Data and Analytics: Taking Wind Power Into the Future

Industrial data can be enormously valuable in the right hands. From operational efficiency, to more cost-effective maintenance, to superior forecasting, many business goals can be achieved through careful analysis. Currently the wind power industry is at the precipice of achieving highly automated and efficient operations. The groundwork is being laid to allow turbines to optimize themselves and talk to one another.

While the industry certainly has achieved excellent forward momentum in terms of data and analytics, there have still be a number of concerns raised. For example, the diversity of systems used by turbines has presented issues. Additionally, the security of systems as they become more connected is an important area of consideration. Nonetheless, the business case for big data in wind power is clear and worth the extra effort to overcome hurdles.

Harnessing Data in the Wind

Realizing the potential of big data in the wind power industry requires efficiently capturing data and translating it into usable and measurable sets of information. This has been a challenge throughout the history of wind power due to the diverse array of equipment being used by most developers. Fortunately, a number of recent innovations have provided keys to moving forward in wind power analytics.

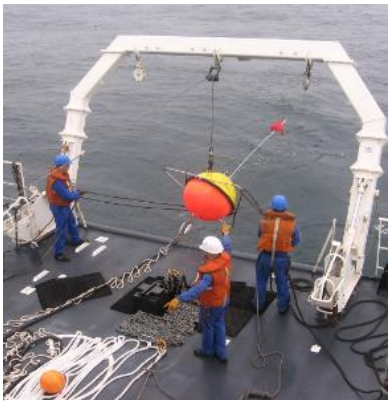

Figure 1: Buoy being deployed

One of the most troublesome aspects of collecting data is getting turbines and other equipment to communicate. In a perfect world, every turbine in every wind farm would operate on compatible software. Unfortunately, many power companies have equipment from varied vendors. Vattenfall found themselves in this situation after acquiring Elsam. To address the issue, they developed a digital translator that today can capture information from 48 different types of turbines and output it in a single, common format[i]. This layer of abstraction provides Vattenfall with an easy way to bring together all of their different types of wind turbines into a centralized SCADA system.

The OPC Foundation has been working towards a similar goal but for the broader market. They have develop a Unified Architecture that can be layered onto proprietary systems to allow different turbines to work together[ii]. The OPC's goal is to enable all wind power equipment to be connected into centralized control systems. Furthermore, they want turbines to be able to easily pass data in a secure manner. Their recent additions to this platform have focused on maintenance optimization.

RWE has been expanding its data set through the use of a new buoy with offshore operations. The metocean buoy is a floating LiDAR based measurement platform that can help to gather more accurate information on winds and tides[iii]. Their goal is to bring more data into their decision making process so they can improve operational efficiency.

Similarly, after several years of net wind production failing to meet forecasts, NextEra Energy set about reimagining the way they collect and use data. By bringing together a cross-functional team they were able to take the 30 million data points collected daily by their equipment and translate it into a simple scorecard format[iv]. They combined this with an operations dashboard that will help personnel to identify turbines that are performing below projections.

Yet it's not just the well-known names that are getting into big data for wind. A recent start up called MeteoPole is seeking to bring together developers with a collaborative platform of tools[v]. This innovative service will initially allow customers to more easily plan wind farm sites using a virtual weather data mast. It is also set to offer tools for optimizing the operation of wind farms throughout their lifecycle. EDF has already signed on for using these innovations.

Driving Business Goals With Data

Although interesting, the data collected from wind turbines is not valuable in and of itself. To translate it into business growth, it needs to be harnessed intelligently to drive specific objectives. In particular wind farm operations and management can be made significantly more efficient by using data efficiently to make iterative improvements. Further, these improvements can lead to attracting more business while accomplishing greater profitability.

