

Strategic Decision Analytics:  
A Risky Digital Twin to Support Decisions  
about Engineering Service Design

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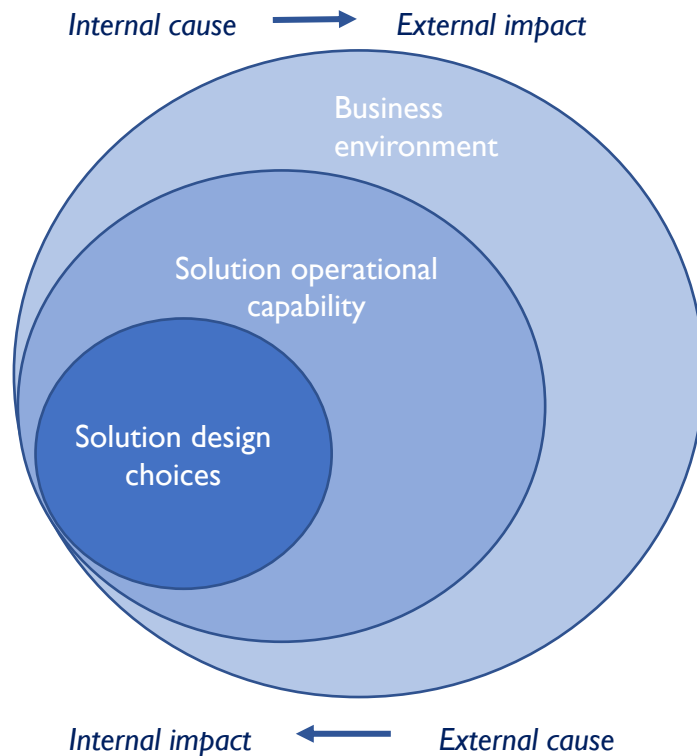


# Rationale of business modelling

- Aim is to integrate the output of a digital twin and scenario planning with a business case model used by vessel owners to inform investment decisions
- Rather than consider a business case in its narrowest sense as the income and outgoing related to an investment, we interpret the business case as the general strategy to construct, finance and operate vessels that are financially viable over its lifetime
- To do this,
  - we develop a digital twin to examine the robustness of logistic concepts in future business environments
  - and develop a modelling approach for a vessel owner business case model drawing upon known methods for propagating parameter uncertainty across the model



# What did we do methodologically?



Method to define scenarios based on exogenous factors (e.g. future external market) from relevant stakeholders

