



Reliability Management: Get the Basics Right

Sandia National Laboratories 2009 Wind Turbine Reliability Workshop

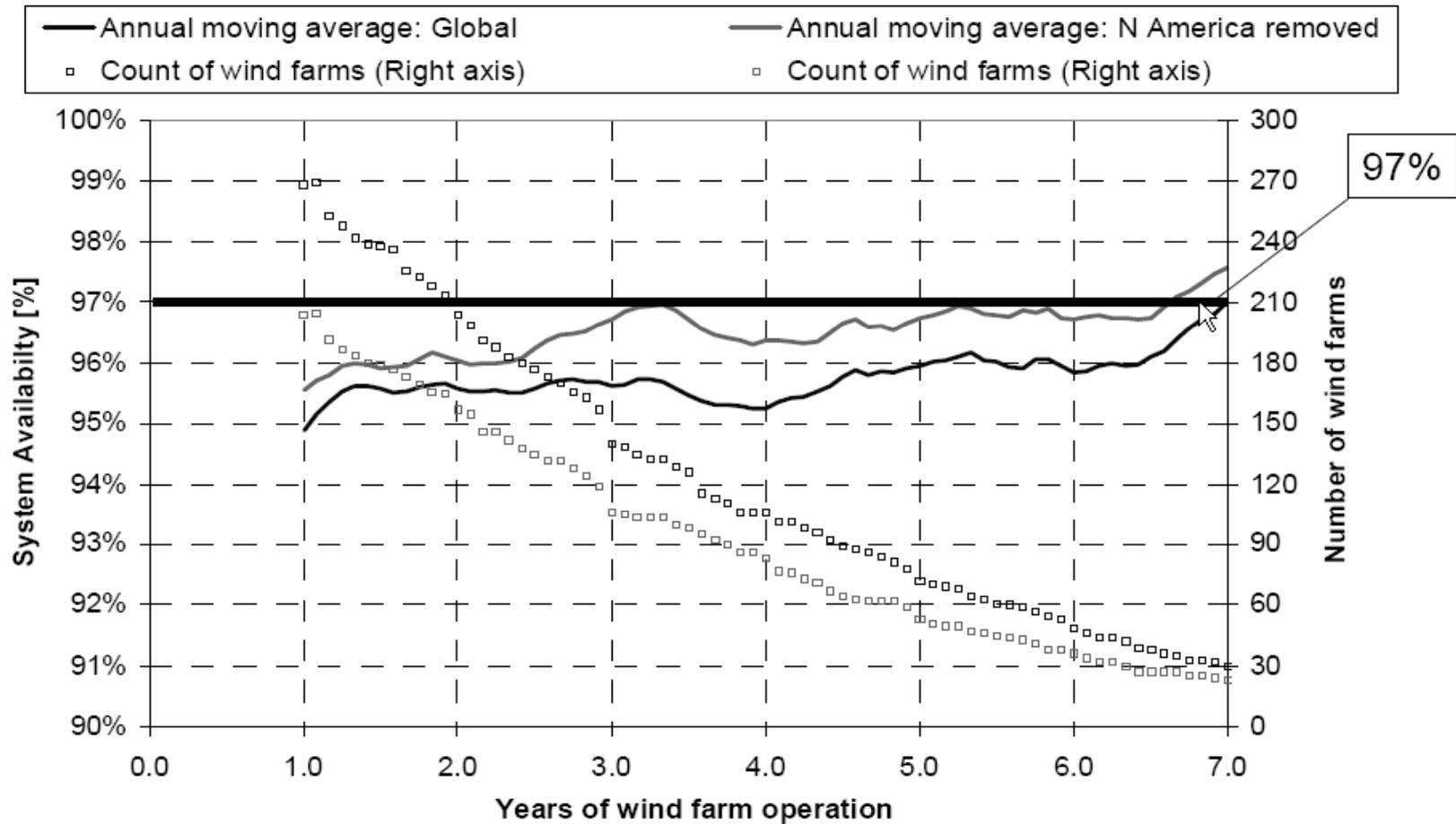


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June 18, 2009

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

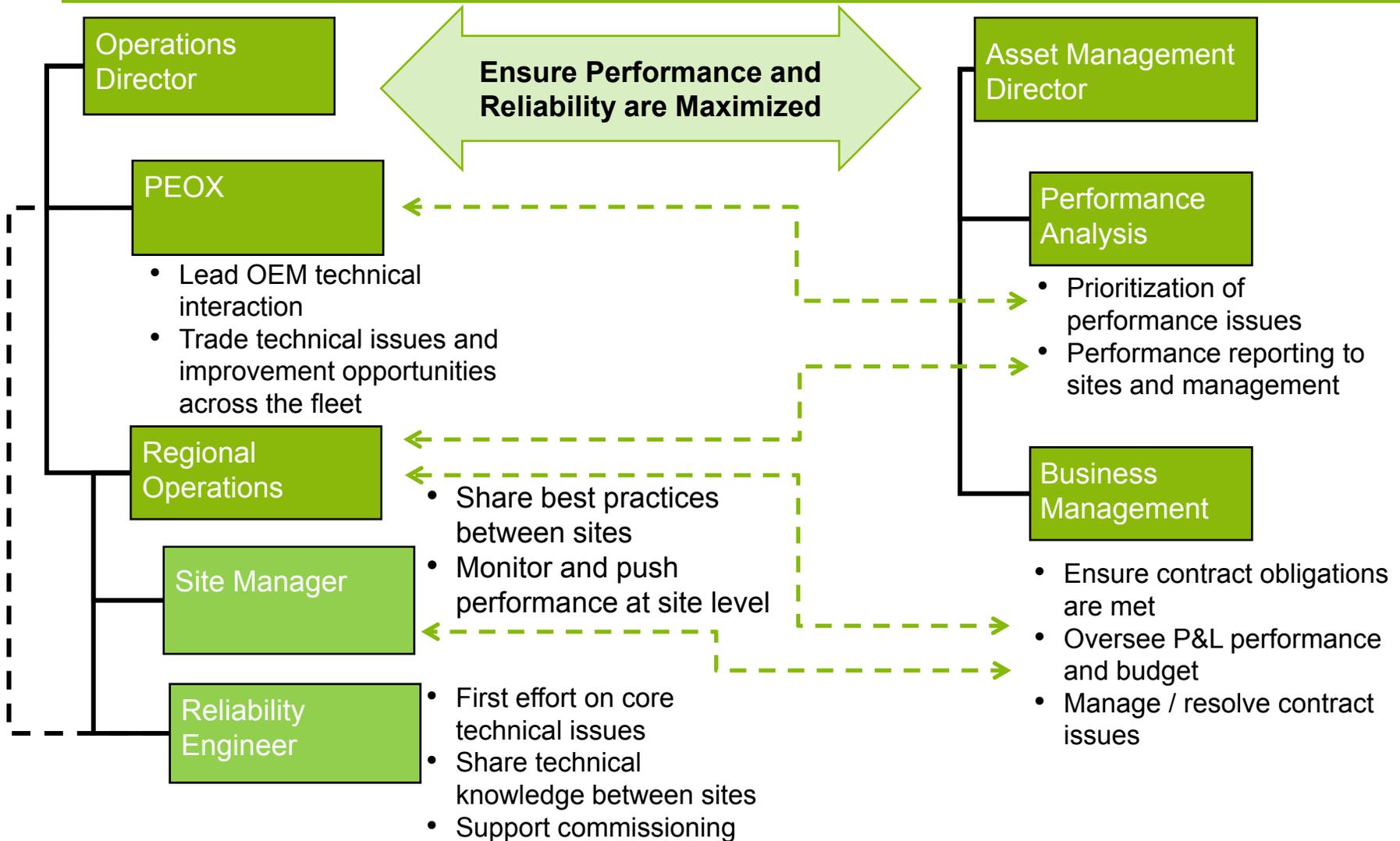
Performance Focused Analytics

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

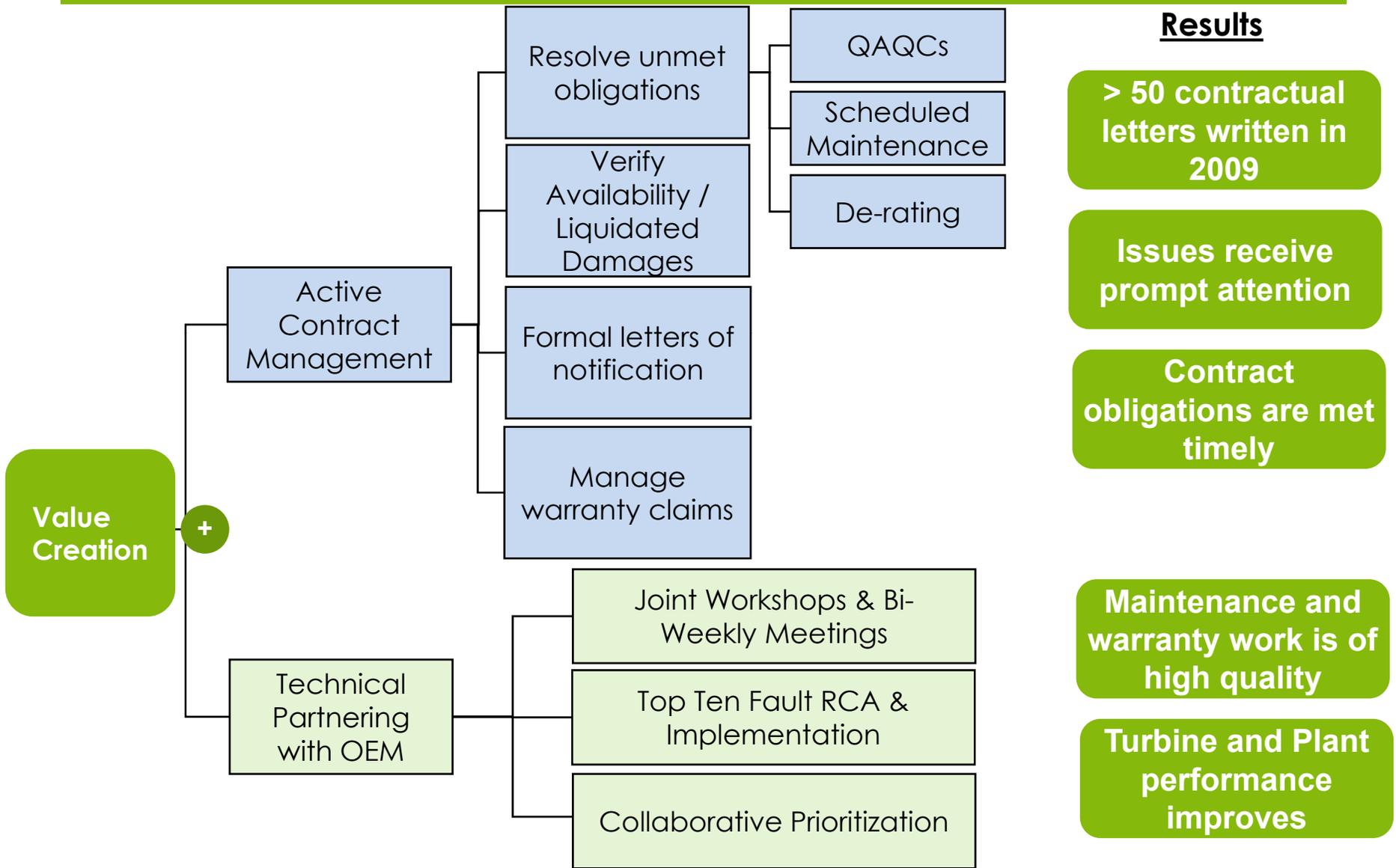
- 1 Managing the Site Successfully
- 2 Ensuring Excellence in O&M
- 3 Reporting Timely and Accurately
- 4 Responding to Incidents & Safety Events
- 5 Complying to Regulations



