

# Utility Maintenance Optimization A Suggested Approach

Sub-Transmission and Distribution Assets

October, 2009

Presented by:



*Energy. Knowledge. Results.*

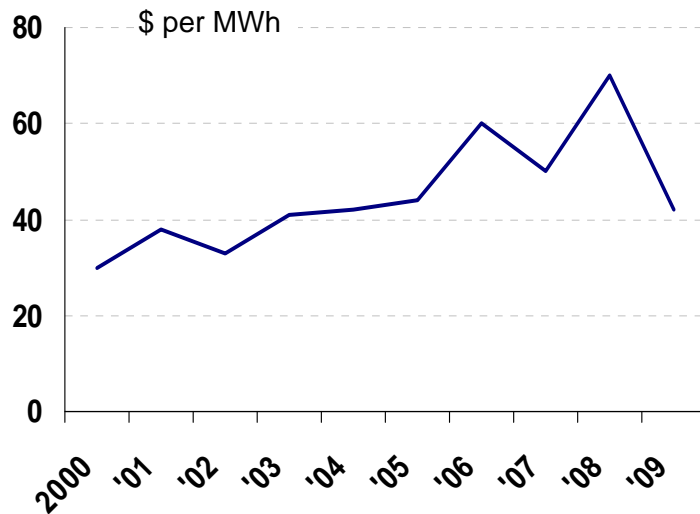
## Industry Perspective

# Utility Operations 'After The Reset'

### **External Forces Continue To Challenge Revenue and Earnings Objectives**

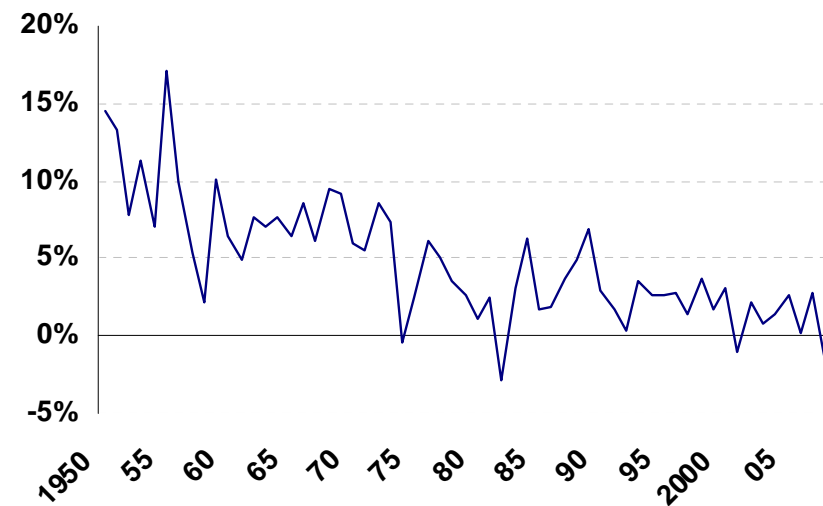
- The recession continues to impact usage and new connects in all segments
- Commodity price deflation negatively impacts market prices and generation profitability
- Energy Conservation and 'Green' sentiment erode traditional business model

