

GM OPSIM EXPERIENCE HISTORY

Operational Simulation to inform decision making

GM OPSIM is a strategic operational planning tool for tailored project analysis. It provides the ability to model, simulate and test the stages, schedule, resources and limiting criteria of your operation. The results of the simulation identify the critical stages, availability and delay, resource pinch points and potential savings of time and effort.

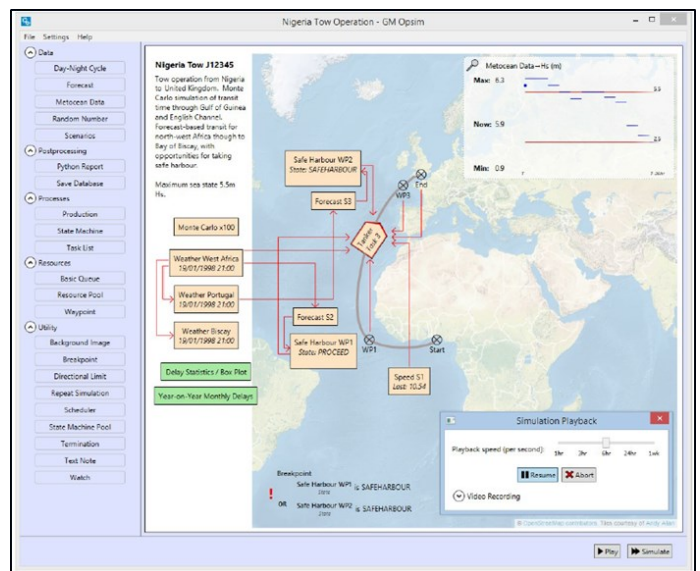
Since its launch in September 2012, GM OPSIM has been custom developed for a variety of different projects. A brief overview of some of these are detailed below:

Side by side cargo transfer

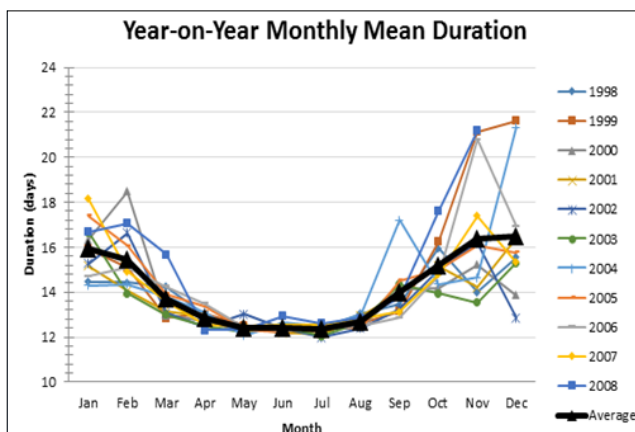
Analysis of weather windows and availability for side by side cargo transfer in open coastal and sheltered water locations to assess differential trip times, and impact on production and storage when using more distant, though more sheltered, locations for cargo export.

Critical buoyancy tank installation Statoil

Schedule, contingency and availability comparison for two installation concepts for critical buoyancy tanks retrofitting to a North Sea semisubmersible platform. The analysis tested the different operational times and weather limits against time series weather data, and identified the option offering shorter schedule and lower downtime risk.



GM OPSIM screen capture



Duration of operational spells (typical output)

Transshipment study

African Minerals

Optimisation of transshipment operation for the export of ore from Sierra Leone.

Cost effective walk to work analysis Total

Analysis of uptime and availability for a cost effective walk to work, daylight only system to support North Sea installation, and avoid high cost accommodation on a short timescale operation.

Crew boat personnel transfer uptime Hess

Simulation to support decision making for personnel transportation to and from a North Sea drilling rig using boat transfer as opposed to helicopter. The simulation tested transport route and offshore boarding weather and daylight limits against time series weather data to identify transport availability.

