
# The Power of Data Visualization for Safer & More Reliable Operations

*Enhancing Decision-Making Through Integrated Data Analysis*

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**Mark Susich**
*MI Group Lead*

Mr. Susich has over 30 years of integrity engineering experience. He is recognized as a thought leader and fixed equipment asset integrity subject matter expert for the Upstream oil and gas industry. He has led teams in the development and implementation of pipeline, fixed and equipment, and subsea structural integrity programs.

Mr. Susich has experienced and facilitated the development and deployment of integrity practices, procedures, and guides to support integrity/inspection programs. He is knowledgeable in the current commercially available off-the-shelf IDMS offerings to support pre-operations integrity management builds (greenfield), as well as brownfield operations.

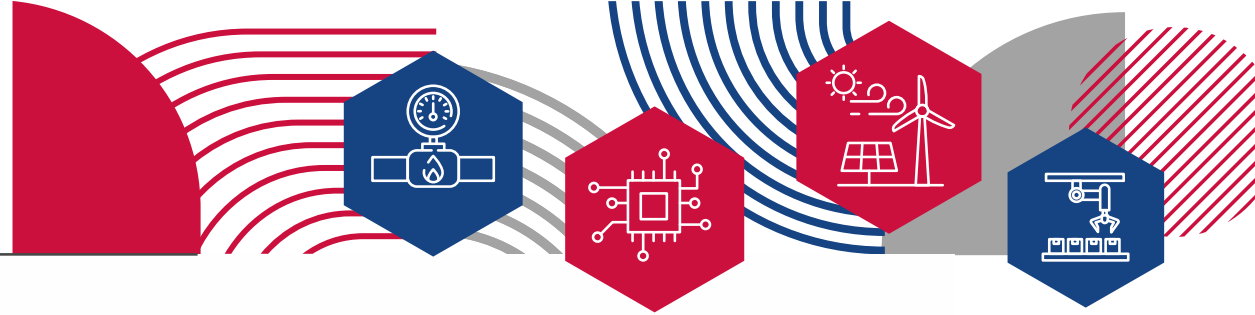
Mr. Susich has been involved in shaping regional and global integrity master service agreement contracting strategies and commercial tenders. His expertise encompasses various critical aspects, including defining technical requirements, leading technical evaluations, and providing valuable support to the supply chain organization in commercial assessments.

Mr. White is a Senior Associate Consultant with AcuTech, with over a decade of expertise in mechanical integrity and reliability program implementation and auditing across a wide array of industries, encompassing refining, petrochemicals, mining, and more. His core strengths lie in the development, execution, and auditing of comprehensive mechanical integrity programs, encompassing predictive, preventative, and corrective maintenance initiatives, with a primary focus on data collection and risk analysis.

**Jarrod White**
*Sr. MI Consultant*

Prior to his current role, Mr. White served as a corrosion engineer at Pinnacle Reliability, where he led Damage Mechanism Reviews (DMRs) and failure analysis based on API 571, spearheaded API 580/581 Risk Based Inspection (RBI) programs, semi-quantitative risk assessments, Integrity Operating Windows (IOWs), and Corrosion Control Documents (CCDs). Notably, he contributed to the advancement of state-of-the-art predictive data analytics software tools, engaging in cross-domain collaboration throughout the Software Development Life Cycle (SDLC) and crafting tailored KPIs for diverse user groups.