#### Average PJM Electricity Price



Source: Wall Street Journal , Monitoring Analytics

#### Annual % Change - US Electric Usage



Source: EIA 2008 Table 8.1

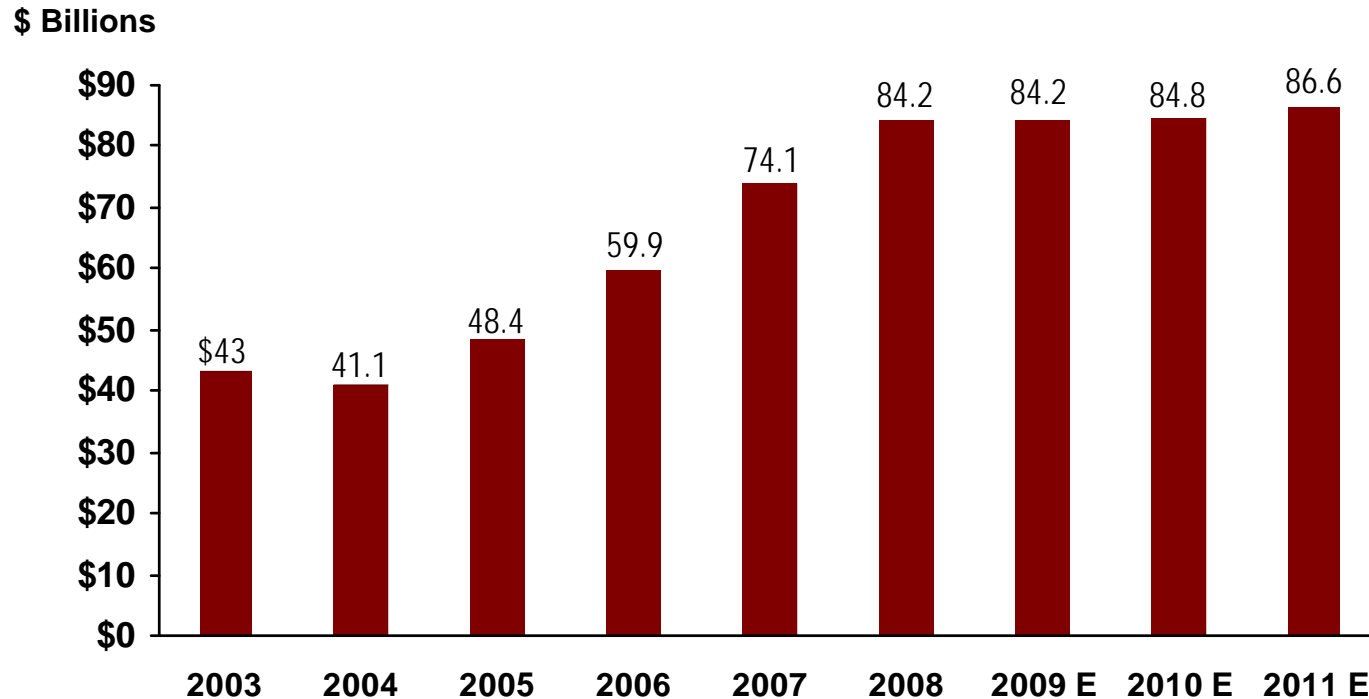
## Industry Perspective

# Utility Operations 'After The Reset' (cont.)

### ***While Financial Challenges Loom, Significant Capital Investments Will Continue***

- Long cycle infrastructure spending is required for new and replacement assets
- Obtaining financing and rate case approval requires tight O&M cost control

### **CAPEX for 60 US Shareholder-Owned Electric Utilities**



Source: EEI and SNL Financial

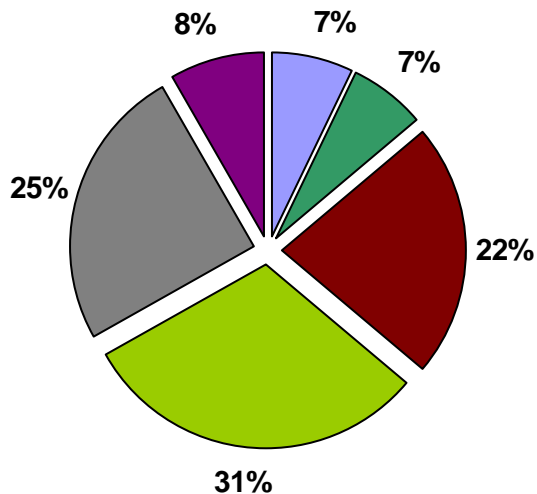
# Industry Benchmarks

## Cost and Reliability

### Analysis Indicates Maintenance Is One of The Largest Controllable Costs

- Distribution maintenance also has the greatest potential impact on safety and reliability

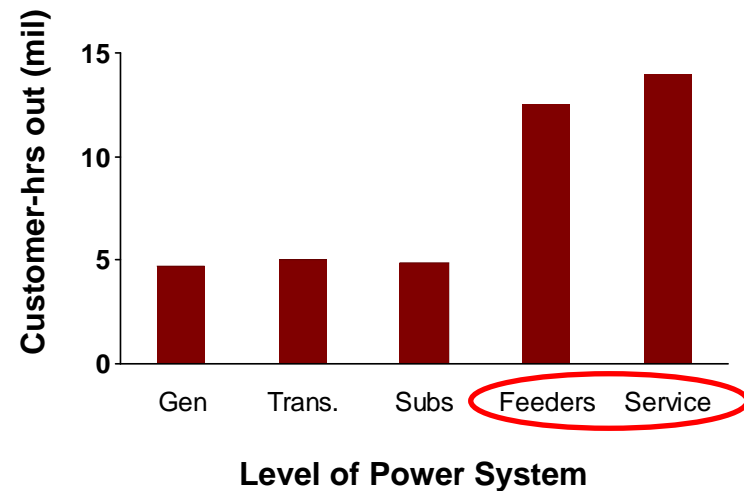
Electric Utility Delivery Expenses



- Trans Ops
- Dist. Maint
- Trans Maint
- Cust. Accounts
- Dist. Ops
- Cust. Services

