves, trucks, solar panels, hospitals, cities, aircrafts, etc.

Physical objects are linked to networked, decentralized, or partially self-organizing services and transactions to support monitoring, collaboration, production, and servicing new archetypes of "extreme" automation.

From Pyramidal Automation Technology Stack to Software-Defined Automation

- Best for monitoring, collaboration, production and servicing of complex automation archetype within operation -intensive contexts .
- Represents the entirety of an operational environment with figurative "objects" evolving over time, space, and volume .
- SDA links physical and virtual "objects" to networked, decentralized, collaborating or even partially self-organizing services and transactions.



SDA Cross-Industry Relevance: Summary

	Ecosystem Services VOLUME	Micro 2 Macro SPACE	Critical Intelligence TIME
As-a-Service Production Assets			X
Autonomous production processes	X	X	X
B2B integration and automation	X		
O&M of generation assets	X		
Distributed flexibility management	X	X	
Outage restoration		X	
Maintenance Automation			X
Predictive Fulfillment	X	X	X
Personalized and contextualized interaction			X
Collaborative Marketplace	X		
Environment-Agnostic Digital Continuity	X		
Operational de-risking	X		
Smart cities Automation			X

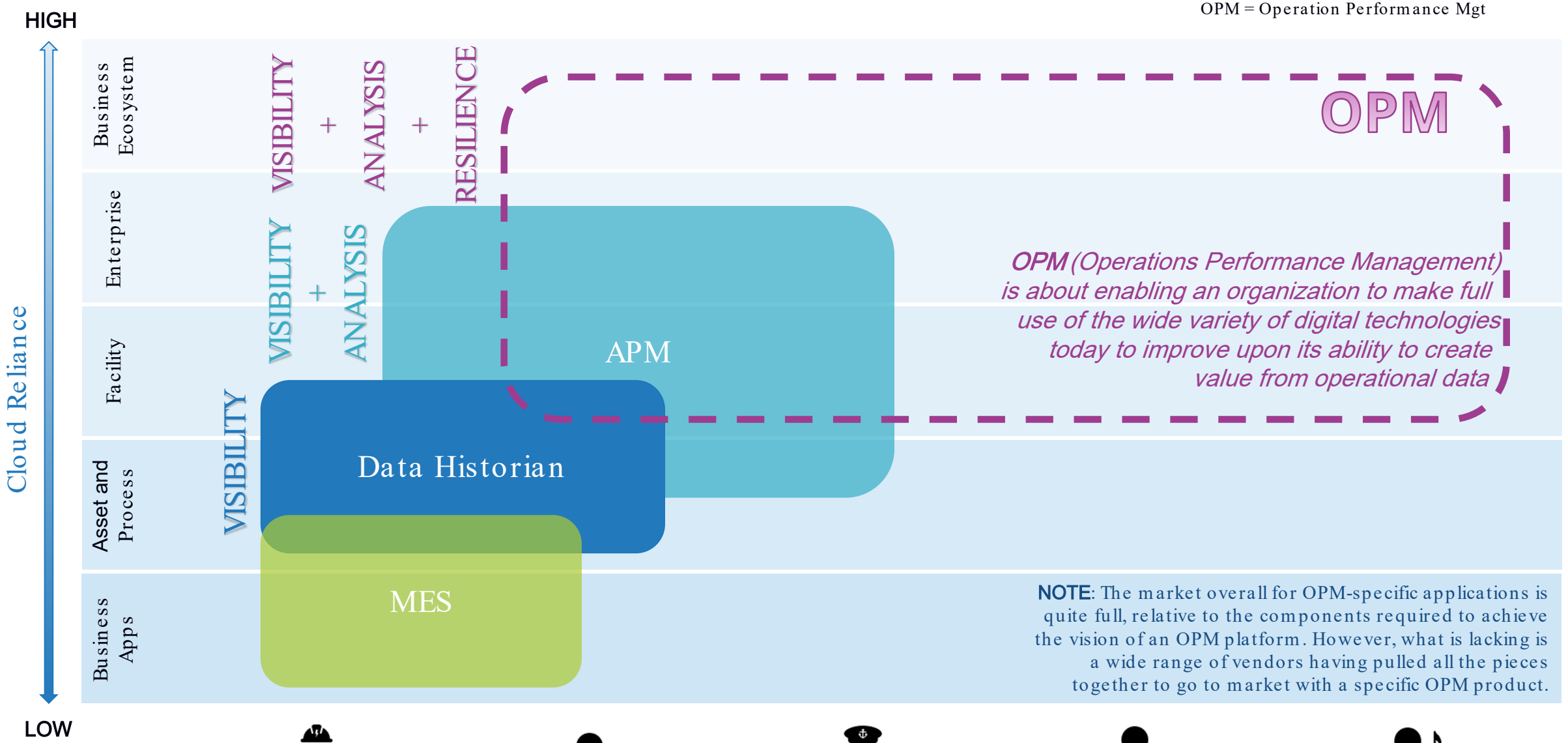
Note: This is a non-exhaustive list of use cases. These are just some examples.

Positioning Data -Driven & Digital Initiatives

	Typical Aim	Primary Technology Model or Leveraging
OX - TRANSFORMATIONAL Innovates & Penetrates Markets at Enterprise Level	Fundamentally change major segments or the entirety of the user's supply-chain offering	Software-Defined Automation applied throughout business functions
IT/OT Convergence - STRATEGIC Enhances Cross Organization Operational Efficiency	Accrued predictability over digital assets, increase in quality of product or service	Streamlined connectivity, and a variety of digital-ready assets morphed into data-centric environment
Adding Digital Capabilities - TACTICAL Solves a Marginal Business Problem at the Local Level	Modify a process or workflow to obtain incremental efficiency gain	Digital capabilities such as IoT, Analytics, Advanced Automation, etc. used, as one off or combined

