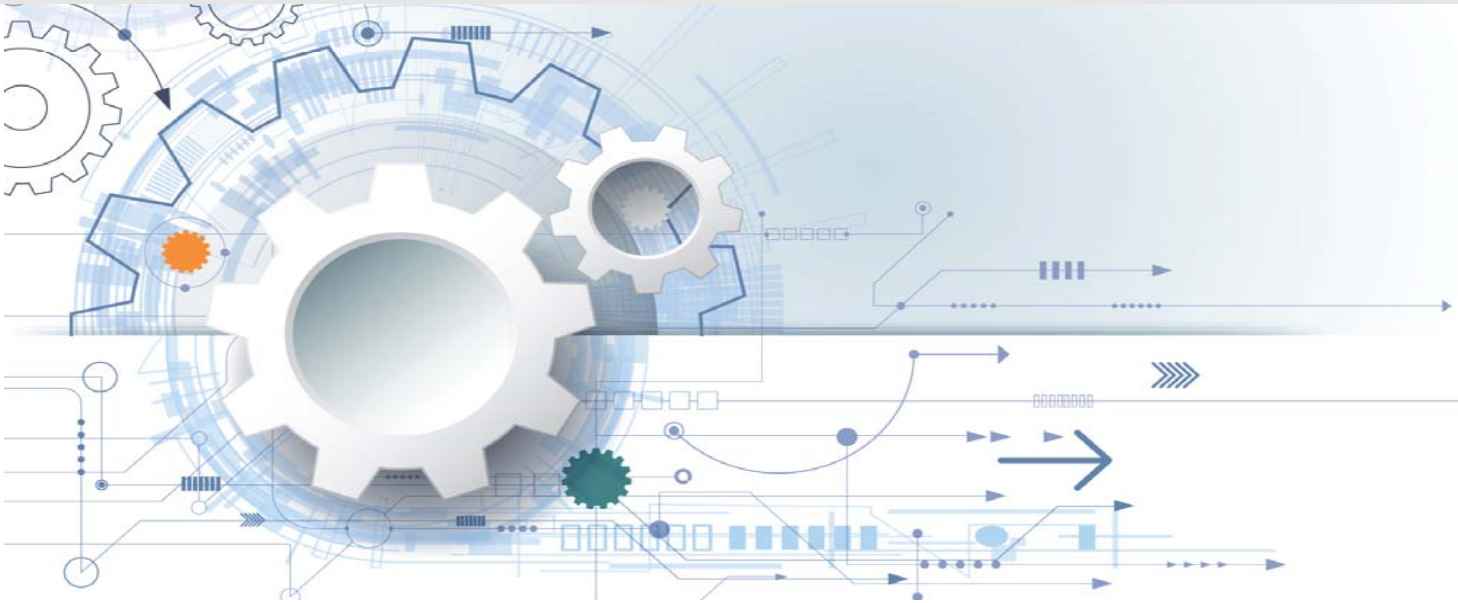
# Why your PdM Program is not increasing Equipment Reliability



TRUE Reliability

## John Pucillo - Principal, True Reliability

## Reliability, Predictive Maintenance & Operation Consultant

Results-driven senior reliability, operation and product management professional with 38 years of successfully executing best-in-class delivery and product strategies to achieve business objectives. Experience in management, product development, deployment strategies, optimizing workflow to reduce inefficiencies and cost. Accomplished in pricing models, software development, website operations, product management, project management, and collaborating effectively with clients.

# Predictive Maintenance (PdM)

Techniques designed to determine the condition of in-service assets in order to determine when & what type of corrective action(s) should be performed.

Part of a conditioned-based maintenance approach that is typically more effective than time-based maintenance activities for many failure modes. Corrective or intrusive actions are performed when warranted based on asset condition, not calendar or hour/run meters.

*With early detection of impending failures, early planning, scheduling, replacement parts/material are in place to reduce maintenance time (MTTR) and to avoid unplanned downtime events, thus driving productivity gains while lower cost.*

A PdM program success, starts with a well-thought-out design and strategy. *Unfortunately, many programs start with technology choices and deployment not strategy.*

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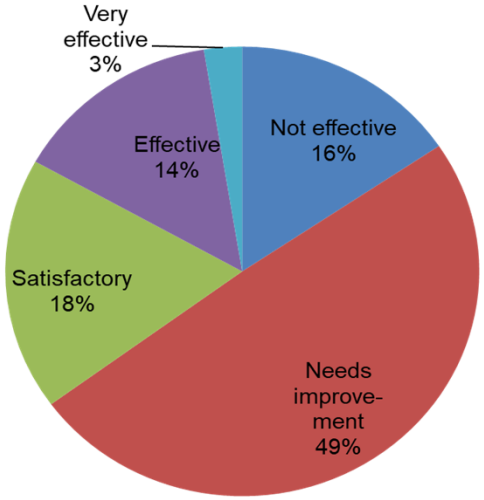
# Complicating Factors

- Many PdM Programs are ineffective (65/35%), understanding why requires an assessment
- Most programs need to improve data analytics, program management, KPIs and metrics
- Many programs desire to push for the next generation PdM, IIoT, Industry 4.0, AI, Predictive Analytics and machine learning. However, without a solid program foundation, identifying failures may continue, in most cases, more efficiently but improvements in reliability will not be increased.

**Overall PdM program performance**

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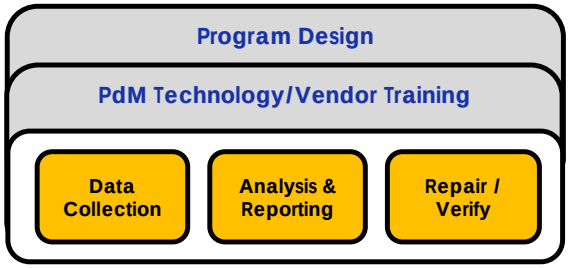
# Traditional Program

## Traditional PdM Program




**Failure Management**

**Cost Avoidance (Soft)**

**Typical Traditional Setup**

- Included assets are not risk based
- Data collection frequencies assigned globally
- Alarm thresholds assigned globally
- Minimal changes made throughout life of the program

*"One size fits all – Celebrating Finding Failures"*

# Failure Management versus Reliability?

Failure management is absolutely a critical need for most facilities and should be continued through your PdM and PM efforts. Managing failures provides early work identification, helps control / eliminate unplanned downtime, and reduce costs. However, PdM programs were never designed to improve reliability, rather the design is focused on effectively managing failures.

