

Fleet Leader Concept

Low Cost Load Monitoring for Offshore Wind Farms



Ashish Dewan

dewan@ecn.nl

16/06/2016 @ WTC Rotterdam

www.ecn.nl



Cost reduction of offshore wind

This project focusses on and aims to have most impact on.....

YIELD

CAPEX

OPEX

WACC

What if.....



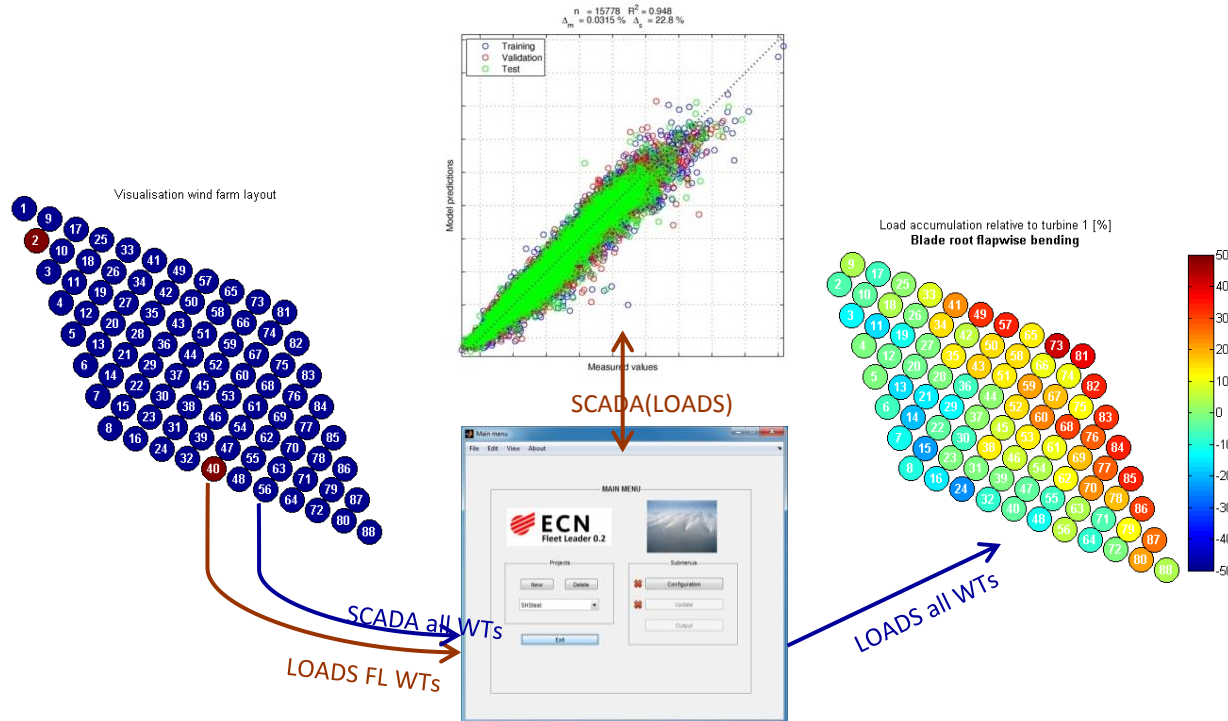
Contents

- Fleet Leader
 - Concept
 - Business Value
- FLOW Project
 - Measurement at Sheringham Shoal wind farm
 - Development of Fleet Leader software
 - Evaluation & Validation of the concept
- Results
 - Blades & Tower
- Current developments
 - JIP Monitor

Fleet Leader: Concept & Business Value

Fleet Leader

Concept



Business Value

Short term

- Root Cause Analysis
 - Understand why failures have happened
 - Improve knowledge on what operating conditions cause most damage
 - Example: Turbines with high fatigue loads in blade: better to park than idle!
- Planning major component replacements (predictive maintenance)
 - Avoid long unexpected downtimes and reduce costs by planning ahead and clustering
 - Example: Plan gearbox replacements in clusters, taking load levels and seasonal weather conditions into account
- End of Warranty
 - Extra focus for end-of-warranty inspections on the most heavily loaded turbines
 - Example: Check for fatigue cracks in blades on turbines with highest fluctuations in the flapwise bending moment

