



Climate &  
Renewables

# Condition Monitoring An Owners Perspective

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## On-Shore - Historical

Historically we had little or no knowledge of wind turbine drive train condition and developing faults

- `Reactive' maintenance strategy, when it broke, we fixed it.
- Commercial drivers were to make turbines
  - Bigger
  - Better
  - Cheaper
- Turbine models constantly evolving, in effect each new site used 'prototype' machines

**Little focus on improving reliability**

## On-Shore Experience - Effects

Failure rates of key components much higher than expected, spares expensive with long lead times

- Poor reliability of turbines
- Turbine Availability lower than predicted within the financial model
- Op-ex costs higher than expected

**We needed to understand what was happening to our plant**

## On-Shore Experience – Understanding our problems

### Condition Based Monitoring

- Gathering data and information
- Understanding the data
- Identifying problems
- Carrying out in-situ repairs
- Planned removal and replacement of components

### **The move from Reactive to Predictive Maintenance**

## On-Shore Experience – Co-ordinated Approach Complimentary Strategies

- Identify, obtain and store critical spares
- Develop a robust Inspection and Maintenance Strategy
- Develop relationships – Gearbox refurbishments, generator re-winds, lifting operations
- Develop systems to facilitate component change-out

**We needed to move from Boutique to Industrial**

## Off- Shore

Greater need to move to a predictive maintenance strategy

- Larger machines
- Harsher environment
- Challenging logistics
- Availability and costs of specialist vessels

**We have to apply to off-shore the lessons learned on-shore**

## Off Shore – Predictive Maintenance

### Applying the on-shore principles

- Monitor the condition of the drive train, in real time
- Track the development of faults
- Plan for component replacement/repair
- Change out the component – on our terms

**We needed to be in a position to see component damage, predict when component may fail and take the appropriate action.**

## Off Shore – Continuing to Apply the Lessons Learned On-shore Strategy Off-shore

- Spares
- Inspection and Maintenance
- Building and maintaining relationships
- Develop systems to facilitate aggregated component change out

**Condition Based Monitoring will not increase the life of a component but it will significantly reduce the impact of any required intervention**

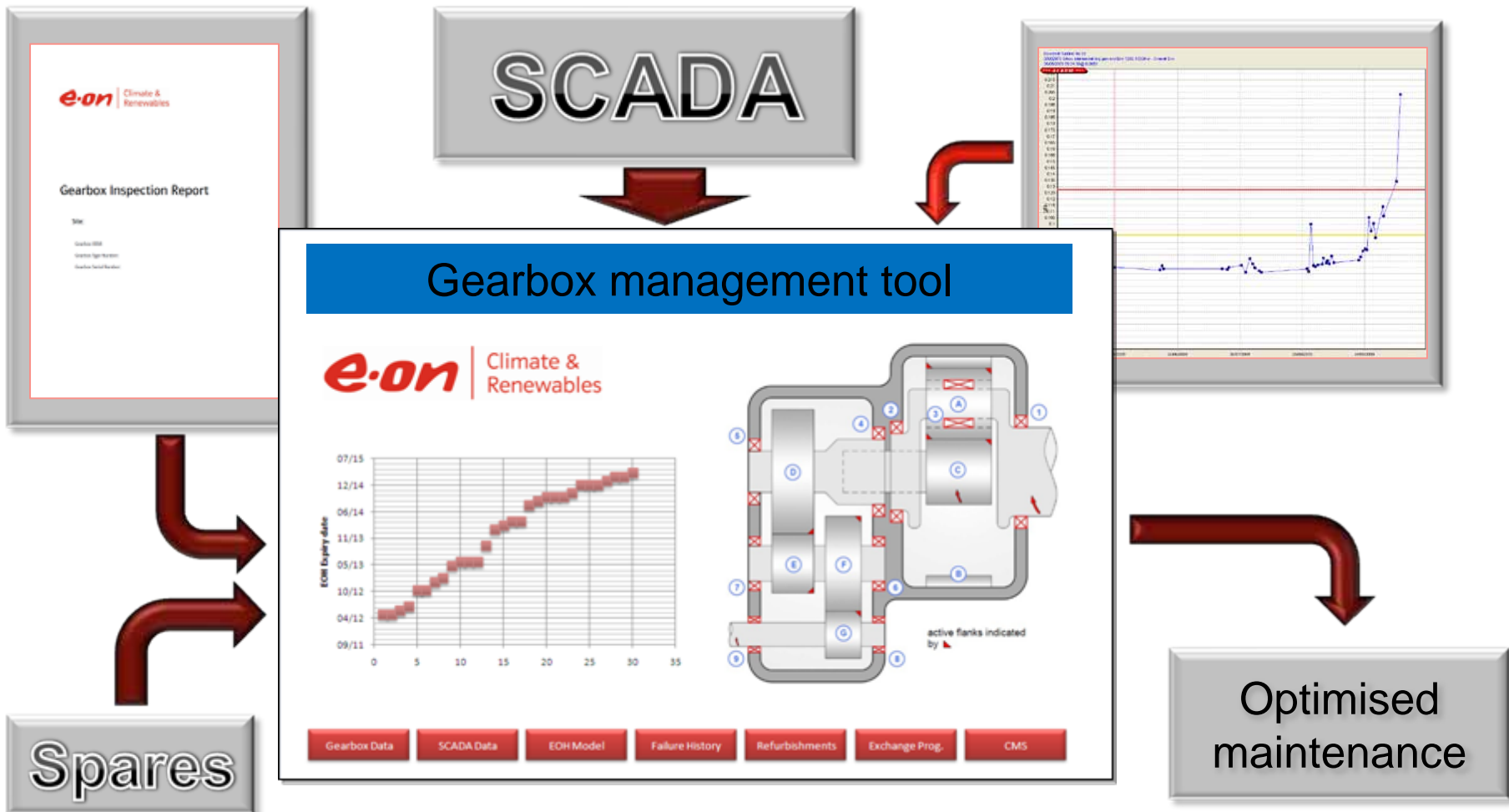
## Off Shore – New Strategies

### Equivalent Operating Hours -EOH

- Standard practice for aircraft, gas turbines and steam turbines
- Optimising gearbox intervention times
- Aggregated component change out
- Optimised use of vessels

**Condition Based Monitoring together with the EOH strategy will help us to achieve our goal of effective Asset Management**

# Integrating all available information



# Overall Drive-train Management Strategy