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



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

1 Horizon Daily Power Pulse

THA*	Technical Hourly Availability							
Plant	THA	Week	Month	11-Jun	10-Jun	9-Jun	8-Jun	7-Jun
Portfolio	THA	91.1%	90.5%	89.4%	89.6%	91.1%	91.3%	91.1%
Northeast								
Madison	GHA	99.0%	98.4%		100.0%	100.0%	100.0%	100
	Delta Forecast	2.3%	1.7%	n/a	3.3%	3.3%	3.3%	3
Maple Ridge I	THA	97.8%	97.3%	97.5%	97.5%	97.9%	96.7%	99

2 OFFLINE TURBINES STATUS, 6/6/09 TO 6/12/09

Plant	WTG	Days	Component	Status	Reason	THA	Delta	Count
Blue Canyon	wtg 124	8 days	Generator	Offline	Parts/ Equipment/ Resources: Avail...	98.7%	98.1%	99
Blue Canyon II	wtg 268	24 days	Blades	Offline	Work in turbine. Blade repair started	88.8%	97.9%	99
	wtg 292	17 days	Gearbox	Offline	Parts/ Equipment/ Resources: Gearbo...	-6.4%	2.7%	4
	wtg 224	19 days	Gearbox	Offline	Returned to Service. Replaced gen se...	99.5%	98.6%	99
	wtg 237	5 days	Generator	Offline	Establishing diagnosis; CIR Submitted	3.6%	2.8%	4
	wtg 240	3 days	Generator	Offline	Establishing diagnosis; CIR submitted	99.6%	98.3%	100
	wtg 274	2 days	Generator	Offline	Returned to Service. Replaced OB and	0.8%	-0.6%	1
	wtg 265	2 days	Generator	Offline	Returned to Service. Replaced mecha...	91.4%	91.4%	89
						-4.1%	-4.1%	-3

