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# Standing up a digital twin for CBM with AVEVA™ PI System™

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“We have designed an asset platform in the PI System but we can’t afford to maintain it at scale.”

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“In our plants, every asset is a little different.  
How can we expect to use templates?”

Frustrated Ops Tech Director

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# Add degrees of freedom to Asset modeling

Free your models by embracing element Families: Parents, Children, Siblings

1. Classify asset elements into types (Pri/Sec)
2. Decouple analytics into elements for re-use on asset elements
3. Deploy accessories to assets forming unique “families” that collectively vary widely but each adhere to their own TEMPLATE.
4. Embrace Parents (Assets) having “optional” Children (Accessories)
5. Understand relationships between asset and accessory classes.
6. Automate “in-family communication” and naming of children  
*Examples: Pumps need to talk to their motors, Tanks talk to their valves*
7. Deploy all assets in the PI System up front, matching Engr/Maint taxonomy

“We have machinery experts in our company and OEM suppliers. But we only hear from them when something fails. How can we use experts to prevent failures?”

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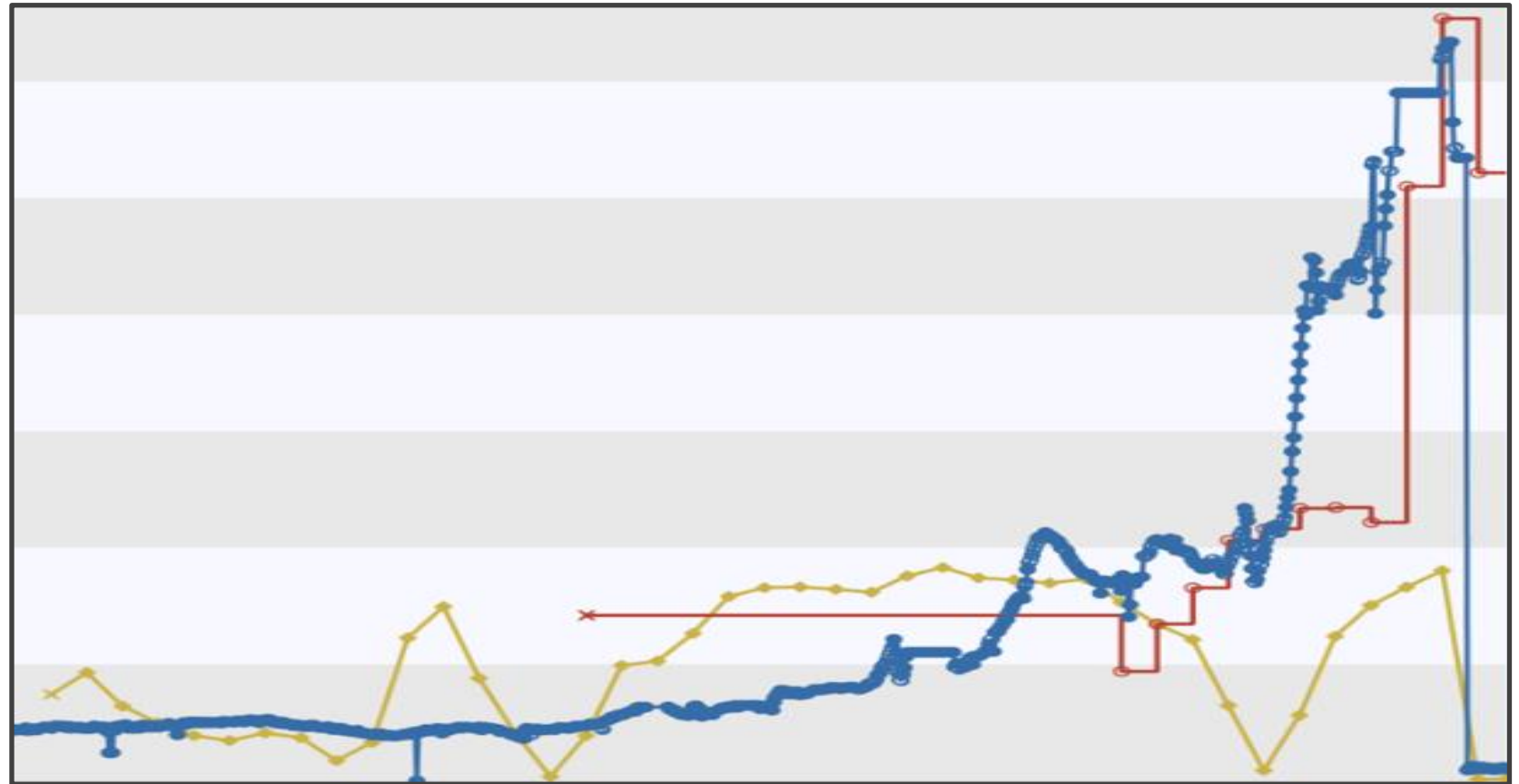
Results-Deprived Plant Manager

