



MANAGING RISK

DNV

Reliability in the Field



A consultant's perspective

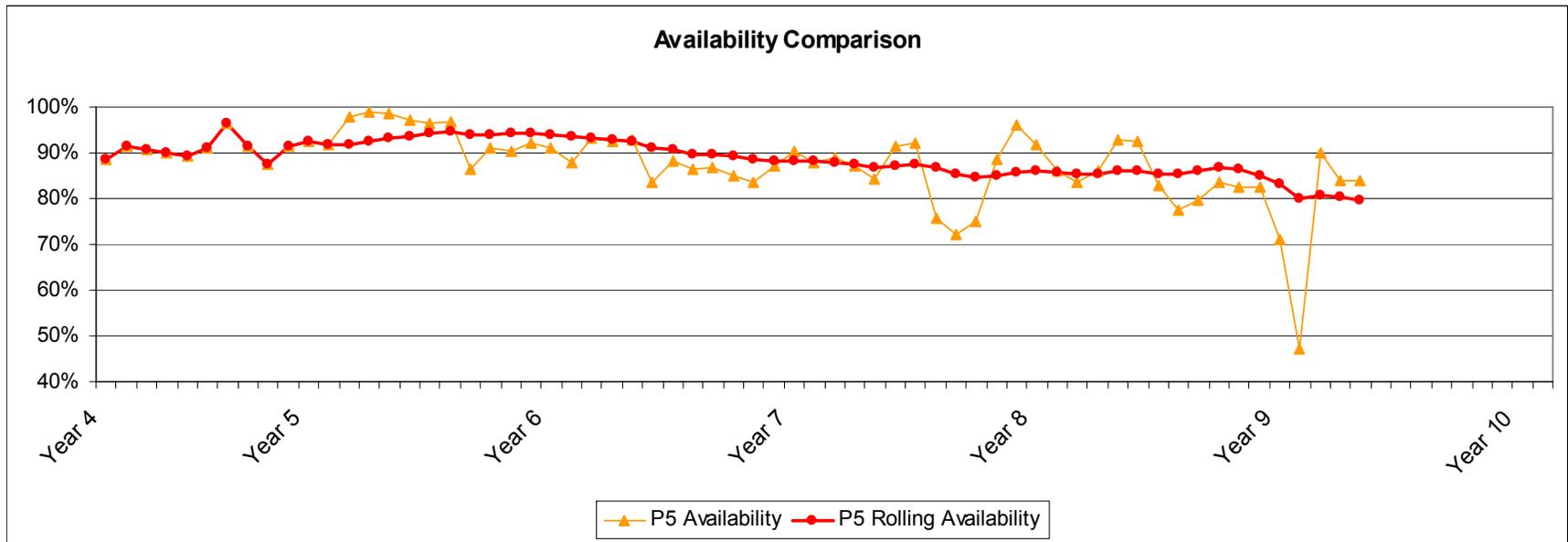
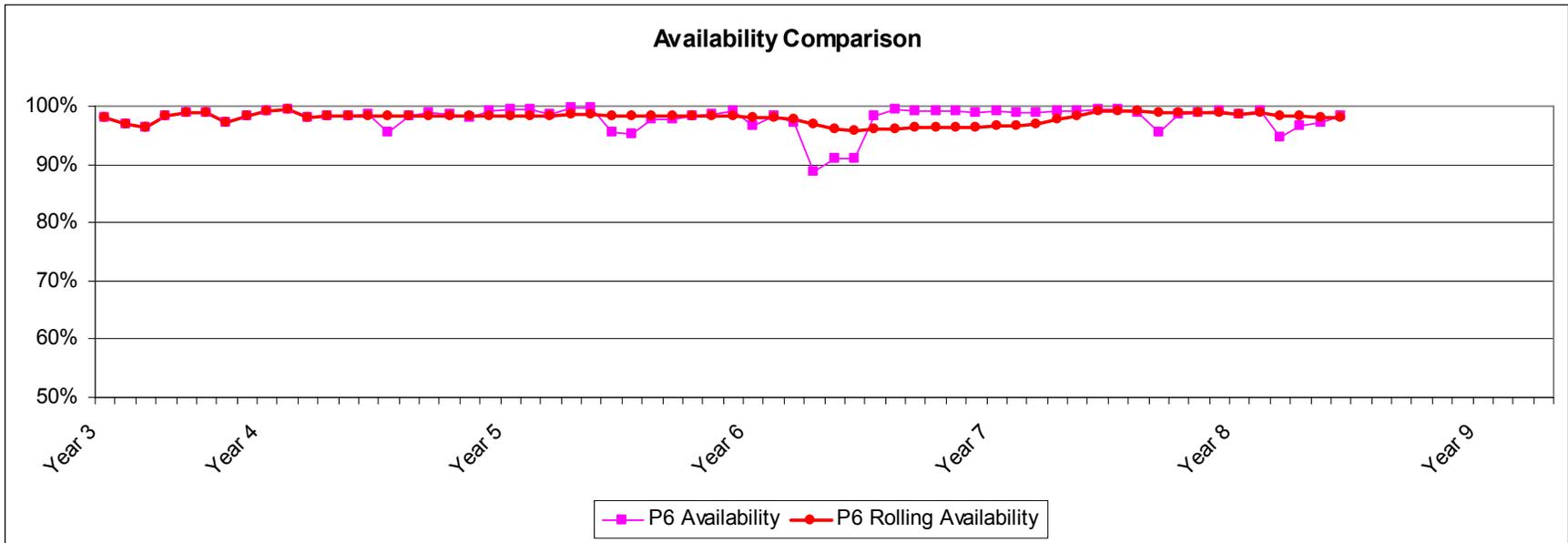
Robert Z. Poore

