Decision Support Tool for Planning Wind Farm O&M Activities

Rafael Dawid, David McMillan, Matthew Revie

CDT Wind Energy Systems, Rm 3.36, Royal College Building
University of Strathclyde, 204 George Street, Glasgow, G1 1XW

rafael.dawid@strath.ac.uk

Problem:

Given multiple vessels/vans and wind turbines requiring a maintenance action, how to decide which vessels/vans visit which turbines and in what order?

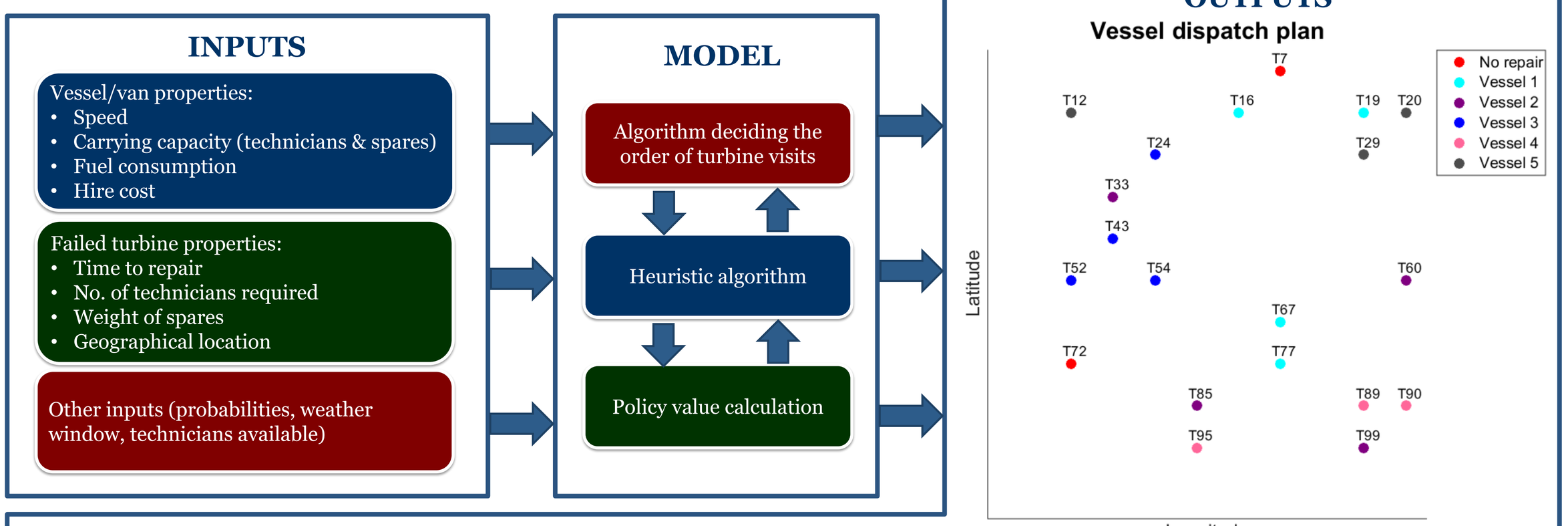
Motivation:

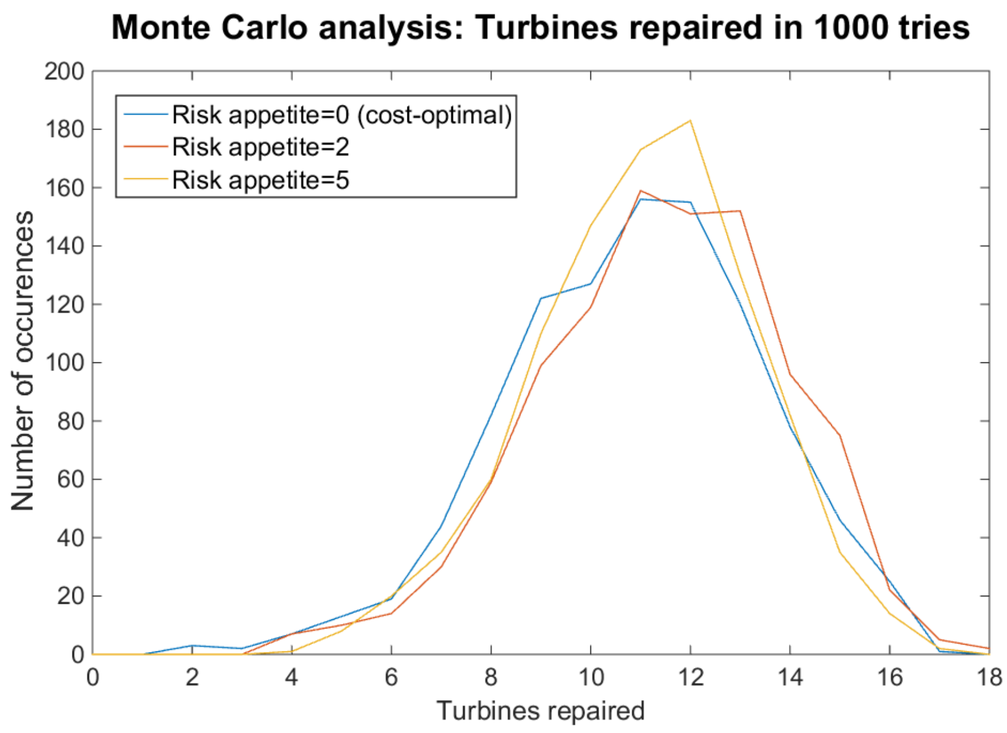
- Improving O&M practices can lead to significant cost of energy reductions
- To date, there hasn't been any published models within the academic domain, able to consider all practicalities of real-life O&M planning
- Decisions are still made by operators without help from mathematical tools
- There are more ways to dispatch 5 vessels to 20 turbines than there are stars in the observable universe (an efficient heuristic method is vital)

