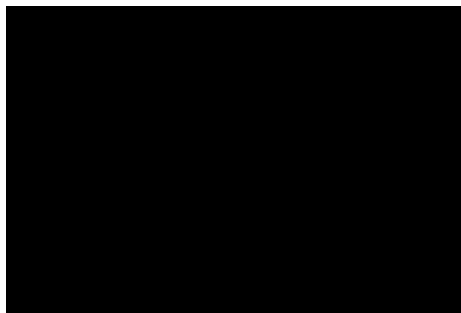
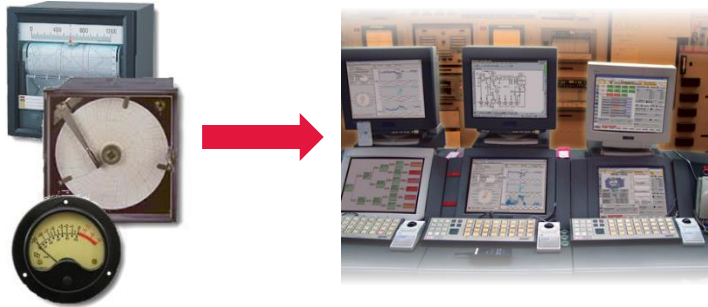


CW Plant Performance Digitalization 2018 and Beyond



Digitalization or Digitization?

1980's



Digitization -
Creating a digital
(bits and bytes)
version of
analog/physical
things such as paper
documents,
microfilm images,
photographs, sounds
and more

Digitalization -
Enabling, improving
and transforming
business operations
and business
functions and
business processes
or activities, by
leveraging digital
technologies and
digitized data to
create actionable
knowledge

2018



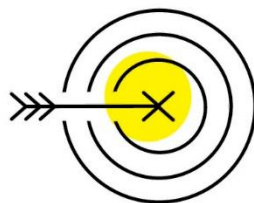
Definitions paraphrased from: <https://www.i-scoop.eu/digitization-digitalization-digital-transformation-disruption/>