For instance, optimal layout of equipment has always been a goal of wind farm operators. This has long been a data driven process; however, recent advances in technology

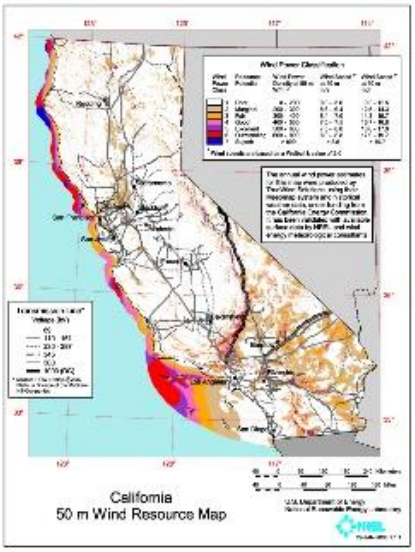

Figure 2: Wind data map

have allowed for significantly more sophisticated analyses. DONG Energy, through its BEACon research and development project, has been able to carefully refine their assumptions and models used in determining wind farm layout[vi]. It is ultimately this type of translation into practical models and frameworks that will truly drive business growth.

Likewise, working with Romax Technology, Statkraft was able to gather data into a series of reports that enabled them to transition their wind turbines to out of warranty operation[vii]. Their goal was to ensure a seamless transition with minimal maintenance costs. This required capturing a large amount of information and distilling it into a concise but accurate picture of the status of all of the 88 turbines in their Sherringham Shoal Offshore Wind Farm. This is a perfect example of how turbine data, when wielded correctly, can greatly improve the maintenance efficiency of wind farms.

Data can also be used to take maintenance from being a purely reactive practice. Algo Engines, an industrial power data analytics firm, recently shared their insight into predictive models for maintenance[viii]. They have created an Asset Health Score, time to failure analysis model, and a time series model. The first is a score card to provide an overview of each turbines' current status. With the time to failure analysis, an operator can determine the lifespan of each asset under normal operating conditions. Finally, the time series model can be used to further refine the prediction accuracy.

In the broader landscape of technology, the concept of the Internet of Things has been a major driver of innovation. E.ON has been pioneering this idea for wind power developers. This vision for the future of technology is based on Machine-to-Machine communication[ix]. E.ON is striving to improve the connectivity of wind power equipment so that they can make iterative improvements to operations over time. This goal is shared by General Electric with their PowerUp technology that automatically adjusts turbine settings to increase output[x].

During a panel on the impact of technology on wind farm operations and management, Brian Hayes of EDP Renewables discussed his firm's use of big data. He indicated they have used a large set of equipment readings to greatly optimize their usage of turbines[xi]. Their goal is to get as much power as possible out of each one. Most recently they have created a condition monitoring system to improve maintenance efficiency.

Looking Forward and Keeping Wind Power Data Secure

It is clear that highly connected wind farms can offer a lot of benefits to the efficient and profitable production of wind power. However, these innovations also introduce a new risk to

turbines: cyber-attack. While allowing different pieces of equipment being to talk to one another improves efficiently, it also creates the possibility for malicious access.

For example, it was recently revealed that a vulnerability in the XZERES 442SR, a small wind turbine for residential use, would allow anyone to access it[xii]. From there, someone could easily take control of the turbine. This vulnerability has caused some to raise the question of why such a turbine even needs to be internet connected. While this is a valid question for small, personal use equipment, the benefits of connectivity for industrial grade turbines are quite clear. As such the question becomes how to keep wind farms and their data safe.

To address this issue, the OPC Foundation has endeavoured to make their Unified Architecture extremely secure[xiii]. As such, information from original equipment manufacturers' proprietary systems needs to only be passed to the OPC UA. From there OPC's architecture uses technologies such as 256 bit encryption and message signing to keep data being passed through the system secure[xiv].

The future for big data in the wind industry is bright. New innovations each year are making it increasingly possible to collect and analyze data from turbines that can be used to drive improvements to operational and maintenance efficiency. Many of these are even making it possible for wind farms to manage and optimize themselves. With such substantial possibilities for growth, there can be no doubt that data and analytics will continue to play a major role in the wind power industry.

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