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O&M Decision Making Model

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Abstracts

SeaEnergy PLC, via a Knowledge Transfer Partnership with Robert Gordon University, is creating a dynamic Operations and Maintenance (O&M) software as a service (SaaS) model.

The SaaS model allows O&M operators to enhance their delivery of services via tactical operational assessments and iterative improvements.

Statistical and metaheuristic methodologies are used in order to generate an optimum list of tasks for the conditions at hand.

Marginal gains on a daily basis lead to substantial increased revenue over the life of a wind farm.

Objectives

Over the past 20 years the offshore wind energy industry has changed dramatically. Technology has improved significantly with larger wind turbines installed in deeper waters and farther from shore. However Levelised Cost of Energy (LCOE) remains high due to high capital (CAPEX) and operating expenses (OPEX) and low availability (approximately 90%[1]). To maximize returns, cost reduction must progress more rapidly than the tariff decline [2].

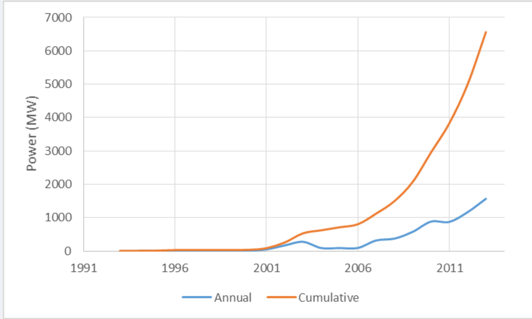

Figure 1: European offshore wind installation [3]

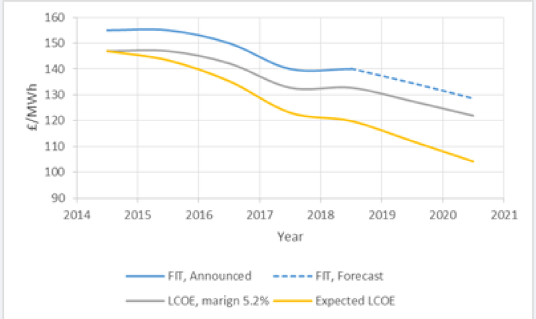

Figure 2: Feed in Tariff and LCOE process [2]

Improving the availability of a modern offshore wind farm (for example 100 WT, total capacity of 500MW) by 1%, the annual production value would rise more than £3,000,000.

In the past a number of O&M software solutions have been developed to assist maintenance strategies and activities [4] but LCOE remains high. Only a small number of O&M software solutions optimise the tactical approach by operators via a combination of metocean variables, vessel specifications and coordinates, amongst other variables.

OPEX challenges are not unique to the offshore wind industry. The SaaS model is pertinent for multiple applications in the complex offshore energy industry, including oil and gas.

Methods

The SaaS model has been designed using a modular structure, as this allows for the greatest degree of flexibility in design, development, validation, application, update and modification.