Business Value

Long term

- Decisions when approaching design lifetime
 - Can operation be extended beyond design lifetime?
 - What is the remaining value of our assets?
- A look into the future: Wind Farm Control
 - Take load levels into account when applying wind farm control
 - Balance power production and (fatigue) life consumption

FLOW Project: Objectives & Work package

Flow Project

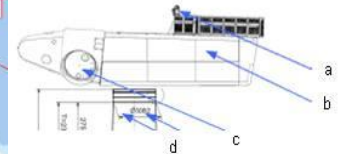
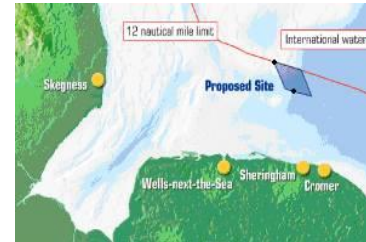
Objectives & Work package

- Main objective: Show that the Fleet Leader concept can be used to influence and steer O&M decisions in a large offshore wind farm
 - Maintenance can be performed according to the actual condition (expected remaining lifetime) of the different wind turbine components
 - This approach contributes to lowering the O&M costs
- Work packages
 - WP 1: Measurement infrastructure
 - WP 2: Development of knowledge for O&M optimisation
 - WP 3: Development of the Fleet Leader software
 - WP 4: Endurance test

Measurement

Instrumentation at Sheringham Shoal

- Data received from Siemens turbines
 - Fastlog (SCADA) data for all turbines
 - Load measurement data for 2 turbines
- Processing of data
 - Resample fastlog data
 - Correction of Yaw direction and Rotor Azimuth
 - Upload data to ECN database

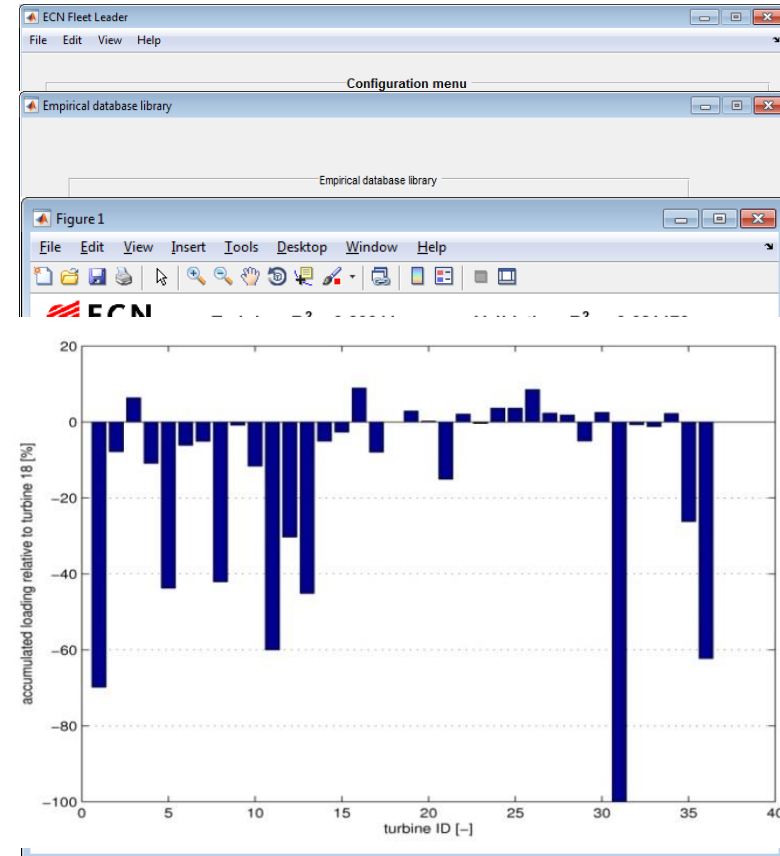


Development

Fleet Leader software



- Import data into software
- Categorise each 10-minute period
 - Turbine operational mode
 - Wake condition
- Check and confirm data quality
- Establish relations between SCADA and LOADS
- Apply relations to predict loads at all turbines in farm
- Compare load accumulation