The “Buzz” about Digitalization



Strategic Technologies

Top 10 Strategic Technology Trends for 2018



Intelligent



AI Foundations



Intelligent Apps and Analytics



Intelligent Things



Digital



Digital Twins



Cloud to the Edge



Conversational Platform



Immersive Experience



Mesh



Blockchain



Event-Driven



Continuous Adaptive Risk and Trust

gartner.com/SmarterWithGartner

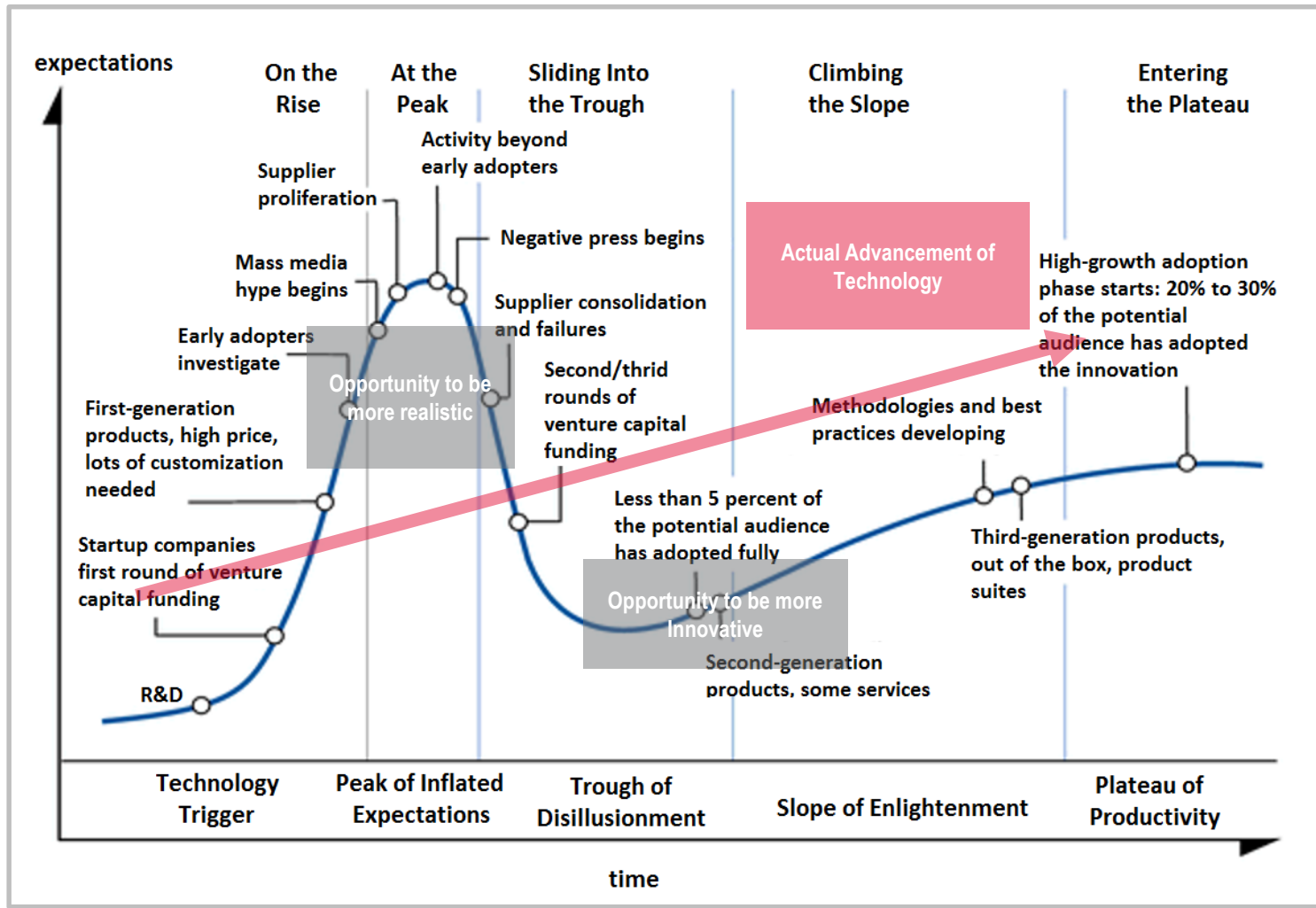
Source: Gartner
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Gartner