Retrofit anode installation

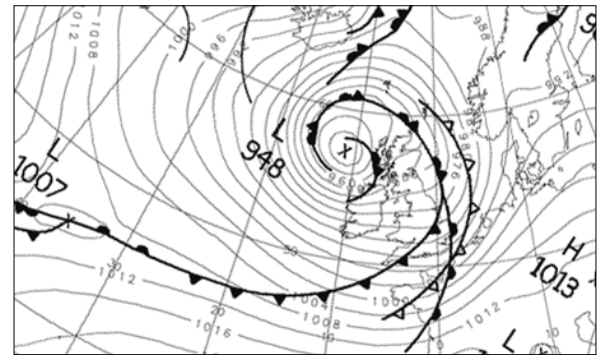
Statoil

Simulation of complex retrofit installation works for wind farm with operations requiring the construction vessel to perform more than 100 tasks with 5 different operational weather limits; analysis of downtime probabilities.

Transport options and arrival windows

Nexen

Investigation of transportation options and the ability to meet installation windows and high cost installation spread schedule. Simulation of dry tow and wet barge tow routes and time distributions via Mediterranean and Cape of good Hope, transportation limitations by heading and sea state, derivation of arrival dates in the North Sea and implications on the high cost installation spread for late arrival.



Weather Data

Nordstream Vessel Collisions

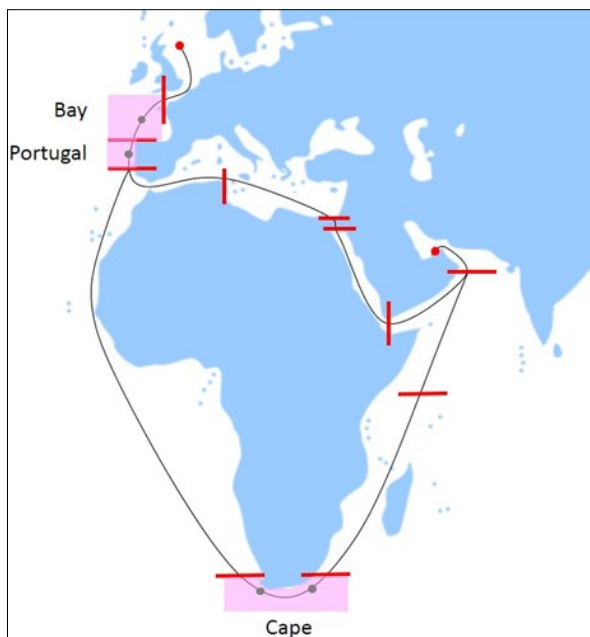
Nordstream

The probability of vessels crossing the Darnalles Straight being involved in a collision with a pipe-laying vessel was estimated using the Vessel Traffic module of GM Opsim.

Met mast transport and install

EDP Renewables

Transport route and installation window simulations to identify downtime risk and the ability to meet tight installation windows for the several phases of installation of a met mast in the Moray Firth.



Transport route sections and critical areas

Offshore operation schedule comparison

Talisman Energy

Simulation of schedule, downtime and potential cost implications of offshore operations comparing a single integrated operation against multiple staged operations. The key difference was the single integrated operation implied a shorter schedule, but imposed low weather limits; while the multiple operations implied a longer overall schedule but with lower individual weather limits in many of the stages.

TANAP Vessel Collision Risk

Worley Parsons

The frequency of vessels crossing the Darnalles Straight being involved in a collision was estimated using the Vessel Traffic module of GM Opsim. The objective of this study was to quantify the risk posed by sinking vessels on a proposed subsea pipeline.

Caspian Pipelay operations

BP

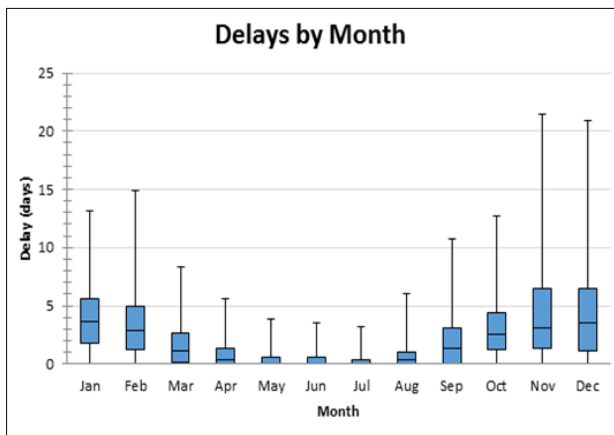
Simulation of Pipelay operations to identify schedule interruption. The probability of waiting on weather was analysed for different laying windows and wave height limits for anchor handling, stinger installation and pipelay.