# Forecast to communicate better

Simple beyond complex communication with operations teams

“When will this asset FAIL”

Use **PI System**  
**Future Data** to see  
Forecast against  
Actual



14day Forecast (In Red)

“We are under pressure to make a positive contribution to the bottom line. How can we use AVEVA PI Asset Framework to drive new value? ”

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Process Engr Group Leader

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# Work by exception is a must at scale

Having Asset data is not enough, use the PI System to recognize patterns and inform you

1. Pattern recognition analytic in one template; re-use
2. Increase accuracy by backfilling across history
3. Combine streams into calcs that filter out false positives and amplify detection
4. Include rich lists of attributes in every anomaly
5. Use BI Tools for enterprise-wide anomaly sharing



“Our CEO visited our plant site. He asked, “Why is it that only the executive level sees the repeat failures around the world at our sites.””

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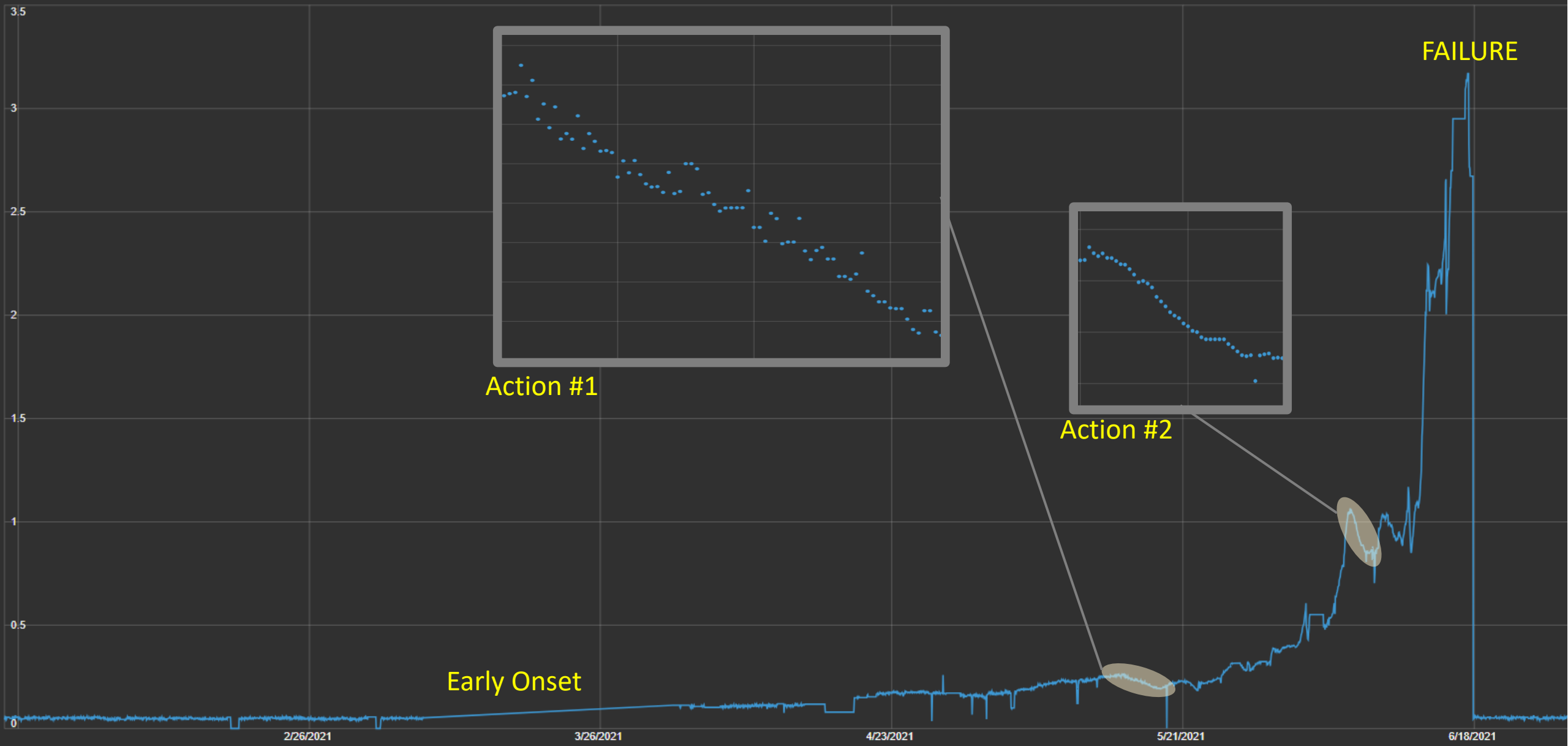
Slightly nervous Technology Dir

