Inspection Management Tools in Offshore Wind
Improving safety, efficiency and compliance

Roberts Proskovics and **Craig Stout** | May 2019

Introduction

The expansion of the wind industry has led to increasing requirements for more inspection tasks, by more technicians, on larger turbines. This demand comes with the parallel requirement for a better means of recording the activity that goes on at offshore and onshore wind farm sites. The management of assets, equipment and operations in the industry is a prime example of how the time, cost, and health and safety benefits offered by digital services can be exploited. This O&M Case Study provides insight from Papertrail, one of the wind industry's leading paperless management service providers.

Key Findings

- Inspection records are still frequently managed manually and filed using outdated and administratively-demanding systems such as spreadsheets.

- Paperless management tools are available on the market and can provide solutions to a number industry challenges, including:

    Health and Safety: Ensuring that technician personal protective equipment (PPE) is appropriate, is not damaged, and is not due a statutory inspection.

    Time and Cost: Reducing administration costs, risk of reputational damage, work repetition, turbine failure and help in accident investigation.

    Compliance: Ensuring that all equipment is inspected and fit for work, and that technician certifications are up-to-date.

- Industry-wide implementation of paperless management tools has been delayed by barriers including:

    Commercial: Limited information sharing between industry stakeholders, perception and difficulty of precisely quantifying benefits.

    Technology: Limited or no connectivity offshore.

    Engagement: Lack of end-user feedback and poor uptake acts as a barrier to new technology.

- Paperless management tools can be implemented using existing technician hardware, seamlessly integrating with current methods of working.

- Tools can be used in the day-to-day operation of wind farms, accident investigations and audits.

- In the future, paperless management tools could form a part of a wider remote supervisory system, further reducing operations and maintenance (O&M) costs.

Introduction

Papertrail

Papertrail is one of the wind industry's leading providers of fully-integrated digital inspection, certification and audit management software. Founded in 2013, the company has recorded more than five million inspections across 45 countries. Initially developed as a safety and inventory database, it is now primarily used to demonstrate compliance. Across all industries, on average 5,000 new products are introduced and 130,000 inspections are recorded on the system each week.

Papertrail's first clients were mountaineering equipment manufacturers. The company then branched out into rope-access providers working on telecommunication towers and electricity pylons. The company is now present in offshore wind, providing their application for PPE, tool and turbine inspection management to wind farm owner/operators including Innogy and Vattenfall. Some of the wind farms that use Papertrail include Gwynt y Môr, Galloper, Rhyl Flats and Pen y Cymoedd.

Through working with Innogy, Papertrail has been adopted by various service providers in offshore wind. These include:

- Ainscough Wind Energy Services – wind turbine erection and maintenance service provider.

- Altura Wind Services – height-related service provider.

- Mistras Group – rope-access services and training provider specialising in blade inspection and repair.

- Offshore Painting Services – weather protection, composite blade repair and training provider.

- Skyform Group – turbine-mounted safety equipment and statutory inspection provider specialising in service lift inspection.

A few of these service providers chose to adopt Papertrail to benefit from being on the same system as owner/operators, while others adopted it through an internal need.

Through these service providers, Papertrail has been used across the majority of offshore wind farms in the UK. Skyform, for example, perform lift inspections on around two-thirds of all UK offshore wind turbines.

Challenges

What is the challenge faced by the industry?

Inspection records are still frequently managed manually and filed using outdated and administratively-demanding systems such as static spreadsheets. This approach is lengthy, can potentially lead to errors and emissions, and can result in large amounts of money being lost by owner/operators through unforeseen failures, sub-optimal production, post-accident investigation delays, fines and reputational damage.

Why haven't more owner/operators adopted paperless management tools?

There are three main barriers holding paperless management tools back from becoming an industry standard. These barriers include commercial (including confidentiality), technology and engagement considerations.

Commercial

Multiple commercial barriers exist that prohibit the wide-spread adoption of paperless management tools. The main commercial barriers include:

- Opposition to changes in long-standing methods of working.

- The limited track record of paperless management tools in the industry.

- The challenges of quantifying the benefits of using a paperless management tool.

- Limitations in information/data sharing by original equipment manufacturers (OEMs), leading to wind farm owner/operators not having access to all required data to maximise the benefit of using such tools.

- A perception of paperless management tools being less important than tangible products, such as safety equipment and condition monitoring devices.

Case Study: Offshore Painting Services

In 2016, OPS swapped paper-based equipment inspections, which were time-consuming and subject to human error, for Papertrail's system. This was to improve PPE inspection management of items associated with rope-access and to reduce the company's exposure to risk. In addition to helping achieve OHSAS 18001 Occupational Health and Safety Assessment Series accreditation, OPS's ability to demonstrate that they have the appropriate equipment management systems in place to maintain safe working practices at all times has helped the company to win business.

Despite logging hundreds of thousands of man-hours offshore on projects such as Gwynt y Môr and Walney, the company has not suffered a lost-time incident.