For Power Industry, Add Wireless



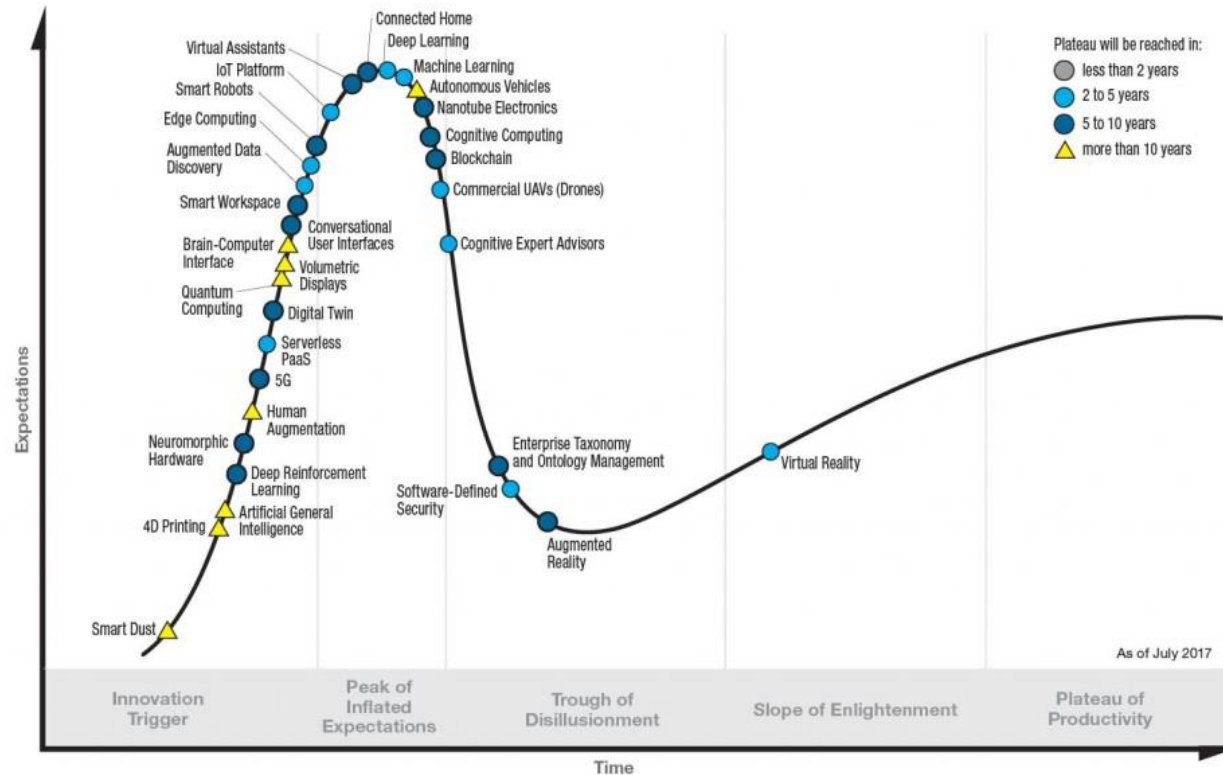
The Gartner Hype Cycle



Source: Chief Marketing Technologists Blog Scott Brinker 2018

The Gartner Hype Cycle for Emerging Technologies, 2017

Gartner Hype Cycle for Emerging Technologies, 2017



gartner.com/SmarterWithGartner

Source: Gartner (July 2017)
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Gartner

Digital Twins – Just Not Yet

- Industry has been selling the concept of “Digital Twins”
- The desired end state product will tell users when a component is likely to fail (Prognostics) and ultimately suggest what should be done (Prescriptive Analytics). In concert, performance monitoring will accurately capture the cost of degraded performance.
- The concept is well received, but what is really available today has been oversold
- Improvements in computing power and the availability of sophisticated open source Machine Learning libraries make the end state more achievable
- Solutions require reliable sensors, performance monitoring, visualization and predictive tools
- Translating information generated by the new sensors and algorithms into actionable knowledge requires subject matter expertise and case histories to validate conclusions



CW Digitalization Philosophy

Leveraging digital technologies and digitized data to create actionable knowledge - innovative, but not at the “bleeding edge”

- Collecting and sharing data much more cost effectively than ever before
 - Interconnectivity – Cloud, Web Services
 - Interoperability – plug-in / navigation to function seamlessly with other applications
 - Wireless – add more critical sensors
- Interpreting this data strategically to turn the data into actionable information.
 - FAMOS Applications (PEPSE, PMAX, PdP, Rules Engine, Tracker)
 - New Functionality (Cycle Isolation, Real Time PEPSE)
 - Leverage other CW solutions like FOMIS and RAPID
- Presenting this actionable information to the right person, either plant personnel or remote expert, and at the right time
 - Mobile Application
 - Accelerated data exchange for charts and reports to speed up reviews
- Delivering performance improvements when personnel take corrective action.