3 Landed Services

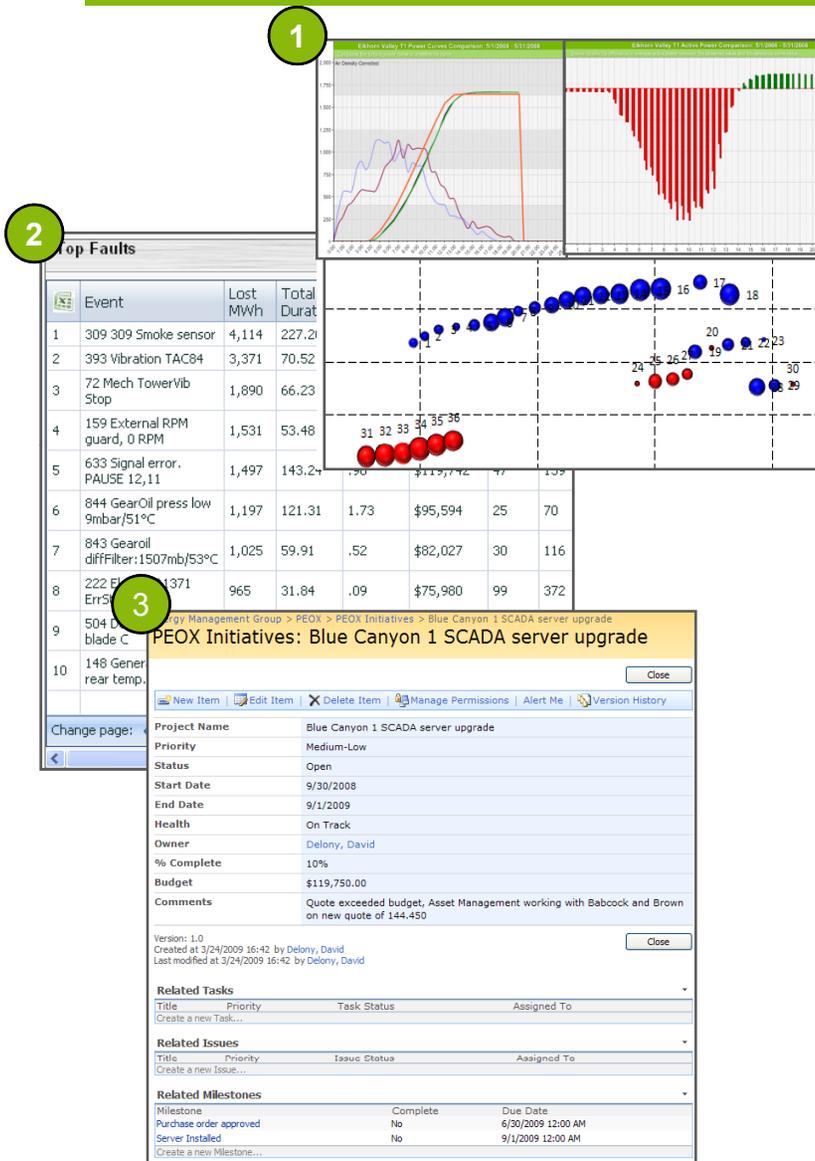
4 Northeast Performance Dashboard

Measure	YTD	MTD	This Week	Next Week	Next Month
NCF	32.5%	14.9%	15.7%	23.7%	23.0%
Delta NCF	1.7%	-8.8%	-8.0%		
Availability TEA	97.7%	98.7%	98.7%		
THA	97.5%	97.2%	97.5%	93.6%	93.6%
Delta THA	0.3%	3.6%	3.9%		
Offline THA	0.5%	0.7%	0.7%	0.0%	
Turbines WTGs	9	1	1		
Days / WTG	12.6	26.0	26.0		
WTG Faults THA impact	0.5%	0.0%	0.5%	1.1%	1.1%
Incidents / WTG	68.6	1.6	1.2		
BOP Faults THA impact	0.6%	0.0%	0.0%	0.5%	
Incidents	5	0	0		
Planned THA Impact	0.5%	0.7%	0.6%		
Services Done Late	1	-	-		

