PO.050

Big data intelligence platform for wind turbines to support RD&I projects

Prof. Dr. Ir. Jan Helsen ; Ing. Pieter Jan Jordaens ; Dr. Ir. Gert Desitter
Jan.helsen@owi-lab.be ; pieterjan.jordaens@owi-lab.be ; gert.desitter@owi-lab.be
OWI-lab / Vrije Universiteit Brussel (VUB)

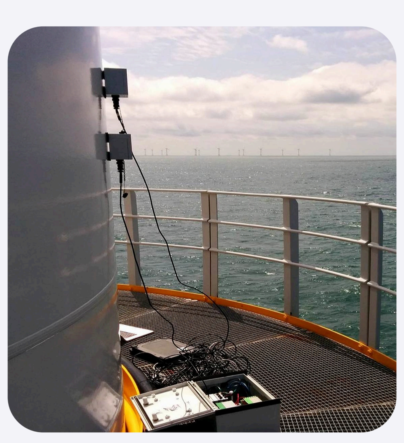
Abstract

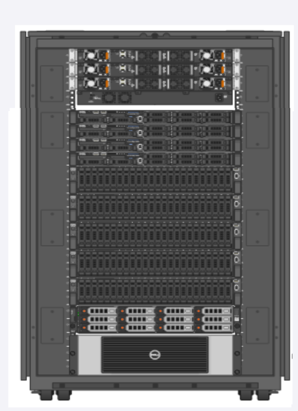
OWI-Lab, the Belgian research, development and innovation (RD&I) platform for wind energy, is performing several research monitoring campaigns at different offshore wind turbines in the Belgian North Sea.

Several research tracks have been initiated based on these field measurements to develop novel structural health monitoring (SHM) and condition monitoring (CMS) tools that can facilitate improved O&M. The date gathered in these monitoring campaigns can also be used for design optimization of components like foundations, transformers, etc…

Customized measurement systems have been implemented to feed researchers and companies with relevant additional data-sets apart from ambient and SCADA data. In order to store and process these high volume, and high veracity of data-sources in an integrated way, a 'big data intelligence platform' has been developed.

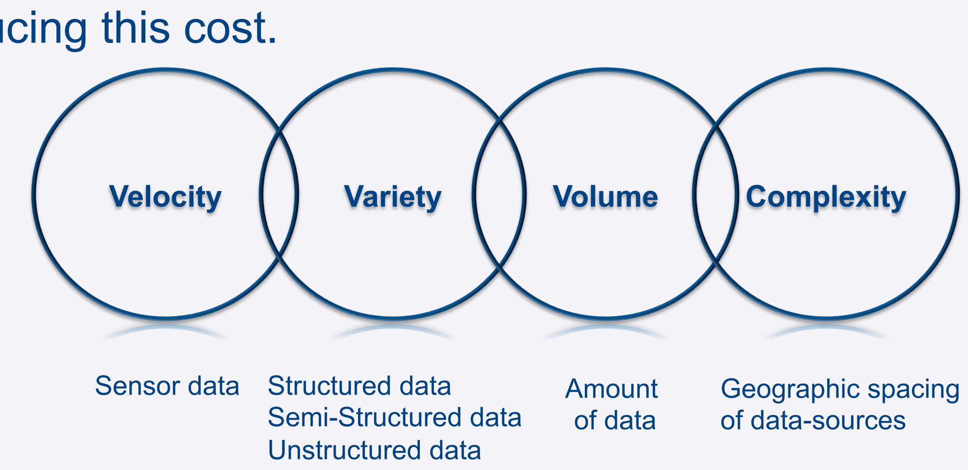
This poster discusses the set-up and architecture of the developed research data platform which can also be used by knowledge centers and companies to facilitate and support research project in the field of wind energy.