APM = Asset Performance Mgt

OPM = Operation Performance Mgt



Facility Mgr

OT Leadership

LoB Leadership

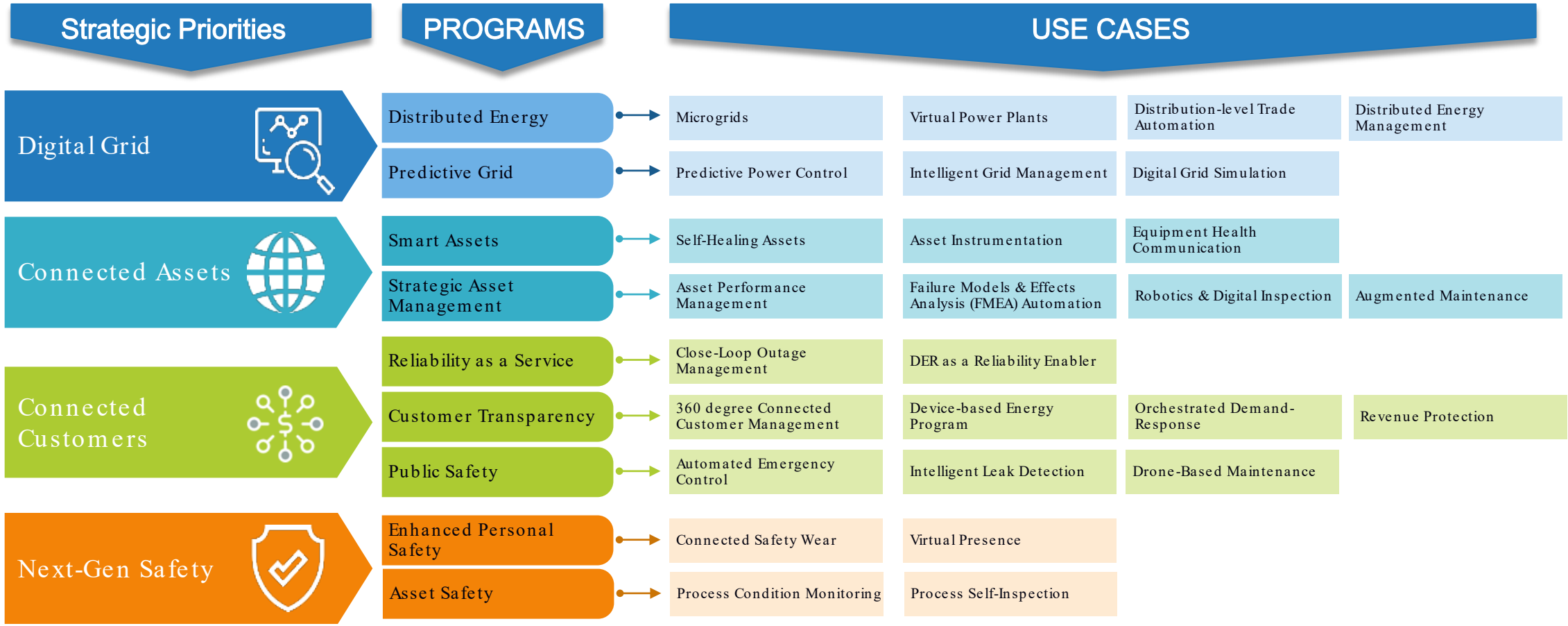
CIO Office

Executive Leadership

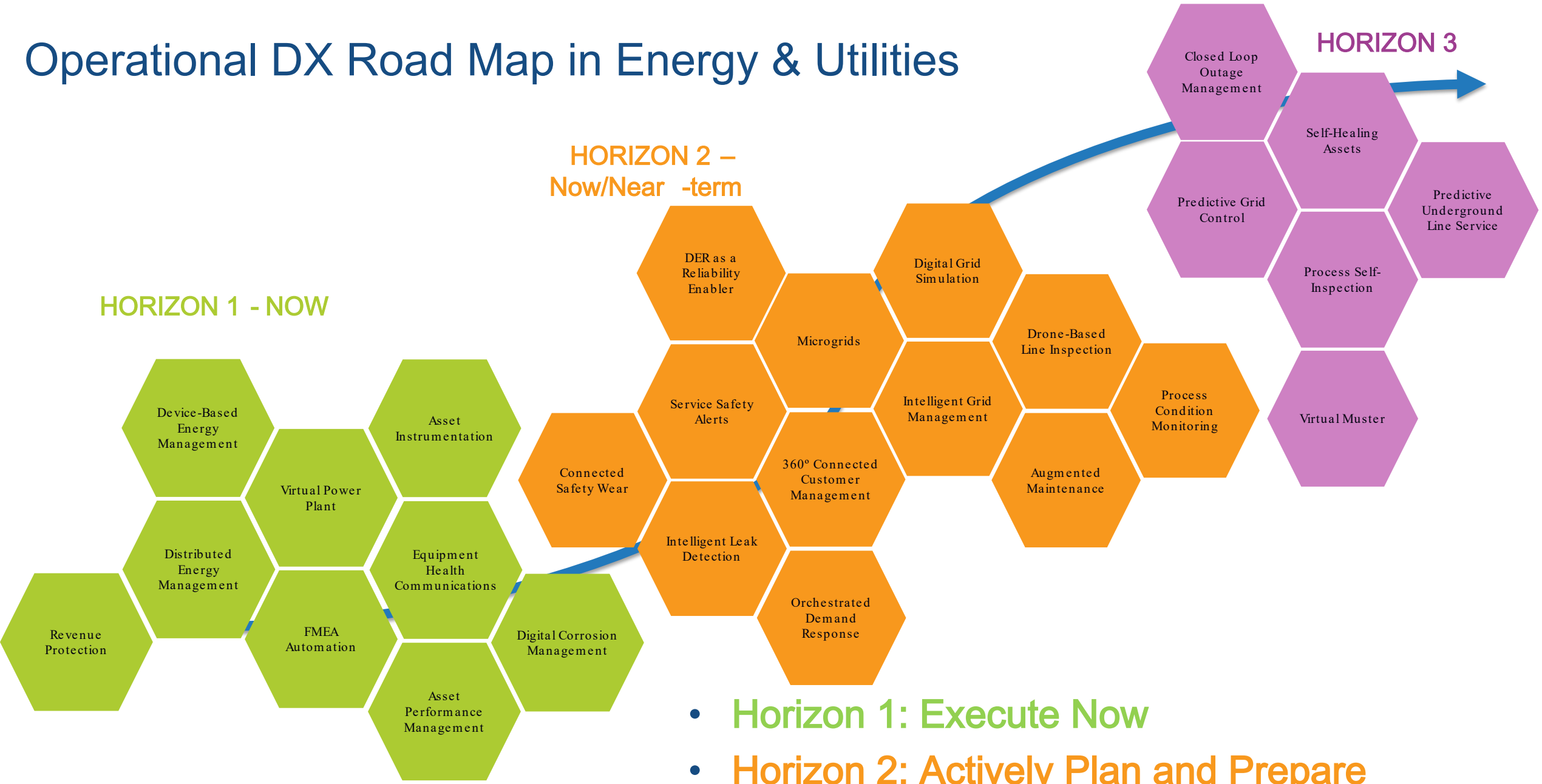
IDC ANALYZE THE FUTURE

Digital Transformation in Energy & Utilities

Mature IT/OT and Data Science Required



Operational DX Road Map in Energy & Utilities



- Horizon 1: Execute Now
- Horizon 2: Actively Plan and Prepare
- Horizon 3: Envision and Project

Building Your Digital Operation Road Map

Identify your baseline state and define what it will take to evolve your organization to the future digital state.

Factor in customer journey maps, capabilities, and portfolio gaps as you establish your programs and use case.

Essential Guidance for Digital OT Leaders

OT Strategy: linked to core digital elements)

Apps are moving to the LOB. **Align yourself with IT supporting the infrastructure for innovation** .

OT Spending Plan: foster essential digital infrastructure

IDC recommends that tech leaders align spending to support enterprise DXprograms

OT Road Map: be the solution, not just part of it

For OT leaders, it is about aligning yourself to the roadmap for **moving and manipulating data and results.**

Cybersecurity: safeguard the growing enterprise -wide digital world

Technology leaders are looking for **agile security that work across all innovation platforms** .

Have a message for the business leaders

LOB is getting more directly involved in app selection, leaving cloud, security, and connectivity to IT. **Again, the priority is a platform that is about connectivity for innovation** .

Data in a DX world: from the point of activity to a place of innovation

It might be edge, cloud, or legacy, but **securing movement of data and providing accessibility** is the message

For More Information

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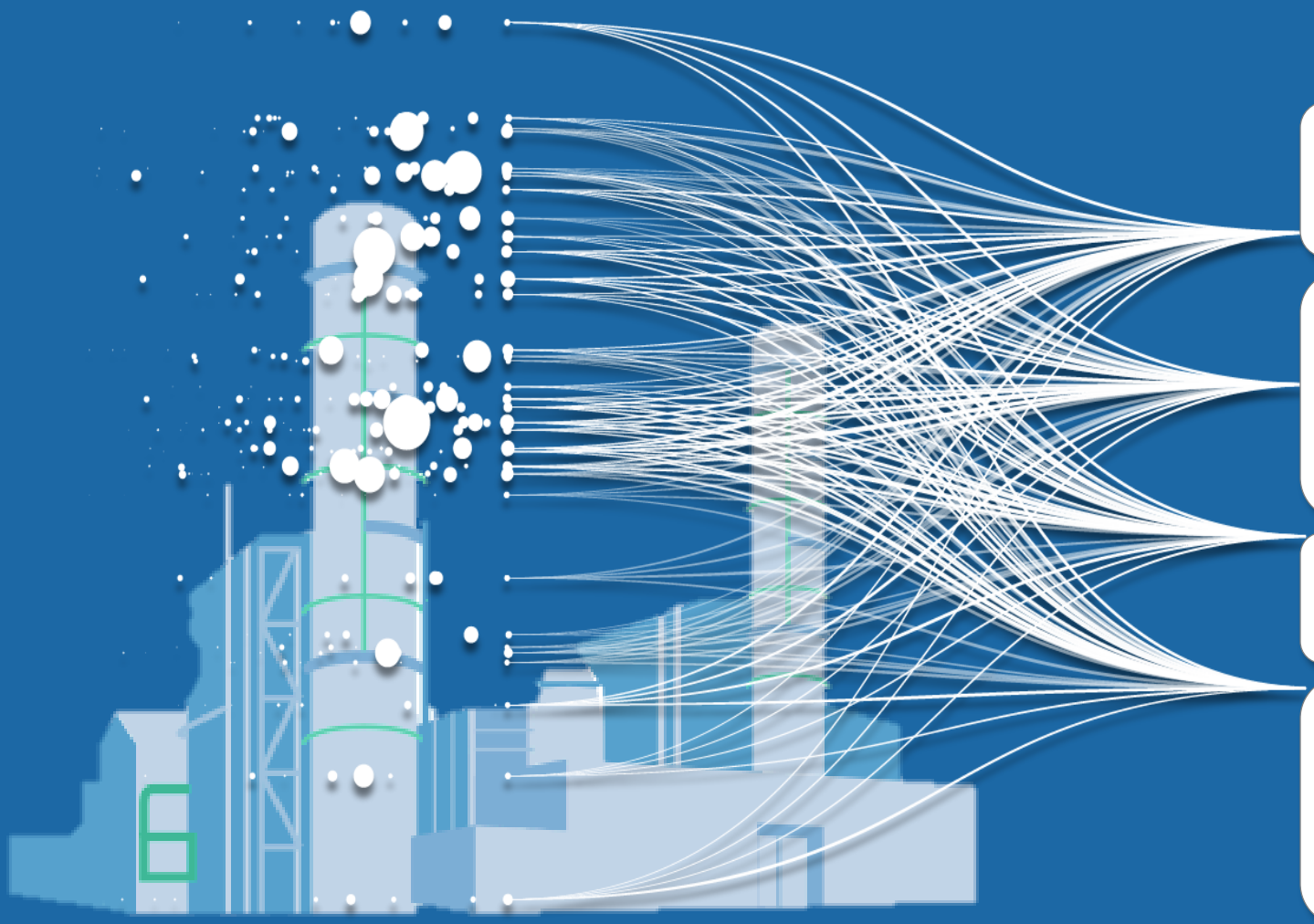
The PI System – IT / OT Convergence and Value Analytics
July 17, 2019

