Wind Energy Benchmarking

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Abstract

Benchmarking is the process of comparing performance metrics and processes of one business to others in the same industry with the aim of determining relative performance. This information is used to identify "best in class" performance and quantify the benefit of implementing best practice. Furthermore, when sufficient data is available, historical industry performance data can give a strong insight into future expected performance. In the context of the wind industry, benchmarking provides a vehicle to improvement for a range of stakeholders:

Owner Operators
- Target areas for improving the availability, reliability and performance of their wind farms.
- Provides investor confidence and the ability to reduce Levelized Cost of Energy (LCOE).
- For international businesses, the provision of multi national benchmarks provides a one-stop-shop for a wide range of KPIs and the ability to further standardise existing KPIs.

Investors
- Help investors objectively assess the performance of asset managers
- Benchmark their asset performance to inform valuation.
- Determine wind turbine reliability over time compared to its peer group to identify value creation opportunities.
- Make informed decisions to decommission or repower their wind farm portfolios, as well as justify investments in operating expenses.

Asset Managers and ISPs
- Forecast maintenance requirements to assist clients in optimising their wind turbine maintenance programmes.
- Optimise procurement of major and minor spares and formulate an effective spares strategy.
- Optimise inventory management and release sunk cost
- Demonstrate credentials to investors.

Objectives

- Understand why benchmarking is important for the wind industry;
- Understand the challenges faced in completing a benchmarking exercise;
- Appreciate the advantages and disadvantages of the solutions to these challenges; and
- Identify the most appropriate solutions to build the overall benchmarking system.

Methods

There are a various challenges associated with building an effective benchmarking system that offers value to each participant. Within each of those challenges, the advantages and disadvantages of the solutions will be evaluated.

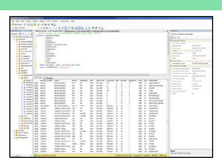
- **Establishing a Common Component Breakdown of Wind Farms**
  - Single Taxonomy vs Multiple Taxonomies
- **Data Acquisition and Processing of Input Metrics**
  - SCADA
  - Business Intelligence System
  - Work Order System
- **Providing Valuable Output Metrics**
  - Categorising metrics suitably: Availability, Energy Production, Operations, Reliability
  - Defining clear and comprehensive metrics within these modules
- **Delivery of Output Metrics**
  - Web browser environment
  - CSV (spreadsheet format)
  - Report
- **Quality Assurance and Dissemination of Best Practice**
  - Ensuring the data accurately reflects wind farm performance and operations
  - Working Groups

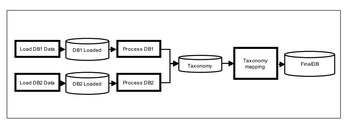
Results

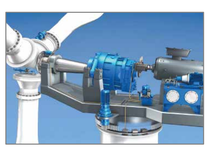
Multiple taxonomies exist for describing the structure of a wind turbine; we must normalise the turbine taxonomy as part of the benchmarking process otherwise cross-peer benchmarking is not possible

There are a number of attempts within industry to standardise the way a turbine is described:
- IEC 61400
- Reference Designation System for Power Plants (RDS-PP)
  - RDS-PP Nordic
  - RDS-PP VGS
- Reliawind Taxonomy
- Sandia National Labs Taxonomy

Different stakeholders will also have a "home-grown" taxonomy:
- Turbine OEMs
- Underwriters
- Engineers
- Claims Managers
- Consultants







Cleansed data table is used….

… run through mapping tables with the taxonomy ….

… applied to give a consistent set of naming conventions to all data rows

The advantages of using multiple taxonomies, with an associated mapping table, is that it allows Owner/Operators to participant in an industry benchmark without the required effort to change their component taxonomy, thus removing as barrier to participation. The disadvantage of this approach is that direct comparison of reliability data across major component s and subcomponents is not possible due to the differing naming conventions and categorisations.

To maximise the amount of usable data, a single taxonomy must be utilised.

SCADA SYSTEM

SCADA data can be considered as raw data, it is collected automatically and can be as granular as 1 second intervals. The advantage of this data is its consistency in collection and formatting. The disadvantage is that the vast quantities of data means it requires significant processing and cleaning to be usable.

