Reliability Management: Get the Basics Right

Sandia National Laboratories 2009 Wind Turbine Reliability Workshop

Horizon Wind Energy

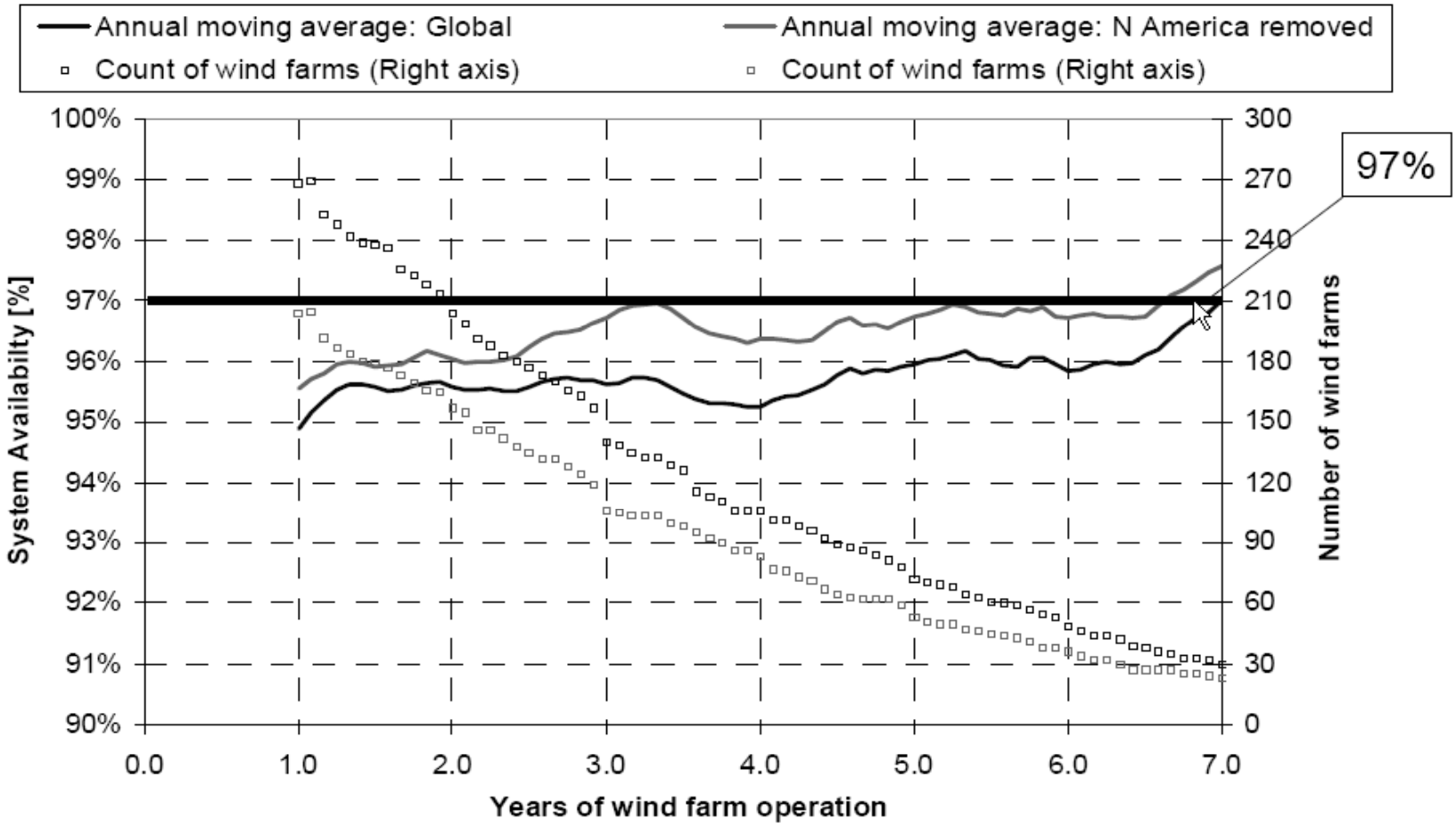
An EDP Renewables Company

Antonio Coutinho, Chief Energy Management Officer

Albuquerque, NM

June 18, 2009

The US has on average lower availability than Europe



Source: Garrad Hassan

There are several possible explanations for this phenomenon

Resource Explanation

- 50% higher NCF
- Extreme weather
- Turbulence

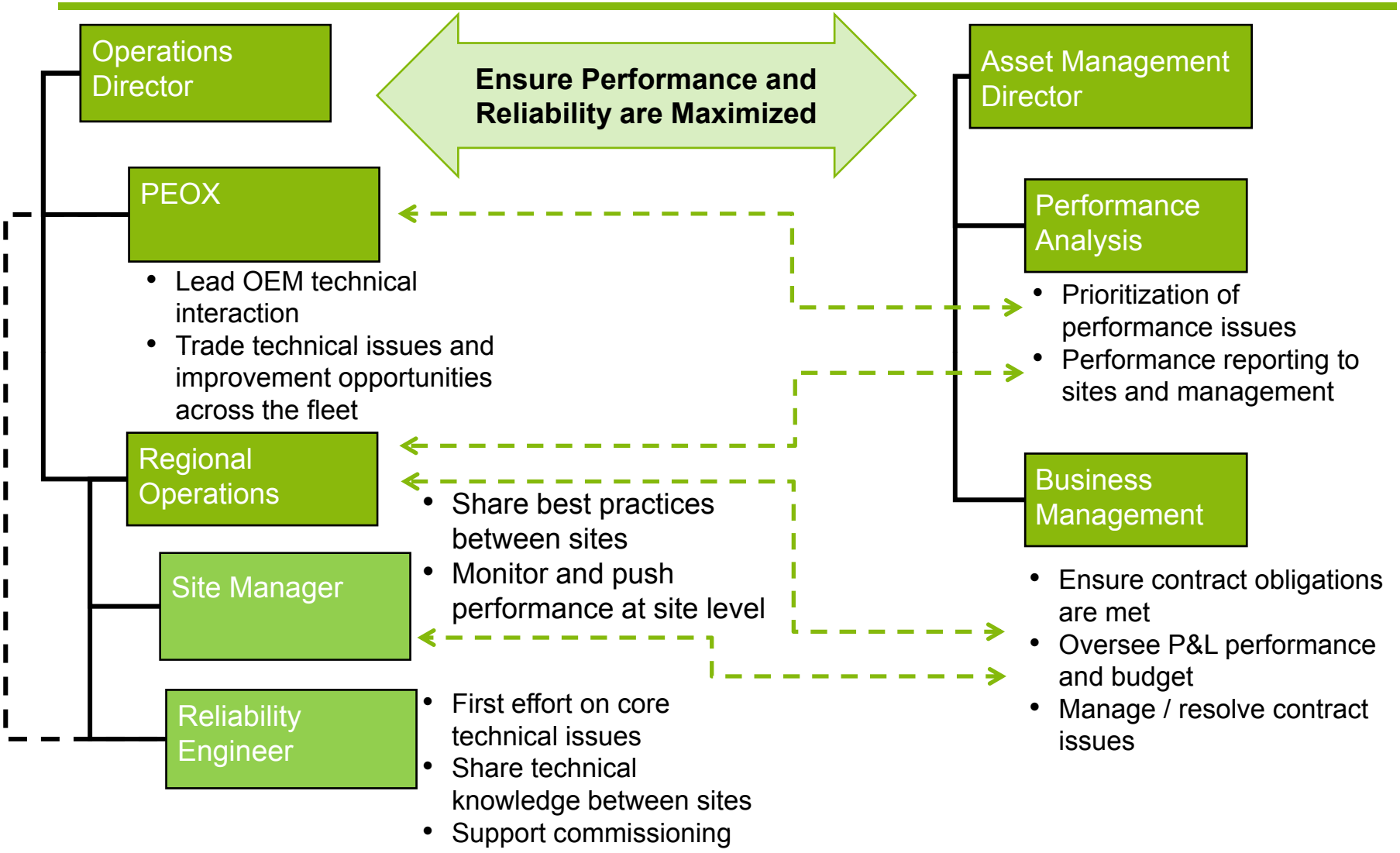
Market Explanation

- Industry less mature
- 45% growth in 2 years
- Less qualified labor
- Wind farms more remote

“Getting the basics right” is the first lever to pull on improving reliability

Organizational Structure	Organization structured around key processes and escalation points to ensure timely issues resolution
Standard Operating Procedures	Standard operating procedures to create accountability and accelerate response to unplanned events
Performance Focused Analytics	Analytic processes in place to manage the day to day activities and the longer term issues and initiatives
Technical Partnering & Active Contract Management	Technical Partnering & Active Contract Management ensure plant performance and fulfillment of contract obligations