OSIsoft®

David Thomason – Industry Principal, Global Power Generation




The Data Opportunity and Challenge



How Do You Turn this Data in to Accessible and Valuable insights?

DAILY PRODUCTION
Current – 312 MWs Forecast – 340MWs

HRSG Performance
Draft Pressure: -0.5
WC Stack Temp: 316°F
Oxygen: 2.5%
Firebox Temp: 860°F
Outlet Temp: 840°F
Cold Oil Velocity: 6 ft/sec

ALERT!
Pump needs servicing in next 72 hours

WEATHER CONDITIONS
Relative Humidity: 34%
Current Temp: 85 °F High: 92 °F Low: 57 °F
Wind: 8 mph/N

And Make Operations Data an Asset Everyone Can Use in Real Time

Process Engineer

Control Room Tech

Production Manager

Data Scientist

Reporting Analyst

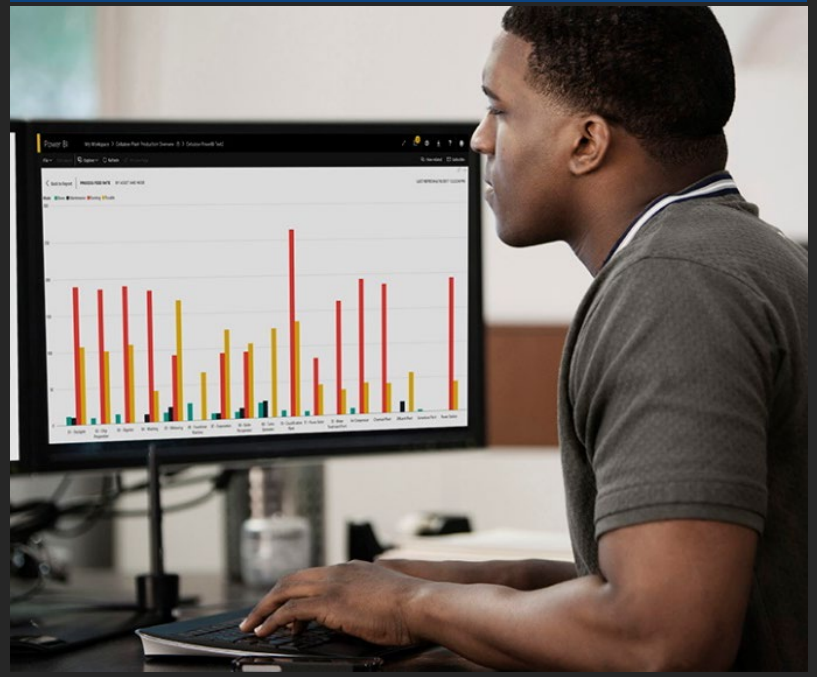
Maintenance Engineer

That's Why We Enable a Data Infrastructure Approach

Situational Awareness
Real-Time Dashboards

On Demand Exploration
Ad-hoc analysis

Third Party Applications
Fit for purpose application




Pervasive
Connectivity
Across
Vendors

Enable: IT and OT Integration

Data Infrastructure for Operations Data Normalization and Governance

PI AF – Asset Framework
Chart of Operations

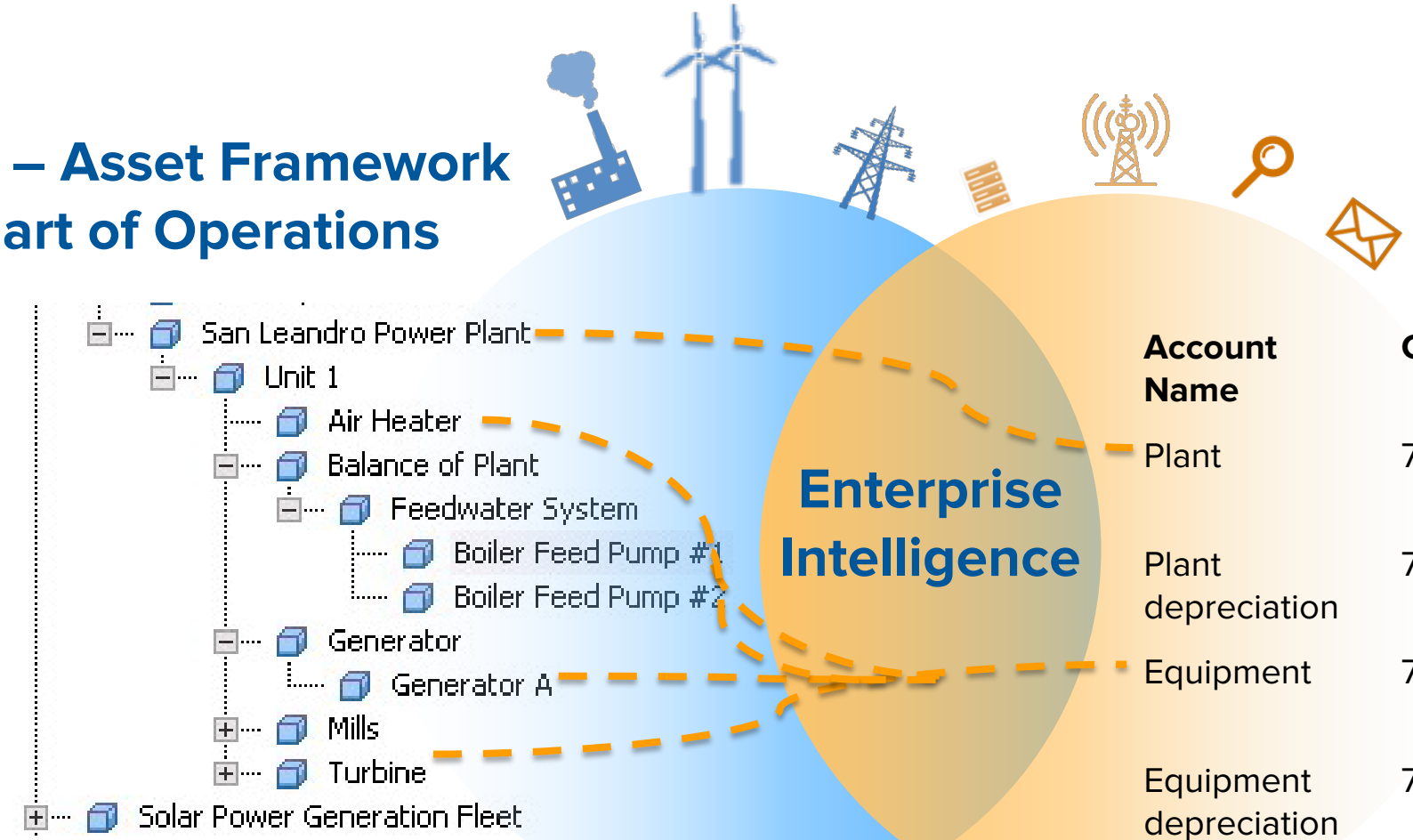


Chart of Accounts

Account Name	Code	Financial Statement	Group
Plant	730	Balance sheet	Power Gen Assets
Plant depreciation	740	Balance sheet	Power Accounting
Equipment	750	Balance sheet	Power Gen Asset
Equipment depreciation	760	Balance sheet	Power Accounting
…			

Enable: Secure Data Infrastructure for Critical Operations

Critical Systems

Transmission & Distribution SCADA

Plant DCS

PLCs

Environmental Systems

Other critical operations systems

REDUCED RISK TO CRITICAL ASSETS

Limits direct access to critical systems while expanding the value use of information.