BI SYSTEM

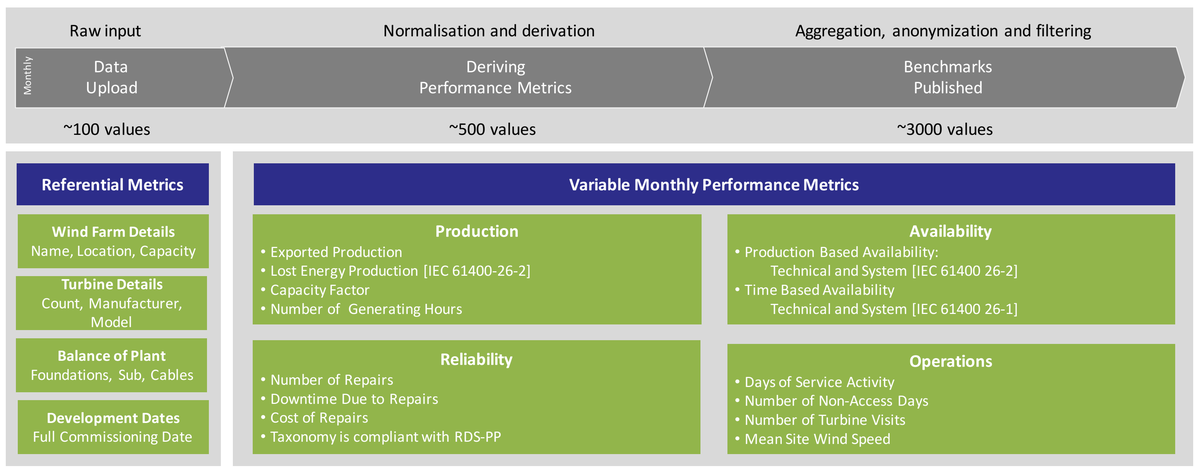
Business Intelligence data is the next step along the processing chain. It is filtered and made available in a more usable and user friendly format than raw SCADA data. The advantage of this data is the ability to quickly navigate through different parameters. The disadvantage is that it is only as powerful as the system user.

WORK ORDER SYSTEM

Work Order system data is used to record maintenance and repairs to the wind farm. This data records specific actions undertaken as part of the O&M programme. The advantage of this data is the additional contextualisation through The disadvantage of this data is that it is typically manually entered, and subject to additional errors.

Results (continued)

Metrics must be defined which are relevant to a broad spectrum of wind farm operations and appeal to multiple stakeholder. These should also include relevant standards within each category and incorporate the chosen taxonomy. By incorporating major standards, uniformity of the benchmarks is achieved which would not otherwise be possible and make effective peer comparison impossible. The disadvantage here is the additional time required to prepare data in accordance with the standard for those participants who not currently use those standards.

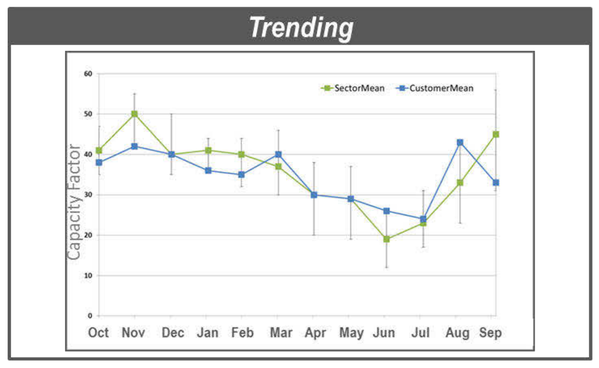


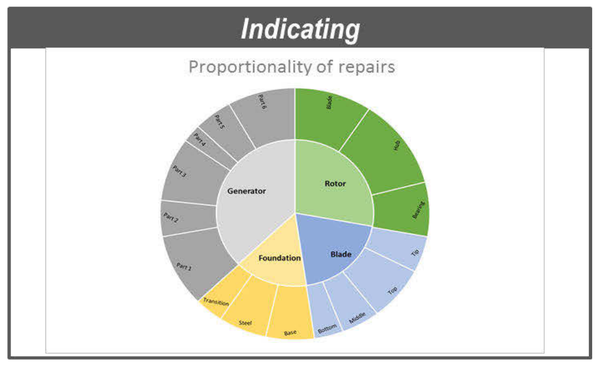
Output metrics must be delivered in a form that allows for visualisation in multiple ways. The displaying of output metrics is best performed via a web browser for access from multiple locations e.g. on site, HQ building etc.