Reliability is defined as the ability of an apparatus, machine, or system to consistently perform its intended or required function or mission, on demand and ***without degradation or failure.***

*Not trying to be controversial, just trying to show the relationship between failure management and reliability improvements. When I ask most people, they say PdM is a reliability program. We don't need to argue about this but rather understand how to drive true reliability from the program. "These are my lessoned learned."*

***So, while the failures are predictable, the result is not necessarily improved reliability.***

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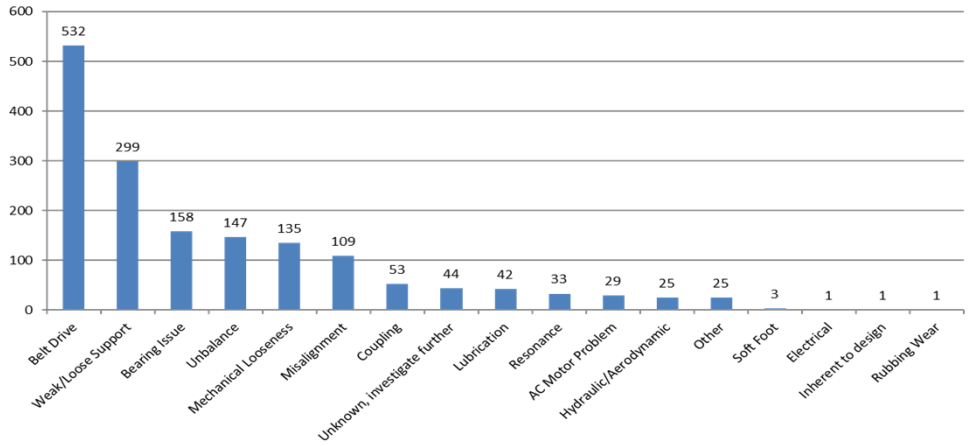
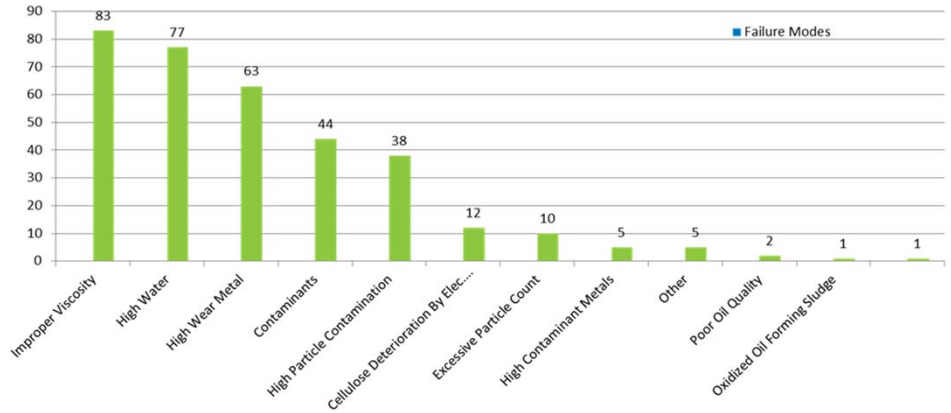
# Trending the failures your program is finding?

However, many of the failure modes predicted by PdM reoccur over and over across the asset base.

When looking at each problem found through PdM, the challenge to our Analyst is to not limit their efforts to detection and recommended repairs. Our analyst may need to take a deeper dive to understand the root cause of each problems or symptom, as best as they can.



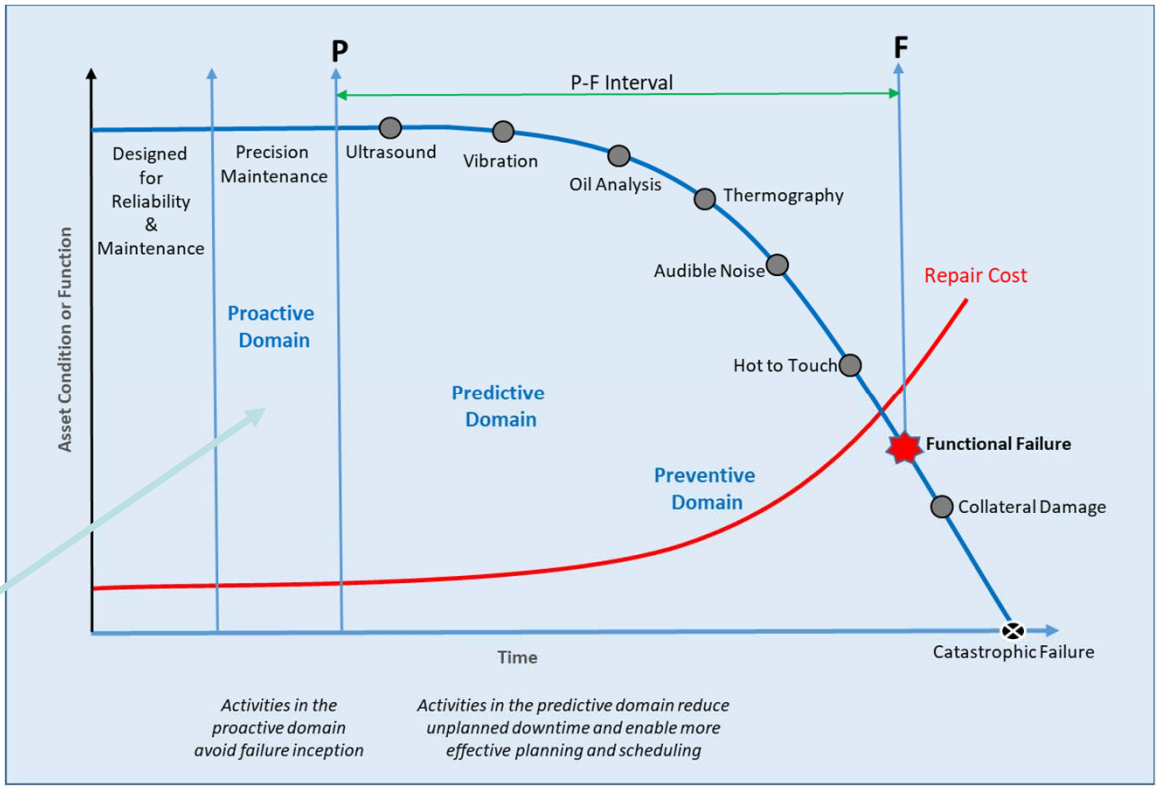



# Changing the paradigm – driving reliability

**Enhanced Predictive Maintenance (*e*PdM)**

- Combines a properly designed, installed and managed deployment of predictive technologies with standard processes and statistical analysis to identify and eliminate most reoccurring failures at their root.
- Adds failure trending (FRACAS), bad actor triggers and root cause failure analysis (RCFA), as key components of your PdM program.
- Adds a precision approach to your maintenance effort through proper training, techniques and tools.
- Not focused just on individual asset failures but failure patterns that affect equipment condition across all assets / types.
- Reliability gains are driven from eliminating failures rather then predicting them.