*Scenario creation method*

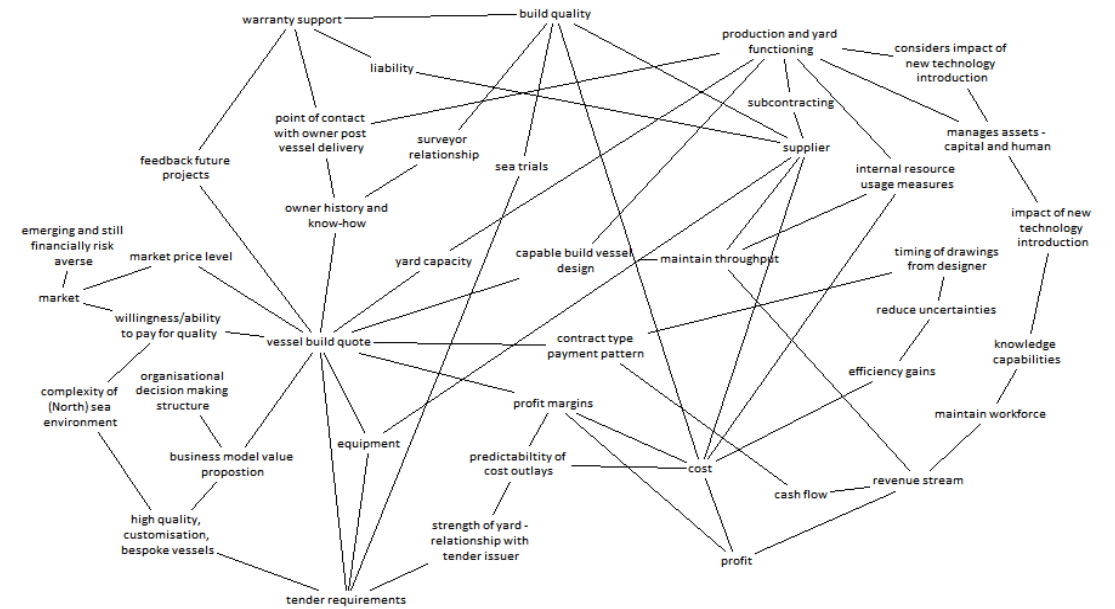
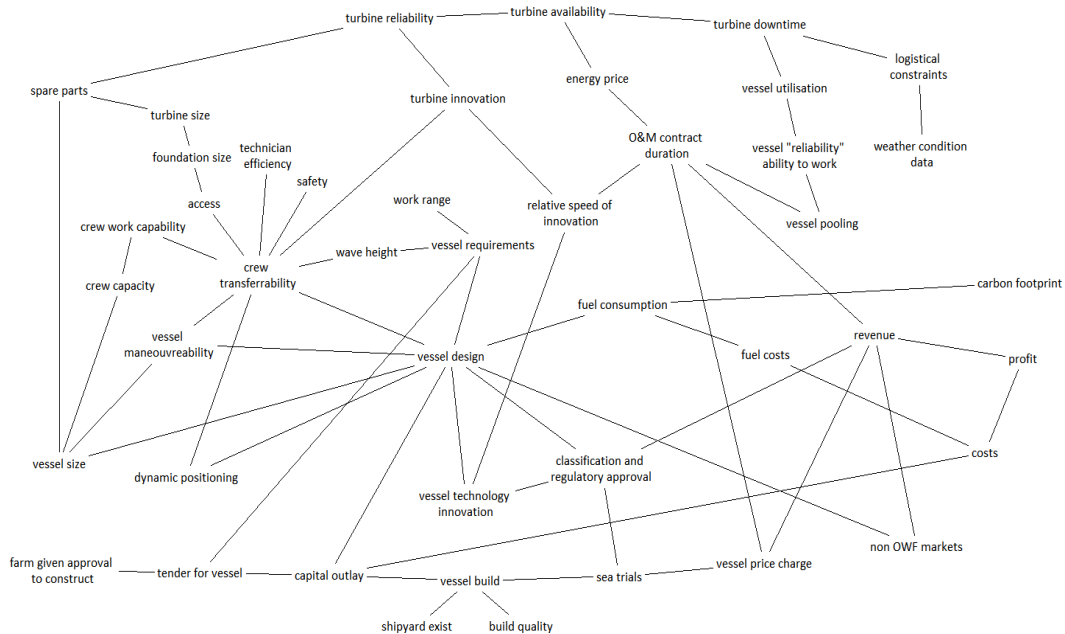
Model to predict off-shore wind servicing capabilities of solution

*Digital Twin*

Model choices, uncertainties and valuations based on factors endogenous to the vessel supply chain partners

*Graphical decision model*

# Emerging issues from actor perspectives



Summary reasoning about key issues and associations between issues raised for each industry partner (e.g. Owner and Yard)