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# Elevate the connected worker

Transform a global enterprise to collaborate at the speed of a small organization

1. Elevate the PI System anomaly data for query across Enterprise
2. Empower connected worker as vital first responders
3. In the PI System data, see your employee contributions and reward accurately
4. Invest in rich notifications to equip first responders at the assets
5. Open communications between corporate expertise and connected worker
6. Include all assets in the PI System to empower connected workers with the newest of failure modes



Action #1

Action #2

Early Onset

FAILURE

Name	Description	Value	Units	Average	Minimum	Maximum	Bottom	Top
		0.055...		0.21522	0	3.1696	0	3.5

“We put some assets in PI AF but we seem to be missing some techniques that make the information easy to find. It just not very intuitive for our operations teams.”

Eager Process Engineer

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# Standardize and get ORGANIZED for Data Discovery

Expect to hyper scale your industrial ecosystem

1. Synchronize template libraries across Enterprise
2. Adopt the taxonomy standards of your sites
3. Keep the PI System centered around Operations and time series data, don't over-emphasize metadata, don't copy any data
4. Classify templates deeply to enhance queries
5. Model all assets in the PI System up front to see the issues all at once, fail early
6. Use a brief, sorted list of attribute categories on all templates
7. Extend asset models vertically into part levels w/ same approach
8. No mouse scrolling

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# Expand SECURITY MODEL to Enable More Contributors

Expand your PI contributors naturally within your company

1. Grow ***Analytics Author*** persona w/ ++ degrees of freedom.
2. Grow the ***Deployer*** persona from the larger pool of connected Ops employees to build tight-fitted families at scale. (an ecosystem)
3. Reach wide across all assets, “don’t rest on today’s priorities”
4. Exceed today’s data requirements to learn faster from your ecosystem
5. Keep electrical and mechanical assets together:  
Share accessories, mingle data to find more root causes of failure

“We use the PI System to detect equipment anomalies, but we don’t see operations teams benefitting. How can we communicate around the clock the best course of action?”

Tired Reliability Engineer

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# Instruct first responders with language, action

Having asset anomalies is not enough – must close the deal in the field

1. Embrace Notifications as extremely valuable property
2. Call for action 24/7 in ops from data patterns
3. Gather SME expertise in the notification in detail
4. Explain the data patterns in written language for first responders
  1. Include **possible causes** that teach all responders
  2. Suggest relevant **corrective actions** to resolve issues quickly.
5. Include related links and relevant guidance in any form in the notification.
6. Capture field evidence immediately in the PI System, it evaporates quickly.
7. Build everyday a proactive culture with Notifications



“How can PI Vision help us have success in CBM.”

