

Quantity and Type Forecasting Tool for Offshore Wind Power Plant Spare Parts Dip.-Ing. Robert Rauer Marine 2013

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Introduction



European targets 2020 35 % of electricity from renewables 12 % of electricity from wind energy 40 GW installed offshore capacity 10 GW plans German government ~2000 5 MW turbines



More than 100 new offshore wind farms in Germany.

BUT in end of March 2013 only 0,32 GW (3,2 % of total) installed capacity today!



Offshore wind farm





Future trends

Building wind farms further from shore, because of limited space Greater distance to shore leads to deeper water at site Larger wind farms / number of turbines

Locistics Concepts



The chosen logistics concept can improve the mean time between failures (MDT). Especially with

- faster transportation of staff and items,
- stock optimization and
- shortening of lead times.

Target: low costs strategy

To ensure supply in case of a turbine downtime, the owner needs to know how many spare parts to keep in stock and of which type to bring the system back online in the shortest time. Lifetime costs = 5.4 million EUR / MW O&M costs (20 years) = 1,5 million / MW (28% of total costs)



Operation & Maintenance



Reliabilty

"as the ability of a system or component to perform its required functions under stated conditions for a specified period of time" ...early designs of offshore turbines were not very reliable

Maintainibility & Serviceability ...serviceability describes the planned schedule to maintain a turbine. Which kind of spare parts have to be exchanged or to maintain.

Operational availibility

"the capability of the wind turbine to maintain operation"

...one of the most important problems regarding offshore wind turbines.

Maintenance strategy

...availability of an offshore wind turbine is directly connected to the chosen O&M and spare part strategy. In general maintenance strategies can be divided into preventive and corrective maintenance.

Maintenance Strategy



...the maintenance strategy is associated with the operational availability. An offshore turbine which is technically not available, cannot produce "money". Reducing the downtime and get the turbine available is very important for the wind farm owner.

The purchase of an offshore wind turbine is often connected with a warranty by the manufacturer for five years -includes fullservice of the site, spare parts management on site, servicepersonnel, heavy lift logistics and spare-parts.





Forecasting Spare Parts



- ... to reduce costs in the operation & maintenance phase.
- ... amount and type of spare parts.
- ... higher availability to reduce costs per kWh.
- ... after five years of full-service possible in-house activity.
- ... demand spatial space in ports, equipment and vessel type.
- ... demand / availability of crane or jack-up vessel.
- ... optimize / implement "new" logistics concepts.



Forecasting Tool





- purpose of the developed software is to forecast the amount and type of needed spare parts for a specific time period and defined availability.
- ... based on limited historical data from offshore wind farms.
- ... challenge because of not-continuous /sporadic demand and .
- ... implemented methods will be Wedekind respectively Croston.

Implemented Methods



Exponential smoothing (time-series)

... is simply an adjustment technique which takes the previous period's forecast, and adjusts it up or down based on what actually occurred in that period. It accomplishes this by calculating a weighted average of the two values.

Formula:

 $F_{t+1} = \alpha^* D_t + (1 - \alpha)^* F_t$,

 D_t = actual value F_t = forecasted value α is the weighing factor, which ranges from 0 to 1

Croston method

The Croston consists of two steps.

- First, separate exponential smoothing estimates are made of the average size of a demand.
- Second, the average interval between demands is calculated. This is then used in a form of the constant model to predict the future demand.

Next Steps



Complete implementing of the tool with VBA or Matlab. Gather and analyze available historical data.

Possible future constraints are

- Availability of vessels
- Availability of weather windows

If not available more space needed in ports!





Thank you for your kind attention. robert.rauer@tuhh.de www.tuhh.de/mls