Data Infrastructure

Security Perimeter

Layered Approach to Analytics

Tabular Context

Community ML/AI

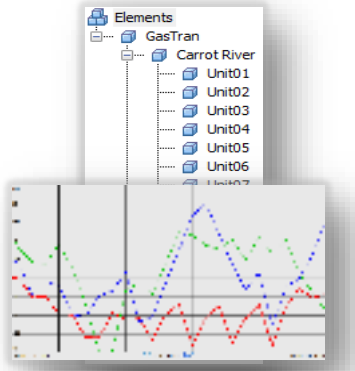
Strategic ML/AI

Tactical ML/AI

Real-tim…Analytics

H…cs

B…

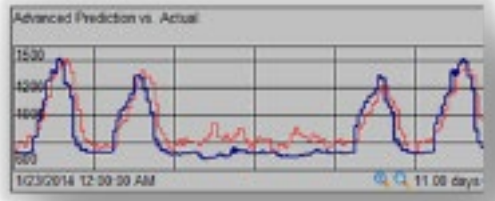


Time, Event and Asset Context

Predictive

Statistical Modelling & Machine Learning/AI (Pattern Recognition)

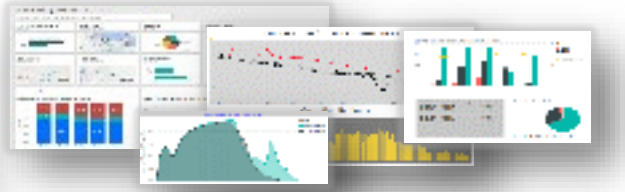
Level 2+ Predictive



Visual

Dashboards & Multidimensional Assessment

Back cast of total company operational performance

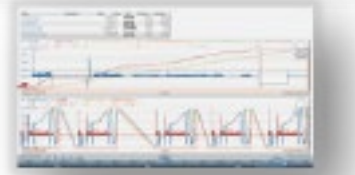


Descriptive & Prescriptive

Level 1 Predictive

$$Q = \frac{\Delta P_{DD} * kh}{141.2 \mu B_0 \left\{ ln \frac{r_e}{r_w} - \frac{3}{4} + S \right\}}$$