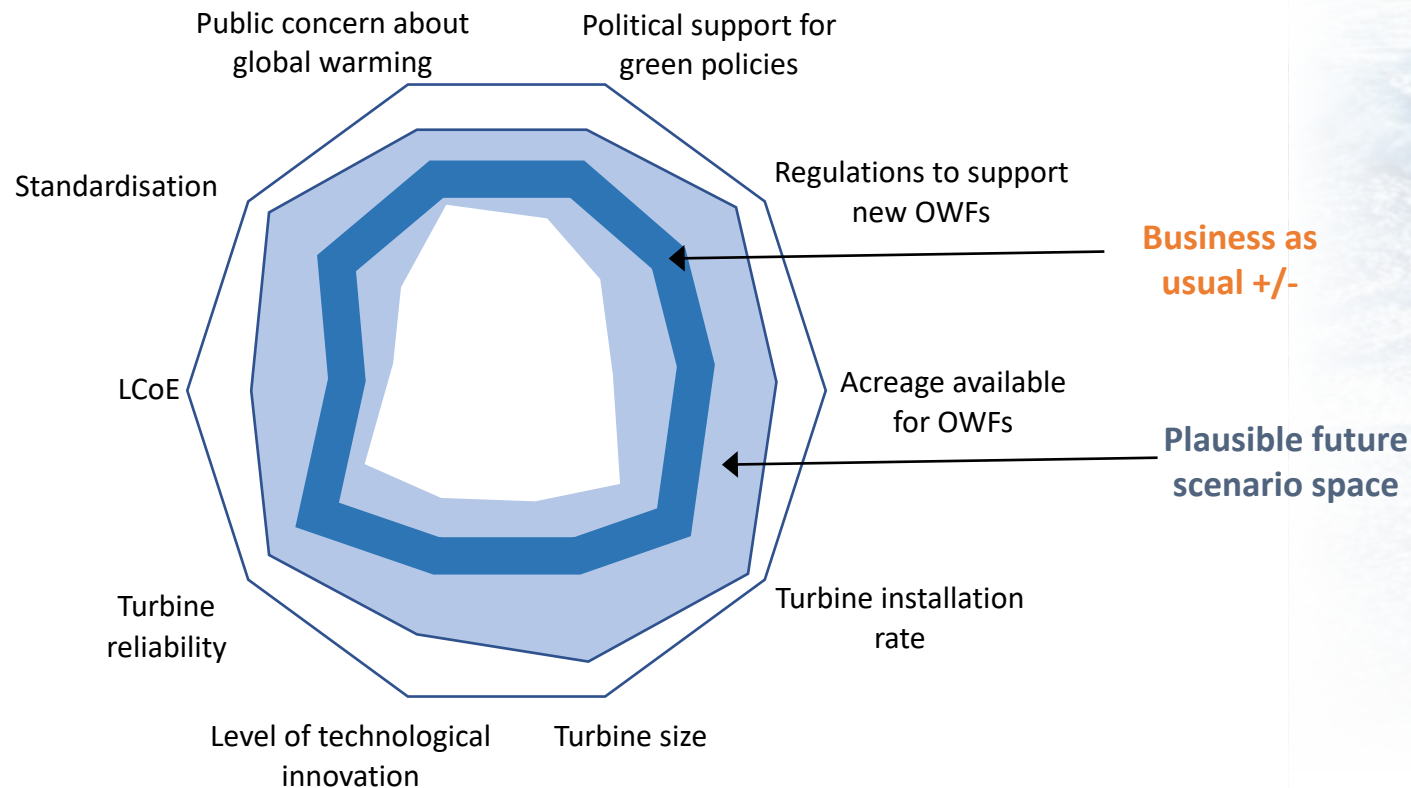






# Why foresight scenarios for future offshore wind O&M?

*Broadening perspectives on the future of offshore wind business environment*



# Foresighting Workshop

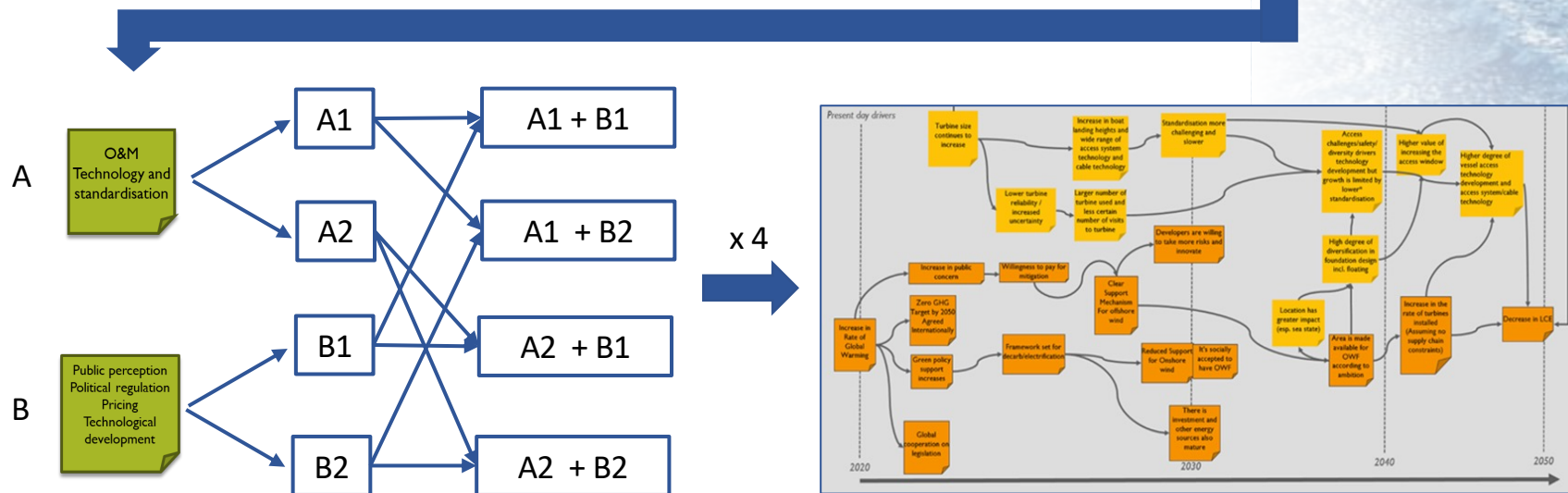
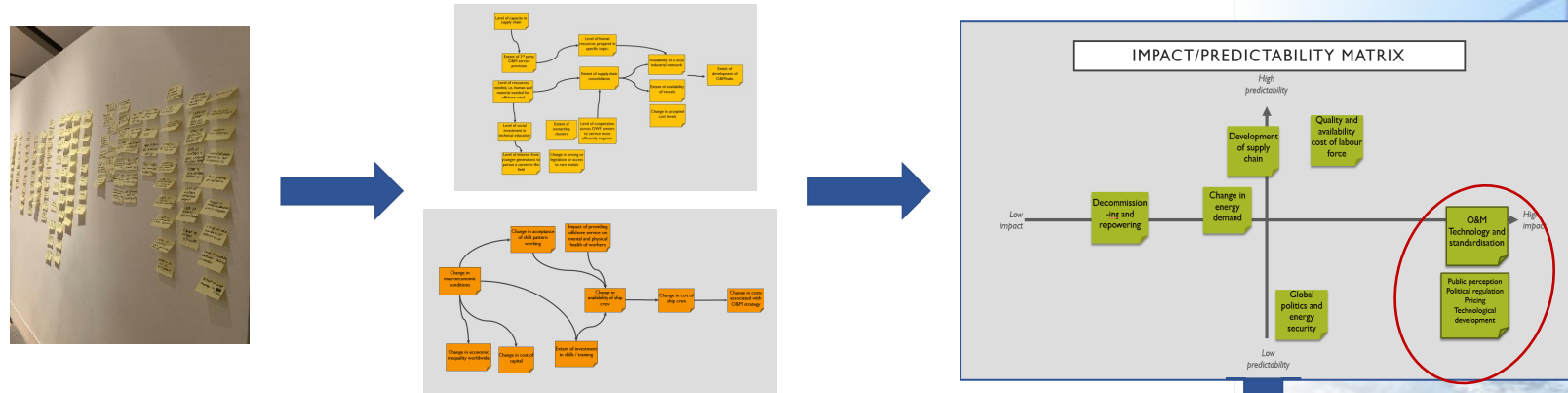
- Two day workshop was held on with 25 representatives from a diverse group of stakeholders in the offshore wind energy industry
- The question asked was:  
Focusing on the supportability of offshore wind farms, which factors – both broader and more specific – will influence the level and type of activity up to 2050?