Tired Reliability Engineer

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# PI Vision exposes the diversity across Digital Twin families

PI Vision is built for work-by-exception culture of CBM and diverse PIDT families

Visualization musts...

1. Discover and display diverse families of elements
2. Bring anomalies to the Operations foreground
3. Record Ops findings from each anomaly in time context
4. Link users to/from the surrounding “industrial ecosystem” in asset context and anomaly context.

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# Condition Based Maintenance (CBM)

“If it ain’t broke, don’t fix it.”

A wise person

# Condition Based Maintenance – Trading Risks

Tread carefully, CBM can be complex, with hidden risks

## PROACTIVE CARE

- 😊 SAFER Operations
- 😞 More sensors
- 😊 Less damage
- 😞 More Repairs
- 😊 Planned downtime
- 😞 Risk of repair failure
- 😞 Risk of infant mortality

## REACTIVE CARE

- 😊 Fewer sensors
- 😞 Higher Injury rate
- 😞 Reduced quality
- 😞 Uneasy Operations
- 😞 Spare Assets req'd
- 😊 Long asset life
- 😞 Extended downtime

## DESIGN FOR FAILURE

- 😊 Fewer sensors
- 😊 Known failure mode
- 😊 Long asset life
- 😞 Spare Assets req'd
- 😞 Unplanned outage
- 😞 Higher Injury rate
- 😞 Reduced quality

“We can add more sensors for CBM. There are some cool new products and networks we could use.”

OT Data Systems Director

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# Sensors not the end-all (not yet anyway...)

Not all Failure Modes can be detected with instrumentation (sensors)

- Adding the right sensors in the right place is always helpful
- Some failure modes don't present an opportunity to be measured
- You can install sensors that don't help and even distract users

There are preferred paths to close this gap...

- Handheld sensors
- Local sensors
- Temporary sensors, Battery powered, IIoT Wireless

# Combines Measured with Unmeasured

Use AVEVA PI System to combine measured conditions with loose unmeasured info in every anomaly record

## MEASURED DATA

Surface Temperature

Liquid Density

Vibration

Pressure

Assay

Mass

SCADA Alarms & Events

## UNMEASURED INFO

Lab Procedures

Manual start/stop sequencing

Repair procedures

Equipment fab procedures

Leaks

Material defects

Contamination



“The answers to CBM success are hiding in your Operations history. Use your past anomalies to solve today’s anomalies and you’ll find new success.”

The Visionary

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# Summary

A comprehensive Digital Twin is vital for CBM success

1. Add degrees of freedom to PIAF Elements
2. Decouple analyses from assets and deploy diverse “families”
3. Forecast failure to reach all users.
4. Standardize all sites, Cast wide nets, Failures are few
5. Add Deployment User persona
6. Add more Author persona
7. Expect a diverse “industrial ecosystem” to develop
8. Ignore Industry boundaries, work to asset class context
9. Sensor data is only “half” of a CBM case.
10. Historical anomalies and observations are critical data for CBM.

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# AVEVA Digital Twin for the PI System

AVEVA Digital Twin Standards from AVEVA Global PI System Practice

1. Use **AVEVA Digital Twin for the PI System** to leap ahead to sustainable full-scale visibility assets across your PI System installations.
2. Accelerate AVEVA PI System into your “**industrial ecosystem.**”
3. Stay aligned to the latest industry-neutral standards and template libraries from AVEVA Global PI System Practice now and in the future



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# Questions?

Please wait for the microphone.  
State your name and company.



# Please remember to...

Navigate to this session in the mobile app to complete the survey.



# Thank you!

The software architecture and design principles included in this presentation are illustrated using AVEVA conventional on-Premise PI SERVER 2023 and PIVision 2023 products. The same approach applies independent of hardware platform. The techniques used here and the dependencies are the same whether cloud-hosted, on-Premise or some hybrid mix of both.

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