Our program's mission statement changes to "early failure detection while adding the trending to eliminate the reoccurring failure patterns, essentially preventing failures from occurring, adding reliability to the facility's operations."




Pushing up the P-F curve

# Noteworthy Items

- The *e*PdM approach is focused on the desired result: improving reliability through failure elimination.
- Predictive technologies become the means to an end in this approach
- In an *ePdM* program, success is not measured by completing PdM tasks but by achieving key KPIs and returning true reliability gains
- Most PdM programs focus on the functional tactics: data collection, analysis and reporting
  - Resulting in detecting and managing failures - Good
  - What gets less attention is establishing program metrics/KPIs, ROI, or tracking other long-term successes – Improvement Opportunity
  - Most programs typically, focus on completing tasks on a regular and timely basis and less on performance metrics – Improvement Opportunity

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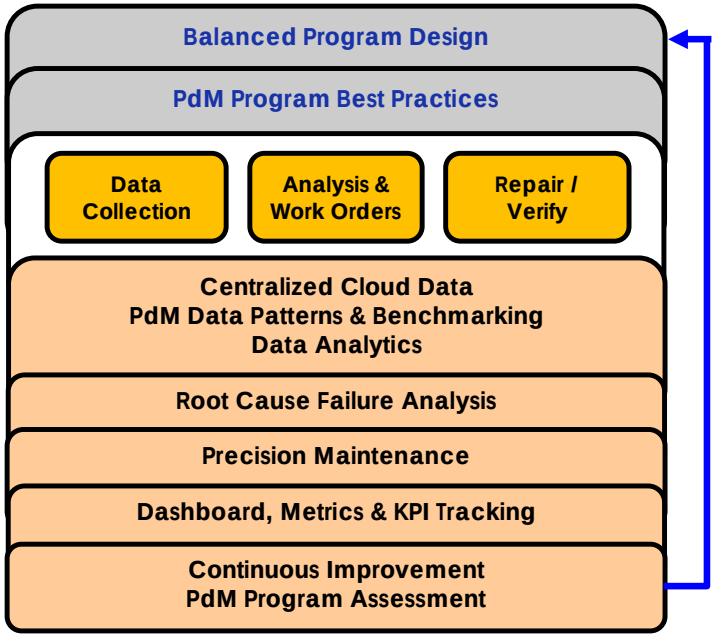
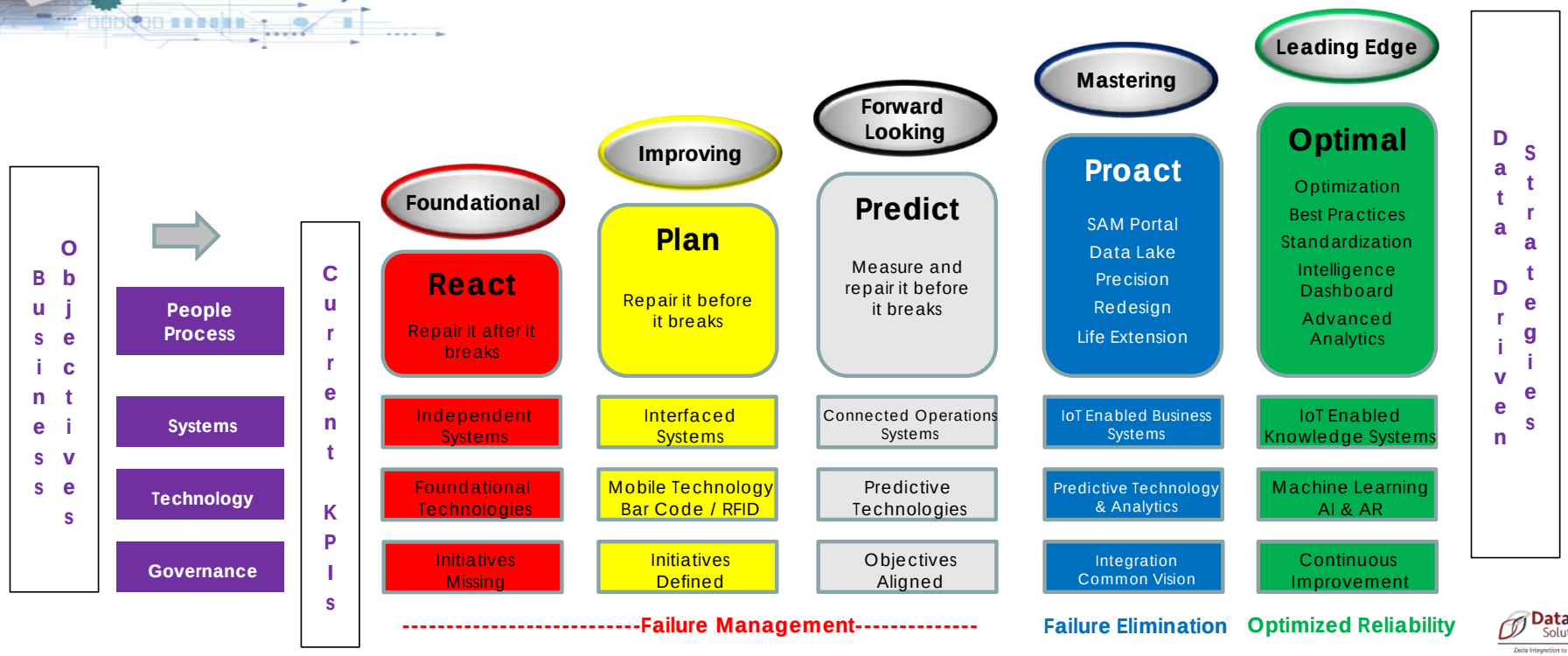
# Enhanced PdM (ePdM)