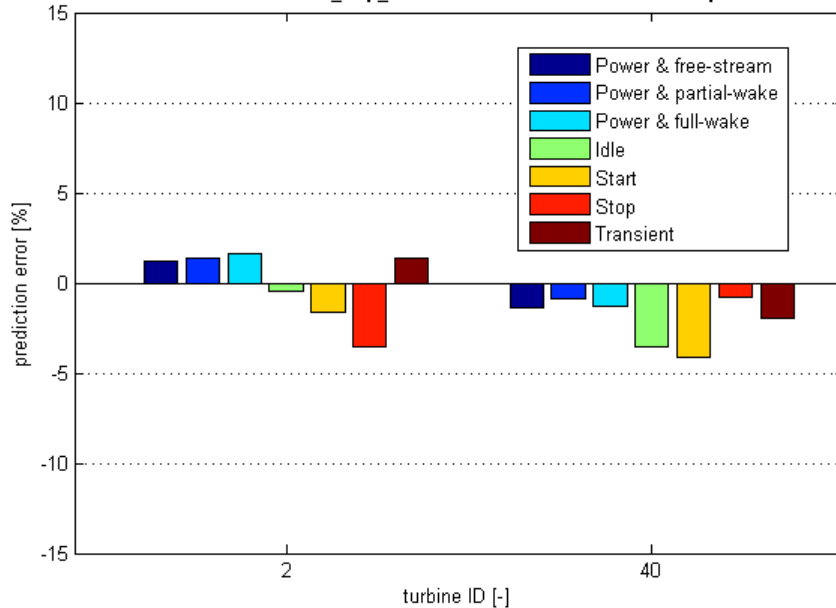


Evaluation

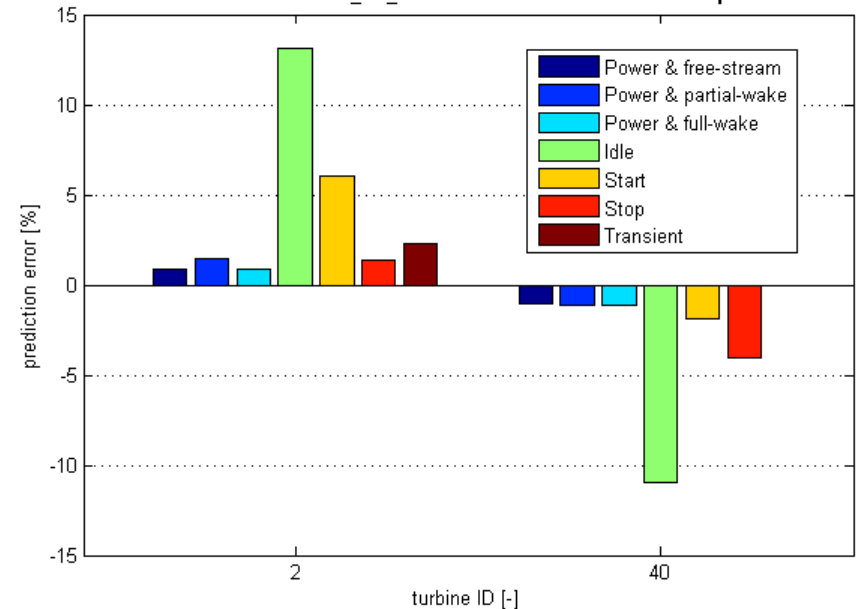
Comparison predicted vs. measured



Difference predicted and measured load accumulation:
Load Indicator: Blx_flap_std for Period: 01-Jan-2013 - 01-Sep-2014