6/18/2009



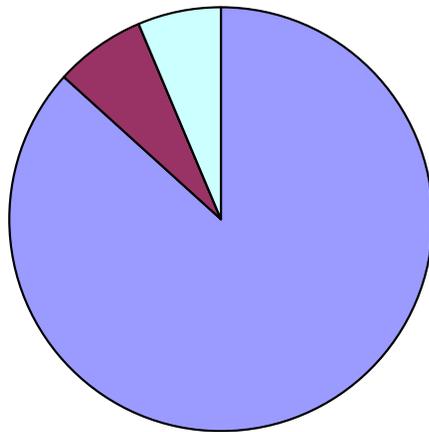
- Wind industry experience
- Reliability data analysis and collection experience – wind and non-wind
- Data sources
 - Multiple projects where we routinely monitor what's happening via collaboration with owners or as the investor's representatives.
 - A range of turbine types, operators and environments

Availability Progression



Manufacturer Downtime

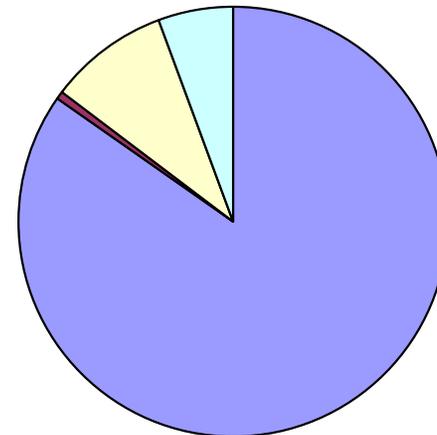
Project 6 Manufacturer Downtime



■ Remaining MNF Downtime (Hrs) ■ Total Blades Downtime (Hrs)
■ Total Gearbox Downtime (Hrs) ■ Total Generator Downtime (Hrs)

Availability = 97.8%

Project 5 Manufacturer Downtime

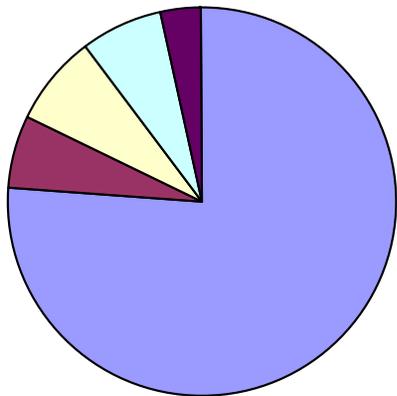


■ Remaining MNF Downtime (Hrs) ■ Total Blades Downtime (Hrs)
■ Total Gearbox Downtime (Hrs) ■ Total Generator Downtime (Hrs)

