

Wind O & M Disparities in Approaches by Country

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Introduction

- Poland & Me
 - Whirlpool Corporation
 - Vestas
 - Consulting
 - Investor Groups
 - CEE Fund, Bioseco,.....
- My Experiences
 - Varied (Aerospace, Wind,.....)
 - Not an O & M Expert
 - Broad Exposure to O & M



Motivation & Approach

- Extensive Field Observations
- Wind Farms in Global Locations
- Varied Projects including Personal Injuries, Fire, Performance,..
- Diverse Clients from Investors to EPC and O & M Companies
- Initial Idea of Country by Country Approach
- Eventual Decision to Speak Without National Discrimination
- Keener Focus on Similarities and Differences

Wind Farm Places & Experiences

- Denmark & EU
 - Vestas Tenure
- Germany
 - Multibruid GmbH (AREVA Renewables/Adwen GmbH)
 - Nordex, Enercon, Siemens
- China
 - SANY Group
 - Goldwind
 - NGC Transmission
- India
 - Suzlon & Godrej Industries
- U.S.A.
 - Various Projects (TX, OK, CA, CO, IA, AZ,....)



Data Collection

- Primary Sources
 - Site Visit Observations
 - Maintenance Staff Interviews
 - Questionnaires & Surveys
- Secondary Sources
 - Document Reviews
 - Maintenance Records
 - Reports
 - Literature, Industry Journals,...



Limitations of the Approach

- Purely Qualitative Approach
- Broad in Nature
- Not an Exhaustive Scientific Review
- No Planned Selection of Sites in Advance for Research
- Clients' Projects Set the Course
- Variations in Wind Farm Sizes, Locations, Equipment,...
- Relatively Brief Review of Literature
- Work in Progress

Travel in Time by Country

- Early Days
 - Maintenance as “Evil” Factor
- Middle Ages
 - Technical Matters or Challenges
- Current
 - Profit Contributor



O & M Departments

- Make up of the O & M Staff Surprisingly Similar
- Significant Variation in Department Size vs. Requirements
- Decision Authority Varies by Country
- Data Secrecy and Protections are Variable
- Very Different Approaches to the Same Challenges

Disparities in O & M

- Preventive Maintenance Schedules are Fairly Uniform
 - Actual Tasks Vary by Location and Operation
- Condition Based Maintenance Differs Widely
 - Lubricant Analysis as an Example
- Reliability Centered Maintenance Similar to Aerospace Roots
 - Quantitative Models of Maintenance & Optimization Strategies
 - Commonly Accepted Standards are Exceptions

Some Common Themes

- Maintenance Challenges the Same but Remedies Differ Significantly
 - Gearbox, Hub, Electrical Components,...
 - Some Justified, Weather, Operating Condition,...
 - Variations in Damage Tolerance Prior to Replacement
- Maintenance Related Accidents are Increasing
 - Personal Injury Cases
 - Property Casualty Claims

Global Investor Challenges

- LCOE and Project Comparisons
 - Easier Within Given Country
 - Significant Challenges for Cross Border Investors
 - Variations in Included Items
 - Difficult to Separate Fixed & Variable O & M Cost
 - In depth and Detailed Comparisons Uncover Disparities
 - O & M Cost Increases by Age, Show a Wider Gap by Country
 - Value Analysis Faces Major Obstacles

LCOE Determination Challenges

- Cost Data
 - Limits on Cost Data Sharing
 - Cost or Market Price Indicator
 - Age of Data Inhibits Extrapolations
- O & M Cost and Calculations are Different by Country
- LCOE Contributors Not Identical
 - Included Items Vary
- Industry Wide Consistency Seems Lacking

Final Thoughts

- Main O & M Challenges Identical but Approaches Heavily Differ
- No Generalized O & M Methodology Applied Across Industry
- Variations in O & M Cost Contribute to LCOE Accuracy Reduction
- Significant Challenges Remain for Cross Border Investors
- Better Sharing of O & M Cost & Other Data Very Valuable
- Failure Research Consistently Increasing but
 - Actual O & M Techniques are Less Investigated
- Further Country by Country Research & Comparison Beneficial