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Diminishing Returns in OBN Fleet Configuration:

A Batch Simulation Approach to Right-Sizing Vessel Count and Arrival Stagger

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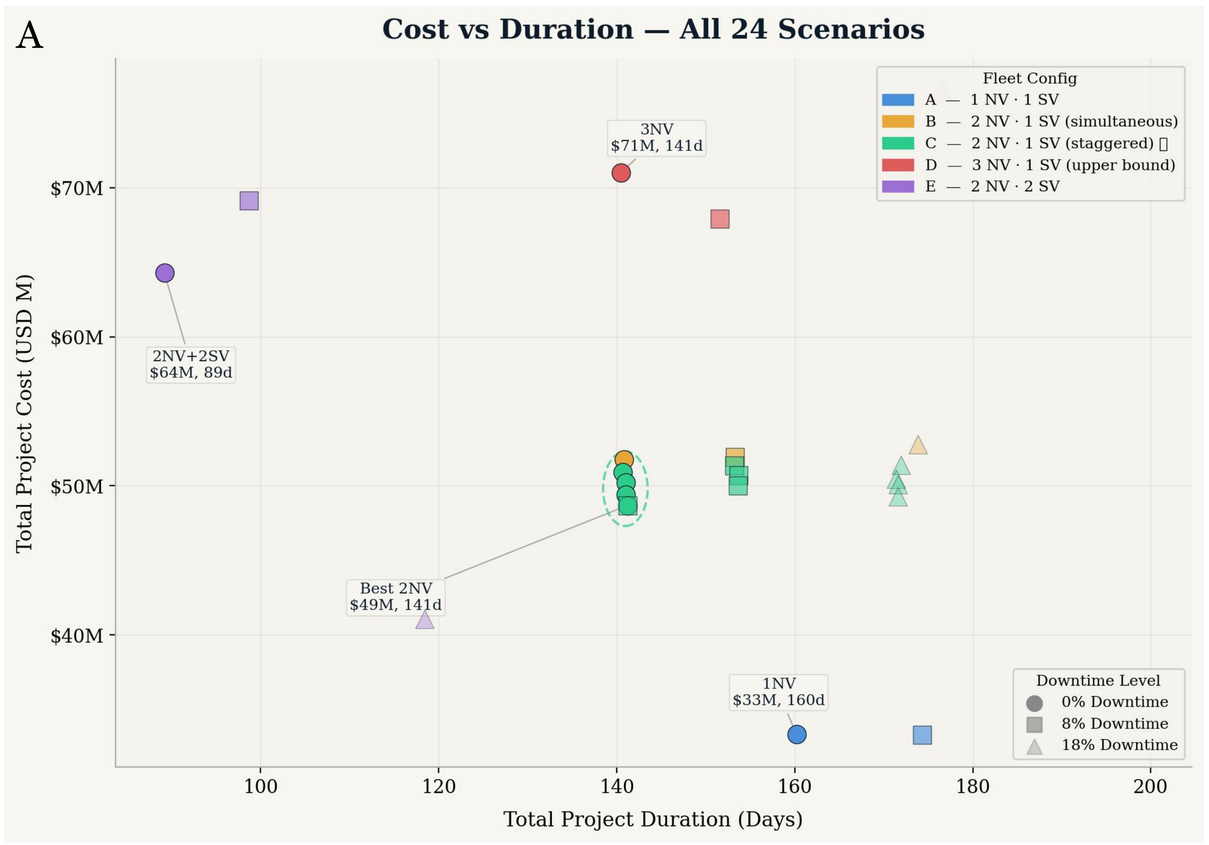