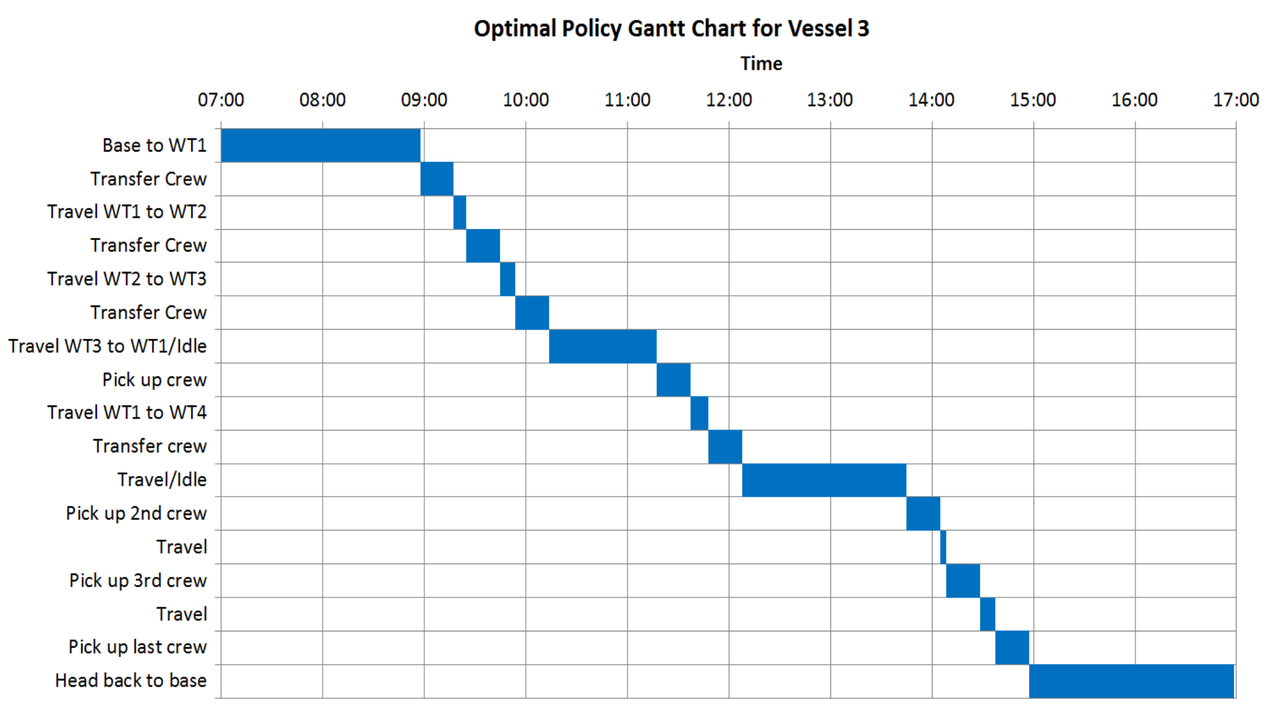
Incorporating uncertainties into decision making process

- Uncertainties modelled include the time of repair, likelihood of successful access and probability of correctly diagnosing a fault
- Probability of being able to successfully repair all turbines within each policy is calculated and incorporated into the model through the risk appetite value (a user defined measure of the trade-off between low cost policies and policies likely to be completed)
- Multiple possible policies can be generated effortlessly by varying risk appetite. These can be analysed and discussed by operators, reducing the time it takes to make a decision and potentially allowing better choices to be made

Model structure







Validation

- The assumptions and functionality of the tool were tested during a visit to an operations centre of a major UK offshore wind farm
- The logic of ordering repairs and clustering turbines was partly validated, as policies generated by the model were similar to those produced by the operators
- The feedback received from the O&M planners was positive, with the only major issue being integration of the tool with current data management systems

Conclusions

- The tool encourages effective use of resources and it can aid O&M cost reductions by supporting decisions made by wind farm operators
- Case studies have shown that the least-cost solution is not always optimal in the presence of uncertainties
- The tool has been created with large offshore wind farms in mind, but can be applied to onshore problems as well
- To our knowledge, this is the first time a mathematical model was applied to a complex, real-life offshore vessel routing problem

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