Key Highlights

- Daily Power Pulse**
 - Availability & key issues at sites
 - Down turbines
- 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
- Performance Dashboard**
 - Monitor scheduled services
 - Recent fault history
- 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

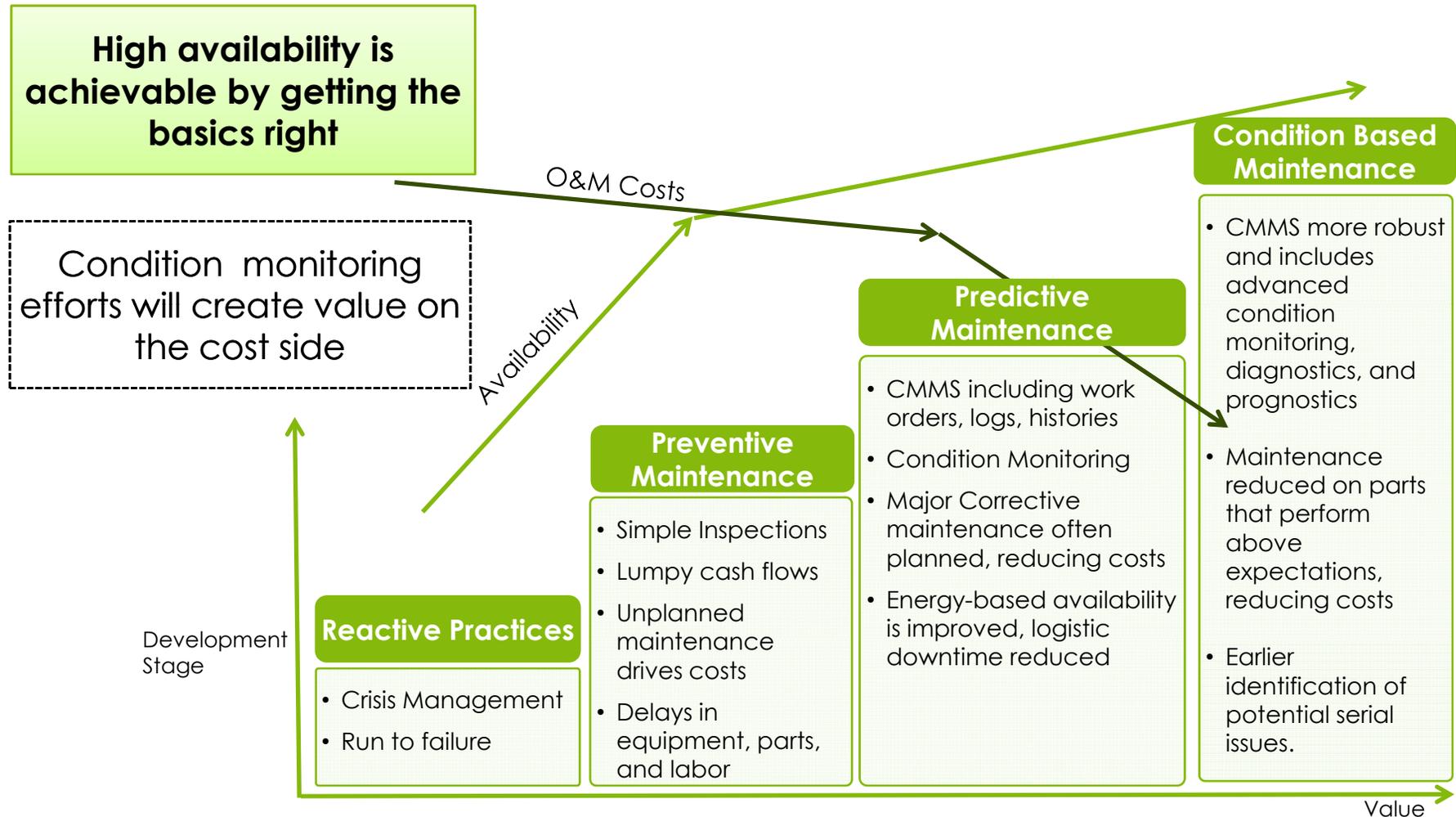
2 Top 10 Faults

- 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**