Integrated Approach

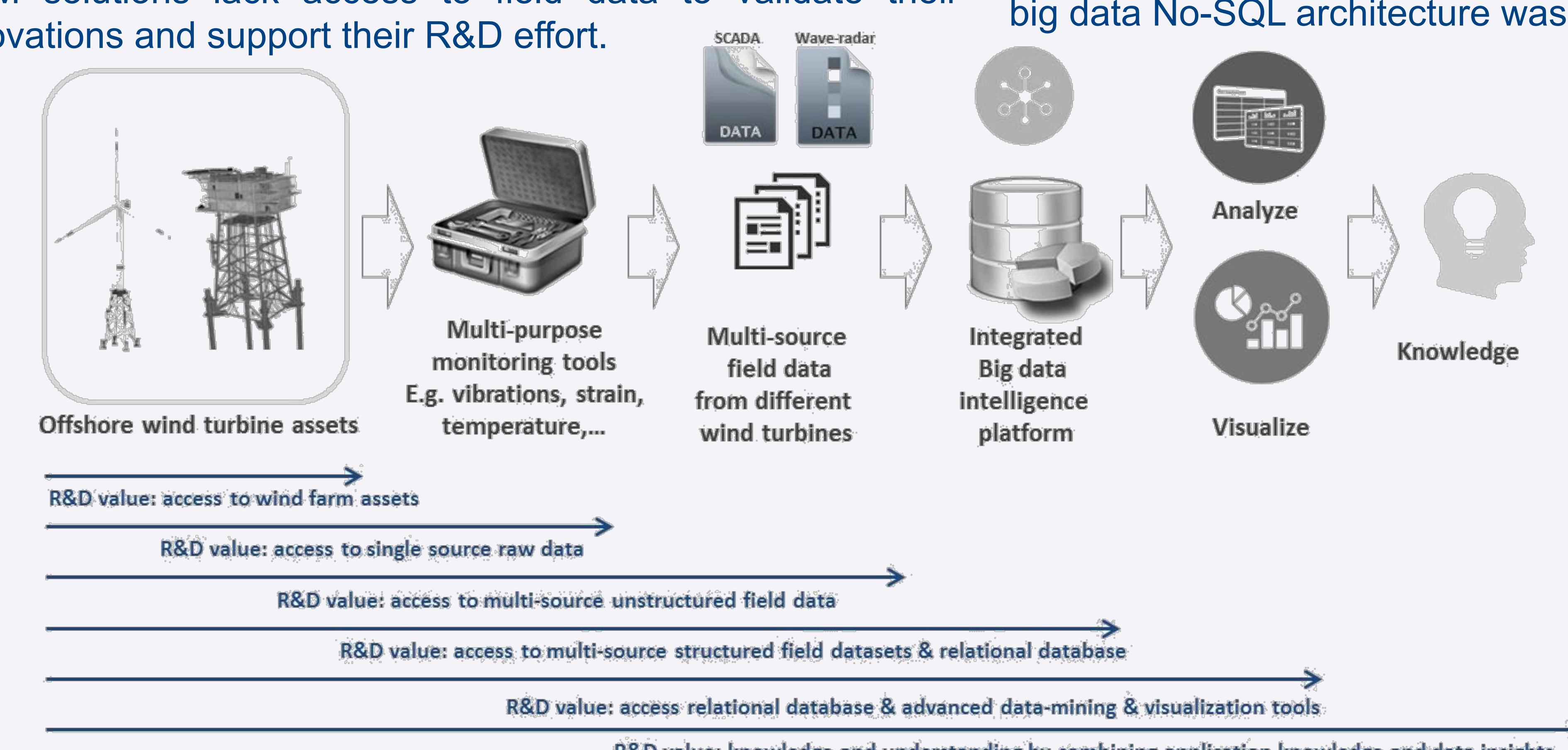
Operations and maintenance actions in offshore wind farms take ±30% of the total production cost. New advanced monitoring - and decision support tools can contribute in reducing this cost.