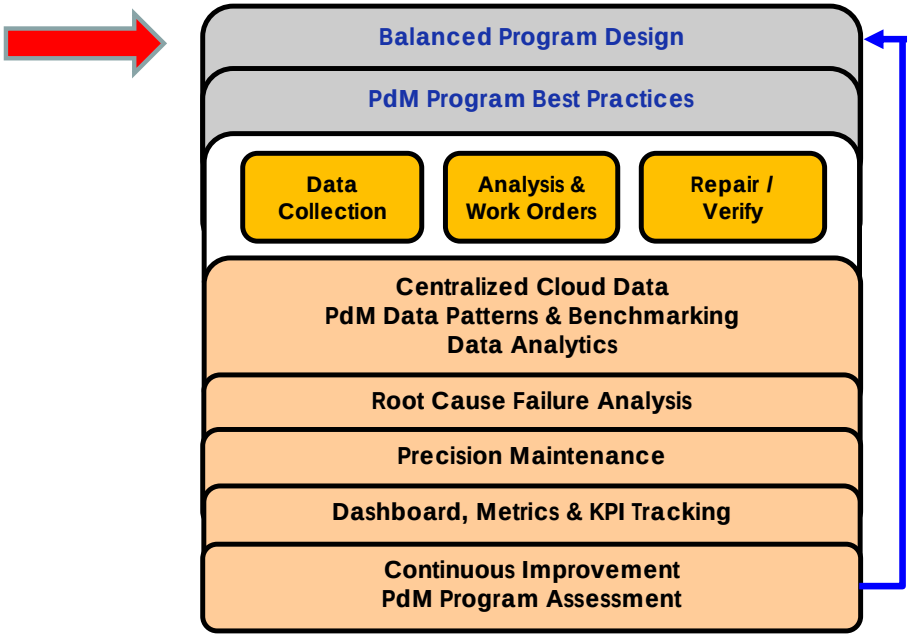

**Failure/Loss Elimination**
**Cost Savings**
**(Hard)**

# First step – determine current state & strategy forward




Asset Performance Management Maturity Framework

# Enhanced PdM (*e*PdM)




**Failure/Loss Elimination**
**Cost Savings (Hard)**

Balanced Design Criteria

- Asset Criticality Analysis
- Failure Mode Mitigation
- PdM Discipline Assignment
- Frequency Decision
- **Cost Justification**

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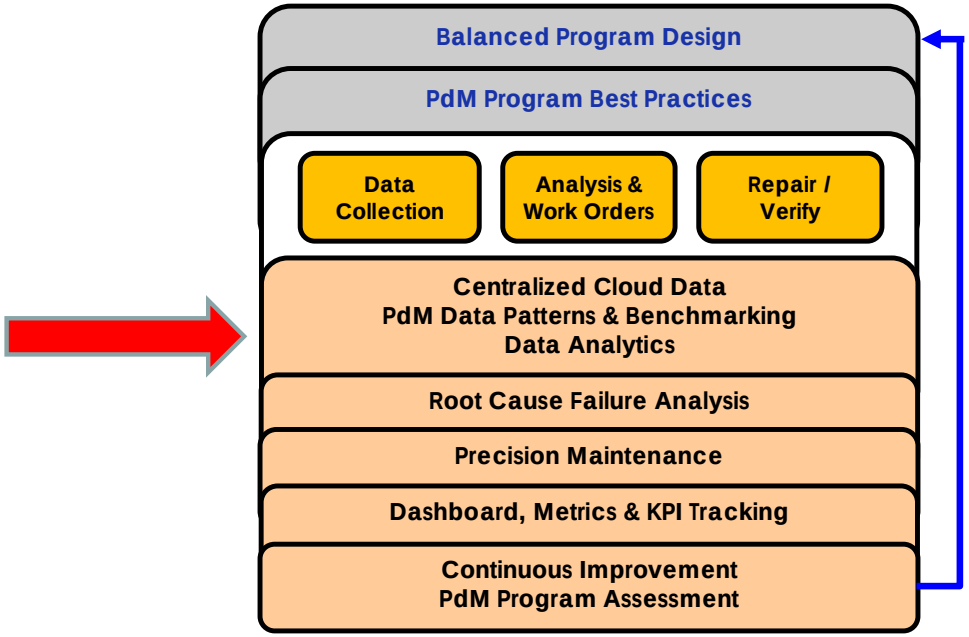
# Enhanced PdM (*e*PdM)

Tracking Failure Data




**Failure/Loss Elimination**
**Cost Savings (Hard)**

# Trending PdM Failure Data

- Highly dependent on how PdM finds are reported and how the corrective action is initiated
- Use the CMMS to facilitate trending
- Establish work order types (CM, PM, PdM, etc.) to filter how the work is being identified
- Establish detailed failure codes that will be assigned to each work order
- Routinely query the system to trend and further root cause analysis of reoccurring patterns.

| Code | Description (English) |
|---|---|
| 0010 | Blockage/Plugged |
| 0020 | Breakage |
| 0030 | Burst |
| 0040 | Cavitation |
| 0050 | Clearance / Alignment Failure |
| 0060 | Contamination |
| 0070 | Corrosion |
| 0080 | Cracked |
| 0090 | Deformation |
| 0100 | Dirty |
| 0110 | Erosion |
| 0120 | External Influences |
| 0130 | Fatigue |
| 0140 | Fouling |
| 0150 | Imbalance |
| 0160 | Improper Fit |
| 0170 | Improper Lubrication |
| 0180 | Incorrect Material |
| 0190 | Leakage |
| 0200 | Looseness |
| 0210 | Other (Explain in Detail) |
| 0220 | Overheating |
| 0230 | Sticking |
| 0240 | Vibration/Noise |