Real-time, contextual, exception based decision support

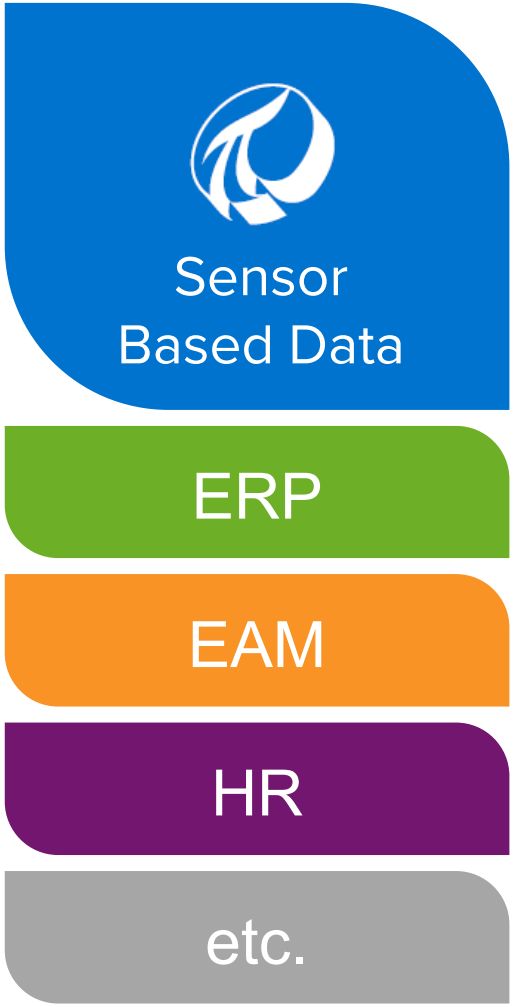


Descriptive & Prescriptive

Level 1 Predictive

Machine Learning/AI/M2M

Analytics Ready Operational Data

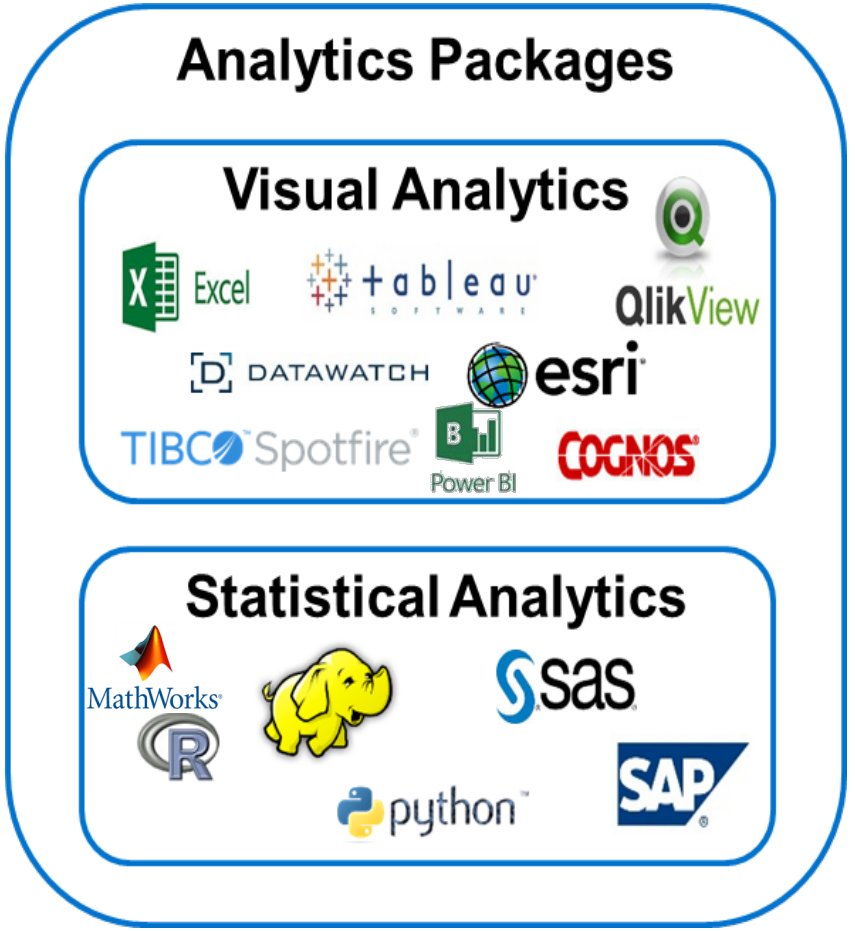


Cleanse
Data quality

Augment
Aggregation

Shape
Model

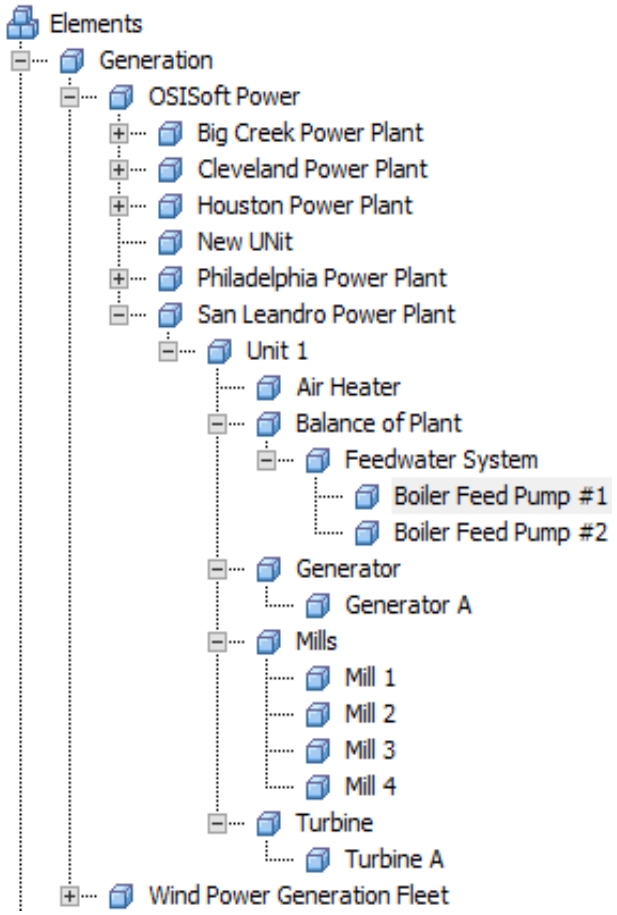
Transmit
Normalization



Real-Time OT Data and Abstraction Layer

Raw Data

Structured data in AF with context and templates



Process Context

Category: Process Data	
Cold Side Inlet Temperature	77.1157989501953 °F
Cold Side Outlet Temperature	131.192291259766 °F
Hot Side Inlet Temperature	374.601501464844 °F
Hot Side Outlet Temperature	292.926361083984 °F

Location

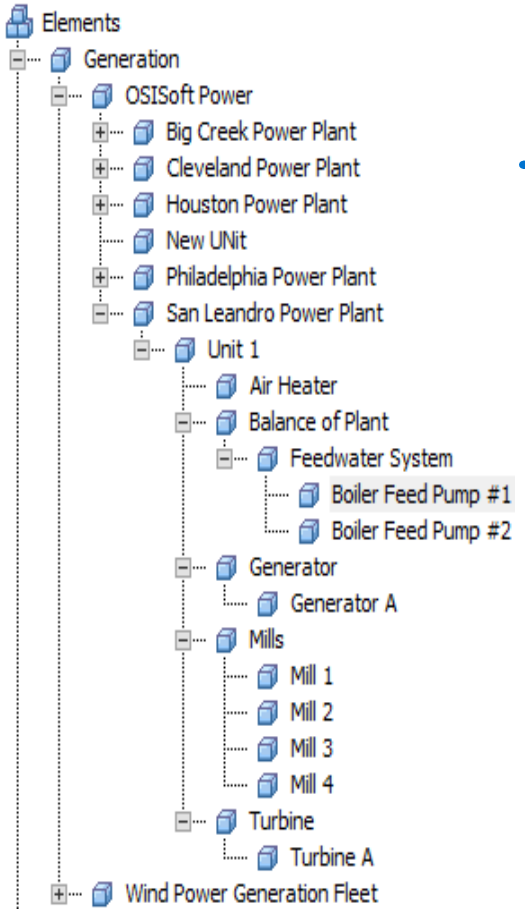
Category: Location	
Address	2265 W Salinas St, San ...
Latitude	29.43027
Longitude	-98.518172

Limits, Design Curves and Specifications

Category: Specifications	
Area	1200 ft2
Coefficient	75.66 BTU per F ft2 Hr
Service	Crude vs. Naphtha

Real-Time OT Data and Abstraction Layer

Structured data in AF

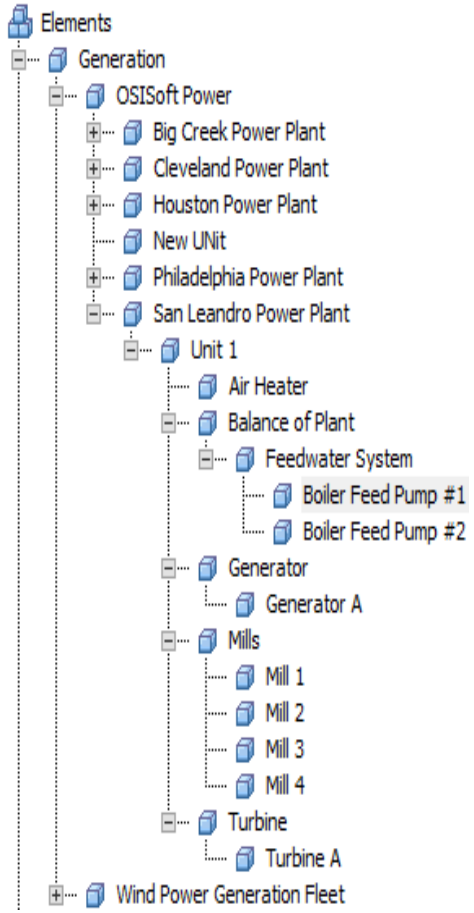


Transform to information - Streaming AF Analytics & Event Frames

- Start & Stop counts / time in service or operating hours
- Rate of change or deviations (ie differential pressure)
- Actual vs design
- Event Frame Analysis (ie number of high vibration anomalies, total time…)
- Efficiency (%)
- Cycles per period
- Notifications on high / low thresholds of raw data or real-time streaming calculated results

Real-Time OT Data and Abstraction Layer

Structured data & Transformed Results



- Condition Score
- Start & Stop counts / runtime
- Rate of change or deviations
- Actual vs design
- Event Frames
- Efficiency (%)
- Cycles per period
- Notifications

Applications and Big Data Analytics

- APR Advanced Pattern Recognition
- Machine learning algorithms
- Analytic hooks into R, MATLAB, PYTHON
- Big data analytics platform & tools
  - Microsoft BI
  - SAP HANA
  - Tableau
  - TIBCO Spotfire

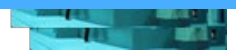
Smart Asset Objects – Configuring the Smart OT Infrastructure

Gas Turbir

HRSG Te

Generato

Smart Application Template



Generators

Smart Applications

Physical Power Gen Plant #2

Digital Power Gen Plant #2

PG Smart OT Infrastructure

It is time to get information Greedy!

A greatly enhanced digital copy with high business value

- Future data for forecasting
- Production schedule and measure deviations
- Incorporate Financial data, Co$t of consumables, P&L calcs
- Real-time Contract and Regulatory Compliance KPIs
- Measure current performance vs best possible
- Streaming Analytics to transform data to information
- Event Framing for Starts / Stops, Runtime counters, Process Analysis
- Hooks into Python, R, and Matlab
- Supporting and supplying data for Level 2 Analytics APR, ML and AI