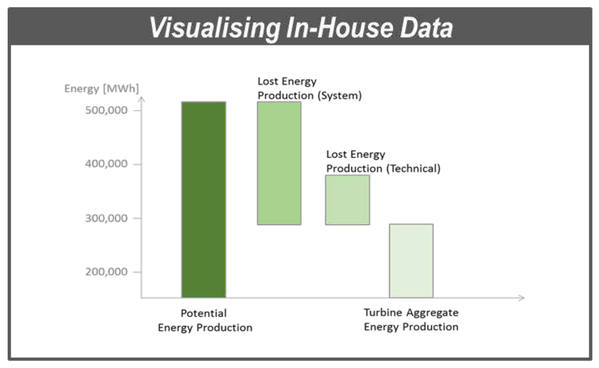
WEB BROWSER Most powerful option for displaying and visualising but is difficult to integrate into existing systems; only limited options for re-analysis by the participants

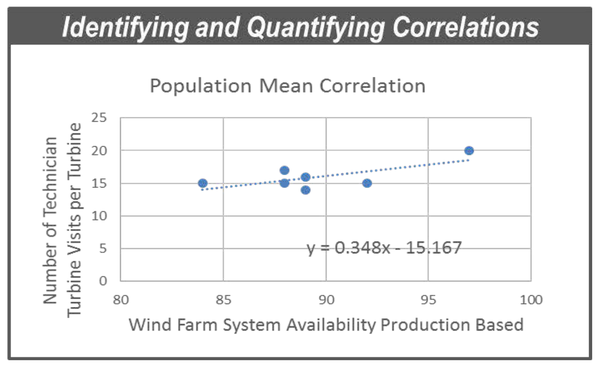
CSV Most powerful option for re-analysis within the participant but substantial effort then required to make digestible and to disseminate with senior management

REPORT Best for communication with senior management and to quickly understand key metrics. No flexibility to re-analyse data or reformat into the most appropriate format for the organisation









Quality assurance and sharing of best practise is essential to achieve continuous improvement of the benchmarking programme and provide confidence between industry peers that the data is objective and directly comparable.
The advantage of undertaking quality assurance is the ability to "score" data points and assign a confidence factor to output metrics to assist in use within the participating organisation. The disadvantage is the upfront investment required in terms of effort to first of all analyse data quality, and then the time and cost required to implement throughout the organisation and change working practices.

Aspect	Areas to address through Quality Assurance
Data Source	What confidence do you have in the sources of data?
Data Classification	The naming, labels and taxonomies used within your organisation. What confidence do you have that things are being named correctly?
Data Categorisation	Demonstrate that of all the relevant information and activity ongoing at your wind farm can be captured in the benchmarking platform.
Process Control	Can you provide data on time? Do you sense check data? Do you follow a procedure?

Conclusions

Crafting an effective benchmarking programme, taking consideration of the required taxonomies, data acquisition and processing, output requirements and delivery, as well as providing quality assurance, is essential in order to participants to realise the following benefits:

Compare Key Performance Indicators
- Benchmark at portfolio, country and global level
- Understand relative operating performance across your portfolio and compared to structurally similar operators on production, cost, reliability and logistics measures
- Track asset performance over time

Enhance Maintenance Strategy
- Enables strategic planning decisions to be made for O&M activity
- Investors and planners can choose the most appropriate time frame in which to carry out repairs

Drive Organisational Improvements
- Motivate and engage your organization to improve by providing a baseline for current performance and informing future targets
- Inform future production, cost and safety targets in annual performance management and planning cycles

References

1. **Designation of wind power plants with the Reference Designation System for Power Plants – RDS-PP® - Special Print; Jörg Richnow, Clemens Rossi and Helmut Wank**
2. **International Standard. IEC 61400-1, Third Edition 2005-08. Wind Turbines**