More Data
+
More Efficient Processing
+
Enhanced Applications
+
Web & Web Services
+
Mobile

CW Digitalization

More Data - Wireless

- **Lower Cost Installation (no wires, conduit, cable pans)**
- **Real-time monitoring of systems that were previously intermittently monitored**
 - Operator Rounds
 - System Engineering Walkdowns
 - Localized recorder data
- **Add critical sensors and sensor types that were too expensive to install with the original build**
- **Enhance real time data analytics by providing important inputs previously unavailable**
- **Avoid pitfalls of earlier entrants – battery life, signal interference**

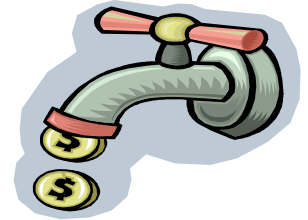


More Efficient Processing - R*TIME V15 Backbone

- Support for 64 Bit Applications – speed be able to use existing data and added wireless data effectively
- Updated Archive Structure – ability to store data more efficiently with quick recall for end users
- Web Viewer Integration (Web Services, Cloud-Friendly)
- Mobile Application

Enhanced Applications: Cycle Isolation Monitoring

- Available in FAMOS Version 22
- Using real-time and manual input data, the FAMOS cycle isolation module provides an estimated leakage flow, MW, heat rate and cost
 - Helps with finding unaccounted losses
 - Prioritizes valves needing repair
 - Valve repair/replacement justification
- Results are based on 6 independent calculation methods
- Valve leakage results can be alarmed, sent via notifications (email) & automated reports, archived & trended