Organization is structured around key processes and escalation points to ensure timely issues resolution



Standard Operating Procedures create accountability and accelerate response to unplanned events

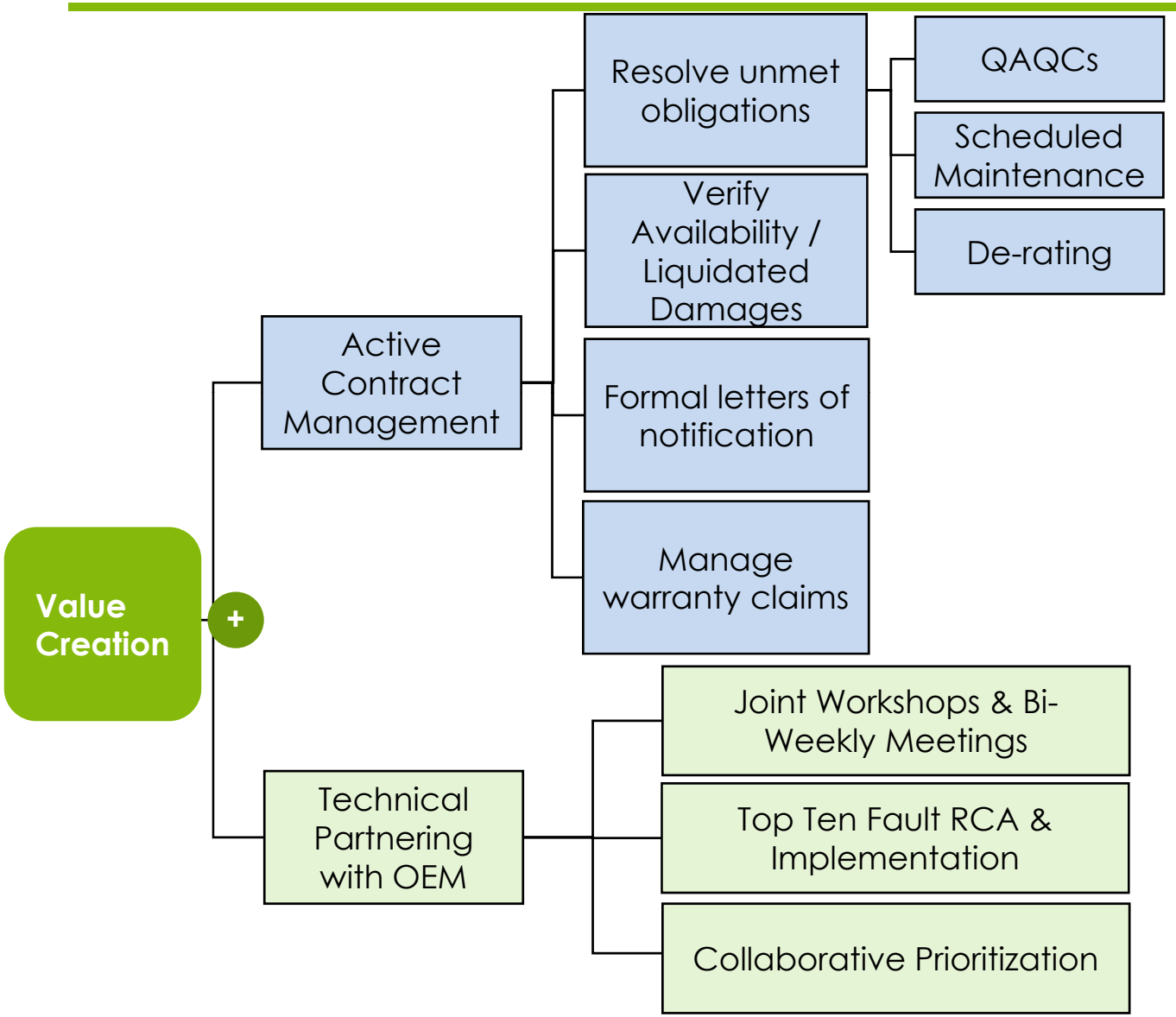
Standard Operating Procedures

1. Managing the Site Successfully
2. Ensuring Excellence in O&M
3. Reporting Timely and Accurately
4. Responding to Incidents & Safety Events
5. Complying to Regulations

