O&M decision problems

Investigating key decision problems to optimise the operation and maintenance strategy of offshore wind farms

Overview

- Investigates 3 decision problems with potential to optimise O&M and logistics strategies for offshore wind farms:
  1. What is the optimal composition of annual pre-determined jack-up vessel campaign periods for heavy maintenance ?
  2. What is the optimal crew transfer vessel (CTVs) fleet for smaller corrective and preventive maintenance tasks?
  3. What is the optimal start month for annual preventive maintenance services?
- Compares problems in terms of potential cost reduction and the variability and associated uncertainty in results.
- Demonstrates the benefits and difficulties of considering problems together rather than solving them in isolation.

Conclusions

a) Predetermined jack-up vessel campaigns could be a competitive strategy

b) Larger uncertainty for jack-up vessel decision problem

c) Not advantageous to consider jack-up vessel problem together with CTV fleet selection

d) Important of seeing the timing of annual service campaigns together with the selection of the CTV fleet

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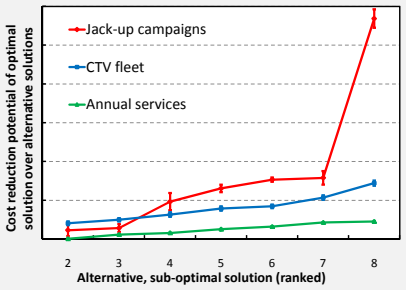
Motivation and background

The offshore wind industry needs to reduce costs and turbine downtime to make it competitive with other forms of energy production. The O&M phase of an offshore wind farm is subject to a vast range of decisions and, therefore, opportunities to improve efficiency and reduce costs. The objective of the EU FP7 project LEANWIND is to improve efficiency and reduce costs across all life cycle phases, including O&M.

Comparison of decision problems



Jack-up vessel decisions have high potential for cost reduction but are associated with high uncertainties (failures requiring jack-up vessels happen rarely but each failure has large cost implications)

Better	1	MarJulOct	1 SCTV + 2 ACTV	May
	2	MarJunSepDec	2 SCTV + 2 ACTV	Apr
	3	JanAprJulOct	3 ACTV	Jun
	4	MarSep	2 SCTV + 1 ACTV	Mar
	5	AprSepOct	2 ACTV	Feb
Worse	6	MarAugSep	1 SCTV + 3 ACTV	Jul
	7	AprJunAugOct	3 SCTV + 1 ACTV	Jan
	8	AugSepOct	1 SCTV + 1 ACTV	Aug

(SCTV = Standard CTV; ACTV = Advanced CTV)

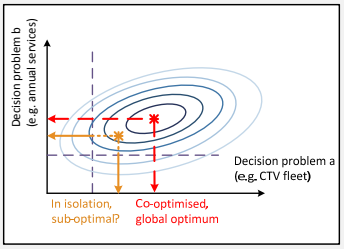
Co-optimising decision problems

Difficulties: Although the optimal CTV fleet and jack-up vessel campaign composition remains the same when co-optimising , including the jack-up-vessels increases the stochastic variability. This introduces "noise" making it more challenging to solve the CTV fleet selection problem.

Advantages: Considering the CTV fleet and annual service start month problems together, it is found that with a larger fleet the start month could begin later in the year, potentially further reducing downtime and revenue losses.

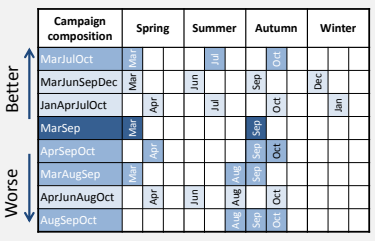
Methodology

- The NOWIcob O&M model, a Monte Carlo discrete-event simulation model developed by SINTEF Energy Research, was applied for the study
- LEANWIND 125 x 8 MW reference wind farm with representative failure data:
  - 3 corrective maintenance tasks requiring crew transfer vessels
  - 1 corrective maintenance task requiring a jack-up vessel
  - 1 preventive maintenance task (annual service)
- For each decision problem, a selection of possible strategy solutions are defined
- To find the "optimal" solution, the sums of direct O&M costs and downtime costs are compared
- First each decision problems (1, 2 and 3) was studied in isolation for a relevant subset of maintenance tasks
- Then the decision problems (1+2 and 2+3) were co-optimised including all maintenance tasks



Jack-up vessel campaigns

- Compositions of 2-4 month-long heavy maintenance campaigns are considered
- Campaign periods spread relative evenly over the year are better
- Comparison with conventional fix-on-failure charter strategies indicate that predetermined campaign periods can be advantageous for large wind farms



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