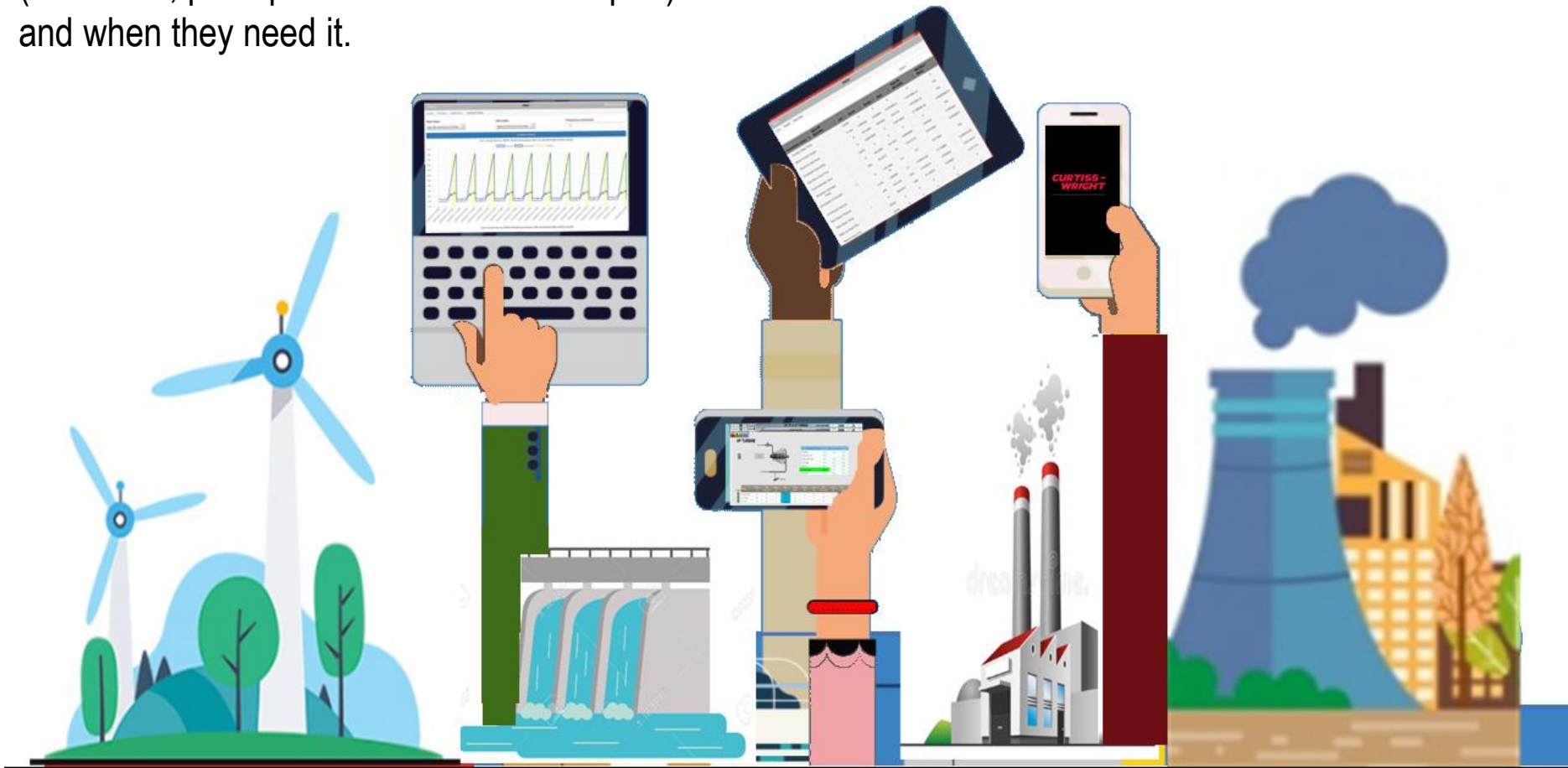


Enhanced Applications: PEPSE R/T

- On-line thermal performance monitoring
- 1 calculation engine (currently PMAX and PEPSE each have a model)
- Drag and Drop model development
- Use customers existing PEPSE models
- Features:
 - Central database – With smart point variable naming (alias names)
 - PEPSE: use for data validation of incoming signals, generating dynamic targets, and “What-ifs?” besides the real-time PEPSE operation
 - Alarms & alerts & notification tools, web based displays
- Initial release is planned for end of 2018 for fossil plant applications, future releases for nuclear and combined cycle plants

FAMOS Mobile 1.0

Presenting actionable information to the right person (executive, plant personnel or remote expert) where and when they need it.



WI-FI connected, view only at first... offline with data entry in future

Moving Forward ... PEPSE R/T 2019 and Beyond

- **Front End Interface:** Mapping of plant signals into PEPSE including data validation, smoothing of input data, engineering units conversion, DCS communication, PEPSE variables to database tag name convention (smart naming (alias names))
- **Software Enhancements:** Implement calculations to support key performance indicators, add error trapping & recovery & messaging
- **Calculation Module Additions:** Controllable Losses & MW Accounting, boiler sootblowing calculations, cycle isolation, fuel blending, CCGT, other modules
- **User Interface and Tools:** Interface menus, smart alarms, utility tools & menus, security features, etc.

Moving ForwardAsset Performance Management

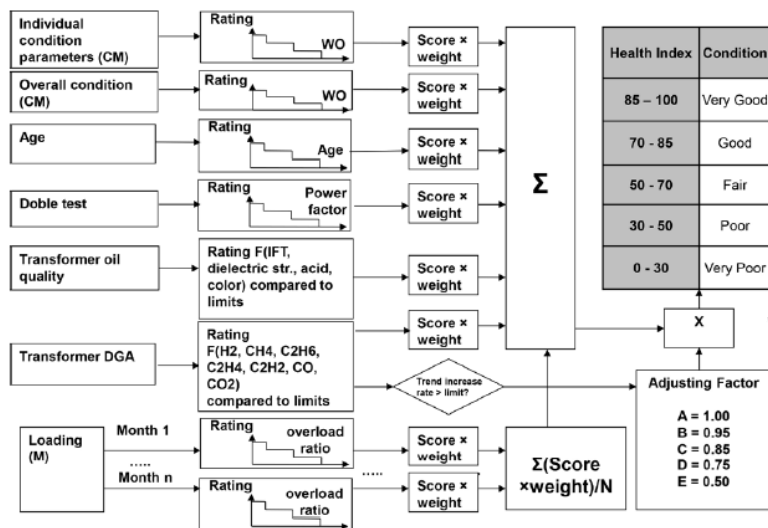


Figure 4-7 | Example of a health index (ComEd 2015, from IEC MSB workshop)