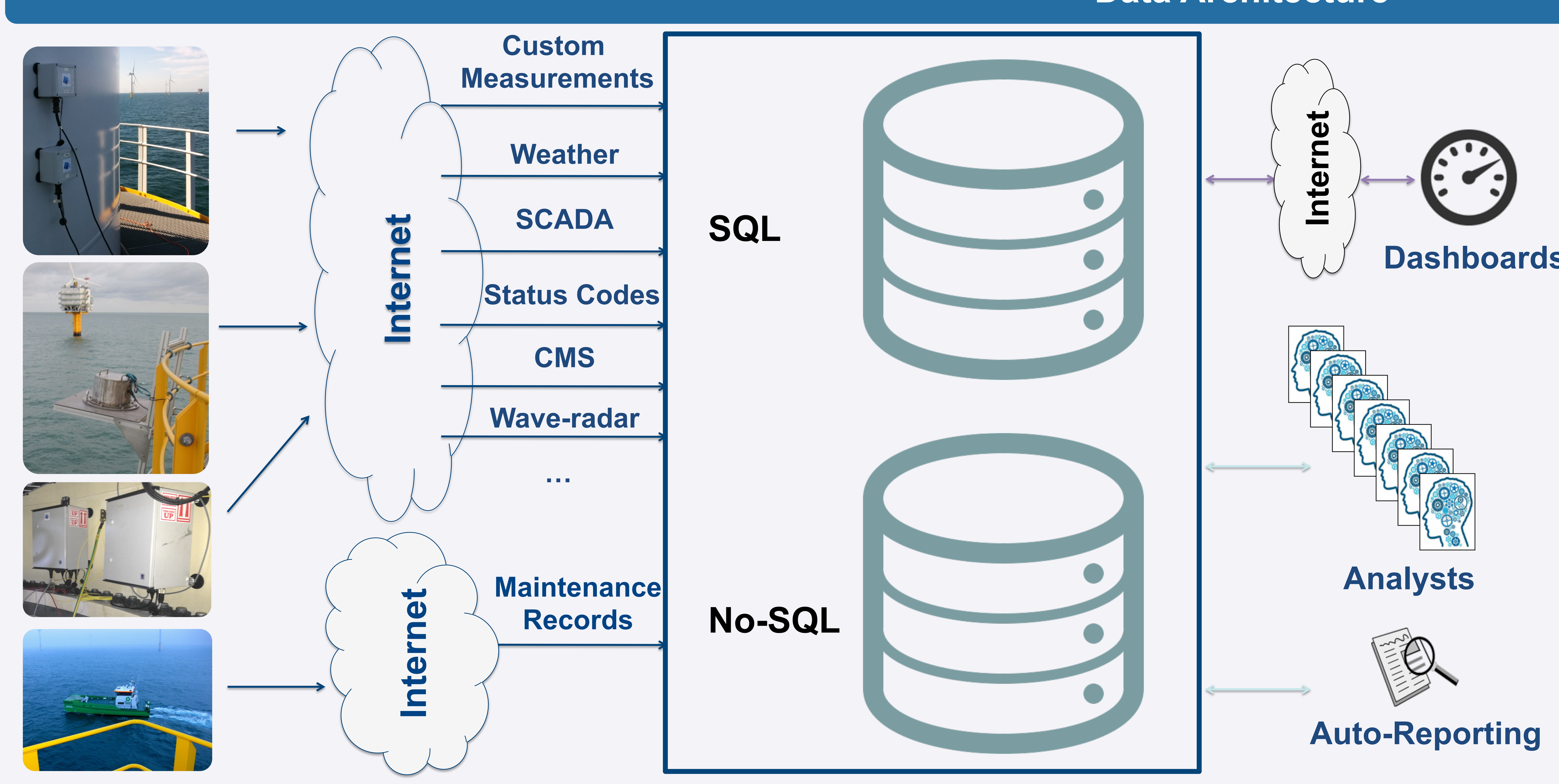
Also, advanced monitoring and analysis tools can be used for design optimization projects and provide insights in potential risks. Many companies working on the development of new O&M solutions lack access to field data to validate their innovations and support their R&D effort.