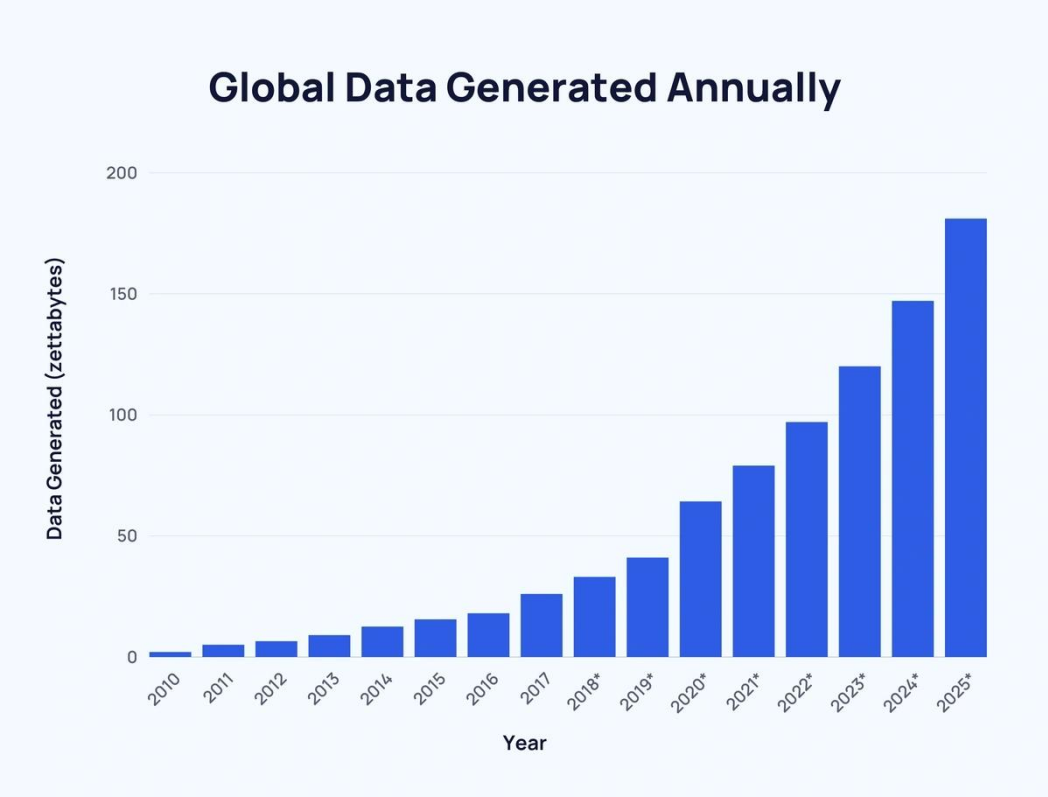
AcuTech
PROCESS RISK MANAGEMENT



# Agenda

- All the Data In the World – Turning Information into Insight
- Good vs. Bad Data – Understanding Quality
- Overcoming Challenges in Data Utilization
- Visualizing PHA Risks and Critical Safeguards
- Training AI for Mechanical Integrity Applications
- Analyzing ITPM Deferral Data
- Dashboards and Beyond – Advancing Data Visualization

# The Data Explosion & Its Impact on Asset Management




Source: *https://explodingtopics.com/blog/data-generated-per-day*

Data production is growing exponentially across industries

More sensors and monitoring devices enable real-time tracking at lower costs

**The Challenge: Making sense of vast data for actionable insights**

# What Makes Data Valuable

**Good data** is accurate, timely, relevant, and structured.

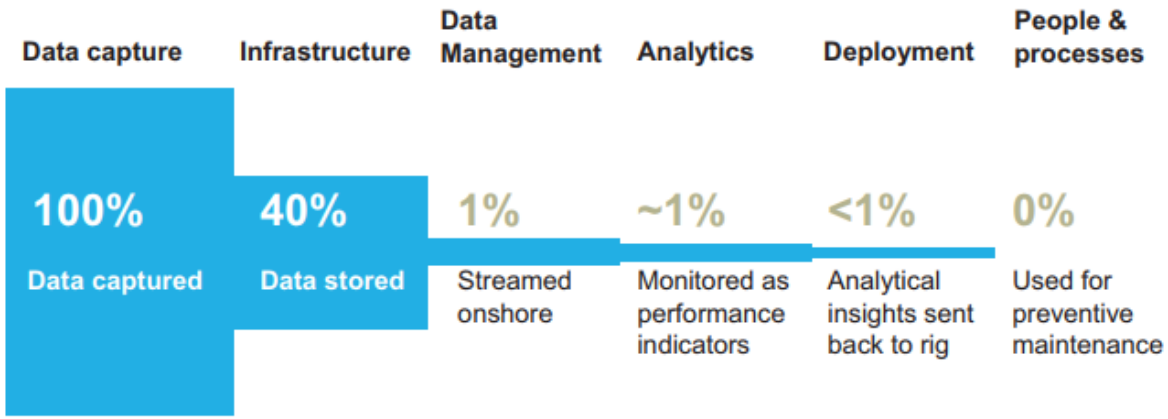
**Bad data** is incomplete, outdated, or misleading.

**Poor data** management leads to incorrect decisions, increasing operational risks.

Data integration & visualization are essential for extracting meaningful insights.

It is important to integrate both quantitative (numerical) and qualitative (contextual) data

Data collected and useable by many different groups is a bonus for controlling costs



# Current Challenges in Reliability Data Utilization

### Siloed Data and Limited Integration

Many facilities collect reliability data from multiple sources (sensors, inspections, maintenance logs), but these datasets often remain disconnected.