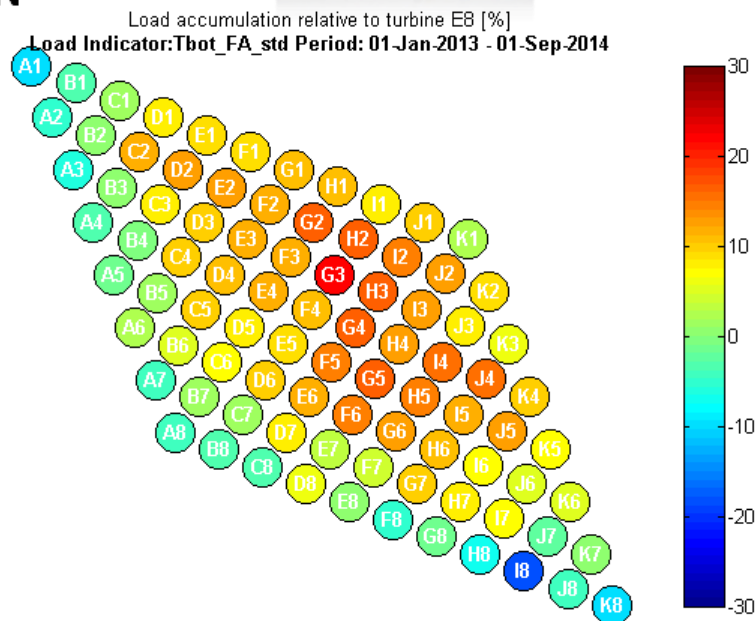
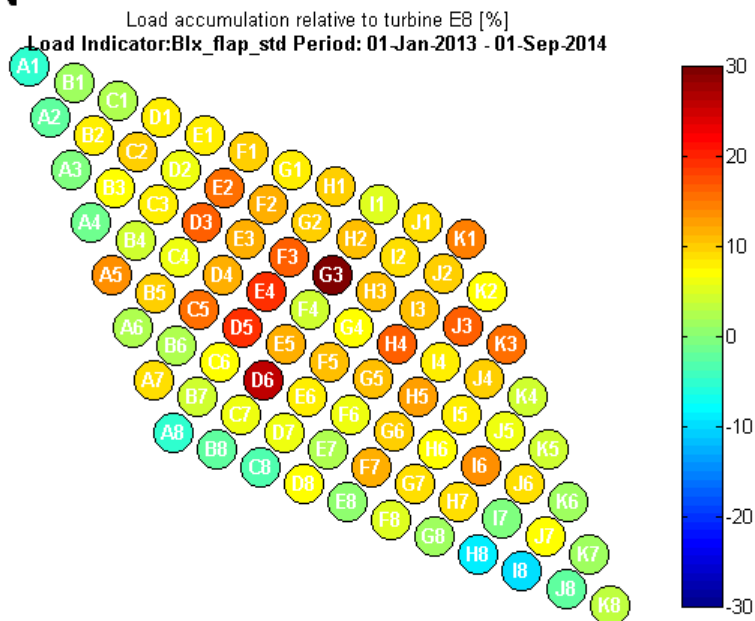
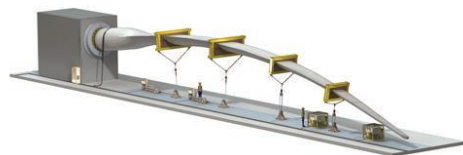
Difference predicted and measured load accumulation:
Load Indicator: Tbot_FA_std for Period: 01-Jan-2013 - 01-Sep-2014