Source: 2008 FERC Form 1 Data Select Utilities

10 Year Service Interruption Statistics



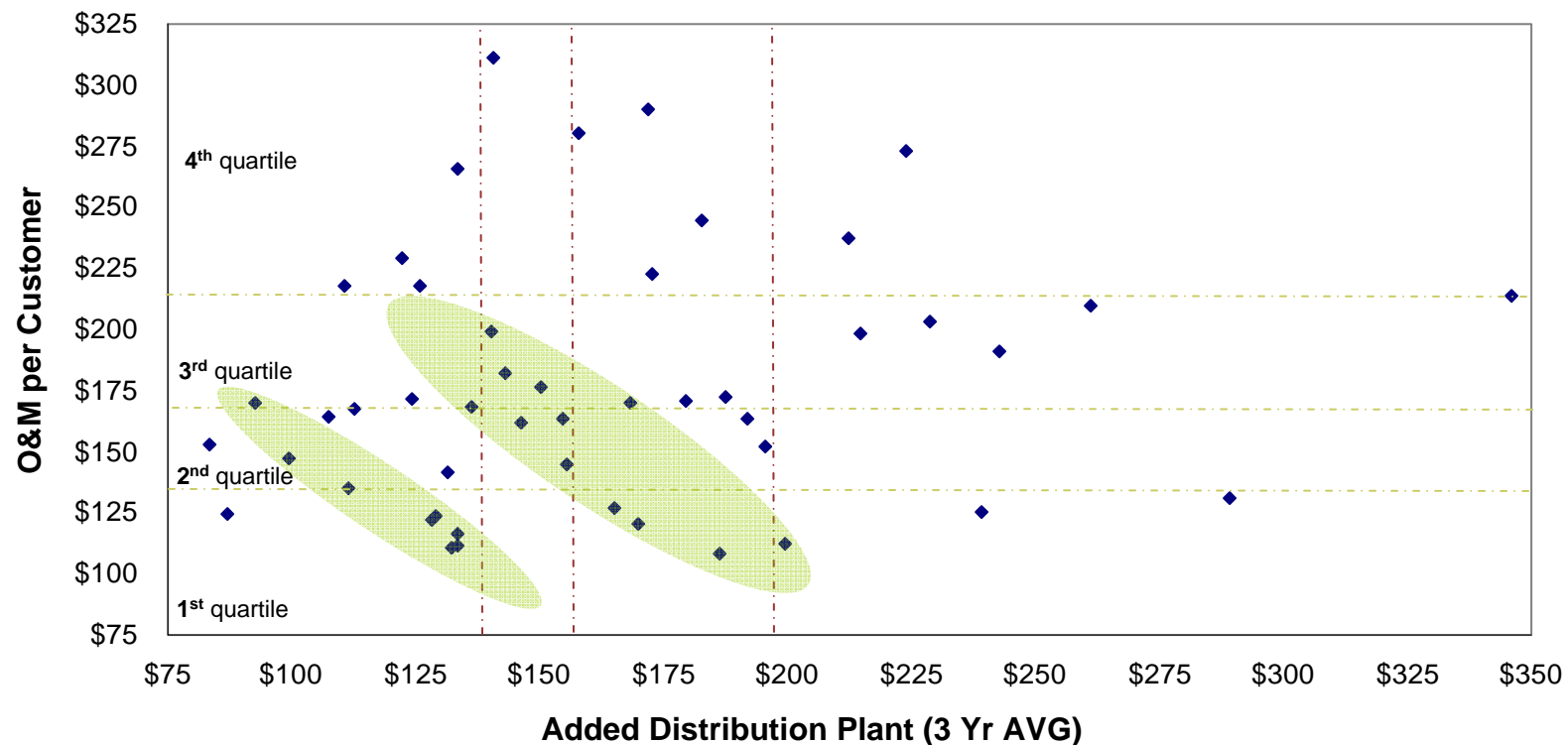
Source: Willis, Power Distribution Planning Reference Handbook

# Industry Benchmarks

## O&M Cost and Performance

### ***Benchmarking Indicates Opportunities for Improvement for Comparable Utilities***

- Analysis indicates isolated correlations between added plant and lower O&M costs
- O&M costs per customer trend lower over a three year period for top tier utilities



Source: FERC From 1 Data, Rich Consulting Analysis of 50 utilities each with more than 500,000 customers

## Opportunity Statement

# What is the Maintenance Problem?

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### ***Problem Statement: We know What It Costs But We Can't Quantify The Value***

- Historically, maintenance initiatives oscillate between two opposing objectives: *Achieving Reliability Goals* – or – *Cutting Costs*. Economic conditions, regulatory mandates, reliability or safety events trigger a shift toward one objective or the other.
- Finding the right balance requires an understanding of asset condition, along with the risk and consequence of failure for each asset grouping. Finding this balance must be the focus of an effective maintenance optimization model.

### ***The Implementation Challenge***

- The holistic impact of maintenance optimization is not typically evaluated or measured today because of the effort associated with:
  - Data gathering, analysis and the associated resource commitments
  - Coordination of multiple utility functions and asset groups
  - Asset management systems and capabilities
  - Organizational resistance and skepticism

# Opportunity Statement

## So How Do Utilities Improve?

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### *The Optimization Opportunity*

- A vast portfolio of maintenance 'IC' has been developed by utilities, consortiums, and consultants to address the problem. Most methodologies have been piloted and a few progressive utilities have implemented maintenance optimization programs and realized significant benefits.
- Rather than riding the 'see-saw' up with overly conservative maintenance programs and down with across the board cost cutting, there is an opportunity to leverage the previous work, determine the value of maintenance investments, and then optimize expenditures.
- A practical approach to leveraging this opportunity is a phased pilot and evaluation program that would assess:
  - Feasibility and opportunity potential
  - Data, system, analytical, and resource requirements
  - Process and procedure re-engineering
  - Scalability of the solution
  - Net cost / benefit