Lack of integration prevents holistic analysis, leading to missed correlations between failures and operational conditions.

### Lagging vs. Leading Indicators

Traditional reliability metrics focus on historical failures and reactive maintenance.

Without predictive analytics and real-time integration, organizations struggle to shift toward proactive risk mitigation.

### Lack of Spatial and Environmental Context

Existing reliability data lacks geospatial intelligence—failures are recorded as discrete events rather than part of a larger environmental or operational pattern.

Example: A recurring pump failure may be attributed to component wear, but spatial analysis might reveal that all failures occur in high-temperature zones or near vibration-heavy equipment.

### Over-Reliance on Standard Dashboards

Static dashboards often present data in simplified tables and charts without deeper contextual layers.

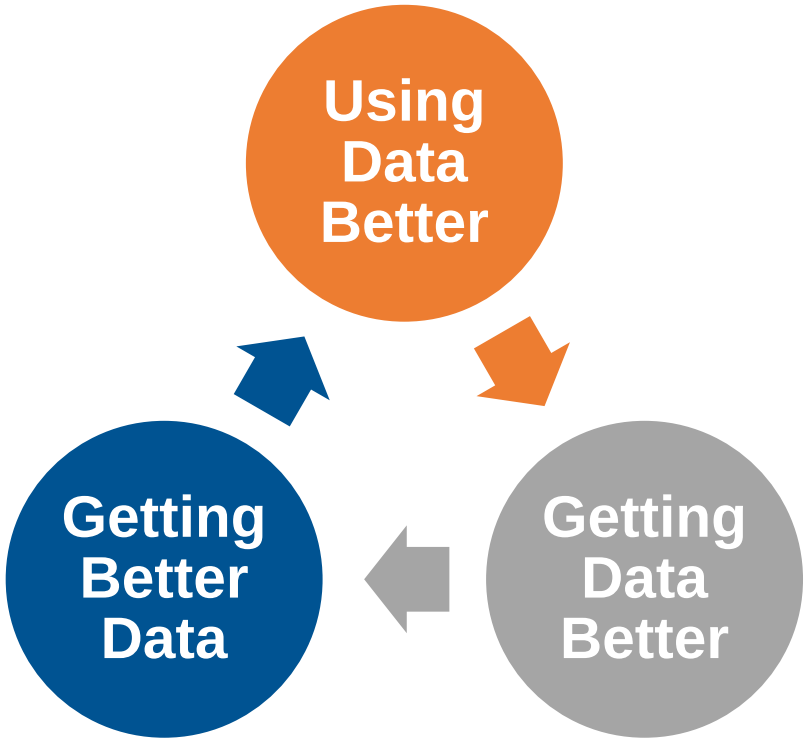
Key insights are lost without the ability to spatially map trends or simulate future failure scenarios.