"Papertrail has been a revolutionary system for OPS with regards to control of our personal protective equipment." – Lee Bolton, Blade and Rope-Access Manager

Technology

The key technological barrier associated with paperless management tools is the limited network connectivity offshore, requiring these tools to be fully operational in offline mode. This barrier is compounded by other considerations, including:

- Round 1 and 2 offshore wind sites were built relatively close to shore (on average between 8 and 23km offshore, respectively). These sites, depending on the location, have either good, intermittent or no connectivity. Round 3 offshore sites are sufficiently far offshore and will not be able to benefit from the onshore transmission infrastructure, as they are located on average 81km offshore.

    - Intermittent connectivity can be particularly challenging in the use of paperless management tools as the system might be continuously switching between different modes of operation.

- Not all of the tools available on the market have the same offline functionality.

- The inherent challenges of storing large amounts of data on a device operating offline.

Engagement

As with any new software, it is important to make sure that the tool is well-received, or it will not be successfully adopted. This requires the tool:

- To be designed with the end user in mind (i.e. improving data management for the operational teams).

- To be simple to use with a strong focus on help and support functions. A system that is difficult to use might deter users from adopting it, with end users reverting to previous mechanisms of information collection.

- To have one or more champion(s) within the team to help with quick and successful implementation.

Case Study: Innogy

Papertrail's first client in offshore wind was Innogy, helping them to improve data control for the Gwynt y Môr project. Since then, Innogy has adopted Papertrail for PPE, tool and wind turbine inspection management, at the same time rolling out the software across other Innogy wind farms (such as Galloper and Rhyl Flats). Papertrail also helps Innogy to stay compliant with the relevant health and safety regulations.

Working with Innogy has helped Papertrail to win over new customers, as various service suppliers to Innogy have also adopted the system.

"Gwynt y Môr is the world's second largest wind farm and as such we take compliance and risk extremely seriously. Working with Papertrail we are able to improve our health and safety posture by streamlining processes and information and in parallel, speed up the information flow around wind turbine inspection planning."

Justin Grimwade, Business Information Manager

Process

Offshore wind turbines are complex systems consisting of a large number of subsystems and components. These require regular maintenance to make sure that they do not break down and are safe for offshore technicians to work with. Different wind turbine models have different schedules for planned maintenance programmes. Furthermore, different components within a wind turbine typically have different maintenance intervals, which can be confusing and difficult to track. For example, a tower system may only require yearly planned maintenance, while rotor and yaw systems may require planned maintenance six-monthly, yearly, two-yearly, five-yearly, and ten-yearly.

Typically, planned wind turbine maintenance activity consists of:

- Identifying which system, subsystems and components require maintenance.

- Ensuring that all tools and equipment are in place to perform the work and are safe to use.

- Technicians transiting and transferring to turbines.

- Technicians carrying out identified maintenance tasks.

- Notes and images being taken by technicians to be later used for filling in paperwork.

- Technicians transferring to shore or to the next turbine to be serviced to repeat the process.

- At the end of the shift technicians filling in paperwork by updating spreadsheets and uploading images.

The last step is crucial in making sure that:

- Statutory requirements are met.

- Wind farm owner/operators do not repeat maintenance before it is required, minimising operational expenditure.

- Turbines continue operating by keeping them maintained and notifying that maintenance work has been performed.

However, if there are delays (for example due to weather or long shifts), technicians might not fill in the paperwork until the next day or later. Furthermore, even if paperwork is filled in on the same day, technicians might forget some details or struggle to remember, for example, which notes and images refers to which turbine.

Papertrail has developed a tool that can eliminate this issue by allowing technicians to complete all reporting simultaneously as tasks are being performed on-site. Additionally, the same tool can be used to make sure that the equipment used by technicians has been inspected and is safe to use.

Technology

Software

Papertrail is a subscription-based software package. Clients receive a license to use the application as well as software support, maintenance and security. The software is iOS- and Android- compatible and supported on all web browsers.

Hardware

As a subscription-based software, Papertrail does not provide any hardware. This helps to keep the cost of subscriptions low and allows clients to use hardware that they already have in place. Offshore wind technicians can use phones, tablets, laptops and personal computers for accessing Papertrail.

Security

Data security is of high importance in all industries, but even more so in the energy sector. Papertrail has been designed with security in mind. The platform is hosted on Amazon Web Server (AWS): a cloud-based service with data backups four times a day.

Papertrail does not own the data, but rather provides the means for improving its management.

Cost of Inspection Record Inefficiency

Inefficient inspection recording has a direct impact on costs. This is primarily a result of increased administration costs linked to technicians having to spend time filling in reports, administration teams spending time amalgamating these reports together, and the time spent producing final management reports. Assuming an O&M spend of £60,000 per MW per year, and that administration costs make up 20% of these , administration costs are £12,000 per MW per year. Even a conservative improvement in efficiency of administrative tasks – 5% percent for instance – will lead to £600 saving per MW per year.

In addition to direct administration costs, inefficient inspection recording can lead to:

• Reputational damage in case of a health and safety incident or wind turbine failure.

• Turbine downtime, including lost production and repair costs.

