# ROMEO Seeks to Improve Wind Farms with Machine Learning and IoT at the Edge

This past summer a five-year, €16 million EU Horizon 2020 project kicked off to reduce the maintenance cost of wind turbines using predictive machine learning algorithms, the Internet of Things and cloud computing.

Machine learning, IoT and cloud will improve wind turbine maintenance ©2011 Palle Peter Skov, ©Copyright Energinet.dk

The project called ROMEO, or "Reliable Operations & Maintenance Decision tools and strategies for high LCoE reduction on Offshore wind", and not the Shakespearean character, includes a consortium of both large enterprises, small and mid-sized companies and academia from six countries and is led by Iberdrola Renovables Energía.

The 12 partners will use the latest technologies, including the cloud, Internet of Things and machine learning, to transition wind turbine maintenance from a calendar-based to a conditioning schedule by analysing the real behaviour of the turbines in use.

The concepts and tools integrated in operations and maintenance (O&M) information management system developed within ROMEO will be exhaustively tested in a real operation environment of three multi-scale offshore pilots: Teesside (UK), Wikinger (DE), and East Anglia 1 (UK).

Leading the research from IBM's Zurich lab is Dr. Dorothea Wiesmann, who along with her team, has been developing predictive maintenance machine learning technologies for projects spanning servers in data centers to bank automated cash machines.

This week the project team gathered in Zurich and she answered a few questions about the project.

**Why it is so important to reduce the maintenance costs of wind turbines?**

Team ROMEO is tasked with keeping wind turbines operational using the Internet of Things and Machine Learning.

**Dorothea Wiesmann (DW):** *While wind energy has grown in the EU there is still a way to go to meet the 2030 target of having at least 27% of the EU's energy consumption coming from renewables. To achieve this we need to reduce the Levelized Cost of Energy (LCoE), which is the net present value of the unit-cost of electricity over the lifetime of an asset, if this case the turbines.*

**Can you go into the specifics on what you and the team will be contributing from IBM Research?**

**DW:** *EU H2020 projects are broken up into various work packages and we are focused on two of them for ROMEO.*

*First, we will be developing advanced machine learning models for predictive maintenance of various wind turbine components for three different wind turbine models operated across three different wind farms. To overcome the limited amount of failure data, we will develop new methods to bootstrap the machine learning models with the engineering models.*

*In the second work package we will collaborate with project partner INDRA to develop the data acquisition and analysis system that connects the sensors and analytics at the edge with the analytics and cognitive capabilities within IBM's Cloud with the O&M information management systems to leverage the modeling insights in business decisions.*

**Why is it so important to analyze the data at the edge, the so called Edge of the IoT?**

**DW:** *Most of the sensor data collected today, such as weather, traffic monitoring or even healthcare, is outdated seconds after its collected. In addition, shuttling data from the sensor at the offshore turbine to the cloud not only takes time, but also is limited given the bandwidth to the remote locations. Therefore, if we can analyze some of the data in realtime, where its collected, we can make decisions faster and in some cases automate them, such as shutting down a turbine to avoid cascading damage.*

**Your previous predictive maintenance research was with computer servers, how much of this can be used for something as different as a wind turbine?**

**DW:** *While not quite 1 to 1, it's all based on a machine learning algorithm. To predict failure in components in cloud data centers we are looking, in essence, at usage data and degradation indicators, e.g. correctable errors, and for the turbines we'd similarly look at system sensor data (vibration, temperature), usage and maintenance history, as well as environmental data.*

*We then leverage machine learning to understand the drivers and indicators of imminent failures. In addition, working with the subject matter experts in the ROMEO project we can ground these machine learning models in the expertise to combine the best of both worlds.*

**I realize the project just kicked-off, but what is the ultimate goal?**

**DW:** *It is estimated that the O&M of offshore wind contribute between a quarter and a third of the total lifetime cost of energy. Therefore, in the end we want to make sure they as reliable as possible.*

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*The ROMEO consortium: IBM Research, Siemens Wind Power, Electricité De France, Iberdrola Renovables Energía (project leader), Adwen Offshore, Indra Sistemas, LAULAGUN Bearings, UPTIME Engineering, Bachmann Monitoring, Ramboll IMS Ingenieurgesellschaft, Zabala Innovation Consulting and Cranfield University.*