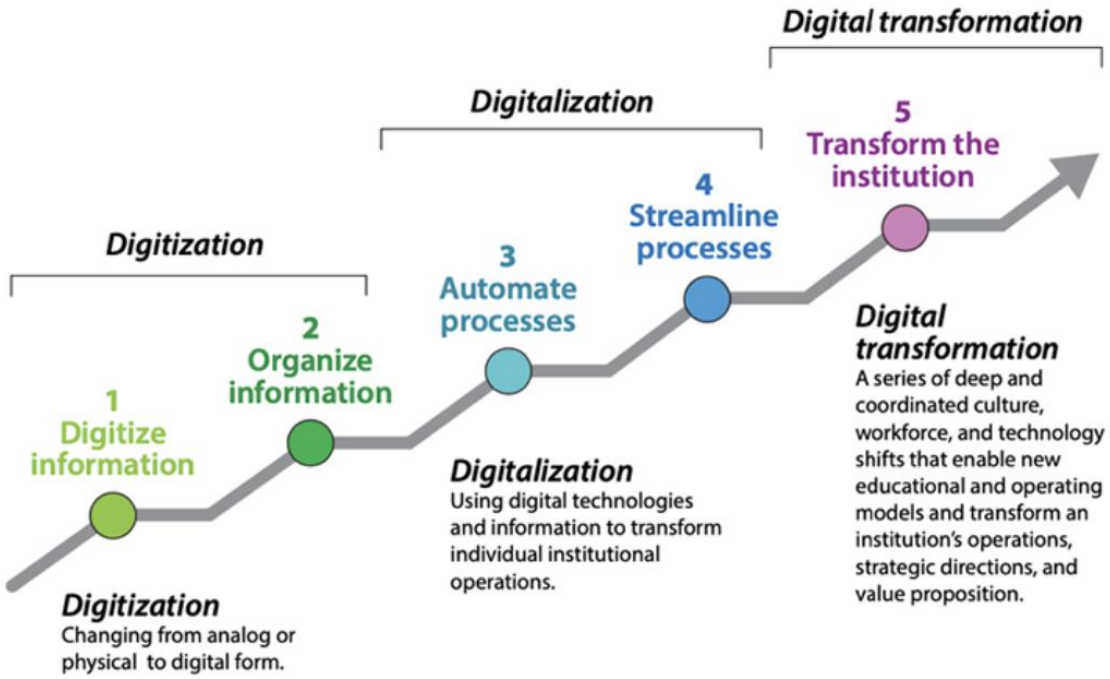
### Challenges in Risk Prioritization

Without a clear visualization of failure risk zones within a facility, prioritizing maintenance and capital investments becomes reactive rather than strategic.

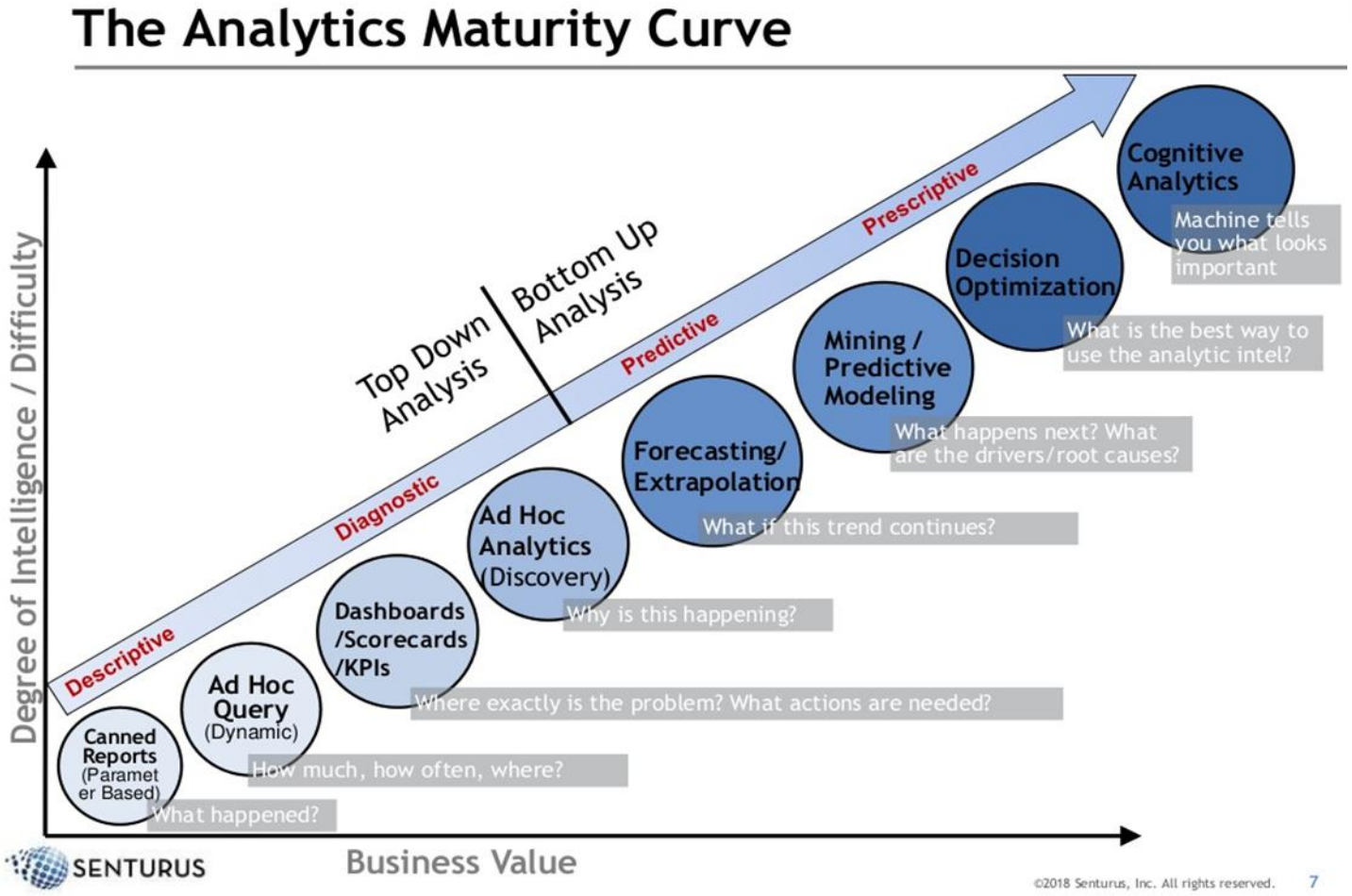
The inability to dynamically assess risk in relation to spatial and operational factors leads to inefficiencies.