Kongsberg Maritime	Equinor	Global Marine Group
EDF	Gondan Shipbuilders	German Federal administration
Ørsted	WindEurope	ECN/TNO
Scottish Development International	ORE Catapult	Generating Better
DSTL/MOD	University of Strathclyde	





# How create scenarios using foresighting?



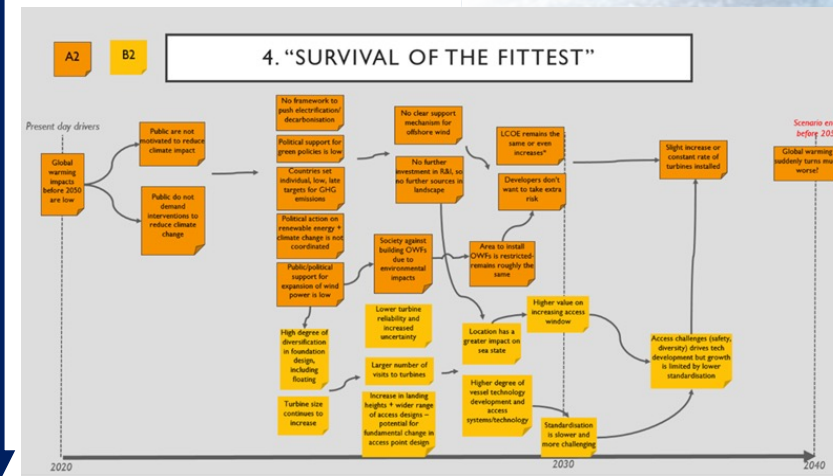
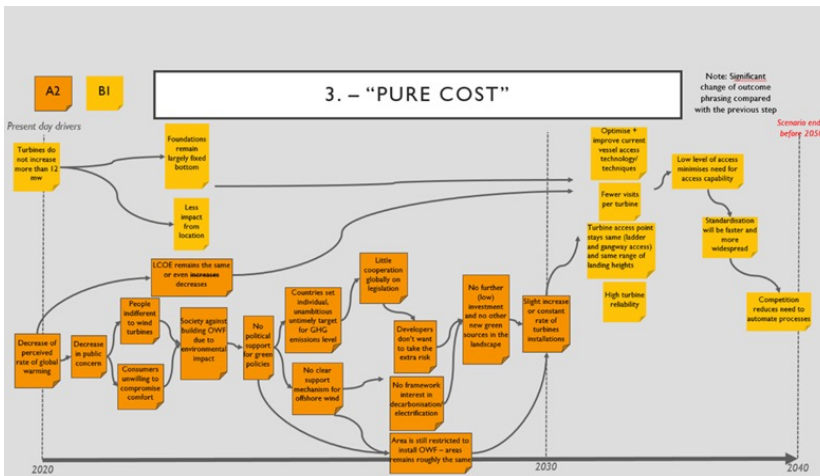
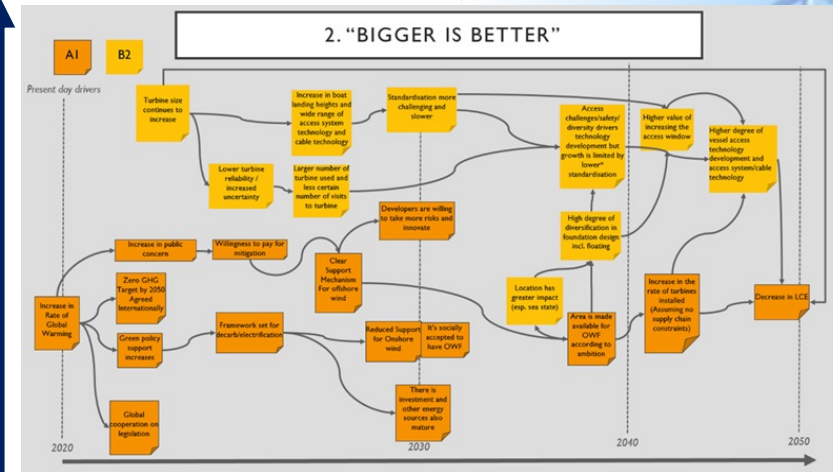
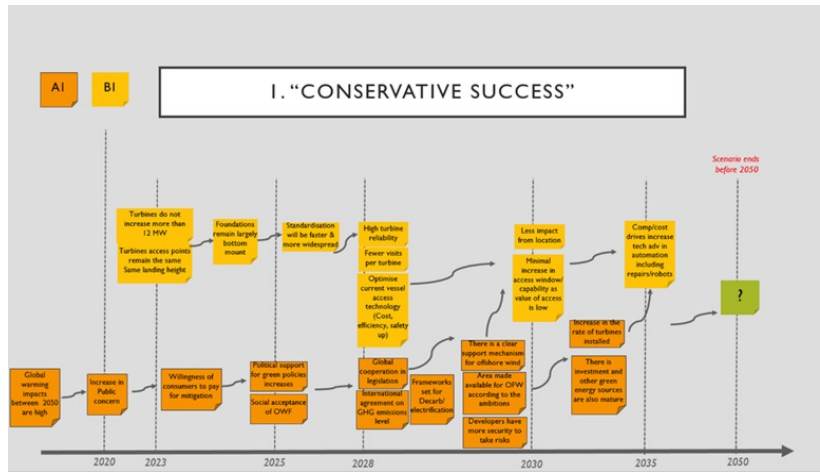


