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Optimised scheduling for weather sensitive offshore construction projects

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Abstract

The significant lead times and costs associated with materials and equipment in combination with intrinsic and weather related variability render the planning of offshore construction projects highly complex. Moreover, the way in which scarce resources are managed has a profound impact on both the cost and the completion date of a project. Hence, schedule quality is of paramount importance to the profitability of the project. A prerequisite to the creation of good schedules is the accuracy of the procedure used to estimate the project outcome when a given schedule is used. Because of the systematic influence of weather conditions, traditional Monte Carlo simulations fail to produce a reliable estimate of the project outcomes. Hence, the first objective of this research is to improve the accuracy of the project simulation by creating a procedure which includes both uncertainty related to the activities as well as an integrated model of the weather conditions. The weather component has been designed to create realistically correlated wind- and weather conditions for operationally relevant time intervals. The second objective of this research is to optimise the project planning itself by using both general meta-heuristic optimisation approaches and dedicated heuristics which have been specifically designed for the problem at hand. The performance of these heuristics is judged by the expected net present value of the project. The approach presented in this paper is tested on real data from the construction of an offshore wind farm off the Belgian coast and weather data gathered by the Flanders Marine Institute using measuring poles in the North Sea.

Keywords: Offshore Construction, Weather Simulation, Stochastic Scheduling, Project Scheduling

1. Introduction

This paper presents a comprehensive methodology for the proactive scheduling of capital intensive projects which are sensitive to weather conditions. This is done by combining heuristic optimisation techniques and weather simulation models which are fitted to data gathered on the North Sea off the Belgian coast. The construction of an offshore wind farm will be used as an archetypical example of a capital-intensive and weather-sensitive project.

The significant lead times and costs associated with materials and equipment in combination with the significant stochasticity introduced by varying weather conditions make the planning of offshore construction projects highly complex. Moreover, substantial economical gains are made when the planning of such projects can be optimised. The goal of this paper is to improve upon the current best practices for creating schedules for such projects.

This paper presents a novel weather simulation model which is capable of generating correctly correlated wind- and wave information. Moreover the paper also presents a novel model for the project and the associated schedule. Both these models include a greater degree of realism than the current state-of-the-art, resulting in

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