THE BRYDEN CENTRE
ADVANCED MARINE AND BIO-ENERGY RESEARCH

QUB-
Mechanical and Aerospace Engineering
2018-2019

Title: Decision support tool for optimal sequencing of installation operations for an offshore wind farm	
Organisation	Queen's University Belfast
Industrial Partner	Gavin & Doherty Geosolutions
Qualification	PhD
Funding Amount	Fee/studentship funding is available for UK nationals or EU nationals who have lived in the UK for over 3 years (EU nationals not resident in the UK are only eligible for fees element). Further information regarding DfE studentship eligibility criteria can be found at: http://www.qub.ac.uk/graduate-school/funding-scholarships/uk-eu-prospective-research/. Successful candidates for this post eligible for DfE funding may also be eligible for an top-up for this project of £3,500 per annum.
Duration	3 years
Anticipated Start Date	September 2018

Project Summary

The decision support tool will assist with logistical decisions (optimal vessel planning) for the installation of an offshore wind farm using available weather data. Initially tool development will focus on fixed offshore wind technologies but method selection will be generic such that floating wind technologies may be included in future work.

Background

Logistic costs associated with offshore energy devices are significant throughout their life cycle. Device scale (including supporting structures), the environment and remote locations which are necessary for device efficiency negatively influence logistics. Limited research is available on optimal sequencing of installation operations for offshore wind farms. To date individual simulation examples are available but there has been no work undertaken to determine the required modelling detail for accurate results or examination of the sensitivity of results to the method or detail of weather representation. Much modelling research is generally available but mostly for controlled static and benign environments. Previous research has represented scheduling in civil construction and represented the impact of weather but methods of construction or installation logistics are fixed and thus not representative of the varying vessels available for offshore transport and installation tasks. Thus there is a modelling knowledge gap associated with methods for optimal sequencing of installation operations within uncertain environments where there is a range of vessels with varying transport and installation capabilities.

Methodology

1. Multiple activities required for the installation of an offshore wind farm will be identified (in consultation with industry partners). Key components to be included within the support tool will include: Foundations, Turbines, Offshore substation, Cables. Each activity will be characterised in terms of pre-requisites, number and types of vessels required, and associated operational constraints for each vessel (alternative vessel plants can be included, for example, foundation installation may be carried out using a purpose built installation vessel or a combination of barges, for component transfer, and crane vessels, for load-out and on-site installation). The overall sequencing of activities for installation of the entire offshore wind project will be represented.
2. A decision support method will be developed for optimal scheduling of installation activities subject to weather volatilities. The tool will be formulated to enable optimisation of the project critical path prior to commissioning of actual installation works and during installation works based on new information and current conditions. Models will be developed to simulate the installation activities and methodologies to represent dynamic weather conditions which will impact transport and installation task. The project will identify the required model detail necessary to capture the critical attributes which affect the duration of activities (wind speed, significant wave height, etc.) to enable installation schedule optimisation, including the optimum selection of ports and vessels for a given wind farm project.
3. The decision support tool will be applied to a case study of an offshore wind farm off the coast of Northern Ireland/Ireland/Scotland to identify optimal duration/cost of installation works. The case study will include available weather data in the area of interest and generic wind farm characteristics (turbine capacity, wind farm layout, water depth, distance to shore, number of substations, inter-array/export cable length, export cable length, determined in consultation with industry partners to represent next generation OWFs.

Project novelty
The project will develop new understanding on the modelling requirements for offshore wind farm installation. The project will for the first time establish the sensitivity of simulation prediction to model fidelity, including the representation of weather conditions. This will enable the determination of modelling best practice for industrial use (simulation expense to match design stage, for example).

Project Impact
The project outcomes can be used in optimal scheduling of installation operations for offshore wind projects, which can contribute to significant CAPEX reductions and less uncertainty around marine logistics.

Key skills required for the post:

A minimum degree of 2:1 (or equivalent) in one of the following areas is required: Engineering, Science, IT, Mathematics or a closely related subject area. Candidates must be able to demonstrate a significant level of mathematics and/or data analysis in their primary degree area.

It would be desirable to have some understanding and knowledge in the areas of modelling or data analytics.

Good computer skills are desirable as the project will involve computer modelling, simulations and analysis of results.

Key transferable skills that will be developed during the PhD:

This research project will enable the successful student to acquire valuable experience of simulation tools, advanced offshore wind projects, and marine logistics. All of which are highly sought after within industry. The project will use a combination of advanced commercial simulation tools, validating their predictive capability against real project data.

First/Lead Supervisor and their contact details	Prof Adrian Murphy (a.murphy@qub.ac.uk) Dr Joe Butterfield Prof John Doran Prof Andrew Rae
Second Supervisor and their contact details:	
Top up available for this project?	Yes – Bryden Centre – www.brydencentre.com
Linked to DTC?	N/A