• Repetition of work if the same turbine is inspected twice within one inspection period.

Types of Users

While typical spreadsheets have two user types – full-access and read only, digital inspection management tools, such as Papertrail, can define different types of users. Currently, Papertrail uses three main account types.

Manager: Full-access users that have ability to create schedules and checklists, as well as editing all information on the system.

Technician: These users have the ability to read all data and upload tasks, images and descriptions of work. This user type can be used for both owner/operator's technicians and external contractors deployed for specific tasks.

Read-Only: Read-only access is typically used for audits or for training purposes. This account type can also be time-limited.

Each account type can be further modified to include or exclude specific features.

Functionality

Papertrail incorporates a number of different management tools, with four of these being of particular interest to offshore wind. These are Certification, PPE, Tool and Turbine Inspection Manager.

- Asset Manager
- Certification Manager
- Facility Manager
- Medical Device Manager
- PPE Manager
- Tool Manager
- Turbine Inspection Manager
- Vehicle Manager

With offshore wind turbine technicians requiring different certifications (e.g. working at heights, offshore survival), certification manager can be used to track accreditation status and expiry date.

Set-Up

Once the platform structure has been agreed with the wind farm owner/operator, Papertrail sets up the system. It also provides online training, which mainly consists of a demonstration. On-site training can also be provided, if required.

Data is typically collected from the moment the owner/operator subscribes to Papertrail (i.e. there is no system backdating).

Benefits

Health and Safety

Papertrail can offer improved health and safety performance for offshore wind technicians by helping to ensure that PPE and tools they use are appropriate, not damaged and have been inspected. For example, Papertrail helped to identify counterfeit safety helmets through mismatching serial numbers.

The tool can also be used to flag up required refresher training for offshore technicians to ensure that they are qualified to operate different equipment and perform their job safely without endangering themselves and others.

The ability to fill in all paperwork on-site at the same time as tasks are carried out can help to ensure that technicians are not overworked by asking them to fill in paperwork after a long shift maintaining turbines offshore.

Time and Cost

A fully-integrated digital inspection platform can help to increase the efficiency of work offshore. Anecdotal evidence suggests that savings of up to four times the cost of the software licence have been achieved by Papertrail users. In addition to savings in administration costs by recording work offshore and maintaining records more efficiently, Papertrail can be used to reduce the risk of reputational damage due to health and safety accidents or wind turbine failures. This is achieved by:

- Reducing turbine downtime including lost production and repair costs by improved inspection management.

- Reducing the number of unnecessary inspections by improving communications to ensure that the same
  turbine is not inspected twice within one inspection period.

- Time saving following accidents by providing full, up-to-date inspection reports to aid investigation.

Compliance

Papertrail can be used to ensure that all equipment is inspected and fit for use and that technician certifications are up to date: information that is crucial when applying for and renewing accreditation or performing audits. For example, ease of access to, and systematic capture of, data relating to health and safety equipment, tools and certifications could be important when applying or renewing the OHSAS 18001 Occupational Health and Safety Assessment Series accreditation.

The Future

In the near-term, digital inspection platforms can be further developed specifically for offshore wind. Backdating of historic reports, especially alarm codes, could be introduced to provide visibility on the operations conducted over the full lifetime of an operational wind farm.

In the long-term, digital inspection platforms could be interfaced with augmented reality glasses to offer a true remote supervision system where offshore technicians could communicate with experts based onshore in real time. Systems such as Papertrail could also be integrated with marine operations planning software to provide an intuitive system to plan, conduct and record all operations at site. More ambitiously, if confidentiality challenges can be overcome between OEMs and owner/operators, the platform could become a "cradle-to-grave" asset management system where the whole lifecycle (from manufacture to decommissioning) of all wind turbine components are captured on the system.

Appendices

Author Profiles

Craig Stout is an engineer, O&M Systems at the Offshore Renewable Energy Catapult. He has a background in mechanical engineering, receiving an MEng from Robert Gordon University, with an interest in wind turbine design. Craig's main focus is the analysis of operational data from the renewables industry. His current work includes industry benchmarking programmes, resource and performance assessment and enabling data sharing for the industry.

Roberts Proskovics is a project engineer, Wind Turbines at the Offshore Renewable Energy Catapult. Roberts holds a PhD in floating offshore wind from the University of Strathclyde. In addition to his work in floating wind, for the last three years he has worked on innovative offshore wind solutions, such as remote supervisory system, wind farm wide control and next generation vessels, that could help to reduce the cost of offshore renewables.

Disclaimer

Offshore Renewable Energy Catapult

Inovo	**National Renewable Energy Centre**	**Fife Renewables Innovation Centre**	**O&M Centre of Excellence**
121 George Street Glasgow G1 1RD, UK T: +44 (0)333 004 1400	Albert Street, Blyth Northumberland NE24 1LZ, UK T: +44 (0)1670 359 555	Ajax Way Leven KY8 3RS T: +44 (0)1670 357 649	Ergo Centre Bridgehead Business Park Meadow Road, Hessle HU13 0GD