Fleet Leader Results

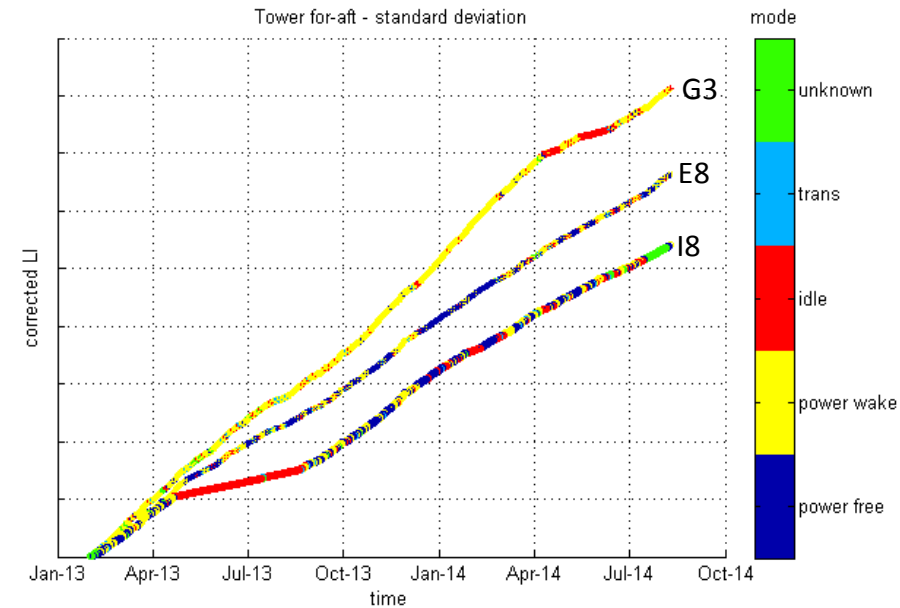
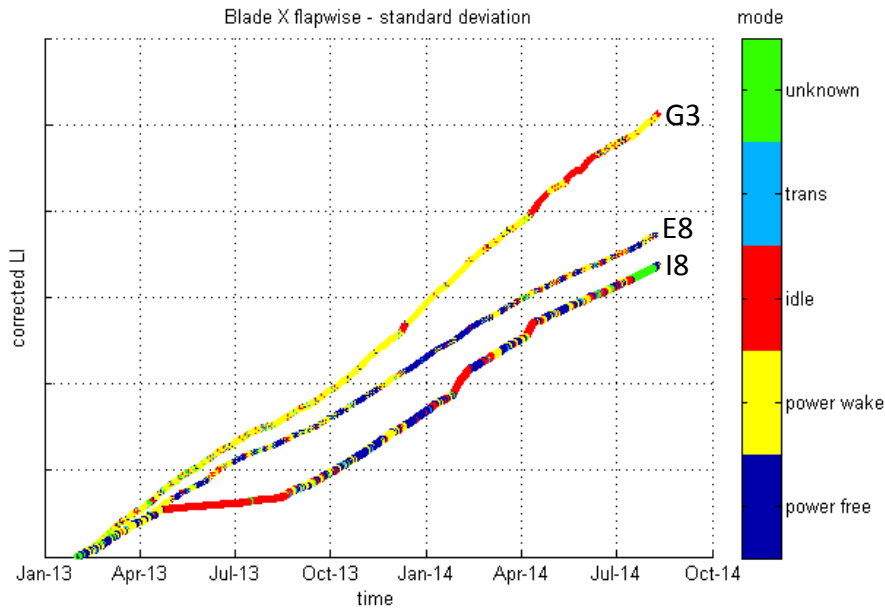
Results

Load accumulation over time



Results

Load accumulation over time



Current Developments

JIP Monitor

Existing project with Van Oord & Gemini

- Develop a robust and effective monitoring system to know and predict the structural health of the support structures in an offshore wind farm
- Allow Fleet Leader approach to be used for structural health monitoring of support structures.



NEWS

MONITOR JIP BEGINS DEVELOPMENT OF STRUCTURAL HEALTH MONITORING SYSTEM FOR OFFSHORE WIND FARMS

14 JUN 2016

Many offshore wind stakeholders acknowledge the relevance of monitoring offshore wind support structures. However, a dedicated standard for the design and installation of a

... ..

Source: TNO

Thank you &
questions please

Special thanks to:

