Condition monitoring of onshore wind turbines: independent thinking
BVG Associates

Market analysis & business development
- Supply chain development
- Economic impact assessment
- Support to industrialisation

Technical innovation & engineering analysis
- Support to investment in technology
- R&D programme management
- Design and engineering services

Project implementation
- FIT project development (UK only)
- SCADA & condition monitoring
- O&M technical support

Technical education
Scope

- Recent trends
- Market situation
- Purpose and cost
- What it’s good and not good at
- Typical business case
- Another way
- The ideal
Condition monitoring: recent trends

1. Market for condition monitoring systems has not grown as fast as anticipated 5 years ago
2. All large wind turbine manufacturers are offering independent ‘add on’ systems, especially on multi-MW turbines
3. WTM and others bringing experience from other sectors
4. Technical trend towards:
   - Use of more types of sensor
   - Monitoring more components
   - Analysing data from many turbines, centrally
   - Use of more wind turbine design understanding

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## Condition monitoring: market situation

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(excludes single-sensor type systems based on accelerometers AE, US, oil cleanliness sensing; also analytics only suppliers)
Condition monitoring: purpose & cost

Use
• Fault detection = finding problem (after failure = needs repair)
• Diagnostic = finding cause of problem
• Prognostic = predicting future failure

To
• Enable service crew to address problem:
  • Before failure (ie. minimising maintenance cost & lost revenue)
  • At planned time (eg low wind)
  • On their first visit
• Understand root cause of problem (may feed back to design)
• Minimise engineer input looking at data from multiple sites

Cost
• WT controller & service crew: nothing extra
• CMS: €5-10k + €1-2k/yr
Condition monitoring: what it’s good & not good at

✅ Bearing damage
  • Detect and prognose
  • Gearbox (especially HS stage), main bearing, generator bearings

✅ Gear tooth damage
  • Detect and prognose

✅ Abnormal operation
  • Gross yaw and pitch system defects

❌ Adding up fatigue life from day 1 & predicting date of failure
  (and are unlikely ever to do so)

❌ Diagnosing root cause
  (yet)
Condition monitoring: typical business case

- Pay €X + €Y/year
- Avoid lost revenue of €Z
- Avoid large component replacement cost of €A
  - eg set of bearings instead of complete gearbox
  - 1 service van instead of 4 vans and a crane etc.

- CMS supplier examples always look great
  - Detect the problem
  - Generic reliability data often ‘old’ and generic

- Customers are enjoying benefits
- Payback average 2-8 years
  (looks best for larger turbines & offshore)
Condition Monitoring: another way

- Think differently: combine with condition-based maintenance = focus on the components that need it

- Challenge: Needs more technology understanding = input from WTM or ?
Condition monitoring: the ideal

1. Turbine control system
   - Multiple systems
   - SCADA (inc. service records)

2. Rotor
   - Multiple components
   - Drive
   - Tower

3. Multiple turbines

4. Turbine Design Knowledge

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