Availability = 87.7%

Manufacturer Downtime

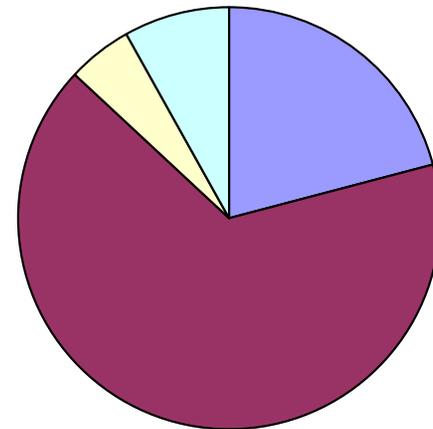
Project 2 Manufacturer Downtime



■ Remaining MNF Downtime (Hrs) ■ Total Blades Downtime (Hrs)
■ Total Gearbox Downtime (Hrs) ■ Total Generator Downtime (Hrs)
■ Total IGBT Downtime (Hrs)

86.0%

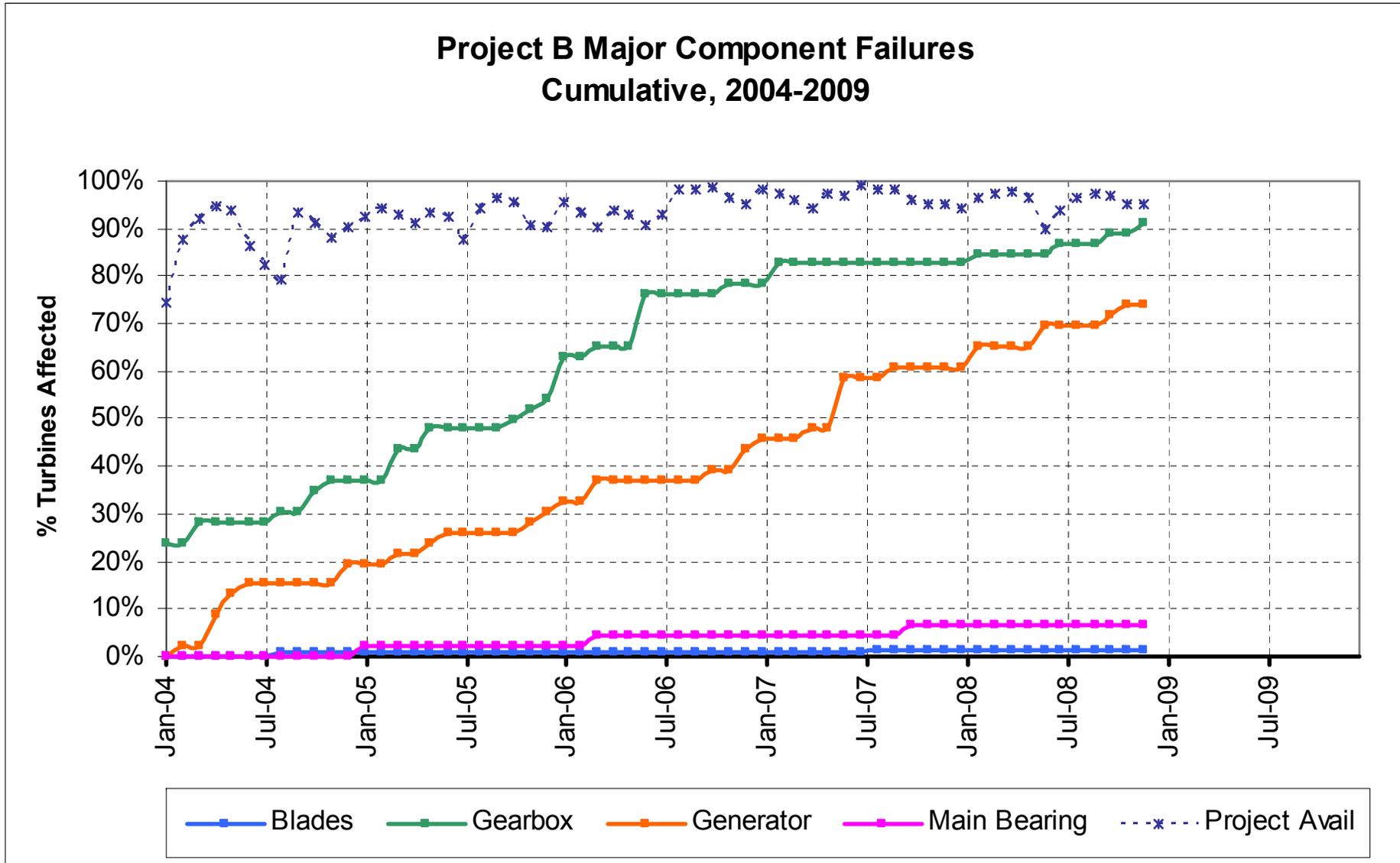
Project 3 Manufacturer Downtime



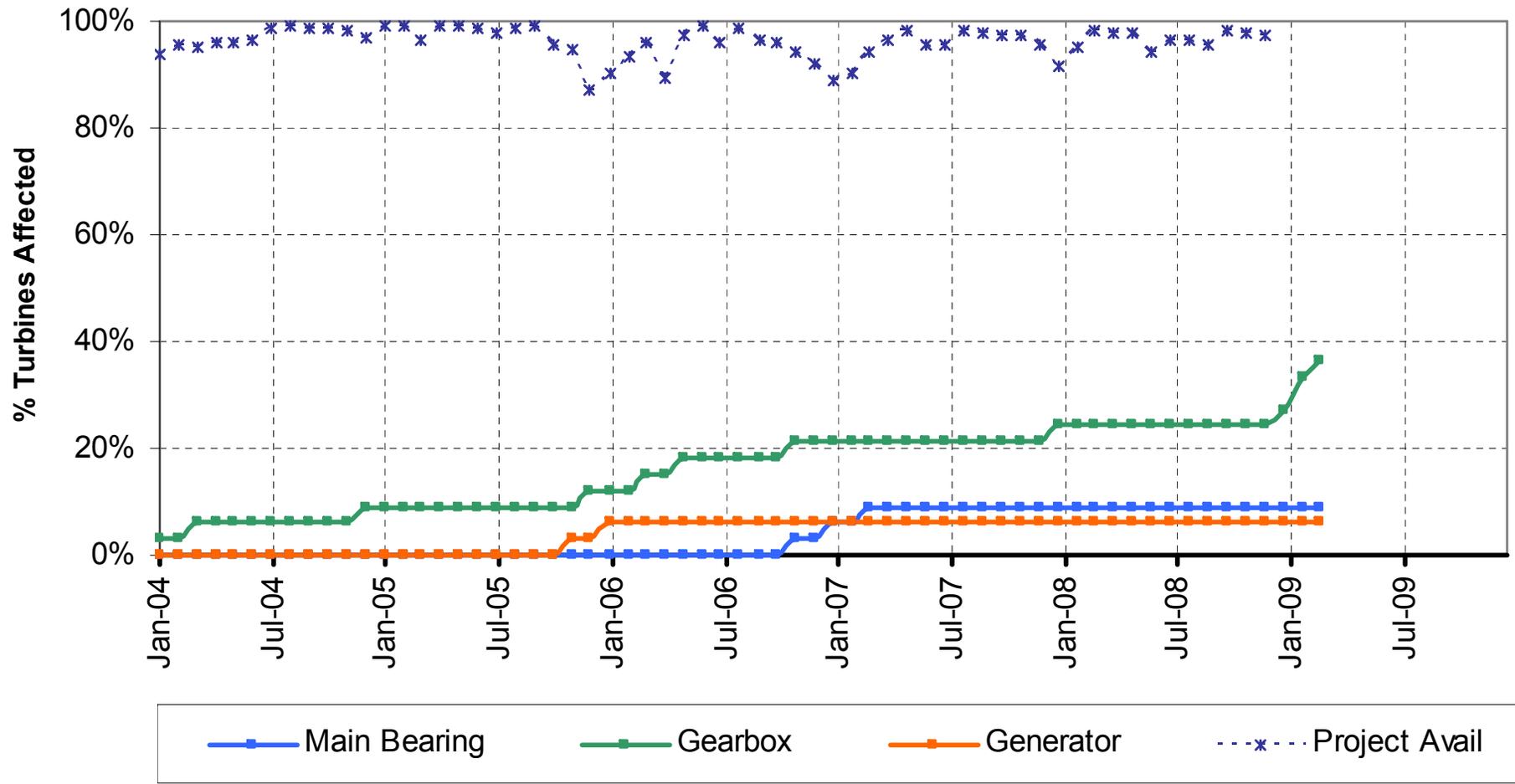
■ Remaining MNF Downtime (Hrs) ■ Total Blades Downtime (Hrs)
■ Total Gearbox Downtime (Hrs) ■ Total Generator Downtime (Hrs)