# The Asset Integrity Management Data Cycle



# Moving from Descriptive to Prescriptive



# Leveraging Process Hazard Analysis (PHA) Data

PHAs identify hazards, consequences, and safeguards (OSHA 1910.119)

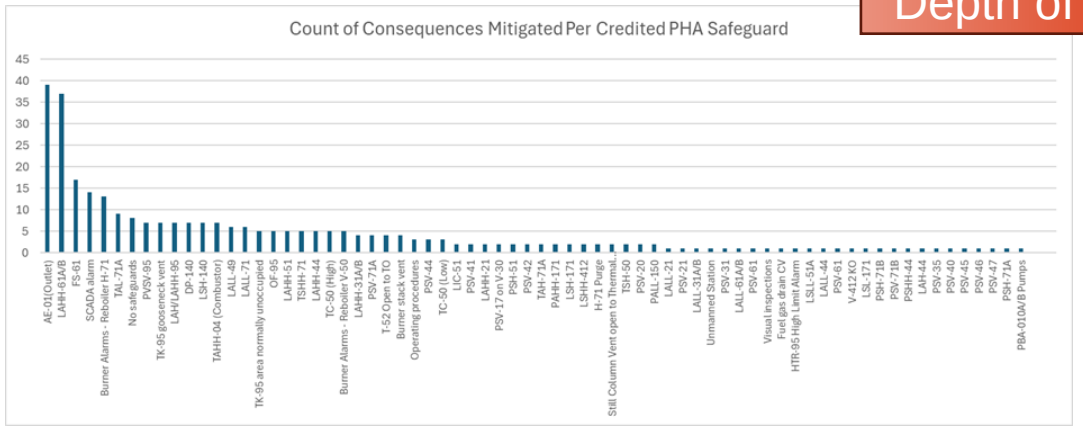
Data from PHAs can highlight critical assets that mitigate multiple failure scenarios

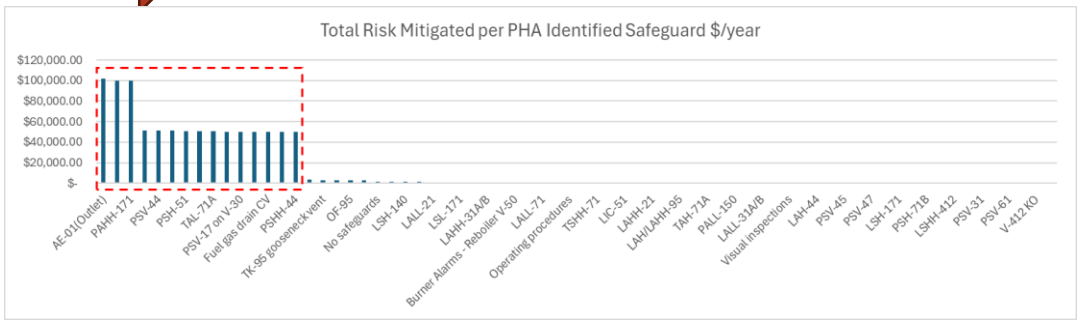
Risk-based analysis helps prioritize maintenance and upgrades

Investing in a high-quality PHA maximizes return by enabling cross-functional use across operations, maintenance, reliability, and safety groups

