Learning to maximise efficiency in a digital world

As the world responds to climate imperatives and grapples with issues of energy security, lost energy production on wind farms is becoming increasingly important for asset owners, operators and investors in renewable energy production. While we can't control the wind itself, as an industry we can take steps to ensure we maximise production, through a focused effort on reducing the need to derate turbines or to take them offline for maintenance.

By using digital technologies, we can leverage the data available to us to derive trusted insights which aid owners and operators in streamlining their O&M activities. Won Shin, vice president of products at ONYX Insight spoke to the company's content marketing manager Mirelle Ball. Together they discussed how the digital revolution is transforming end to end integration and reducing lost energy.

Mirelle Ball: Firstly Won, it would be great to start by asking what is the most rewarding part of your job?

Won Shin: I manage the software and machine learning development at ONYX Insight. My main mission is to work collaboratively with owners and operators around the world and try to solve their operations and maintenance challenges. This involves helping them scale, by bringing practical engineering knowledge together with machine learning and advanced data to create innovative products that can solve their challenges, today and in the future.

MB: It certainly sounds fulfilling. What's your view on the future of the wind industry?

WS: I think the future is automation, with more software and machine learning, but it won't happen immediately. There are still data limitations, but we can see automation is taking prominence in other industries, so there will be more automated analytics, decision making and planning.

Overall, I think we will see more efficiency through automation. For example, centralising and standardising data will allow our customers to streamline their operations. With all their data in one accessible place they will have more visibility and time to make better, more informed decisions.

MB: Can you explain what is meant by the term 'lost energy'?

WS: Lost energy is lost production. Anything that's causing a loss of production is causing lost energy. We want to use data to detect issues that are causing lost energy. There is so much information within data. Previously, data scientists would need to manually analyse the data to be able to extract key information from it, but we have found that there are commonalities within it that can be automated. For example, wind speed sensors can show repeated issues, and can be automatically detected.

By identifying these data patterns, we're able to give site recommendations early on and easily, so the owner or operators can avoid costly reactive, unplanned maintenance and can fix and improve their production. This in turn limits the downtime of their turbines and the reduction in energy production.

Reliability used to be the most important thing; now, however, everyone wants to optimise their turbine performance and boost efficiency.

Typically power curves are the first analytical tool used to identify lost energy, but this is just a starting point. ONYX Insight is developing a suite of complex analytics which focus on identifying the cause of lost energy to enable better O&M decision making, unlike so-called big data approaches.

MB: What do you see as the big data limitations in wind?

WS: We are working on pitch bearing failures. They are rare, for example, on a 100-turbine site a pitch bearing failure can happen only one or two times per year. There's not a lot of data around this, and if you don't have data then a typical machine learning approach doesn't work. The solution to this is a hybrid approach of combining machine learning with engineering knowledge to curate a model and find a way to detect the failures without the data sets.

ONYX monitors 9,500 turbines around the world, which brings together that data with a proven track record in monitoring turbine components beyond the drivetrain.

MB: ONYX refers to this as 'beyond the drivetrain'. Can you give us some examples of this?

WS: One of our customers is a US operator, who is running 1,000 turbines. Their lost energy was coming from the blades and electrical systems. When the operator wanted to maximise turbine production, we needed to expand the predictive maintenance beyond the drivetrain.

There is a lot of data and knowledge around the drivetrain now. We understand drivetrain issues and can put in place good measures to prevent failures with long lead times. By looking beyond-the-drivetrain we are bringing the same level of monitoring to other components, such as pitch monitoring, blade imbalance, inspection data, generator electrical faults, and generally lost energy issues such as yaw misalignment and sensing issues, etc.

In offshore turbines, it's even more of a priority as we need to monitor the full turbine. Even the minor faults that need correcting can lead to a loss of energy, and a significant loss

Mirelle Ball

Won Shin

of money from accumulated issues.