90.8%

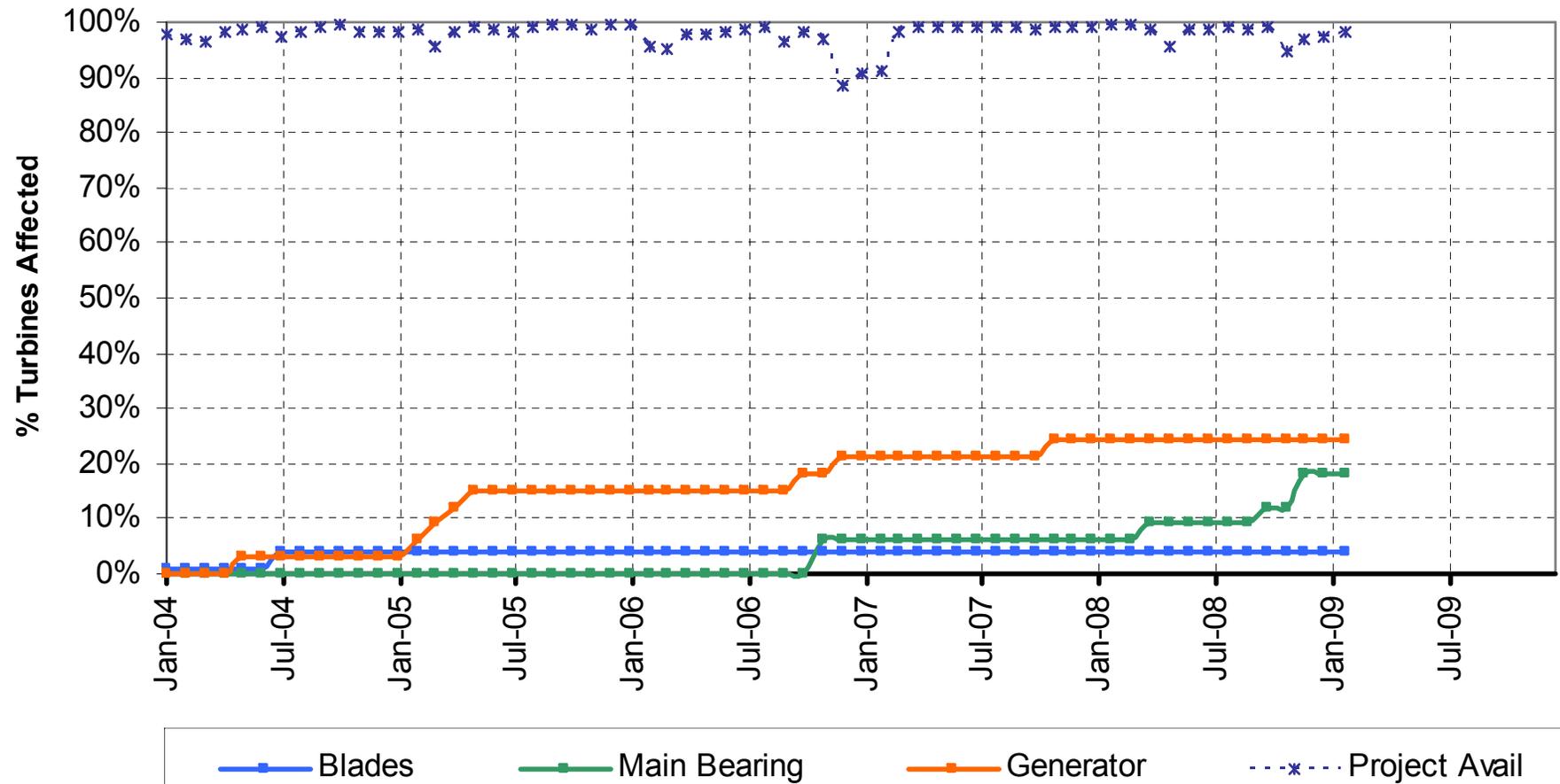
One project's major component history



Project A Major Component Failures Cumulative, 2004-2009



Project C Major Component Failures Cumulative, 2004-2009



- Averages and generalizations are useful, but can be dangerous
 - Challenges are frequently highly project specific
 - Major component problems not the only source of poor availability
 - All gearbox failures are not the same
 - Availability trends can vary widely
 - 20 year life
- Manufacturing defects are an important contributor to the industry's reliability challenges
- Good operators make bad turbines look good and vice versa!
- GOOD statistical analysis without GOOD data is impossible - "GIGO"
- A well defined, common taxonomy is an essential foundation to developing good data
- Need to understanding WHY we want the data – high level knowledge or detailed understanding – different strategies may be appropriate
- Broad, easy access to data is essential to maximize value to industry
- We are not facing a new set of problems!