# Maintenance Optimization

## The Maintenance Evolution

### *Maintenance Programs Continue to Evolve with Technology and New Analytics*

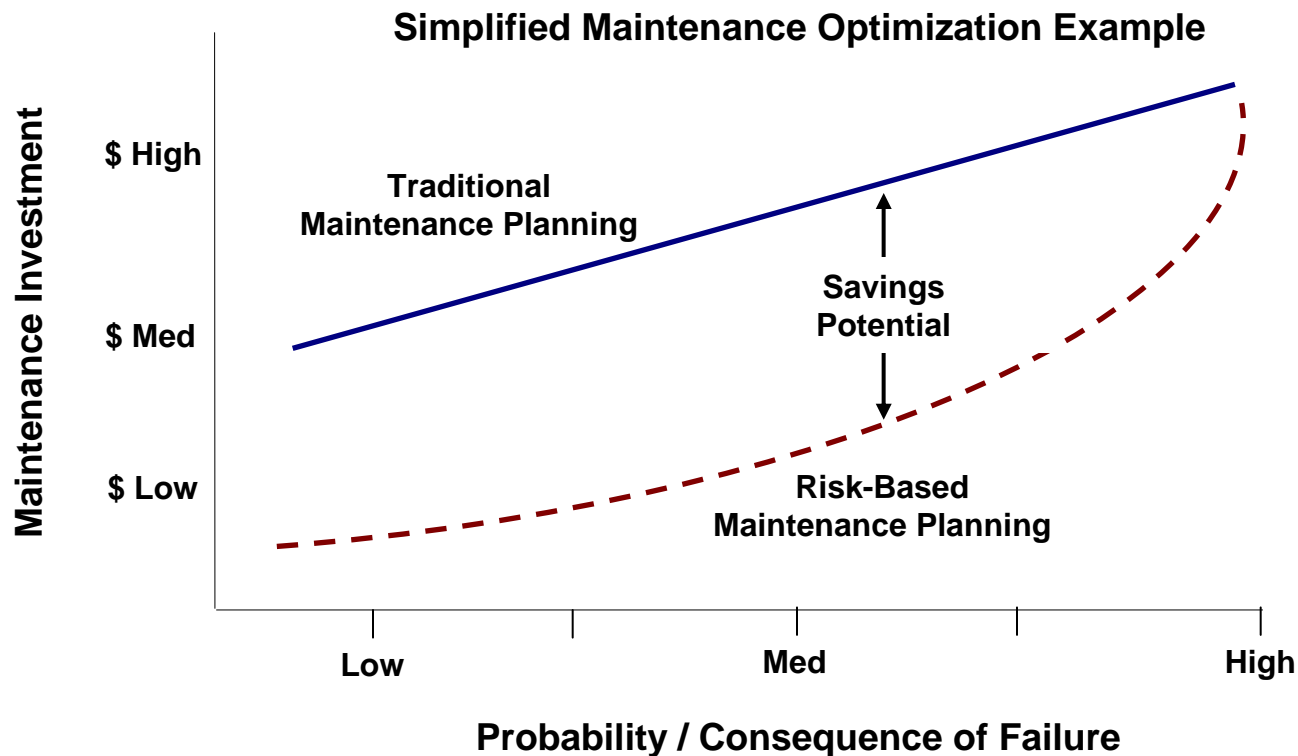
Type	Description	Considerations	Requirements
<b>Corrective Maintenance</b>	- Reactively repairing or replacing what is broken	<ul style="list-style-type: none"> <li>- Random anomalies w/ varying consequence</li> <li>- Multiple unplanned activities</li> <li>- Resource and cost intensive</li> </ul>	Utility resources
<b>Preventative Maintenance</b>	- Scheduled tasks designed to prevent typical failure modes based on equipment requirements and experience	<ul style="list-style-type: none"> <li>- Supplier specifications narrow &amp; conservative</li> <li>- Condition not known before maintenance</li> <li>- Some equipment maintained unnecessarily</li> <li>- Cost effectiveness difficult to measure</li> </ul>	Coordination with suppliers, engineering and operations
<b>Reliability Centered Maintenance</b>	<ul style="list-style-type: none"> <li>- Preservation of function over individual equipment operation</li> <li>- Achieve optimal balance between cost of maintenance and service reliability</li> </ul>	<ul style="list-style-type: none"> <li>- Maintenance effort proportional to importance</li> <li>- Shift resources and adjust frequency</li> <li>- Some corrective maintenance is 'okay'</li> <li>- Repair / replace decision not well addressed</li> </ul>	<ul style="list-style-type: none"> <li>- Reliability data</li> <li>- Risk analysis</li> </ul>
<b>Condition Based Maintenance</b>	<ul style="list-style-type: none"> <li>- Assessment to detect equipment asset health and impending failures</li> <li>- Analysis of events &amp; trends resulting in process or equipment redesign</li> </ul>	<ul style="list-style-type: none"> <li>- Condition understood before action taken</li> <li>- Resources and frequency vary</li> <li>- Maintenance may not be required: fail/replace</li> </ul>	<ul style="list-style-type: none"> <li>- Asset data</li> <li>- Risk analysis</li> <li>- Condition analysis</li> </ul>
<b>Performance Focused Maintenance</b>	- Extension of RCM and CBM integrating reliability, condition, and operating analysis to drive optimal scope and type of maintenance with continual feedback loop	<ul style="list-style-type: none"> <li>- Measure effectiveness 'quantitatively'</li> <li>- Ability to develop maintenance business case</li> <li>- Understand affect of specific decisions</li> <li>- ROI culture established</li> </ul>	<ul style="list-style-type: none"> <li>- Multiple data types</li> <li>- Risk analysis</li> <li>- Condition analysis</li> <li>- Operating analysis</li> <li>- Feedback loop</li> </ul>