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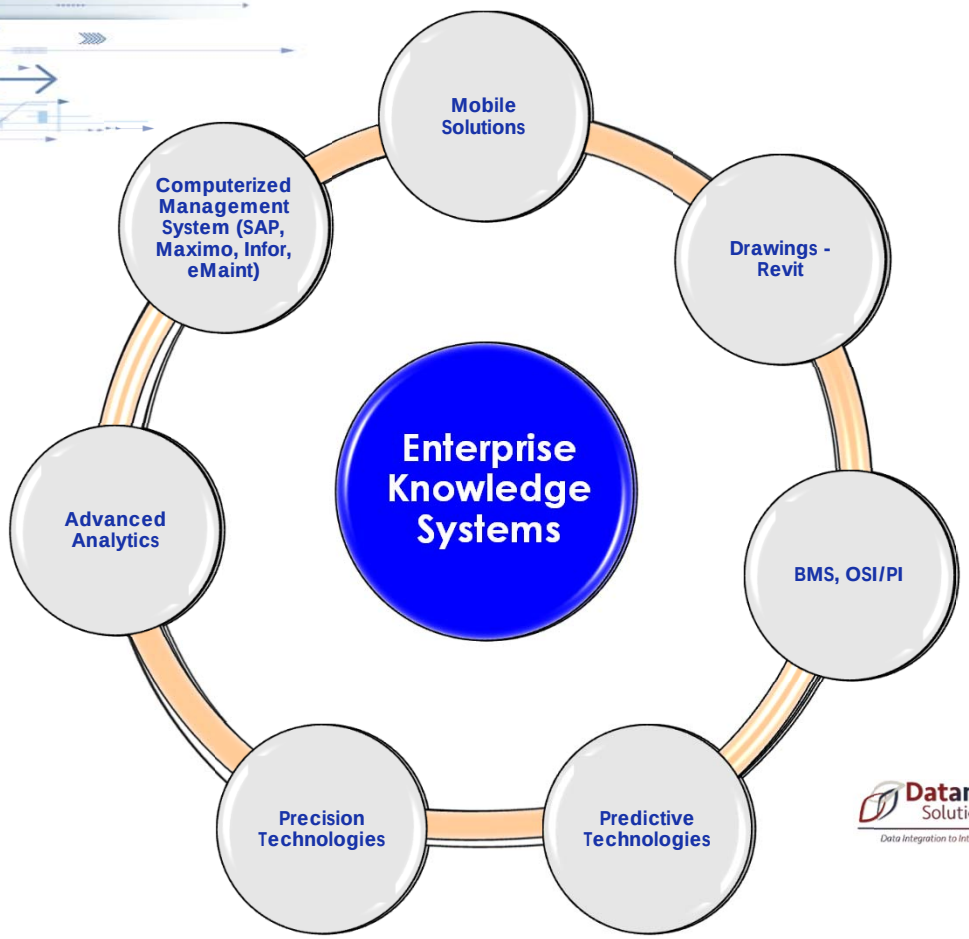
# Integration of Enterprise Knowledge and Decision Systems

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Data Integration to Intelligence™

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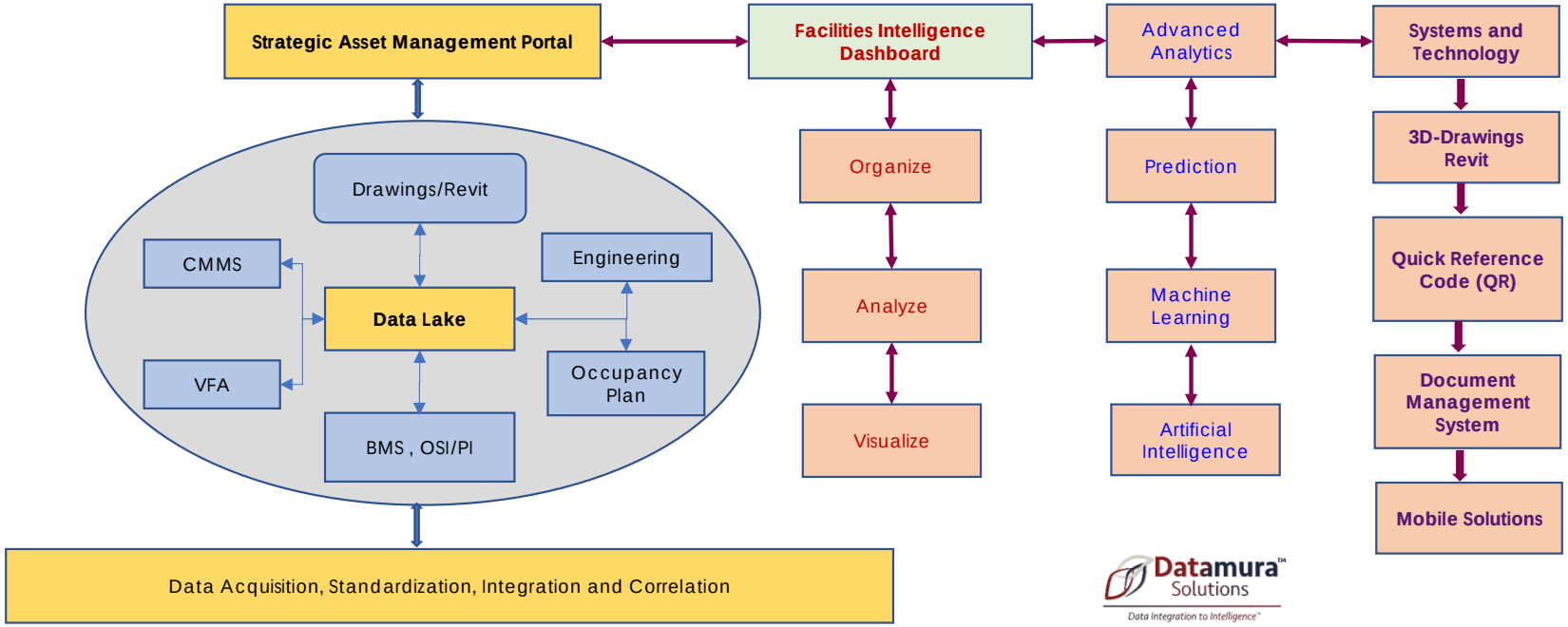
# Data Integration to Intelligence

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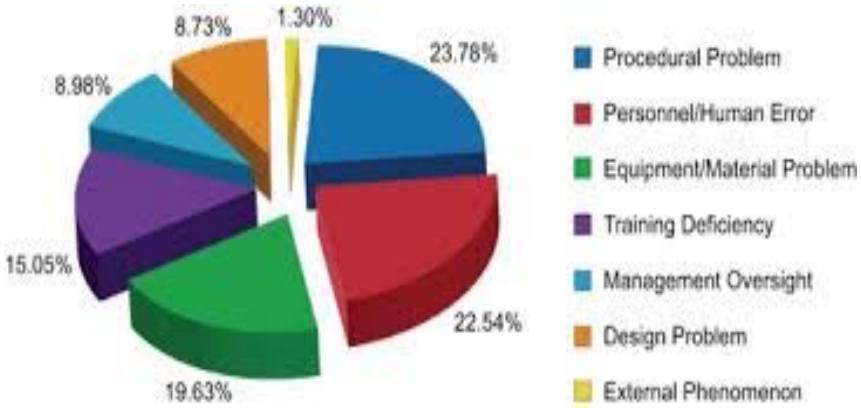
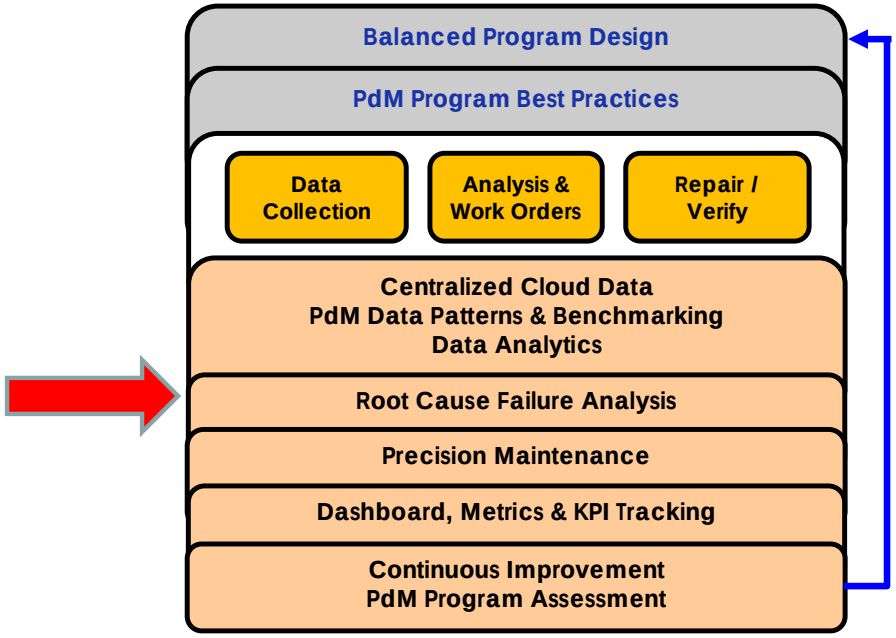
# A More *Precise* Approach



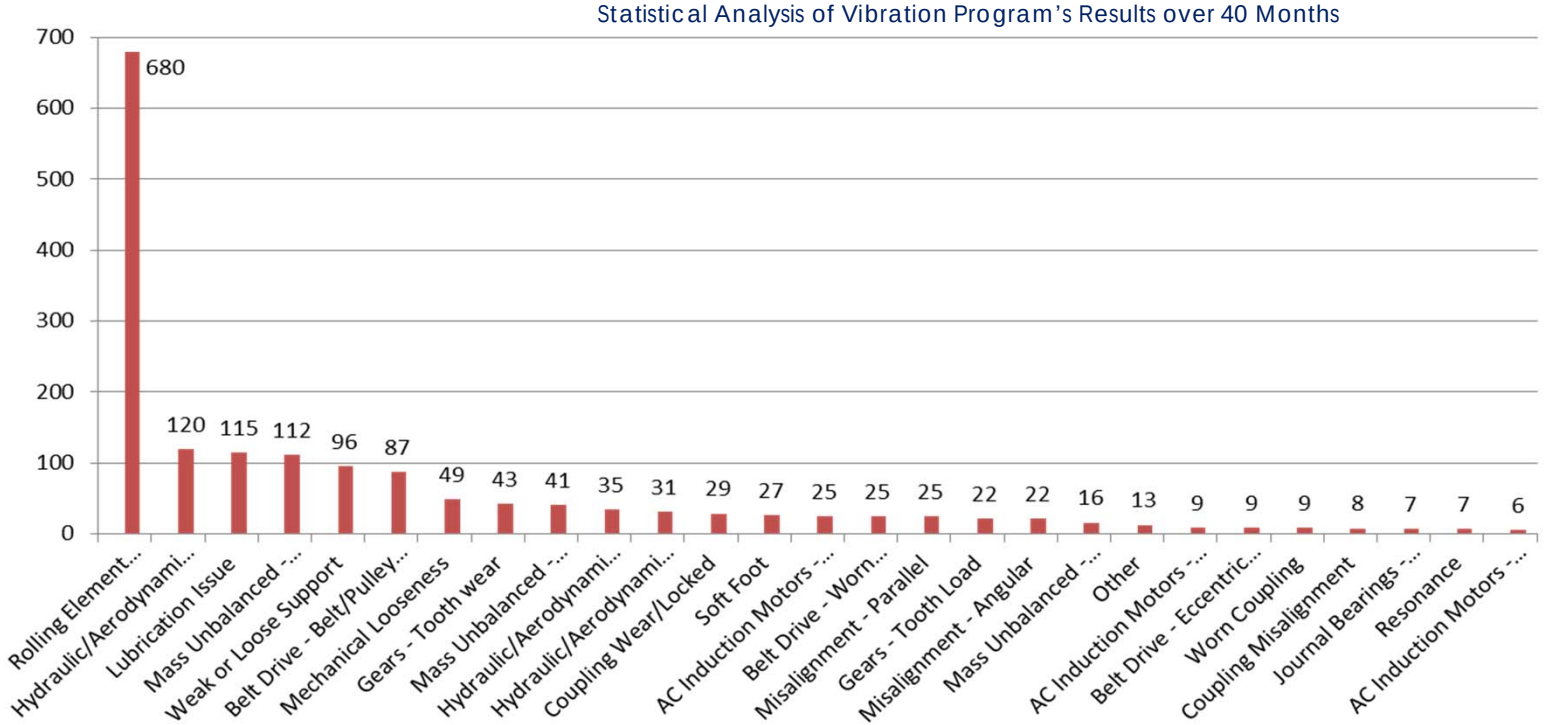

Machinery Lubrication, Survey 2010

Readership survey of 'What goes wrong in the factory" based upon the general failure cause categories outline in the U.S. DOE's root cause analysis standard (DOE-NE-1004-92). **The reply shows that equipment is to blame in less than 20 percent of the occurrences. Nearly 80 percent of what goes wrong can be attributed to people issues. Problems with procedures and training (combined) are responsible for nearly 40 percent. Personnel/human error constituted a little more than 22 percent of the vote.** Management oversight represented about 9 percent. Also, design problems totaled roughly 9 percent.