Data Filter Module

- Maintenance filter
- Metocean filter
- Vessel filter

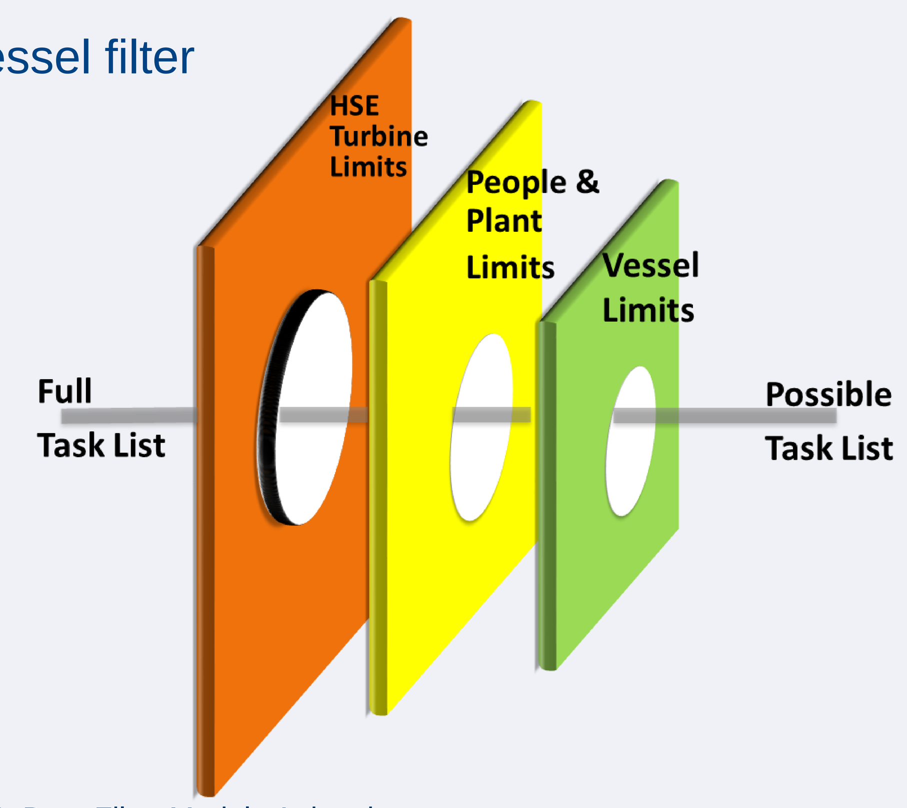

Figure 3: Data Filter Module Animation

Logistic Module

- Single Vehicle Pickup and Delivery Problem with Time Windows
- Metaheuristic method
- Genetic algorithm
- Time fitness test

Energy Module

- Linear interpolation applied on manufacturer's power curve
- Air density correction applied following IEC61400-12-2 methodology [5]

Cost Revenue Module

- Cost fitness test

Results

In an offshore wind farm the total number of available approaches depends on the number of wind turbines, N.

$$Total\ Maintenance\ Approaches = \frac{(2 * N)!}{2^N}$$

The total number of potential approaches is enormous and only a few reduce LCOE. The challenge is to identify the optimal approach.

The SaaS model identifies the best O&M approach in the context of the wind farm's requirements at that time.

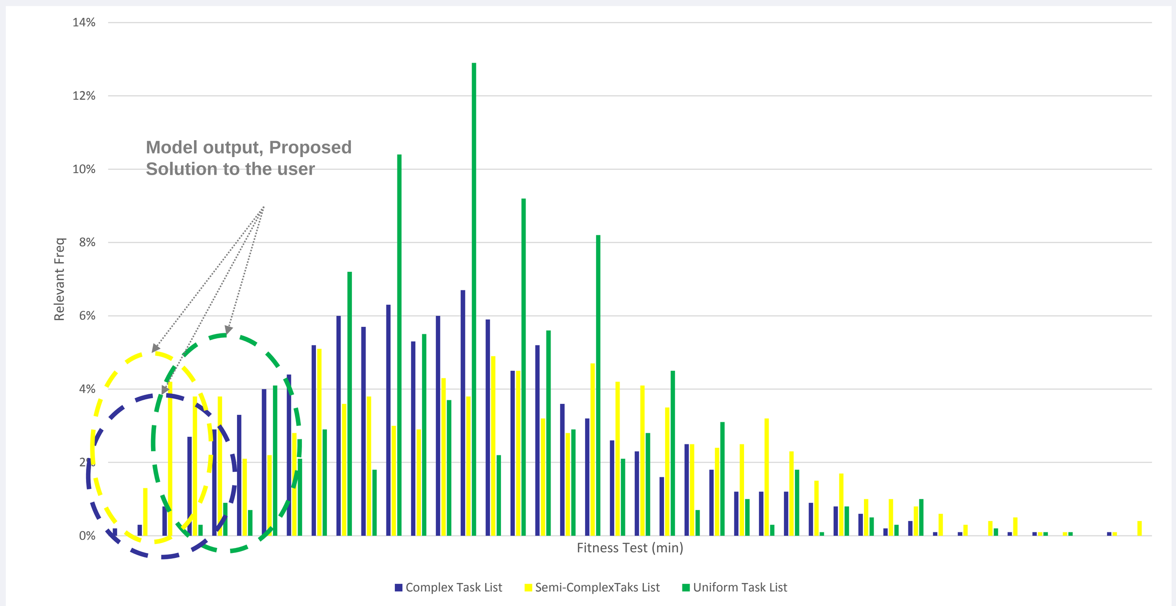

Figure 4: Proposed solutions depends on task list similarities

Operational efficiency depends on:

- Size of task list
- Complexity of task list (type, duration, etc.)
- Weighting factors of the fitness tests

Future work

Research, analysis, and testing continues on the SaaS model, including:

- Uncertainty analysis
- Validation
- User interface
- System integration

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References

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