Therefore OWI-Lab initiated the project OWOME (Offshore Wind O&M Excellence) which has the goal to support and enable the development and validation of smart cost-reducing O&M solutions.

A challenge in providing the multi-source datasets to support the development of smart O&M-tools, is to cope with the processing and storage challenges associated with long time period (multiple years), high and low frequency sampled (0Hz →5kHz), geographic scattered datasets (different wind farms), and the variety of data-files (SCADA, weather buoys, SHM-systems, CMS-systems, wave radars,…) all having their own sample rate and data structure and complexity. In order to cope with this challenge a data platform with integrated traditional relational database and big data No-SQL architecture was developed from scratch.



Data Architecture



Storing measurement data for historical data analysis over a long time period results in tens of terabytes. Nonetheless, we want to use this integrated high frequency sampled dataset, since it allows much deeper understanding of the degradation mechanisms by investigating the whole picture

Traditional data approaches are not well suited to handle these types of high volumes combined with high veracity in their datasets. To tackle these challenges OWI-lab is developing a wind intelligence data platform with integrated traditional relational database and big data No-SQL architecture

OWI-Lab's turbine data intelligence platform stores these different data sources in a relational database in by a fully automated Extraction, Transformation and Load (ETL) process. The benefit of automated ETL is that it supports massive parallel processing for large data volumes and the possibility to schedule data movement jobs on a regular basis in an automated way, making data processing much faster.

Application Cases

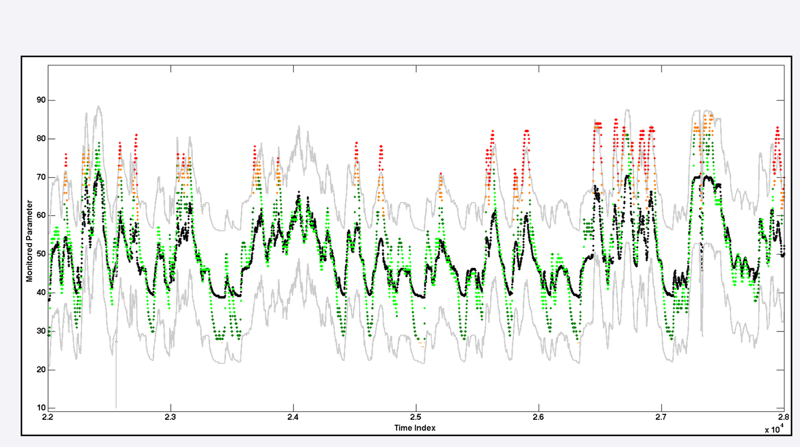
Condition Monitoring

For CMS purposes different signals are tracked ranging from temperatures to accelerations. Absolute alarm levels are inadequate for monitoring of wind turbine parameters, such as temperatures, vibration levels, etc. Due to constantly changing operating conditions affecting both loading and speed of the system, constant alarm levels would need to be set too high in order to avoid false alarm during e.g. turbine start-up.

Therefore a linear model is constructed that filters out the influence of speed and load variation in order to only track the evolution of the monitoring parameter. An example of the resulting classified alarm signal is shown.

Structural Health Monitoring – Fatigue life progression

Fatigue life is often a design driver for foundations. By measuring vibration and strains on existing foundation and tower structures we can link the fatigue life progression to different operational and environmental conditions.



The obtained data and insights be used as a design input. In addition, the continuously monitored fatigue life can serve as an important criteria in deciding over wind farm repowering or lifetime extension after its calculated service years.

The coming years OWI-Lab will gather SHM-data from different type of wind turbines in the Belgian North Sea and an approach to continuously estimate the fatigue rate of existing offshore structures will be developed in partnership with VUB.

Acknowledgements

This work has been founded by the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT) in the framework of the "Offshore Wind Infrastructure Application Lab" (www.owi-lab.be).

QR Code (leave blank)