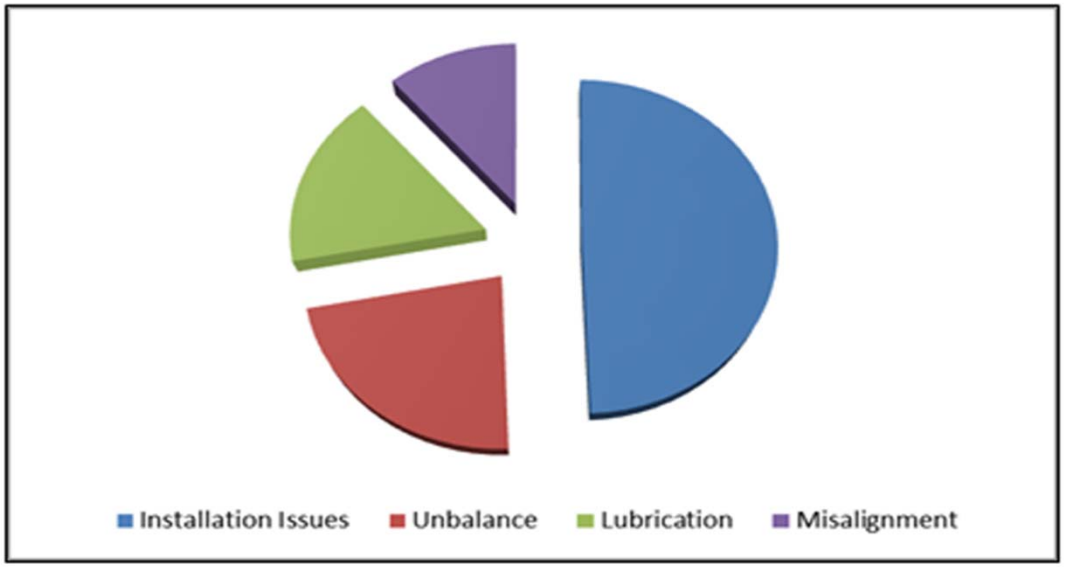

**Failure/Loss Elimination**
**Cost Savings (Hard)**

# Example - reoccurring failure patterns

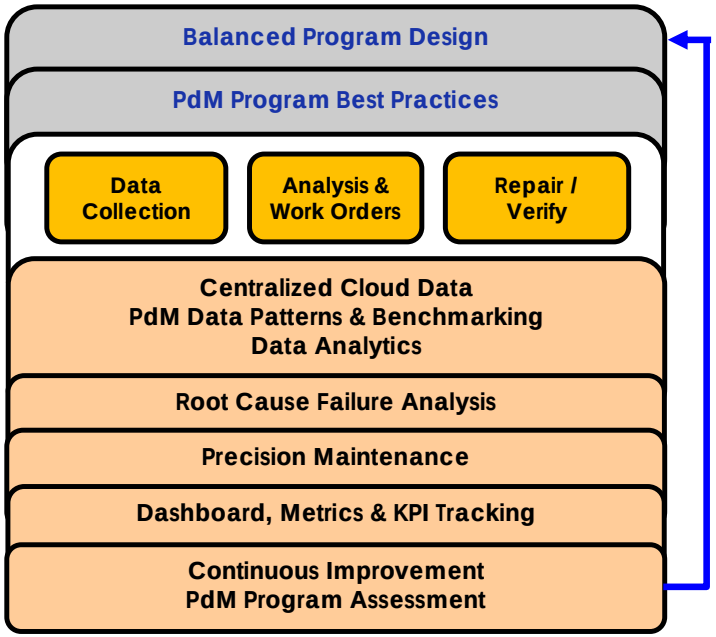


# Example - reoccurring failure patterns

Root Cause Analysis Results of the top reoccurring failure – rolling element bearing faults



# Example - reoccurring failure patterns

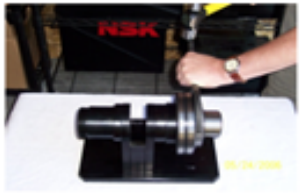



**Failure/Loss Elimination**
**Cost Savings (Hard)**

Precision Maintenance training for installation issues

**Handling Precautions:**

- Store in **clean**, dry area with minimal vibration
- Keep bearing in original packaging until needed
- Hands should be **clean** and dry
- Keep surrounding area **clean**
- Do not wash new bearings
- Keep bearings covered when not in use




**Mounting Considerations:**

- Use Proper, Unworn Tools
- Clean Shaft and Housing
- Check Shaft and Housing Dimensions
- Ensure Proper Alignment
- Support Proper Bearing Ring
- Avoid Impacts on Bearing - No Hammers!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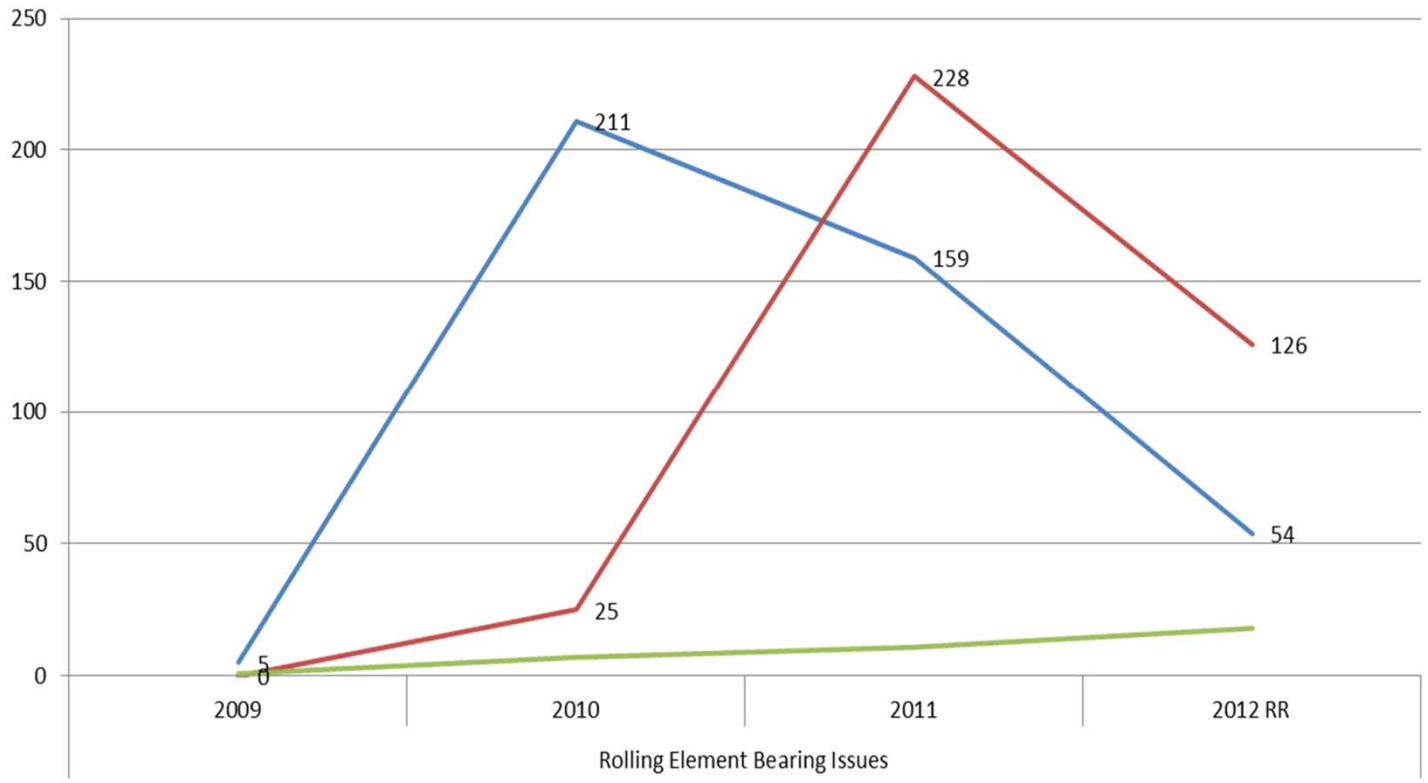
# Example - reoccurring failure patterns