# Suggested Approach

## Methodology

### ***A Multi-Dimensional Analysis of Assets, Maintenance Investment and Process***

- Greater emphasis on high value tasks and reduction low risk / low value tasks
- A holistic understanding of risk based on asset condition, operational flexibility, and reliability impacts



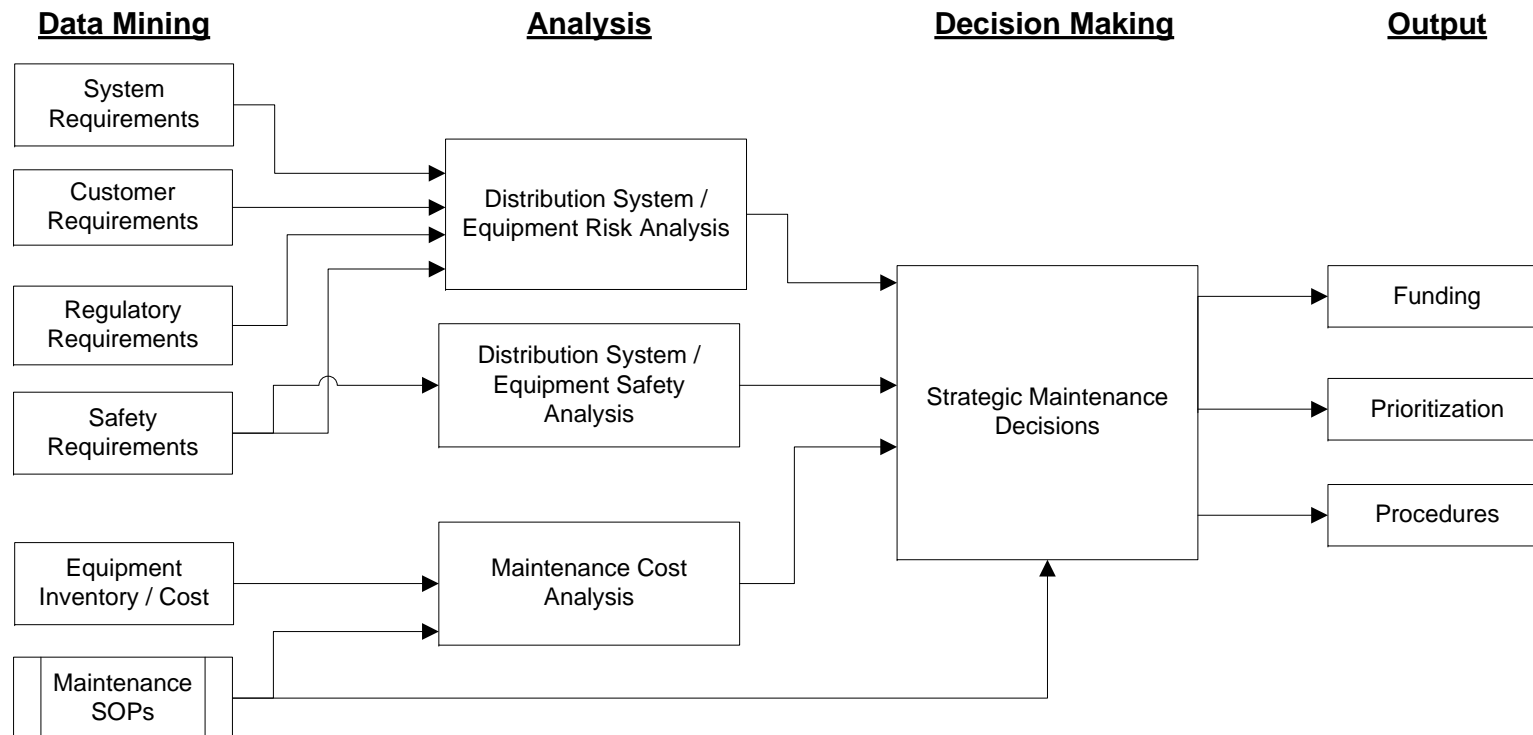
## Suggested Approach

# 1. Perform Current State Assessment

### ***Evaluate Performance & Question Maintenance Planning and Investment Rationale***

- Data gathering, process mapping and identification of optimization opportunities
- Quantitative assessment of maintenance investment and effort versus benefits

### Process Mapping Example



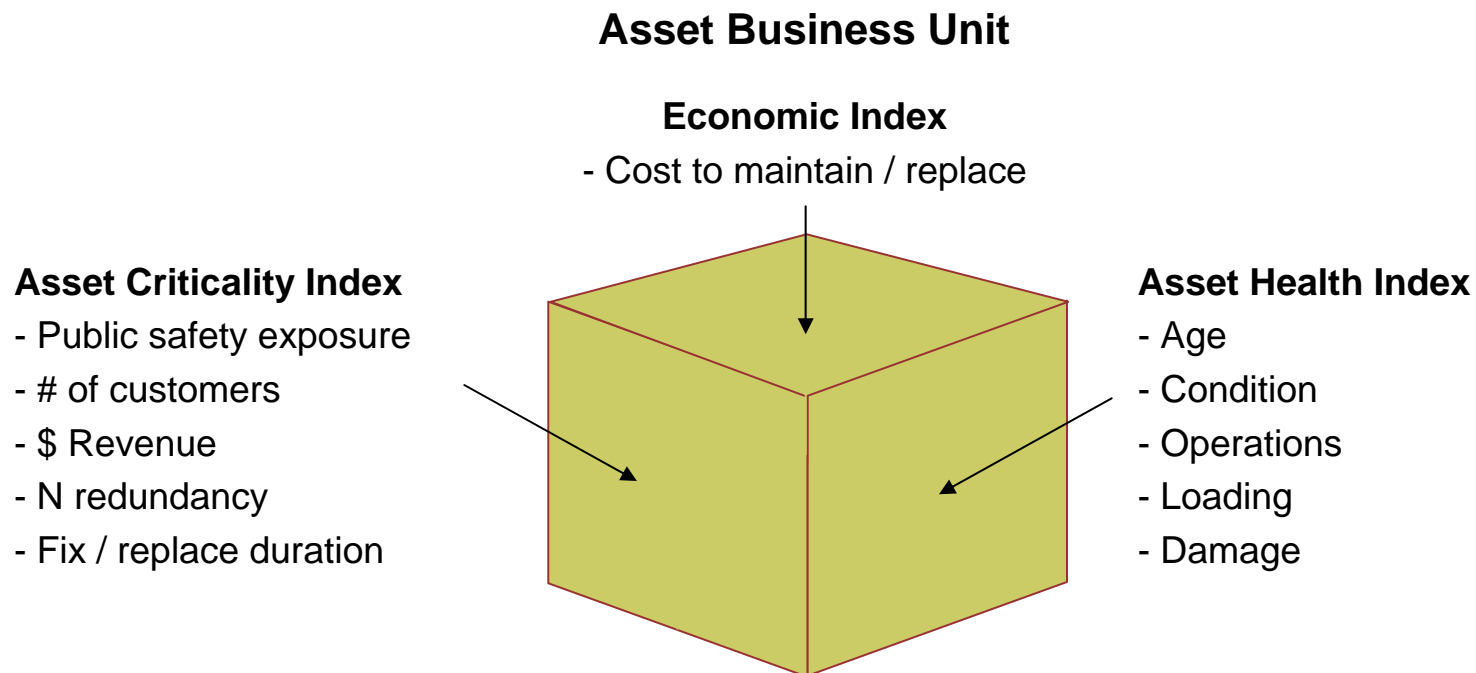
## Suggested Approach

# 2. Align Metrics with Business Objectives

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### ***A Holistic Evaluation Requires Definition of Indices and Performance Metrics***

- The evaluation of an asset as a business unit provides a multi dimensional indicator of maintenance effectiveness and ultimately determines value



## Suggested Approach

# 3. Evaluate A Sample Set

### ***Organize and Evaluate Assets Based on Objectives and Available Data***

- Considerations include equipment, system, subsystem or maintenance program

#### **Distribution Circuit Equipment Risk Analysis Sample Excerpt \***

Component	Equip	Sub Category 1	Sub Category 2	Scenario - 1		Scenario - 2		Risk Indicator
				Reliability Impact	Probability of Failure	Reliability Impact	Probability of Failure	
Mainline 3-P	Splices	PLC		3	4	5	4	240
Mainline 3-P	Wire	Open Wire		3	4	4	5	240
Mainline 3-P	Switch	Load Break	R/C SF6	3	3	4	4	144
Mainline 3-P	Reclosers	Load Break	L/C	3	2	3	3	120
Mainline 3-P	Support	Pole	Wood	3	2	4	3	72
Sideline 1-P	Wire			2	3	2	4	48
Mainline 3-P	Splices	Heat Shrink		2	2	3	2	24
Secondary	Support	Pole	Wood	1	2	2	3	12
Mainline 3-P	Cable	Direct Buried		2	1	4	1	8
Mainline 3-P	Control	Regulator		1	1	1	1	1