TransCanada Anomaly Detection & Predictive Analytics

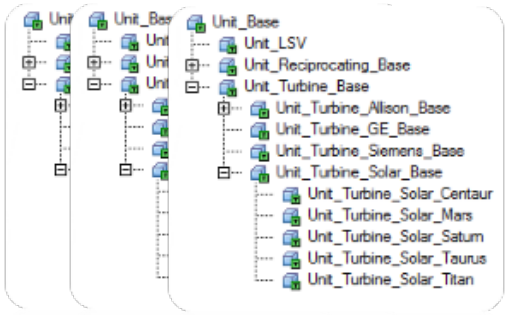
Centrifugal Compressor Templates

Health Index Templates

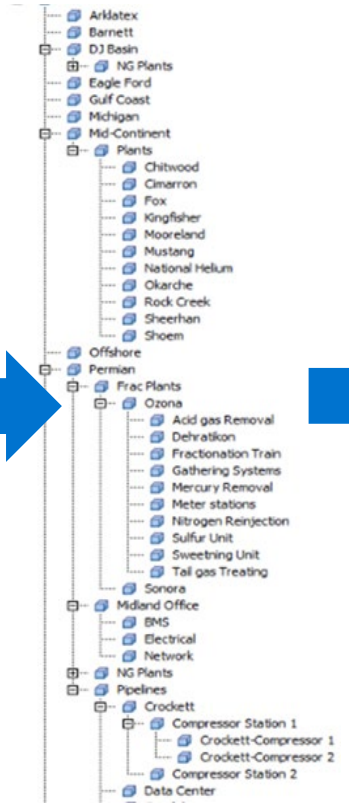
Anomaly Detection Templates

TransCanada
In business to deliver

Physical Compressor Stations

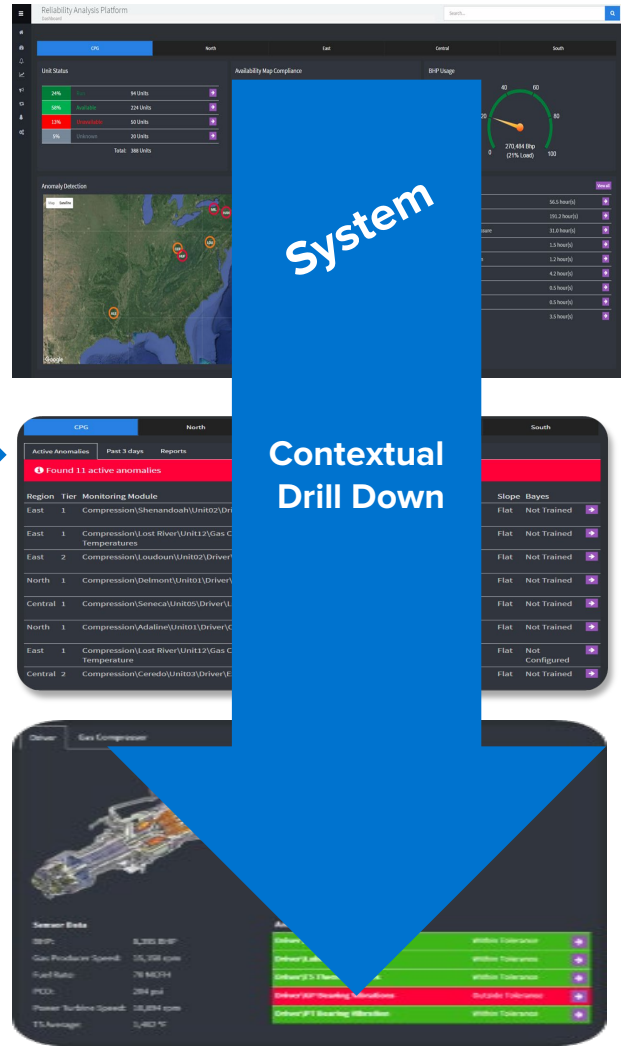


Digital Compressor Stations

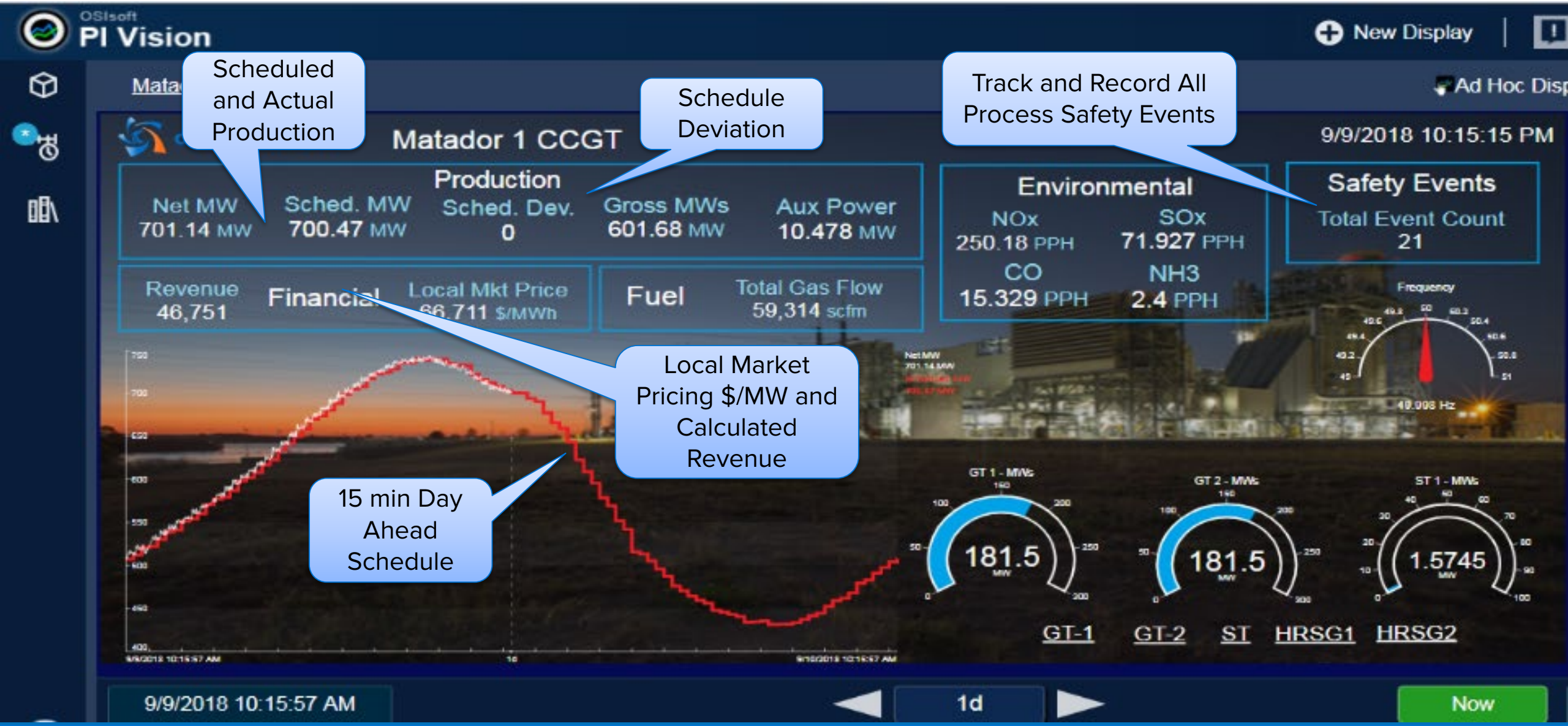


TransCanada Smart OT Infrastructure

Exception based KPI Dashboard system



Market Data and Forecasted Schedule

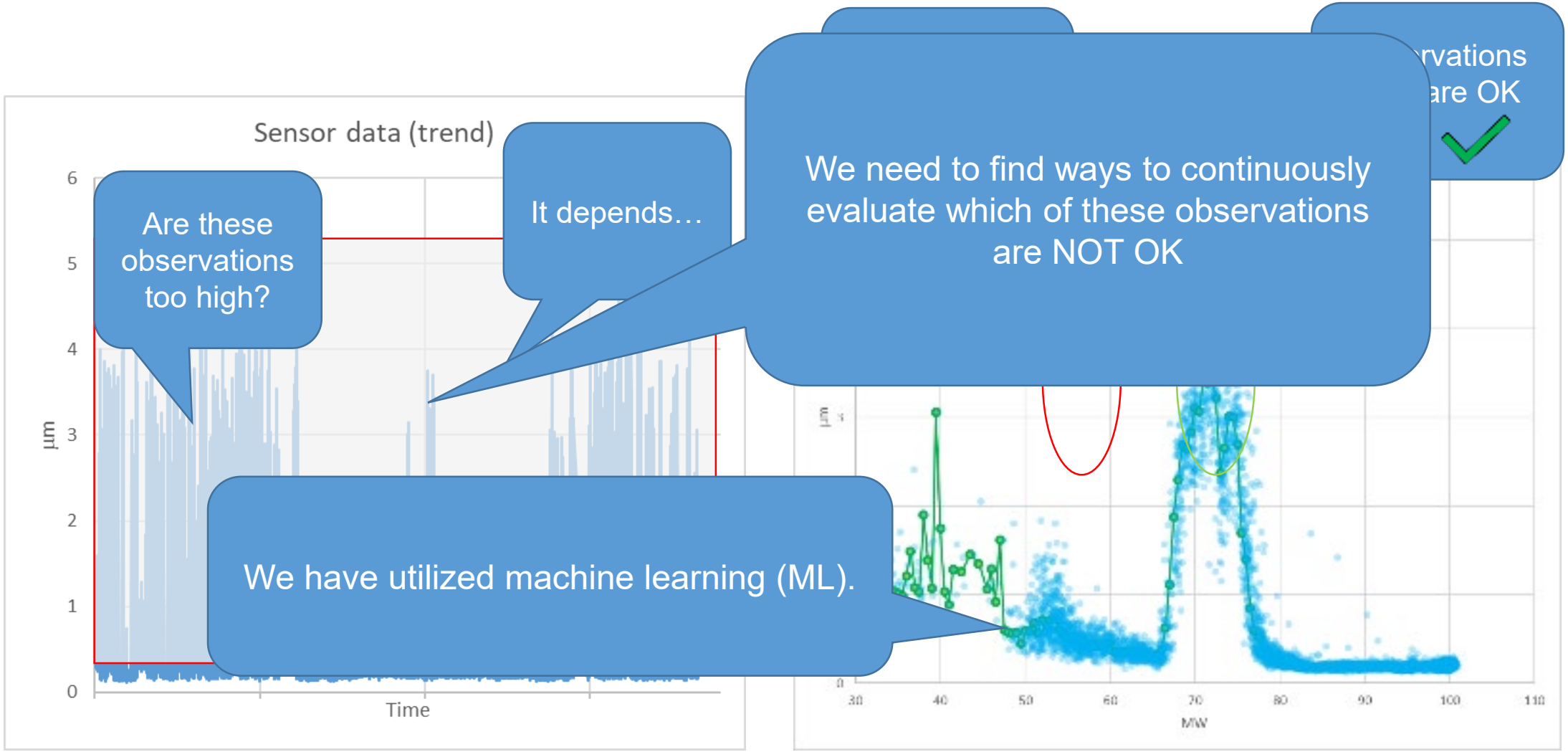