# What scenarios created?

Public interest in climate change

High

Low

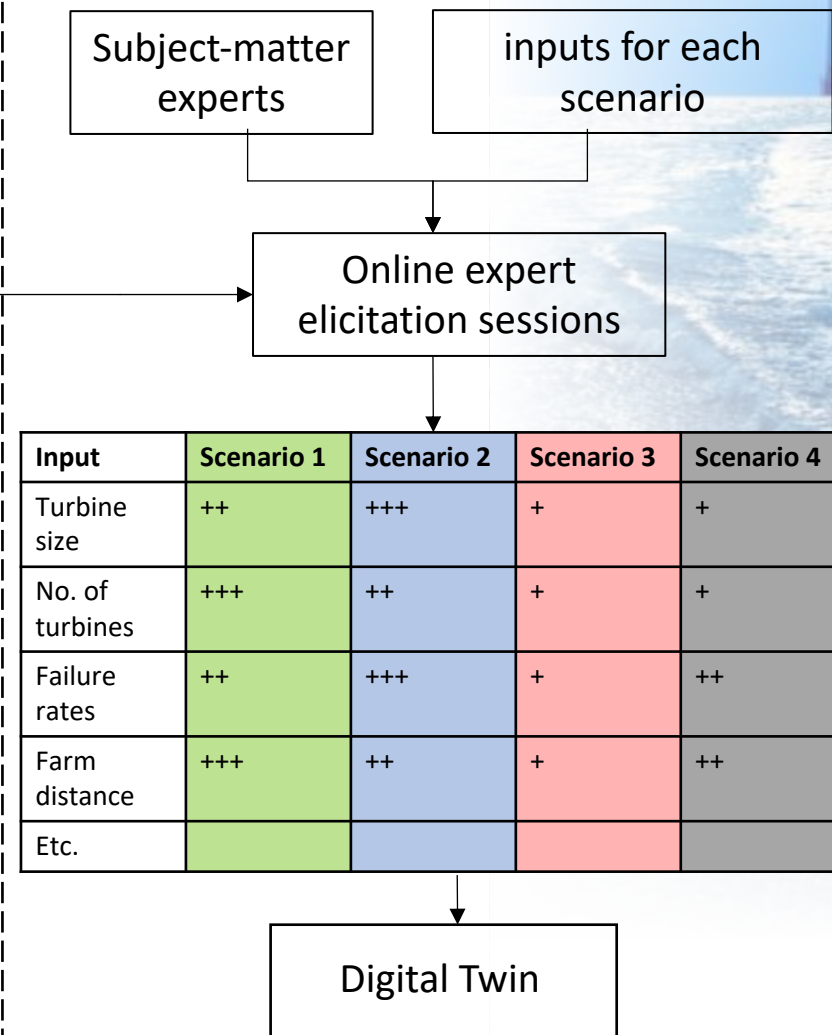
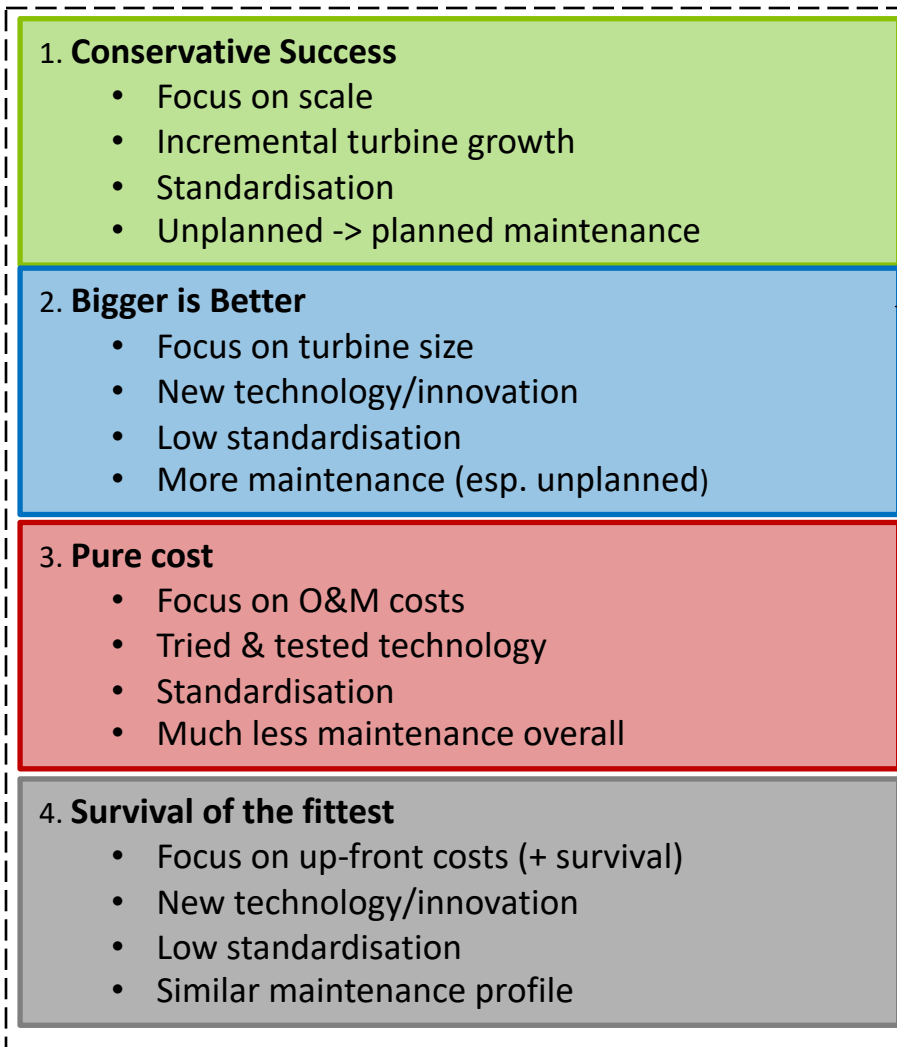


More standardisation

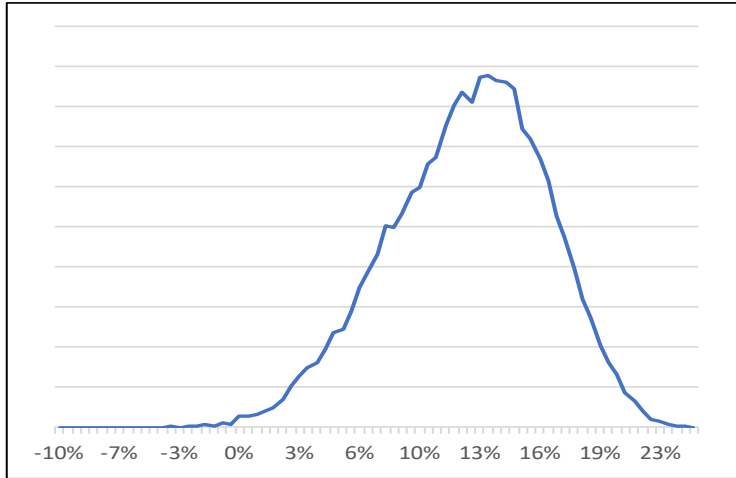
More innovation

Standardisation vs Innovation

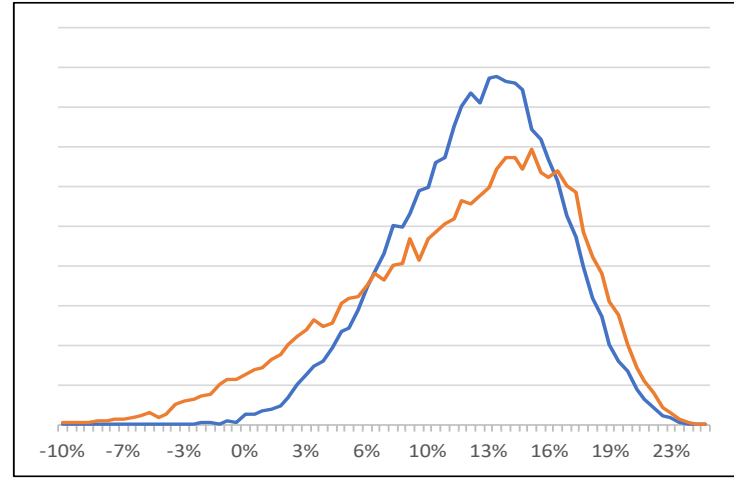
# How transform scenario outputs for use with quantitative model?



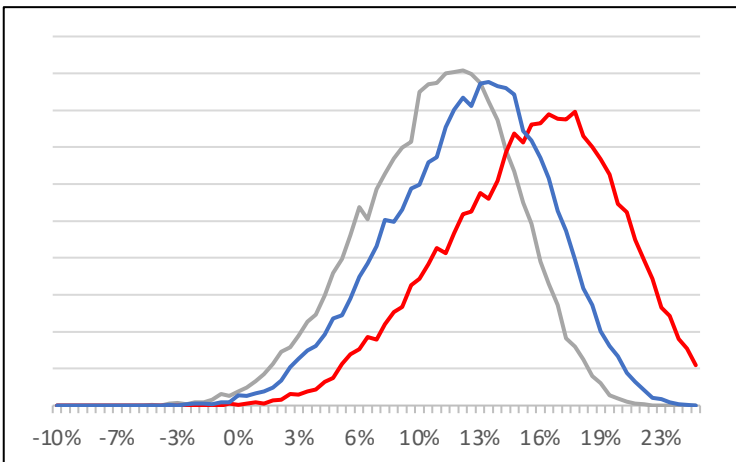
# Modelling uncertainty in vessel owner internal rate of return (IRR)



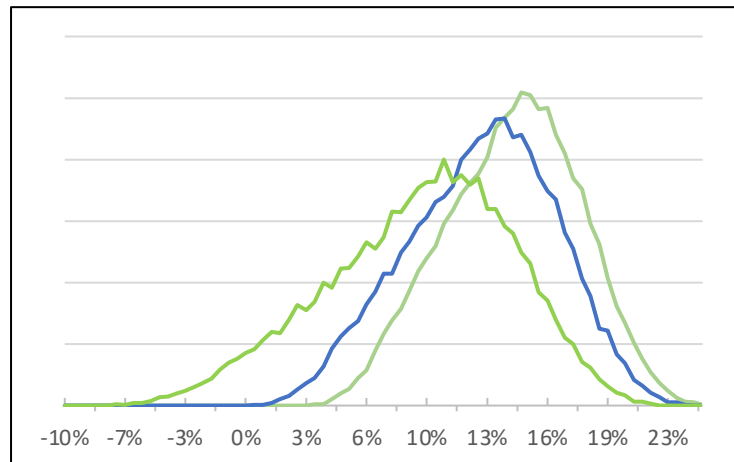
Uncertainty distribution for internal rate of return for **baseline case** illustrating the potential outcomes for the vessel



Internal rate of return under **baseline case** and **alternative vessel case** which has greater business risk



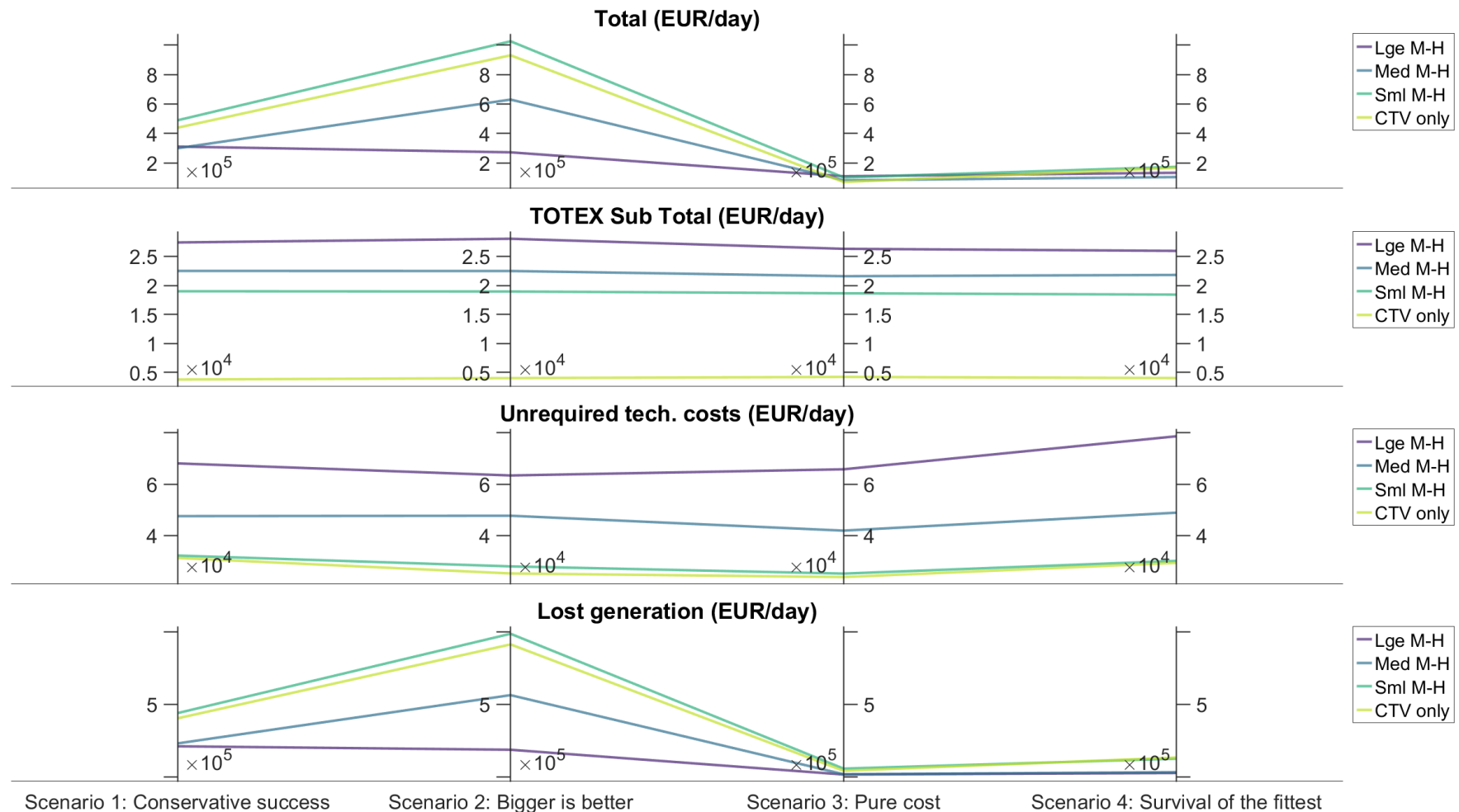
Internal rate of return for **baseline, high inflation, low inflation** showing increases in IRR as inflation increases



Internal rate of return for **Scenario 3, Scenarios 1 and 4, Scenario 2** showing shift in IRR as residual vessel value increases



# Scenario-informed analysis of logistical concepts given future uncertainties





Next generation support vessels providing safe  
and more efficient offshore wind farm servicing



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and more efficient offshore wind farm servicing