\* Excerpt of Distribution Circuit Asset Analysis, includes ~100 line items

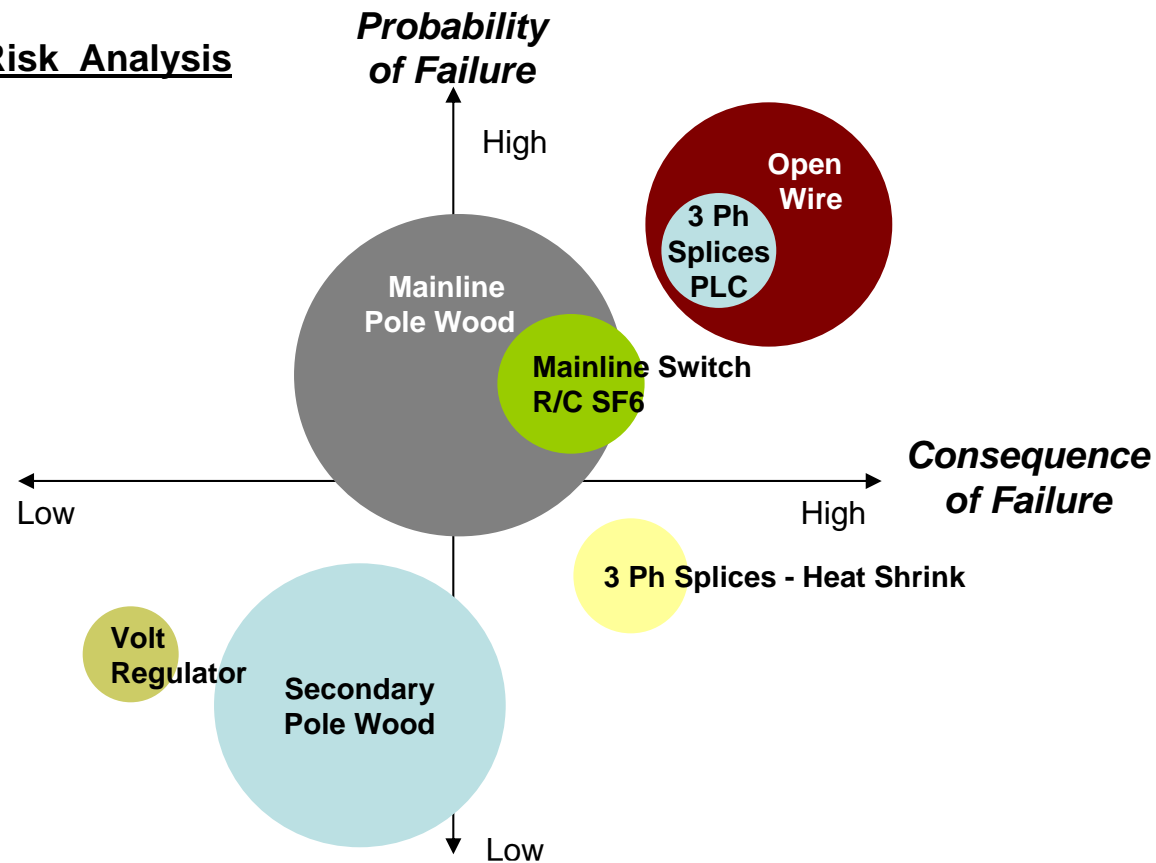
## Suggested Approach

# 4. Identify Pilot Opportunities

### **Select Pilot Opportunities Based on Business Objectives and Ability to Implement**

- Current maintenance scenarios should be included in the pilot to forecast effects