Results

- **Clear accountability** within Horizon and the maintenance provider
- **Quick on-boarding** of resources
- Increased turbine and BOP **maintenance quality**
- **Fast response** to unplanned turbine and BOP events

Technical Partnering & Active Contract Management ensure plant performance and fulfillment of contract obligations



Results

> 50 contractual letters written in 2009

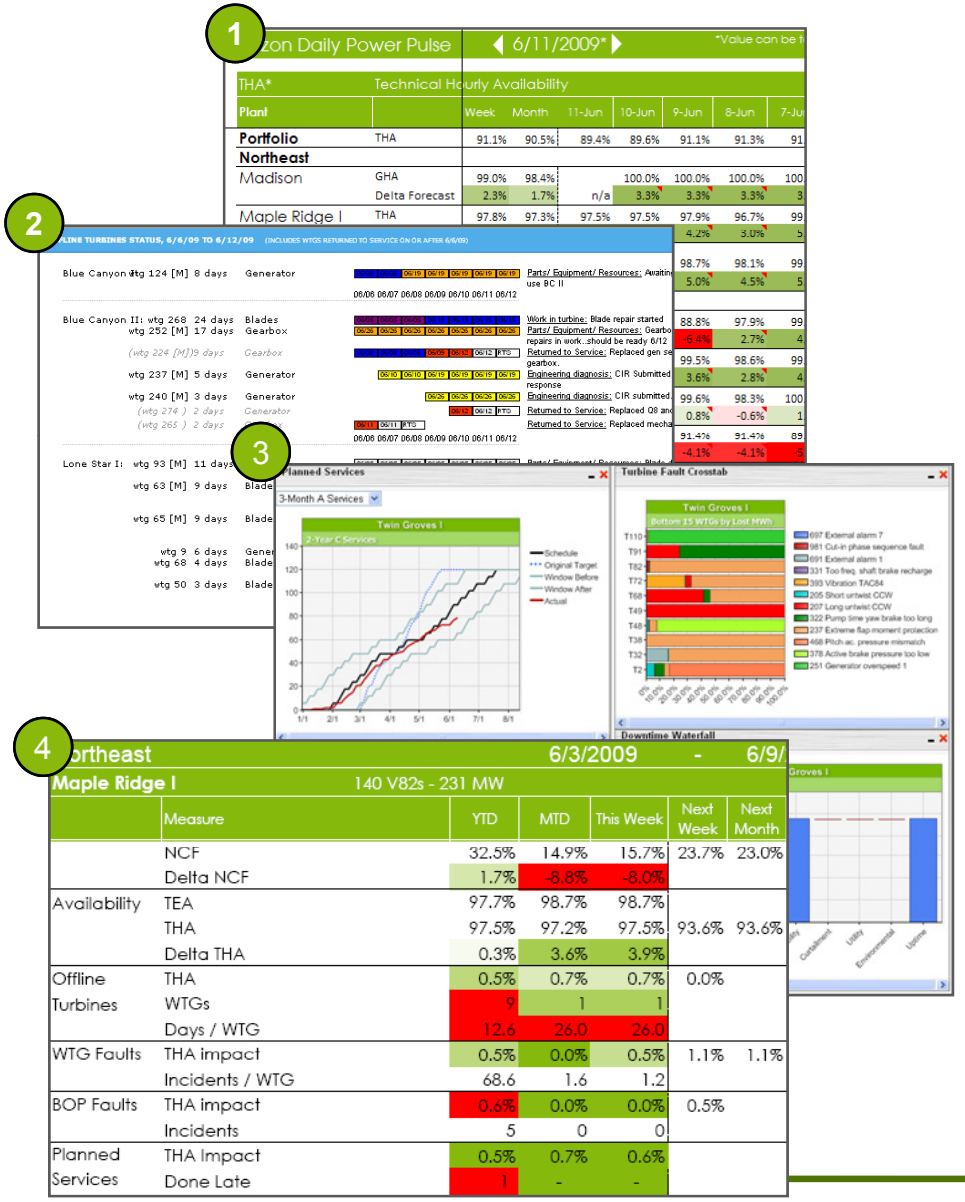
Issues receive prompt attention

Contract obligations are met timely

Maintenance and warranty work is of high quality

Turbine and Plant performance improves

Analytic processes are in place to manage the day to day activities…



Key Highlights

1 Daily Power Pulse

- **Availability** & key issues at sites
- Down turbines

2 Offline Turbine Database

- **Turbines do not wait offline unknown** – knowledge is transparent across organization
- More leverage with manufacturer due to hard data on days spent waiting for parts, etc