ONYX Insight's AI-HUB can ingest a wide range of data types and collate them in a single location to streamline workflows for all users, from engineering, to site, to management.

MB: Are there other examples of customers who have benefited from ONYX technology?

WS: One of our offshore customers had identified a pain point with their pitch system, with quite high failure rates on one of their hydraulic components with their accumulator. There isn't any data for this, so they couldn't really predict the fault, which took a lot of inspection and measurements that would require them to shut down the turbine for three or four days. They asked ONYX to help because they couldn't detect any failures from their SCADA data.

We combined our knowledge and machine learning models with their SCADA data and were able to develop a model that would predict this fault before a replacement was needed, moving them from a reactive situation to a predictive one. This reduced downtime from four days to six hours, an improvement of over 90%. Particularly in offshore wind, these improvements can be significant in maximising energy output and in scheduling maintenance.

We also found an issue with their wind speed sensor. This small issue was hidden and went undetected for a year for one particular turbine that was causing an accumulation of lost energy. It was a simple fix, with the site team able to replace the sensor. It shows the benefit of automated analytics. If these are actionable with a simple fix we can bring tangible results.

Automate detection of common issues

- **Temperature issue**
- **Hydraulic system issue**
- **Bad anemometers**
- Cooling system issue
- Yaw misalignment
- Pitch misalignment, calibration
- Rotor imbalance
- Bad control parameters
- Icing
- LE erosion

+ Many more issues (long tail)

80% lost energy → Automated, Real-time Notification

20% lost energy → Manual analysis
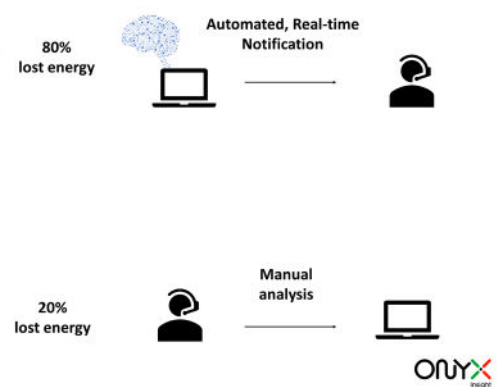
MB: And finally, a challenge for you; do you think it is possible to describe ONYX in four words?

WS: Problem solving, passionate, innovation, customer focussed.

The industry is benefiting from increasing digitalisation, with its value demonstrated by operators and suppliers across a multitude of different problems and disciplines and at different levels, from holistic identification of risks and issues through to detailed analysis of individual component health. The value, however, really lies in using multiple data sources in multiple contexts and combining insights to build optimal O&M plans, which limit downtime and derating to maximise production.

Understanding linkages and dependencies between issues, identifying opportunities to take advantage of unavoidable downtime to reduce future risk, enabling owners and operators to make smarter, more certain decisions are all challenges digitalisation can help solve.

It's not just a digital problem though, it's a digital and engineering problem and companies like ONYX Insight are combining these two disciplines to drive real value generation for our customers in areas such as lost energy.

Won Shin, Vice President of Products, ONYX Insight

Won heads up the Product development team at ONYX. He has 15 years' experience working in the automotive and renewable energy industry, focusing on data science, machine learning, optimization.
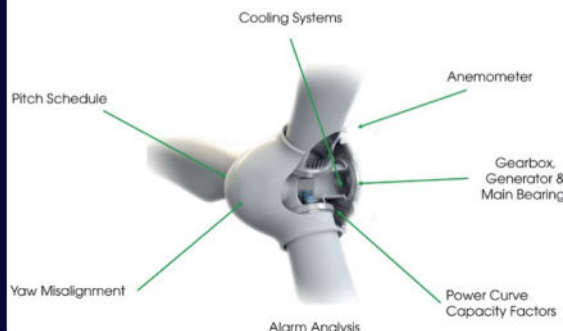
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Big Data

Powered by ML & AI