Utilizing the Flexibility in PI System to Incorporate ML and AI in CBM

Jørgen T. Foss, Ole Kristian Grindbakken
and Joakim Gundersen

Eidsiva

How to evaluate observations

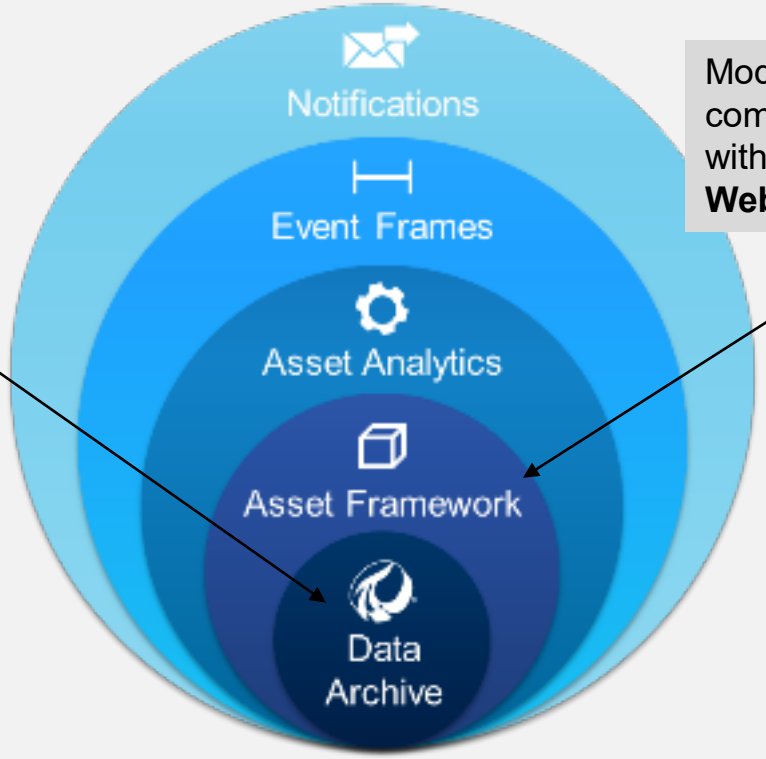


Implementation – Machine learning

Existing sensor infrastructure

- Sensors
- SCADA system

PI System



Model communicating with AF using **PI Web API**

Machine Learning

Excel/vba, Python

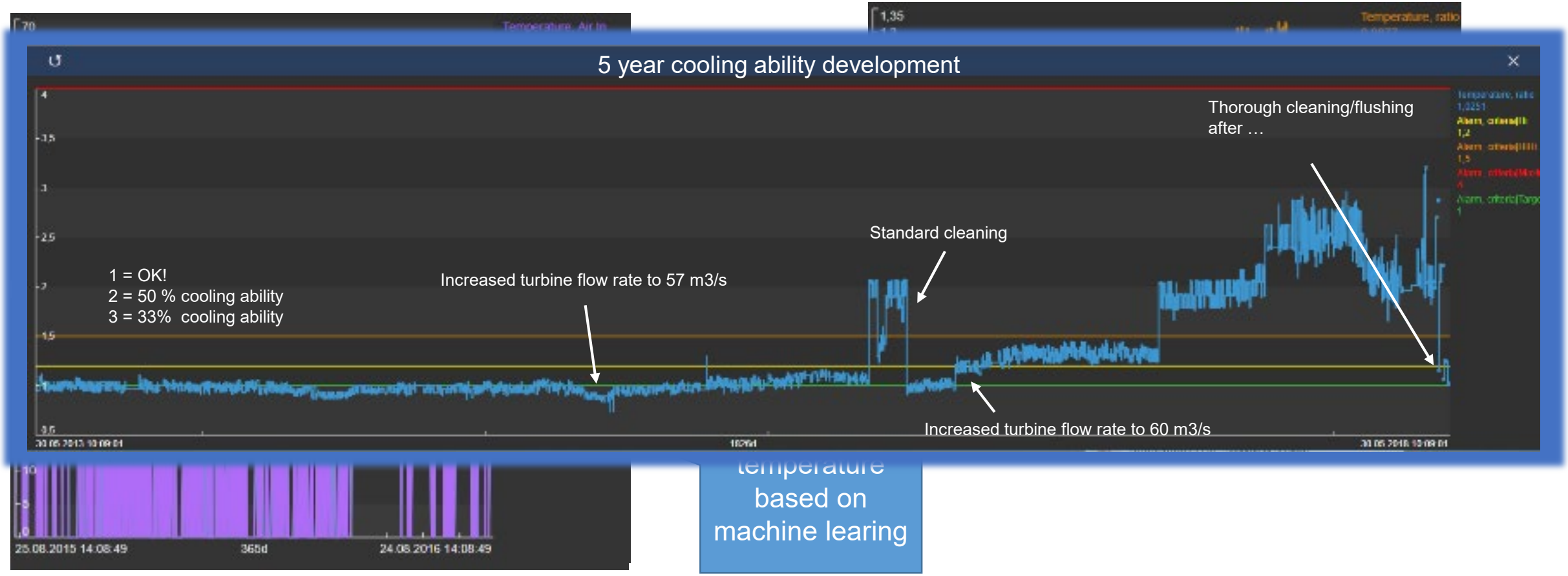
- Searching AF structure
- Retrieving normal period
- Retreiveing data for normal peirod

Model parameters

Historical data

Machine learning (Excel/vba, Python)