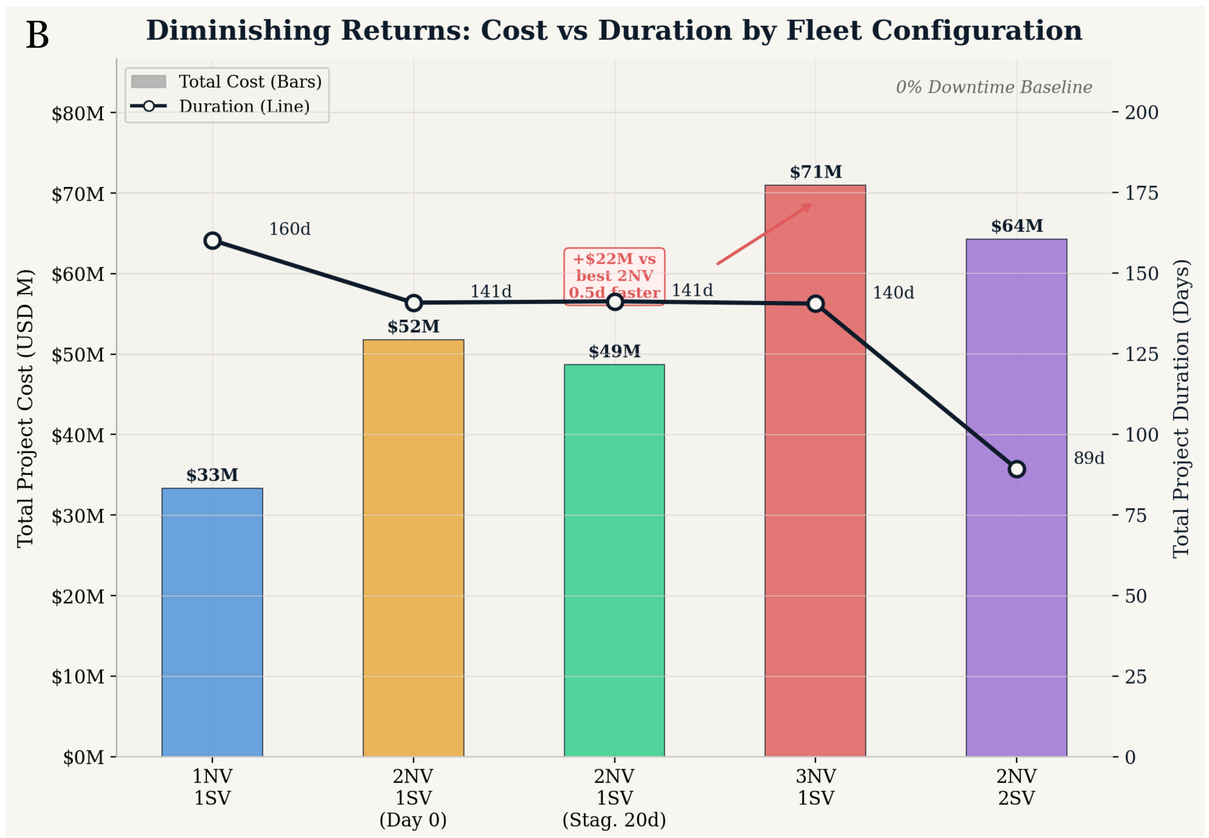

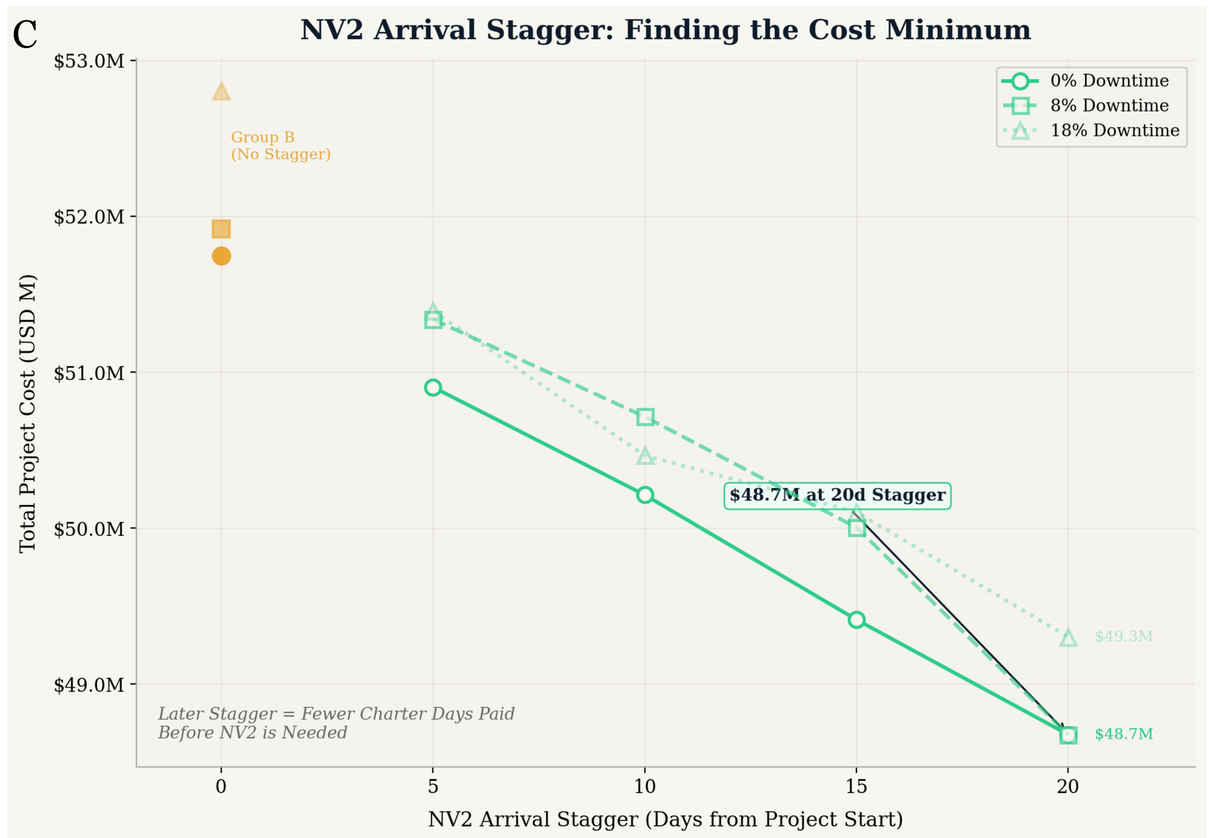

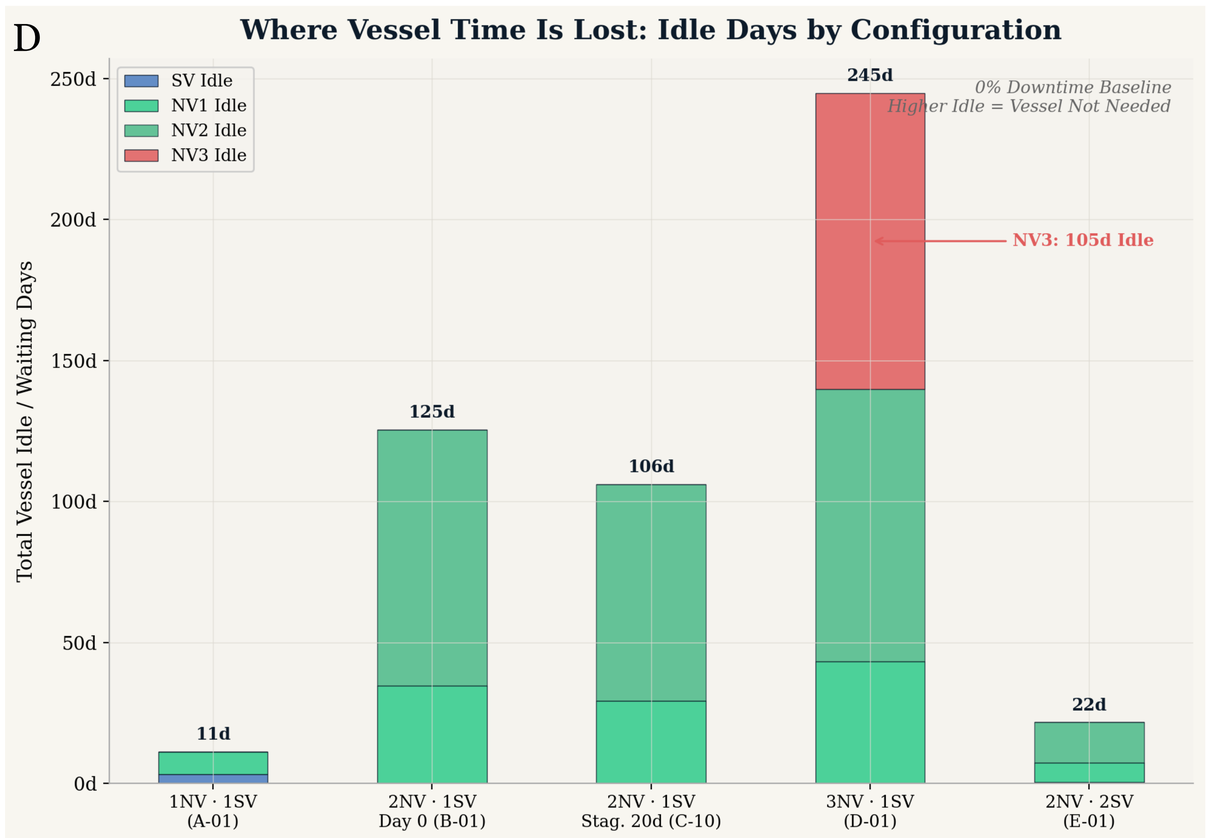

(A) Cost vs duration — all 24 scenarios, marker shape = downtime level. *(B) Diminishing returns: cost and duration by fleet config at 0% DT.*
(C) NV2 arrival stagger vs total cost across downtime levels. *(D) Cumulative vessel idle days — NV3 accumulates 105 idle days on a 141-day project.*

INTRODUCTION

OBN fleet configuration decisions are typically made using day-rate multiplication, a method that cannot capture the non-linear relationship between vessel count, idle time, and total cost. This study uses a purpose-built OBN simulation tool to run 24 parametric scenarios across a three-area North Sea campaign, systematically varying fleet size, second-vessel arrival offset, and downtime level.

METHODS

A purpose-built OBN simulation tool was configured for three survey areas: Survey Alpha (7,679 nodes, OBN), Survey Beta (6,014 nodes, OBN) and PRM Field (2,385 permanent nodes, source-only), running north-to-south with the source vessel transitioning to PRM upon OBN completion.