Wind Industry (Our) Objectives?

■ Improve safety

- by providing experience and data on risks

■ Improve reliability and availability

- by use of reliability data to select most reliable equipment and configuration, and reveal weak designs for future improvement

■ Improve maintenance effectiveness

- by using failure data to refine maintenance strategies

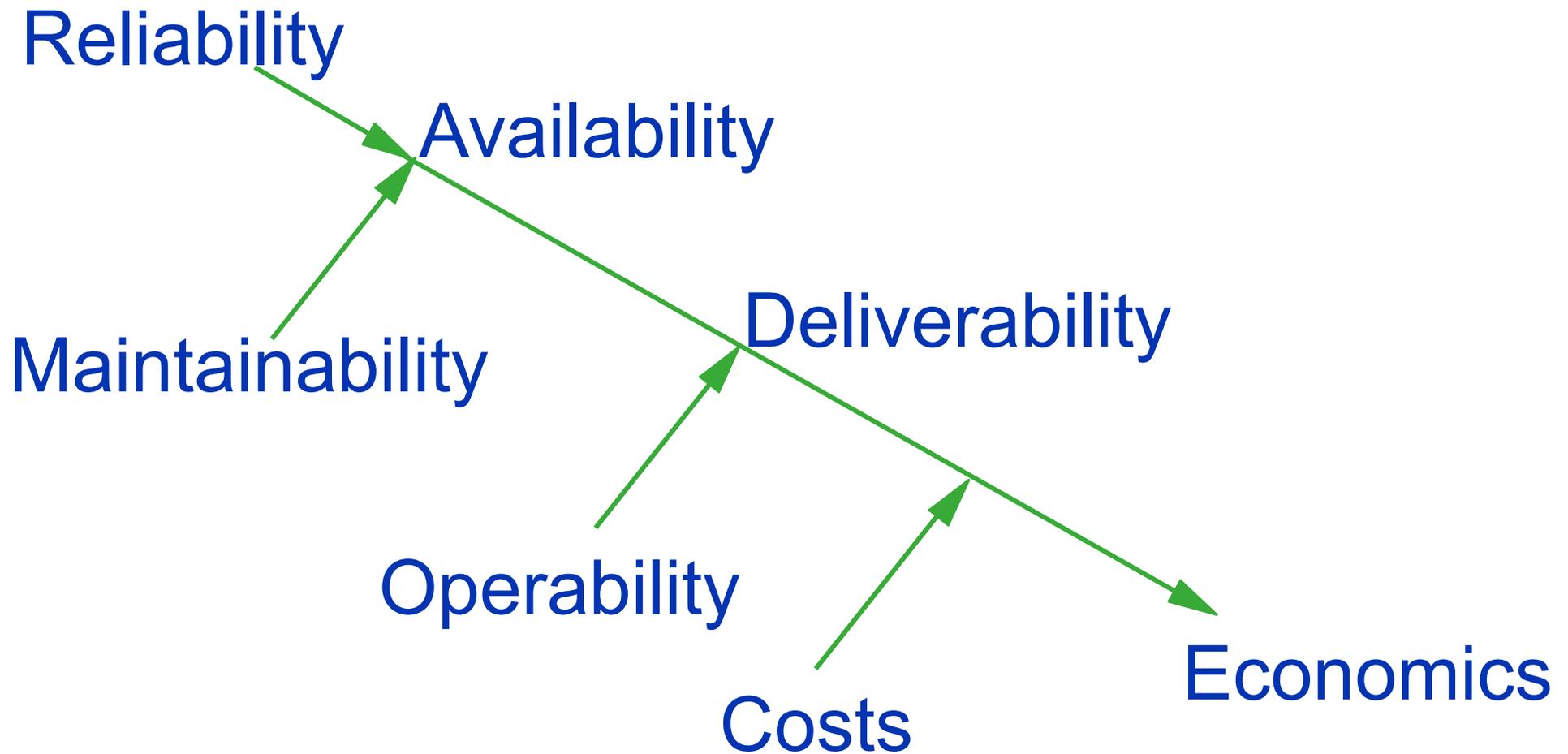
■ Enhance industry reputation

- by demonstrating a high degree of understanding of equipment performance and characteristics

General Objectives of the Offshore Reliability and Data project (OREDA)

- A Joint Industry project in which major oil companies COLLABERATE to understand reliability of offshore oil production. Running over 20 years

Wind Project Performance Simulation ?





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