Example of ML – Stator Cooler



temperature based on machine learing

BRINGING IT ALL TOGETHER:
REAL TIME CAPACITY MONITORING

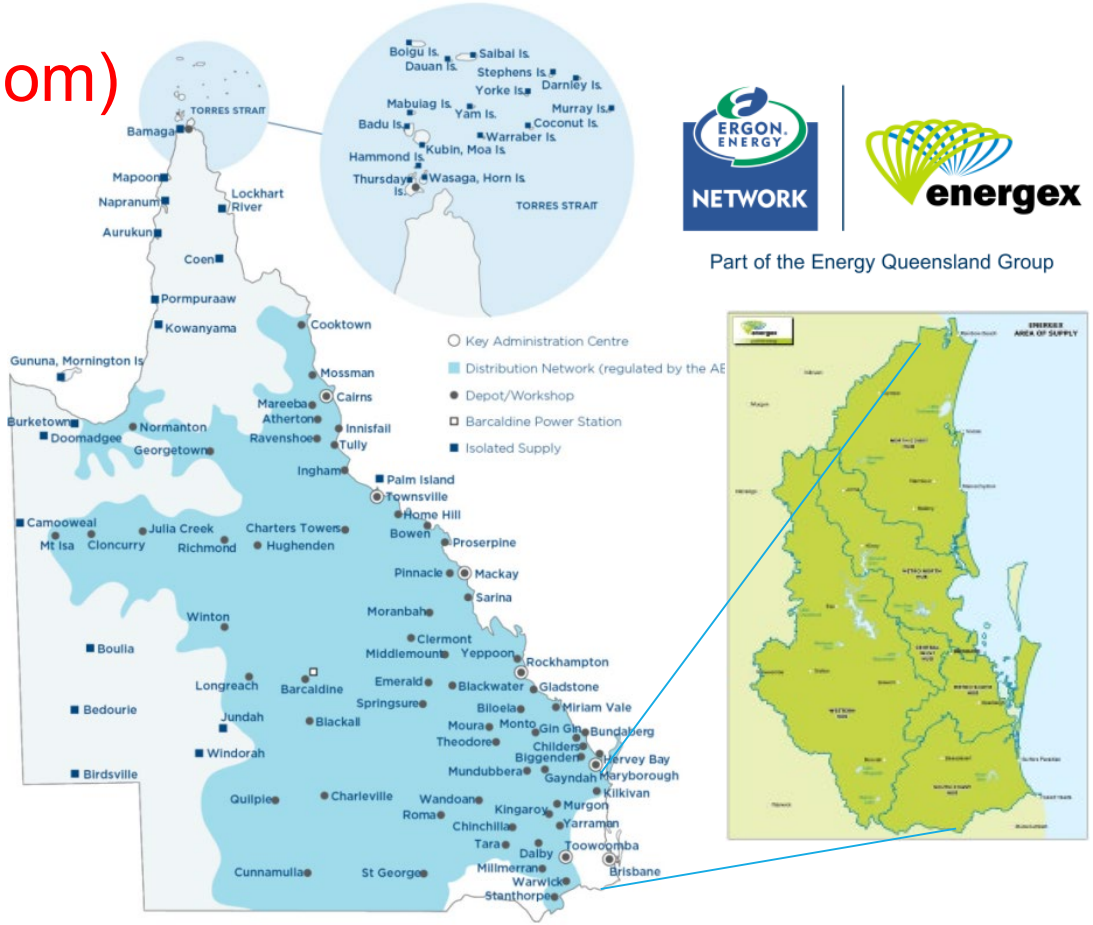
Timothy Lewsey CPEng RPEQ (ITEE)

12TH September 2018

Introduction to Energy Queensland

Merger of **Ergon Energy** and **Energex** distribution networks

- **1.7** million square km (7x United Kingdom)
- **$24** billion in electricity assets
- **33** remote power stations
- **500+** zone substations
- **3000+** distribution feeders
  - **27,000+** km underground
  - **192,000+** km overhead

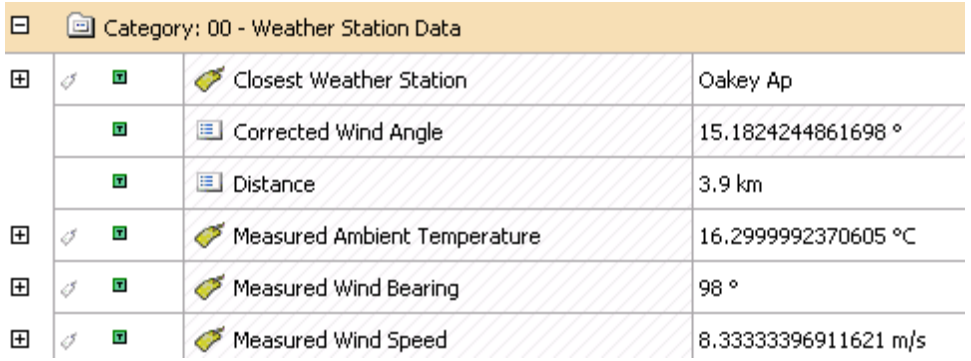


Weather Data

REST API

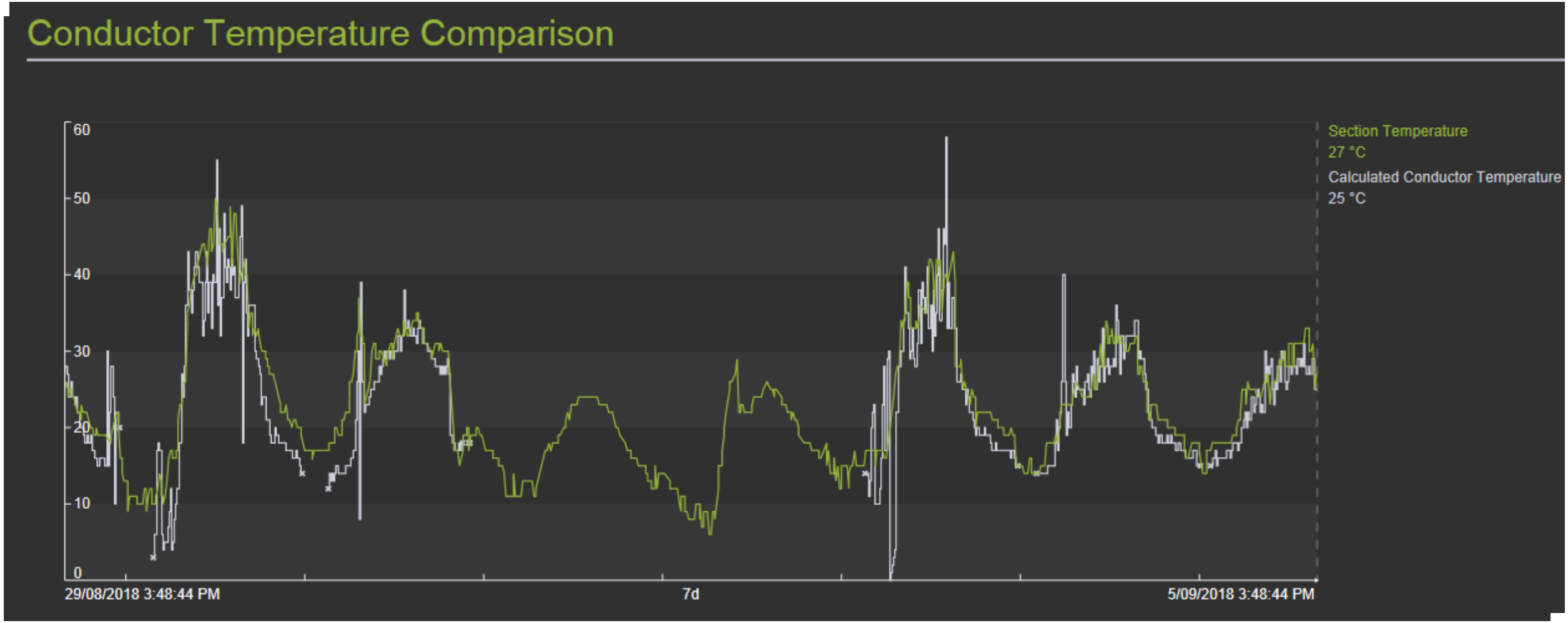
Co-ordinates

Conditions



PI Asset Framework

Bringing it all together: PI Vision



Real Time Capacity Monitoring: Summary

Changing electrical distribution landscape.

Downward pressure on operating costs.

Need to improve asset utilisation.

This project has demonstrated potential asset utilisation improvements of **20+%**

Business Results: Information is an agent for change

Availability and Reliability	Fleet Management	Resource Optimization	Process Improvement	Digital Transformation
				
Reduce unplanned losses across a mixed technology portfolio. ***$18.7M of avoided losses in 3 years***	Plant data available to all personnel ***Over USD 10M savings from analysis & optimization***	Average increase in energy generation: ***30% with peaks above 60%***	Startups are more consistent. ***With accuracy improved by roughly 95%***	Performance / efficiency improvements Fuel savings Maintenance optimization Dispatch management

We believe **People** with **Data** can **Transform** their world

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