# Visualizing PHA Safeguard Criticality

Depth of analysis



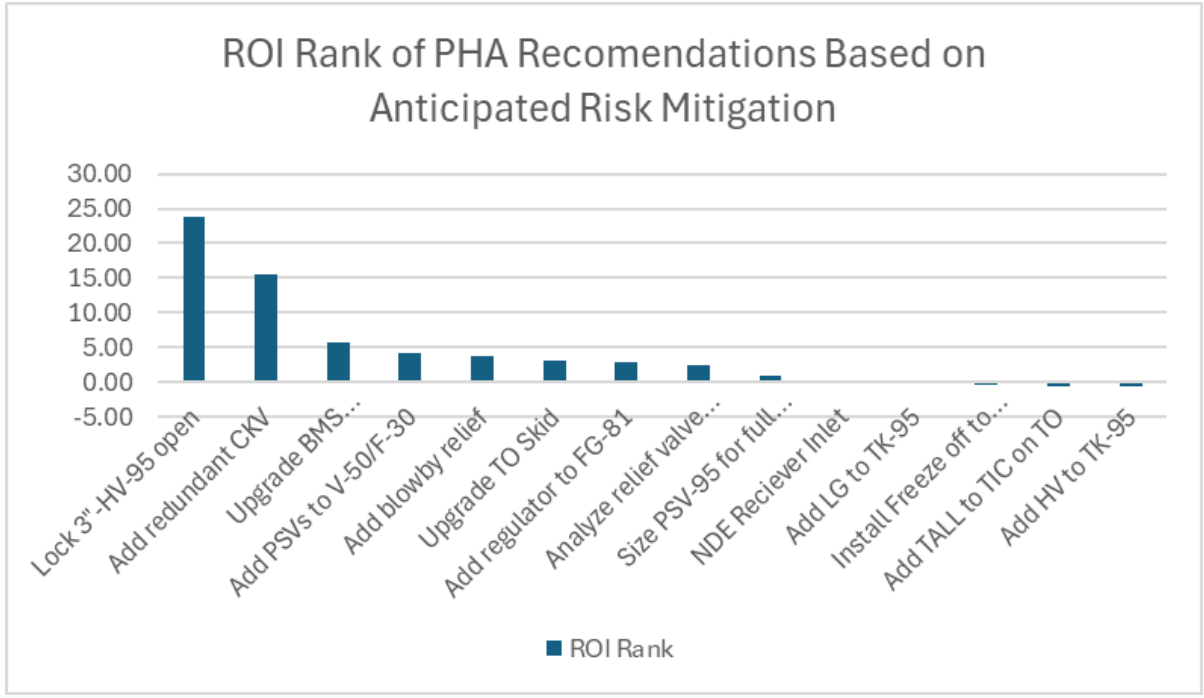




The number of times a safeguard is credited provides a quick and broad ranking of its criticality.

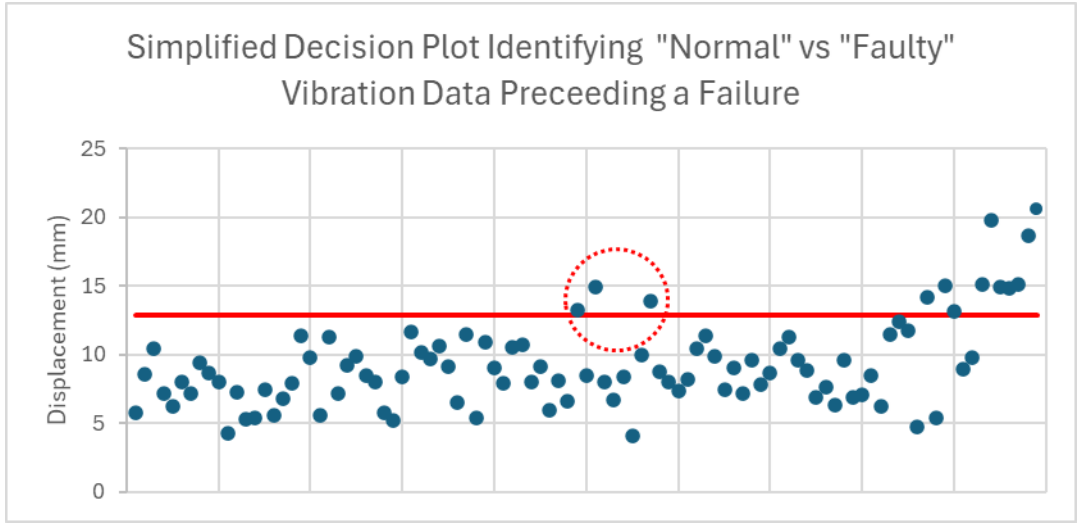
Aggregating the mitigated risk per safeguard refines criticality assessment using relative risk ranking.

# Visualizing Risk & Prioritizing Maintenance Activities

- Combining safeguard reliability with risk mitigation helps calculate **residual risk**.
- Investments in maintenance can be justified through **Return on Investment (ROI)** analysis.
- Applying Layers of Protection Analysis (LOPA) concepts
- Example: A safeguard mitigating $1M of risk annually with 96% reliability still leaves $40K of residual risk.