#### Distribution Circuit Risk Analysis

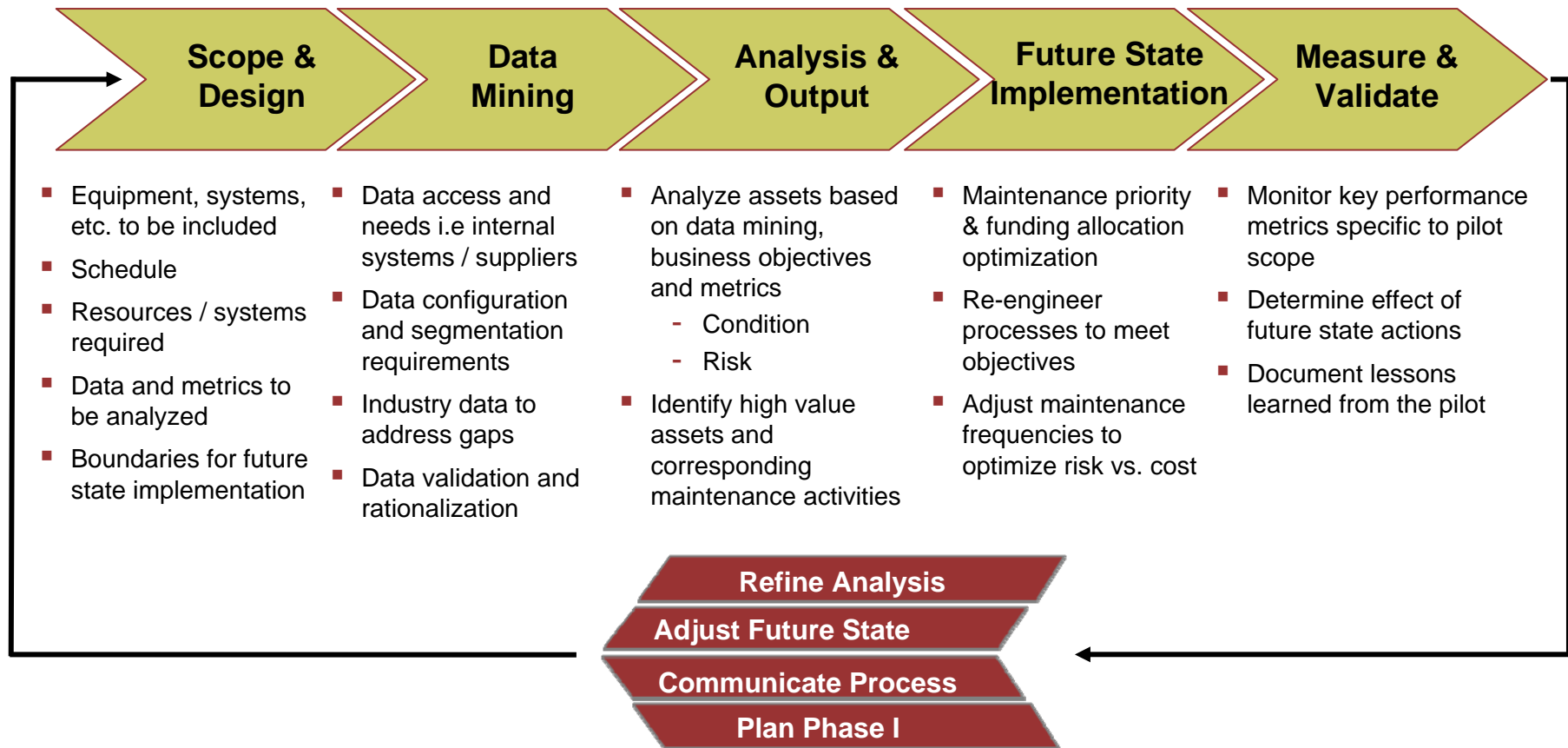


## Suggested Approach

# 5. Design and Implement a Pilot Program

*The Pilot Life Cycle will be Tailored to Address Specific Maintenance Opportunities*

### Equipment Maintenance Pilot

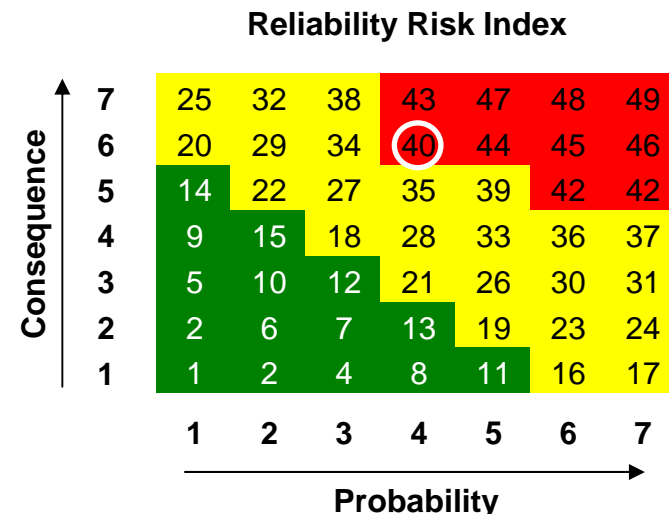
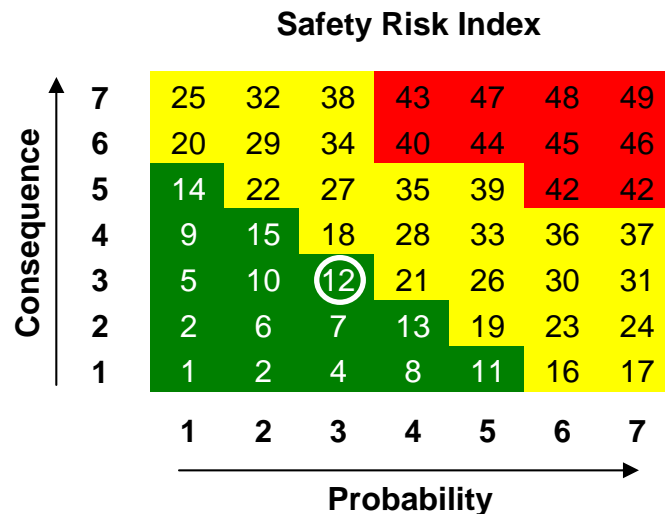


## Suggested Approach

# 6. Build the Future State Model

### ***The Future State of Maintenance Planning and Process Should Incorporate:***

- Uniform processes and tools to evaluate sub transmissions assets or systems
  - *i.e., safety, reliability, condition, environmental impact, maintenance cost*
- A technical approach to determine, monitor, and improve the cost effectiveness of maintenance programs associated with those assets
- A comprehensive and defensible maintenance plan: funding, prioritization, and process



## Conclusion

# Optimization Efforts Provide Increasing Benefits

***Each Step in the Optimization Process can Provide Substantial Benefit***

<b><i>Potential Activities &amp; Deliverables</i></b>	<b><i>Anticipated Benefits</i></b>
Current state assessment	Low hanging fruit / no regrets changes identified
Asset index framework and metrics definition	Uniform comparisons and reporting
Data mining	Data / system gaps identified and addressed Data rich environment for analysis / decision
Asset / Maintenance Analysis <ul style="list-style-type: none"><li>▪ Reliability / Risk</li><li>▪ Condition</li><li>▪ Operating</li></ul>	Nar term reliability improvements Unplanned work and overtime reduced Degradation of assets mitigated Maintenance scope and frequency optimized Defensible activities and budget
Pilot design	Low risk / cost entry to demonstrate benefit
Maintenance optimization framework	Prioritized and scalable platform based on business objectives, pilot and analysis
Maintenance process re-engineering	Systematic implementation for change that aligns with framework, prioritization, and risk



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