Resulting in a decline in reoccurring failures YOY, eliminating failures



# Performance Management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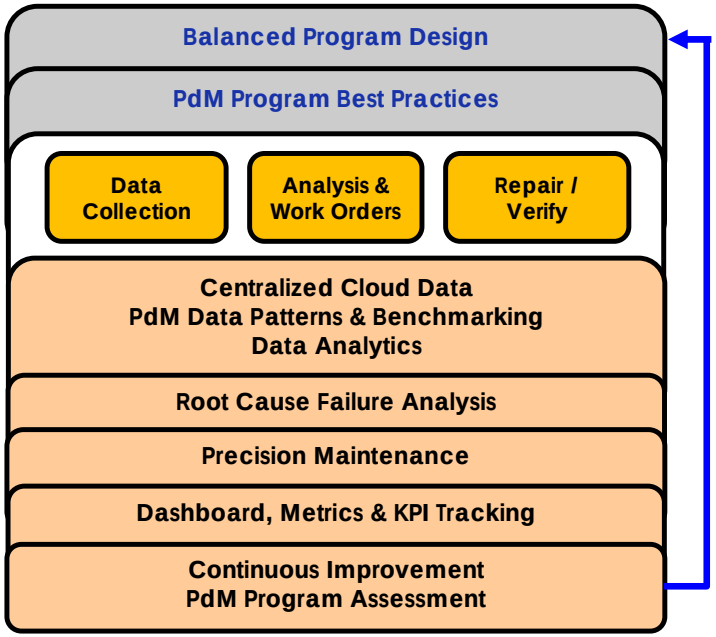


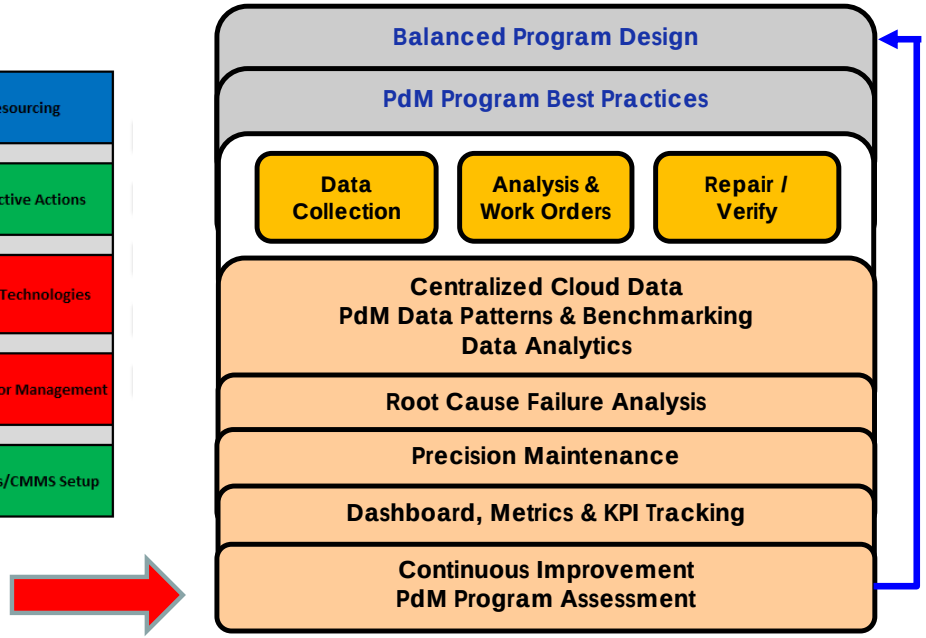

**Failure/Loss Elimination**

**Cost Savings (Hard)**

# Continuous Improvement

## Assessment Results Dashboard

| | | | | | |
|---|---|---|---|---|---|
| Program Management | Awareness & Site Support | Sharing Results (Communicating) | Continuous Improvement | Audit & Review | Resourcing |
| Measuring & Acting on Results | KPIs | Program Performance Metrics | Financial Perfromance Metrics | RCA Reducing Failures | Corrective Actions |
| Technology Application | Vibration | Ultrasound | Thermography | Oil Analysis | Other Technologies |
| Applying your Program | Data Collection | Analysis | Route Management | Non-Route Applications | Contractor Management |
| Setting up Program | Methodology for Choosing Equipment | Roles & Responsibilities / Stakeholders | Defined Goals & Processes | Training/Skills | Systems/CMMS Setup |




**Failure/Loss Elimination**
**Cost Savings (Hard)**

# Benefits of enhancing your existing PdM with *e*PdM

- Enhances or creates additional value to the PdM investments
- Ensures your PdM efforts are focused on the value stream
- Enhances focus on failure elimination and overall reliability
- Increases planning & maintenance productivity
- Improves quality
- Improves safety
- Increases throughput / reduces downtime / MTBF
- Reduces emergency work
- Reduces PM events
- Reduces troubleshooting time / decreases MTTR
- *e*PdM will help facilities prepare for new approaches like IIoT, machine learning and predictive analytics by focusing on four key areas:
  - Doing the right things for the right reasons (design or optimization of new or existing programs)
  - Managing to set standards, processes and procedures to achieve KPIs and stated goals
  - Delivering high-quality analysis, reporting and statistical trending
  - Identifying reoccurring failure modes and applying RCFA techniques for corrective actions

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# Summary

*Enhanced Predictive Maintenance combines the time proven PdM / condition monitoring approach with Risk Based Asset Performance Management's "best practices" to achieve superior results quickly.*

*Combining traditional PdM program results with advanced trending and analytics, provides a means to move from failure management to failure elimination thus reducing cost avoidance in favor of cost savings.*

*The goal, where possible, is to detect and eliminate failure patterns at its root, reducing the reoccurring failures to create true long-term reliability, maximizing return on investment.*

*In addition, leveraging advances in technology, condition monitoring devices and cloud-based software, will allow for a unique platform to manage and improve operational and asset productivity across the enterprise asset base.*

# Questions?

# Thank You


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