# Predictive Maintenance & Machine Learning



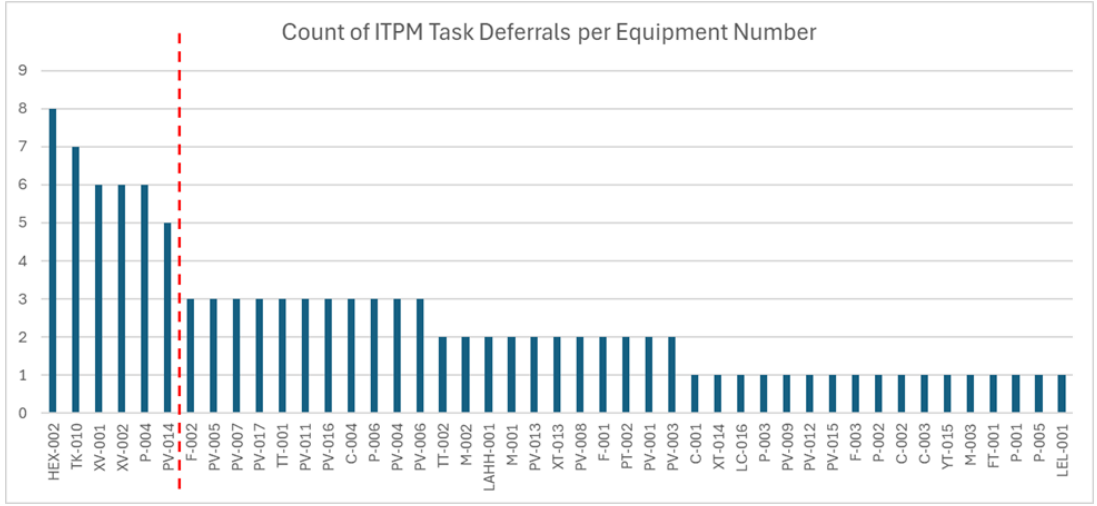

- Sensor data (vibration, temperature, pressure) enables anomaly detection.
- Machine learning models can predict failures before they occur.
- Real-time monitoring enhances proactive maintenance strategies.
- Anomalies often indicate damage occurring but may not be able to identify the exact cause.

# Tracking Deferrals & Their Impact

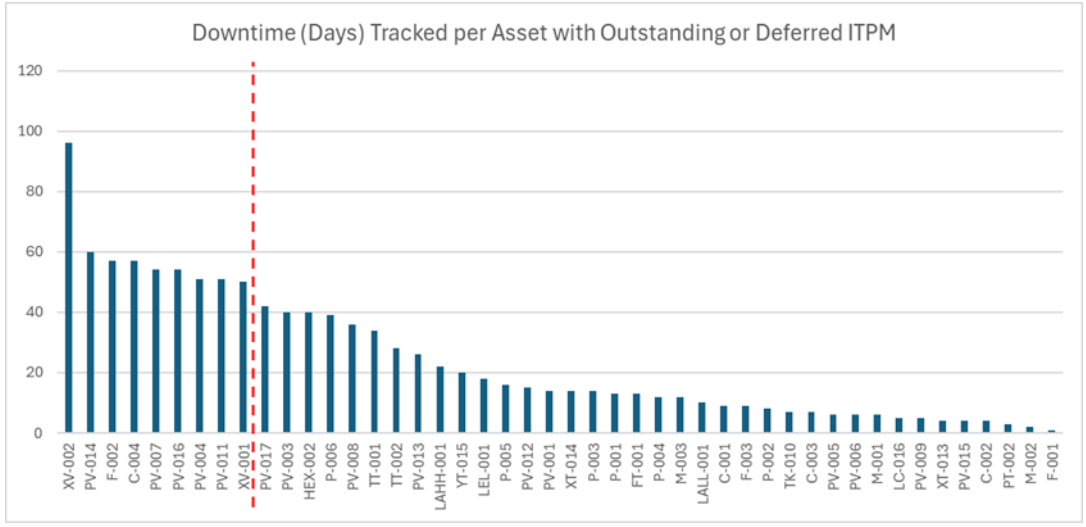
Deferring maintenance or bypassing critical safeguards can increase safety risks over time.

Visualization tools help track deferral frequency, age, and associated risk.

Heat maps and pareto charts help highlight high-risk deferrals.



# The Cost of Deferrals – Downtime & Safety Impact




Deferred tasks can lead to increased downtime and operational inefficiencies.

Prioritizing maintenance based on risk impact improves reliability.

Example: 20% of assets often contribute to 50% of downtime.

# The Power of Data Visualization in Decision-Making

Visualizations make complex data more accessible, enabling faster and better decision-making.