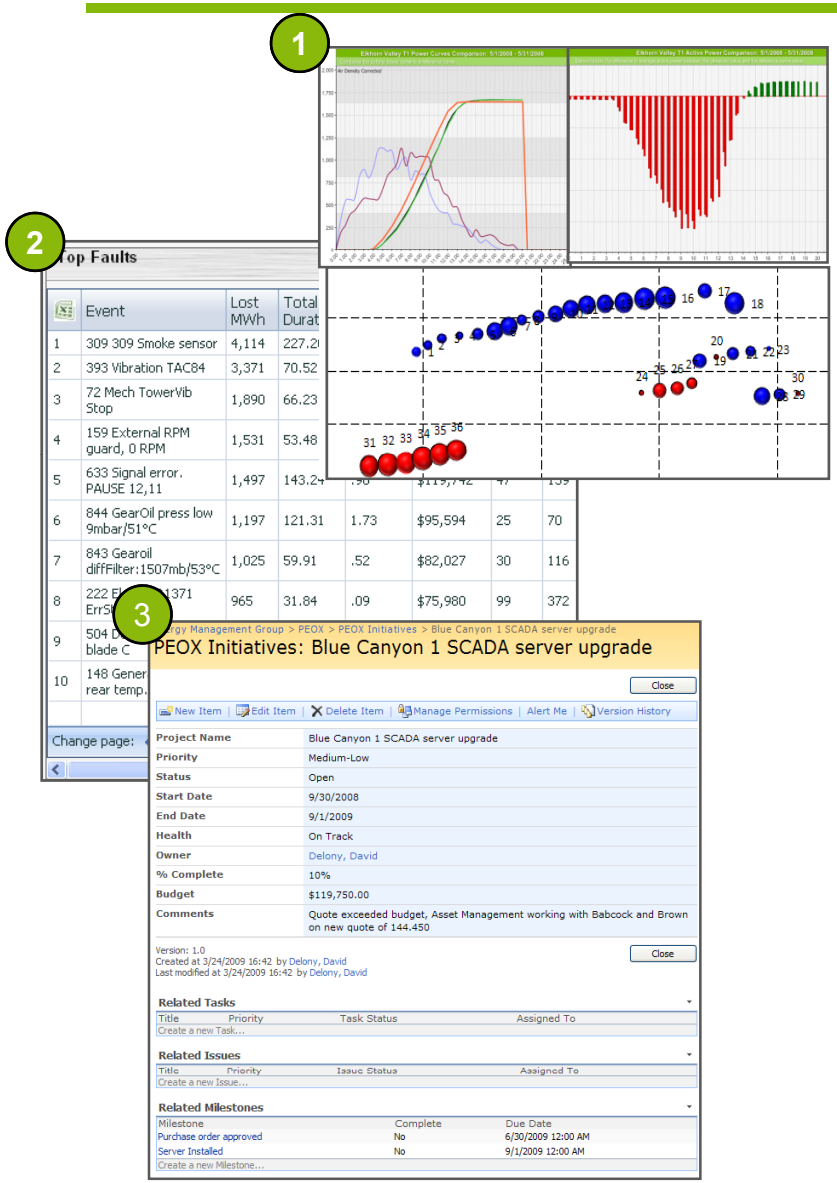
3 Performance Dashboard

- **Monitor scheduled services**
- Recent fault history

4 Weekly Report

- **Key Performance Indicators** reviewed
- Sites can quickly prioritize top faults
- Weekly discussion among site managers disperses knowledge across organization

…and the longer term issues and initiatives



Key Highlights

1 Efficiency Analysis

- Identify underperforming turbines
- Investigate de-rates, periods of unexplained performance