Five fleet groups (A–E) were simulated at 0%, 8% and 18% downtime, with events distributed across the project timeline. Cost model: source vessel $50,000/day, node vessel $160,000/day.

Beyond a threshold fleet configuration, adding vessels increases total project cost without proportionally reducing duration. The simulation identifies this inflection point and quantifies the cost effect of delayed vessel arrival, whether planned or operationally driven.

This workflow applies to any multi-vessel OBN campaign where phased vessel arrivals and shared node inventory are operationally feasible.

RESULTS

1. A single node vessel (A) completed in **160 days at $33M** with fewer than 8 days idle, the project was node-constrained throughout, with the source vessel waiting on node availability.
2. Adding a second node vessel reduced duration to **141 days**. Staggering NV2 arrival by 20 days (C) achieves this at **$49M, saving $3.1M** versus simultaneous arrival (B, $52M), as NV2 is not on charter during the stagger period. The duration increase is negligible (+0.4 days).
3. A third vessel (D) saved just **0.5 days at an additional $22M**, with NV3 idle for 105 of 141 project days (74%). Node availability, not vessel capacity, is the binding constraint once two vessels are deployed.

At 18% downtime, the optimal two-vessel config (C) remained **$27M cheaper** than three vessels at comparable duration.
Two source vessels (Group E) reduced duration to **89 days at $64M** - a speed trade-off requiring deblending and subject to vessel availability.

CONCLUSIONS

1. **Right-sizing is non-intuitive.** The cost-optimal fleet is 2 node vessels with a 20-day stagger - not maximum resource. A third vessel costs 46% more for 0.5 days saved.
2. **Staggered mobilisation reflects operational reality.** Delaying the arrival of a second node vessel by 20 days saves $3.1M with no meaningful schedule impact - and vessels may be unavailable at project start anyway.
3. **Idle time is the diagnostic.** NV3 spending 74% of the project idle is the indicator that vessel capacity has exceeded the work available.
4. **Robust to disruption.** The cost advantage of the optimal two-vessel configuration persists across all downtime scenarios tested (0-18%).