➤ Base maintenance decisions on evaluated current asset health (Condition Based Maintenance)

- Estimate trajectory towards failure under current and modified operating regimes
- Plan and prioritize repair strategy based on expected value of cost benefits

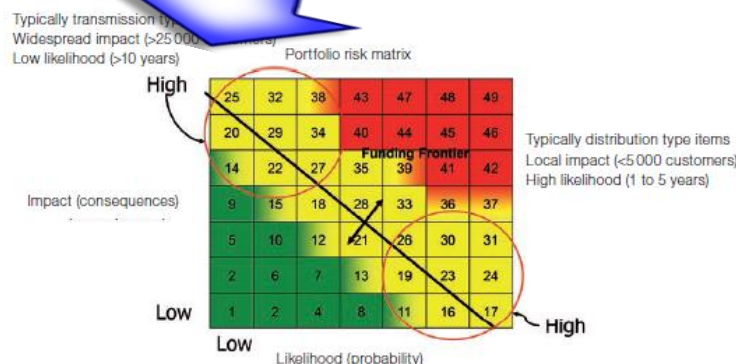


Figure 4-1 | Example of a risk matrix (ComEd 2015, from IEC MSB workshop)

➤ Reduce PMs

- Less potential for introducing faults as part of PM activity
- Save cost of unwarranted preventative effort

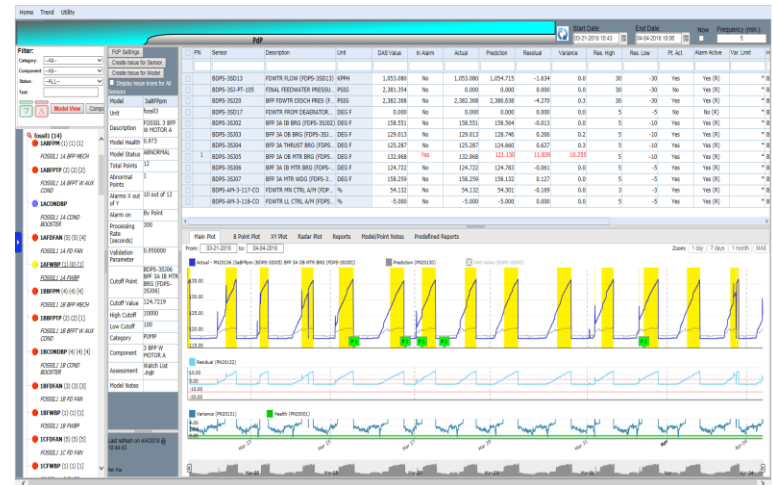
Source of Graphics: Strategic Asset Management of Power Networks, IEC Whitepaper 2015

Moving Forward ...Machine Learning and AI

Targeted Attributes

- Machine learning where appropriate
 - Unsupervised / Semi-supervised learning where data helps determine model construction
 - Reduced SME involvement
- Use Natural Language Processing (NLP) to incorporate operating log and maintenance info
- Neural/Fuzzy classifiers tie patterns of data to specific faults
- Cloud computing, data lakes, simple and quick to get data from multiple sources.
- Prognostic and Prescriptive – Manage Risk
- Fast and Flexible Visualization

A critical element to improving current and future technologies is access to **Data and Subject Matter Expertise** to classify anomalous vs normal behavior



Moving Forward . . .

- Expand Wireless Sensor Variety
- Prognostics and Condition Based Maintenance
- Data Reconciliation in FAMOS
- Targeted Solutions that provide real path towards prescriptive
 - Deeper Dive on specific assets to strengthen models and lead to prognostic, prescriptive
 - PdP/StressWave targeted solutions
- Work with clients and APM / CMMS vendors to build a flexible interface with their existing systems and an enhanced Tracker to provide a plug-in alternative to existing solutions

Digitalization Platform – Moving towards a “Digital Twin”