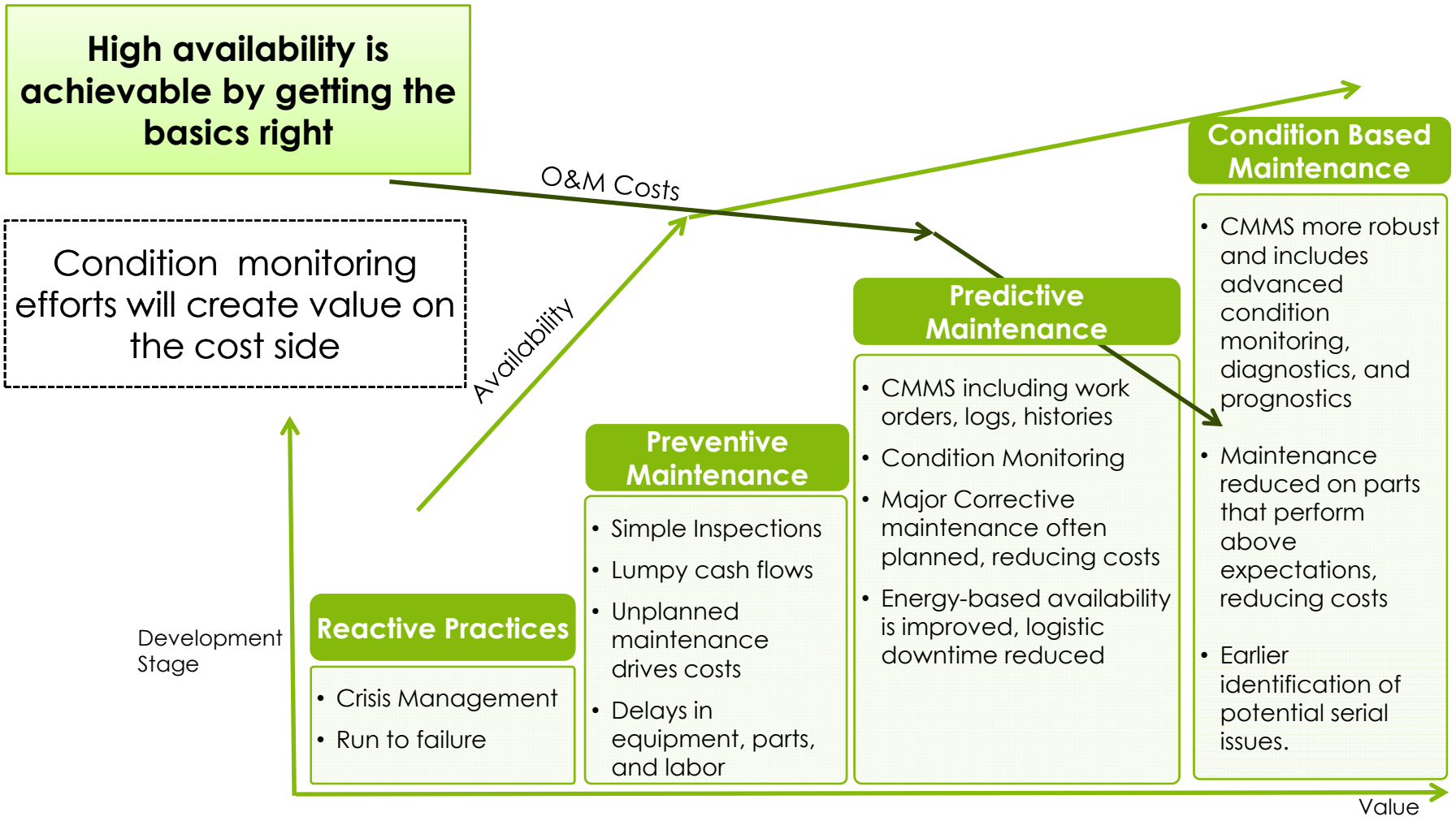
2 Top 10 Faults

- Prioritize Top 10 Faults by manufacturer
- Monitor seasonal trends, conduct data analysis to feed root cause analysis

3 Initiative Tracking

- Monitor progress of long-term improvement initiatives
- Tracking in online, collaborative system creates accountability

Proactive infrastructure investment over present-day performance monitoring creates long-term value



Concluding Thoughts

- **Get the basics right and availability will go up**
  - Organizational Structure
  - Standard Operating Procedures
  - Performance Analysis
  - Technical Partnering
  - Active Contract Management

- **Market factors will improve over time**
  - Industry is maturing
  - More data history
  - Work force gaining experience

- **"Next Wave" of Condition Monitoring will bring down costs**