Dashboards provide real-time insights, combining lagging and leading indicators for comprehensive analysis.

Leading indicators in dashboards predict future trends, while lagging indicators track past performance for informed action.

Risk matrices and trend analysis foster transparency, empowering stakeholders to identify opportunities and mitigate risks.

# Deeper than Dashboards: 3D Geospatial Fusion

### From Visualization to Actionable Insights

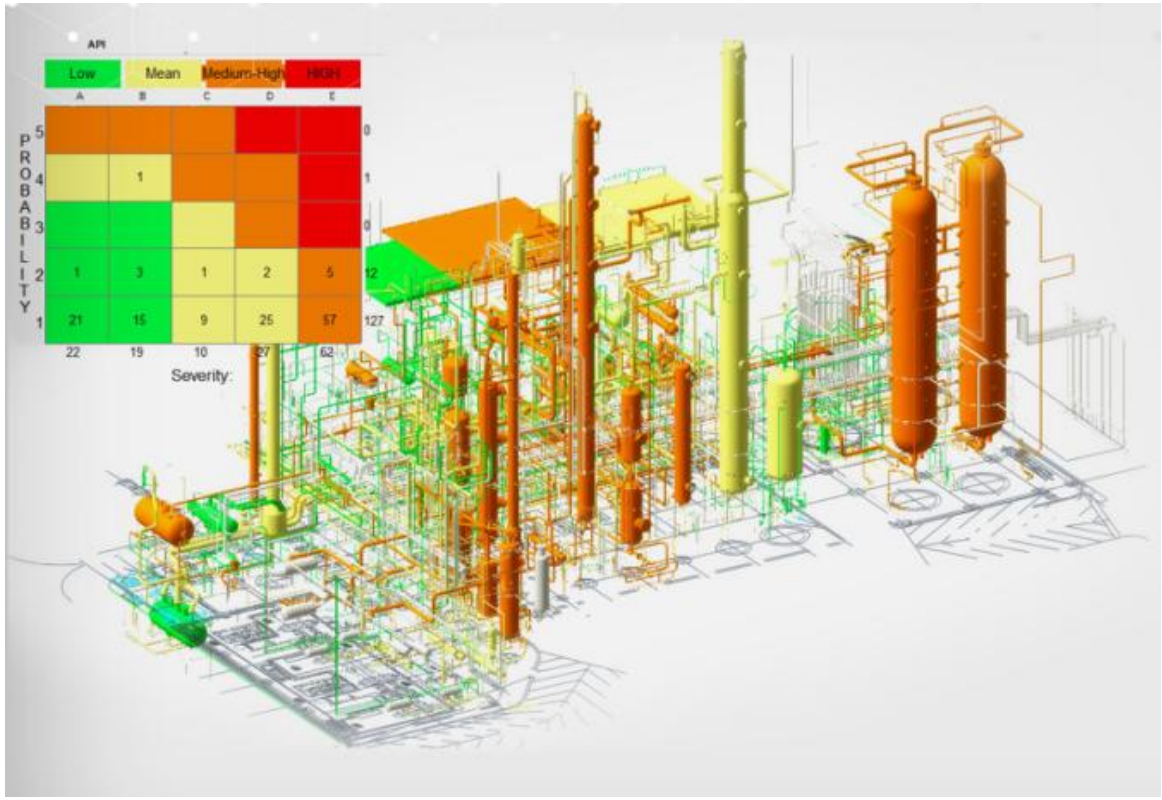
Traditional dashboards offer static snapshots, while 3D geospatial data enables dynamic, spatially aware risk assessments enabling predictive insights and proactive risk mitigation.

### Integrating 3D Geospatial Data with Reliability Analytics

Mapping equipment health, sensor data, maintenance and failure history, and environmental factors onto facility layouts enhances decision-making.

### Highlighting Risk Areas with Contextual Data

Identifying spatial patterns of failures and high-risk zones improves maintenance efficiency, communication between teams and risk management.



# Final Thoughts

- Integrating data from multiple sources enhances situational awareness, allowing for a more holistic approach to asset management and risk assessment.
- Combining qualitative and quantitative data in visual dashboards and 3D models improves decision-making by uncovering hidden trends, emerging risks, and optimization opportunities.
- Risk-ranking methodologies can optimize maintenance planning by prioritizing tasks based on operational impact, safety concerns, and asset integrity as a function of return on investment.
- Advanced visualization techniques, such as 3D geospatial modeling, provide contextualized insights by mapping risks and maintenance priorities within a spatial framework

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