

Simulation and Optimisation of Offshore Renewable Energy Arrays for Minimal Life-Cycle Costs

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The project

- Improve scheduling logistics of operations on modern windfarms in the North Sea
- Literature tends to split the life-cycle in three phases
 - Installation (~2-3 years)
 - Maintenance (~15-25 years)
 - Decommission (~2-3 years)
- Large industrial vessels used for major operations; small improvements can lead to large savings
- Most research in literature chooses a phase to focus on; my work looks at how the phases interact

Research Questions

Question

Can considering the entirety of the life-cycle of an Offshore Wind Farm, and how each of the phases interact, improve logistical decision making on these projects?

Sub-Question 1

Can considering how phases in the life-cycle of a windfarm overlap and share resources improve logistical decision making on these projects?

Sub-Question 2

Can considering the entire life-cycle of a windfarm provide useful data to base logistical decisions on in the later phases of these projects?

Sub-Question 3

Can considering the long-term effects of logistical decisions early on in the life-cycle of a windfarm improve these decisions?

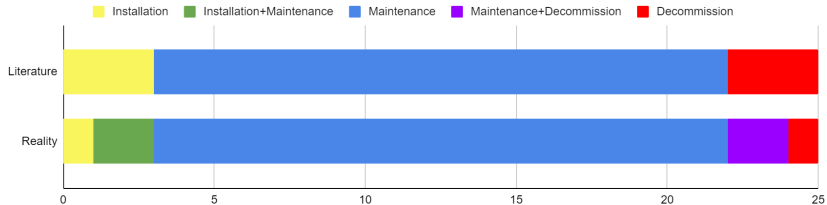
- Developed individual deterministic optimization models for each phase
- Combined models in lifespan model
- Experimented with ways to make models stochastic and robust
- Implemented each of the models in C++ using Xpress
- Used basic test cases to improve models and test sanity of solutions
- Experimented with variants of models to improve computational efficiency

- Increased my own knowledge reading literature
- Focused on reading about maintenance scheduling
- Gained access to extensive weather data
- Helped teach a course
- Followed an online course
- Made an actionable plan to work towards first publication

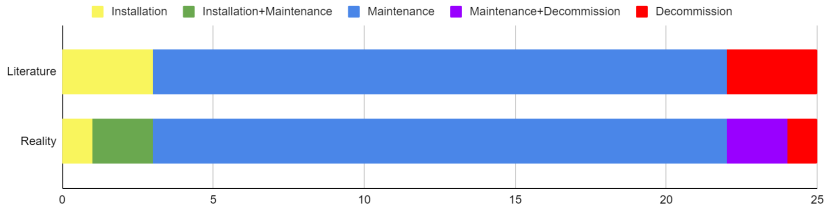
Sub-Question 1

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Direct focus



Direct focus



- Will investigate the time intervals at which phases overlap
- During this time resources are shared
 - Can lead to complications when ports or maximum amount of vessels are in use
 - Can lead to optimizations when vessels can reduce idle time working on multiple phases
- The number of active turbines varies, potentially complicating maintenance
- Overlap time *might* have a disproportionate amount of failures

Sub-Question 1

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| | Nov | Dec | Jan | Feb | Mar |
|----------------|-----|-----|-----|-----|-----|
| Design | | | | | |
| Implementation | | | | | |
| Experiments | | | | | |
| Analysis | | | | | |
| Writing | | | | | |

- Build simulation model for the life-cycle
- Use this model to answer other sub-questions
- Consider failure rate informed by individual (predicted) history of turbine
- Hopefully publish any significant results found
- Finalize writing
- Complete the project in the next 12 months

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Thank you for listening!