**Selection of shuttle tanker offtake system
BP**

Screening of alternative tanker offload systems for a North Sea production platform, testing the windows and parcel sizes and the likelihood and duration of delays to offtake and to production in the event of tank tops events.

**FPSO offtake and production uptime
Maersk**

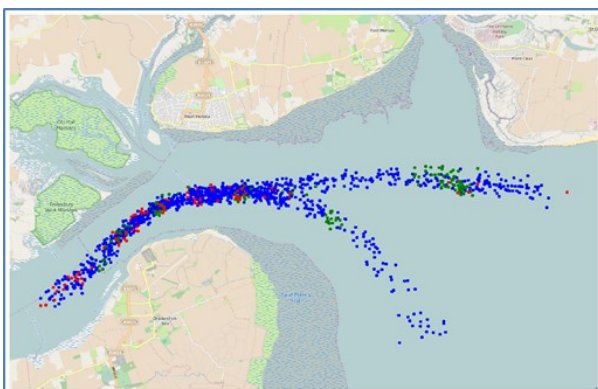
Simulation of tanker offtake and production integrity for proposed offload configurations for an FPSO offshore Angola. The model included production rates, storage volume, tanker arrival, and offtake limits for different systems and comparing downtime for the future options against an existing system in operation.



Example P25, P50, P75 box plot output

**Crane operability and offshore lifting uptime
KCA Deutag**

Limiting sea state and wave directions for combinations of crane radius and lift weight were tested to identify availability and weather delay for offshore operations.



Vessel Traffic Analysis Module

**Wind Turbine Generator Installation
Beatrice Offshore Wind Ltd. (BOWL)**

The loading, transit, installation of 83 Wind Turbine Generators and transit back have been modelled. The results for the study show the P50 and P90 result for time to completion and the associated weather downtime for each.

The impact of the number and orientation of boat landings has also been assessed.

	Proportion of time spent in field (percentage)					
	0 hours	6 hours	7 hours	8 hours	9 hours	10 hours
January	70.3%	2.1%	2.8%	2.8%	1.8%	20.3%
February	68.2%	1.3%	1.3%	1.8%	0.8%	26.8%
March	62.0%	1.8%	2.1%	2.1%	2.1%	30.0%
April	44.3%	2.6%	3.3%	3.3%	1.7%	44.8%
May	33.2%	0.9%	2.5%	3.0%	0.7%	59.7%
June	26.0%	0.0%	2.4%	1.2%	1.9%	68.6%
July	22.6%	0.2%	2.1%	1.2%	1.4%	72.6%
August	30.2%	0.0%	2.1%	2.3%	0.5%	65.0%
September	40.5%	0.5%	4.5%	2.6%	1.4%	50.5%
October	62.2%	1.4%	3.2%	3.7%	0.7%	28.8%
November	70.0%	1.0%	2.6%	2.4%	2.6%	21.4%
December	72.4%	0.7%	1.6%	0.9%	1.6%	22.8%

Example computation of the time spent on fields

Operability of a subsea support and construction vessel

Total E&P Ltd. (TEP)

A "walk to work" gangway equipped to the vessel allows personnel to access a fixed platform from the floating vessel quickly and safely under certain environmental conditions. Likely downtime associated with using the gangway for daily crew transfers was assessed. Other downtime considered was that associated with performing helicopter operations from the ship helipad and using the main offshore crane for lifting operations.

**SPM utilisation and oil production simulation
For joint venture oil production**

Simulation of vessel operations and production including weather operability downtime and production variations to determine the berth utilisation, vessel delays and required shore tank levels. Variations of the operational configuration were also examined as ongoing sensitivity studies. Multiple berth utilisation was considered and several weather limitations existed including berthing, operation and berth departure based on 5-year hindcast weather data.