nabla
wind hub

GRADUAL DISMANTLING STUDY

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INTRODUCTION

Thanks to the Data obtained in the Reliability Model, the **Gradual Dismantling Analysis** provides an initial plan for the dismantling process of a wind farm or a portfolio with similar characteristics of technology, location...

The process is based on the next points:

- Each turbine will be kept in operation up to finding its financial death: i.e. the moment in which an investment in maintenance (e.g. replacement of a gearbox) will not have a positive financial return.
- At that moment each sane turbine component will be available for the most suitable exit strategy: cannibalization, aftermarket, recycling or waste. Different components will have different exit strategies, depending on the type of component and needs of spare parts of the remaining compatible turbines in same or other wind farms of the portfolio.
- Those components suitable for cannibalization for other turbines will generate a spare parts pool, which other turbines will use to continue in operation up to finding their financial death.

CONCEPT

The Gradual Dismantling Analysis will provide the following benefits:

- Identifying per year the annual revenues associated to:
  - keeping the turbines running with cannibalized components
  - selling the spare parts in the aftermarket
  - recycling of scrap metal
  - other exit strategies (to be treated as a separate business plan)
- Identify per year the annual costs associated to keeping the turbines running with cannibalized components.
- Creating a detailed understanding of the realistic financial death of the assets, after extracting all its remnant value.

METHODOLOGY

The Gradual Dismantling will cover different aspects of the wind farm beginning with:

The Type of Components:

- **PAMPC – Preventive Ageing Management Plan Components:** these are the structural components which have been subjected to preventive reinforcements as the consequence of an AMP – Ageing management Plan. This class includes for example: blades, towers, foundations, mainframes or hub.
- **RAMPC – Reactive Ageing Management Plan Components:** these are structural components in which the reinforcement is not applicable, and its life extension strategy consists on sophisticated maintenance actions linked to condition based predictive maintenance in which the life of the component will be pushed to its limit This class includes for example: gearboxes, main shafts, generators or yaw bearing.
- **PC – Perishable Components:** these are those components which cannot be repaired once they have lost functionality and must be replaced, finding typically a technical and market obsolescence as one of the main difficulties to be sorted out (e.g. in the market these exists no motherboard for the controller PLC). This class includes, for example: pitch bearings, main bearings, controller electronical boards, transformers, converters, cabling, yaw actuators or pitch actuators.

The Exit Strategies per Component:

- **Cannibalization**: use of this component as spare part for other turbine in which this component is compatible (e.g. main shaft of G87 and G90).
- **Aftermarket**: selling of this component in the market as second hand component for those wind farms in which an AMP – Ageing Management Plan has not been executed and are in the need of spare parts (e.g. blades).
- **Recycling**: mostly metallic components which can be sold as scrap metal to metallic recycling factories (e.g. towers, mainframes, hubs).
- **Waste**: those components which single exit is to be dismantled or demolished and wasted in proper waste centers (e.g. Foundations, nacelle covers).

Both aspects are merged on a **Components Compatibility Diagram**, enabling that different wind farms with different turbine models generate the spare parts that other compatible turbines can use.

Once the diagram is completed we obtain the next outputs:

- **Spare Parts Flow Engine**, showing:
  - Exit strategies for the components when created
  - Compatibility matrix
- **Costs Engine**, identifying offer vs the demand of internal consumption of spare parts each year has been created, an economical evaluation for each action is provided:

- Cost per cannibalization action
- Cost of aftermarket spare parts generation
- Cost of recycling action
- Costs of waste

- **Revenues Engine.**
- **Financial Modeling**, for:
  - For the long term operation of the wind farms based on the gradual dismantling and cannibalization of components
  - Other exit strategies

OUTCOMES

Nabla Wind Hub delivers a Technical Report covering all the aspects of the Gradual Dismantling Study, including the Components Compatibility Matrix, and the most suitable exit strategy, including costs and revenues figures.

REFERENCES

Nabla Wind Hub is an independent technology platform that delivers asset redevelopment projects for the wind industry worldwide. End-to-end & one-stop-shop partner for SPVs and Porftolios revaluation, through Life Extension, Performance Improvement and Maintenance Optimisation; based on state of the art technologies, such as top-accuracy aeroelastic models, in-house rerotoring components, and advanced monitoring solutions.

700 wind farms assessed

1200 wind turbines monitored

2000 blades installed

200 wind turbines guarded

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