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STRATEGIC PLANNING OF LOGISTICS FOR OFFSHORE ARCTIC DRILLING PLATFORMS SUPPORTED BY SIMULATION

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ABSTRACT

The operation of offshore drilling platforms requires a lot of logistics: supply of platforms by platform supply vessels (PSVs), backward transportation of waste in containers and transportation of oil by tankers to export ports. The severe weather conditions of the Arctic Ocean increase the number of possible disruptions that influence the logistic system. The operation of PSVs and tankers has multiple constraints and interactions. An agent-based simulation has been developed in AnyLogic to support the strategic planning of logistics by year 2042. The presentation discusses the use of the model to determine the required number of vessels and compare different options of crude oil outbound logistic network design.

1 INTRODUCTION

One of the biggest oil & gas companies is planning to develop a network of 7 drilling platforms in the Arctic Ocean by year 2042. During the strategic planning of logistics the following questions arise: How many supply vessels should be bought and when? Should we rent floating oil storage? What size of onshore supply base should we build? The price of any mistake is very high: purchasing an unnecessary supply vessel can result in multimillion losses, and the lack of tankers can lead to emergencies with platforms and even oil spills. An agent-based simulation model in AnyLogic has been developed to support strategic planning of logistics.

2 DETERMINING THE REQUIRED NUMBER OF PLATFORM SUPPLY VESSELS

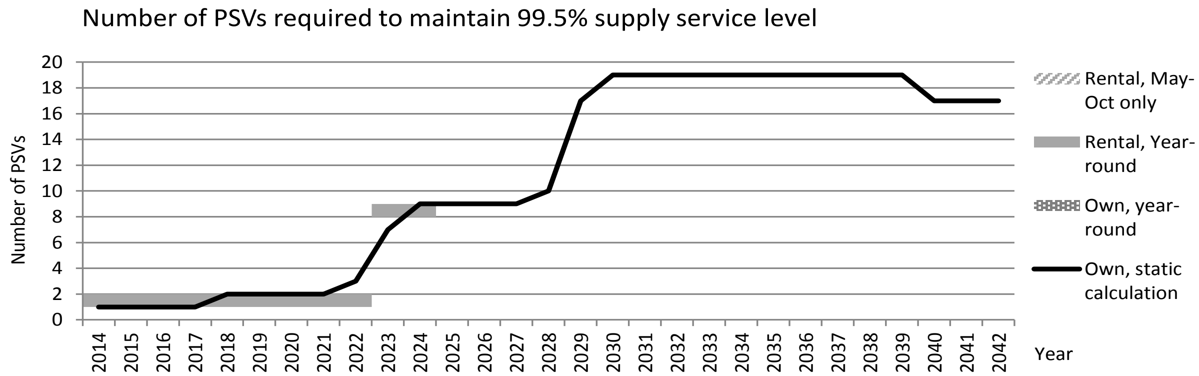
The primary task of the simulation model was to determine the quantity of PSVs in each phase of the project. PSVs participate in two material flows:

1. supply of platforms with inventory from onshore supply bases, and
2. transportation of waste from the platforms back to onshore supply bases in containers and empty containers back to the platforms.

The operation of PSVs has multiple constraints and interactions. Each PSV has several storage zones each of them having its own limitations on weight and volume. On top of that, the total load of a PSV should not exceed its maximum capacity. The containers for waste share the same space with the inventory. At each platform, PSVs can wait in a queue before previous PSV finishes unloading. A PSV can wait at a platform even after it is fully unloaded waiting for containers to be filled to take more waste out of the platform.

In order to simulate these operations, a dynamic scheduling algorithm for PSVs has been developed. This algorithm is used every time a PSV enters a port to plan its next transportation cycle. The planning algorithm chooses which platform to supply and determines the inventory and the number of containers to be sent to the platform. The algorithm tries to prevent the first deficit in product or the first overflow of waste. Each product and waste type has its weight that shows how damaging it would be to have a deficit in product or an overflow of waste, respectively.

The simulation has demonstrated that between 2029 and 2040 the company can escape with 17 PSVs as opposed to 19 which was determined by the previous static calculation. The first peak of demand for transportation in 2021 and 2022 can be covered with 15 seasonal (from May to October) rental vessels (see the figure below).

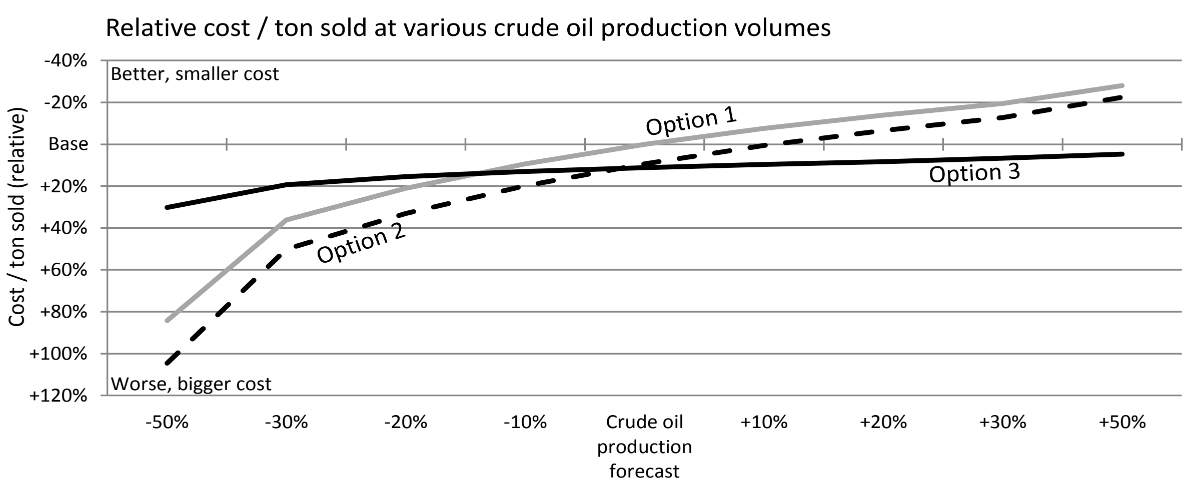


3 EVALUATION OF THE OUTBOUND LOGISTICS DESIGN OPTIONS

Tankers are used to transport oil from the platforms to the export sea ports. Three variants of outbound oil logistic network design (referred to as options) have been evaluated using the model:

1. The use of the floating oil storage as a hub, use of supertankers (300,000 ton) to transport oil from the hub to export sea port, and smaller tankers (70,000 ton) to transport oil from the platforms to the hub.
2. The use of the floating oil storage as a hub with the use of smaller (70,000 ton) tankers only. In this option, smaller tankers are used for all routes and there are more opportunities for dynamic re-routing of the tankers.
3. The use of smaller (70,000 ton) tankers only without a hub to transport oil directly from the platforms to export sea port.

The results of the simulation showed that Option 3 is cheaper only if volume of crude oil production is 90% or less than the basic forecast. Otherwise, Option 1 is more preferable and results in 17% – 33% less relative logistic cost than Option 3 (see the figure below).



CONCLUSION

The simulation replicates the process of operating different logistic network designs and considers multiple significant factors like disruptions caused by weather, the queues of vessels at ports and platforms, vessel dispatching rules and others. The model has an interactive animation which is used to additionally check the modeling logic and present the simulation to top management. The model is a standalone application which loads all its input data from MS Excel files and can be further used by company management to support decisions during strategic planning of logistics.