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Model-based Assessment of the Submarine Support System

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Capability Systems Centre

Complex capability management

- Strategic decision making related to defence capability management is a complex problem with large number of entities and dynamic processes
  - Equipment (Acquisition and retirements, maintenances…etc)
  - Personnel (recruitment, training, ..etc.)
  - Facilities (building, decommissioning,..etc.)

Complex capability management

- Complex interrelations exist between the various processes.
  - Functional
  - Causal
- Capability performance emerges from the complex interactions among
  - system design (e.g. supply chain design, resources relationships)
  - management decisions
  - the future conditions
- This dynamic behaviour cannot be simply predicted and can be counter intuitive.

Model-based Assessment

- Use of developed model to design, test and compare capabilities performance (e.g. availability) under different:
  - requirement levels (e.g. required availability)
  - resource supply and demand scenarios
  - resource management decisions (e.g. procurement decisions)
  - constraints (e.g. maintenance cycles)

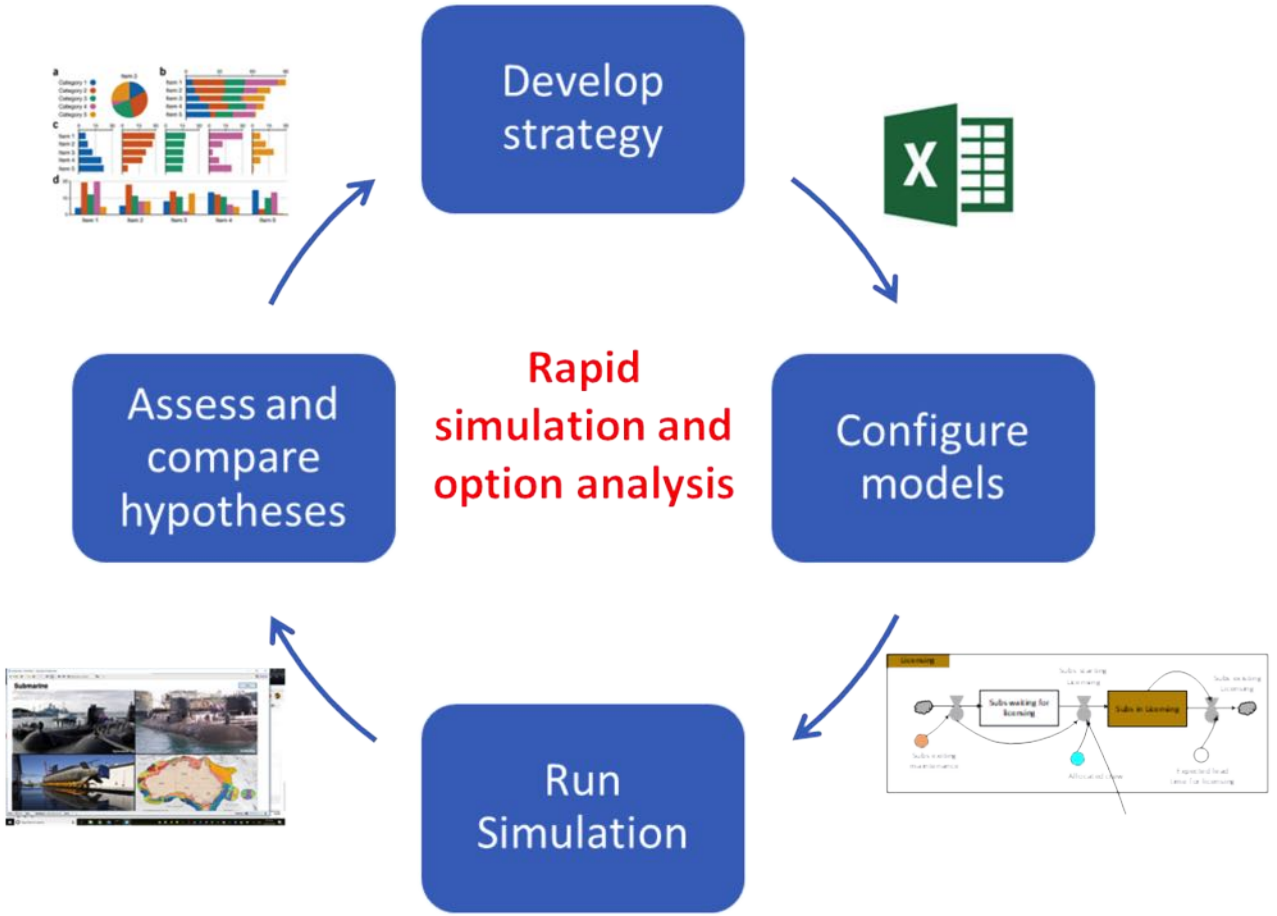
Methodological approach

- Model's capability to represent the complexity of the submarine enterprise
  - focus on feedback and delays
- Model's capability to represent mixed-fleet and examine fleet transition scenarios
  - setting up different acquisition and retirement schedules
- Model's capability to represent the system as what 'it can be' and not only what 'it is'
  - policy exploration and system (re)design

Methodological approach

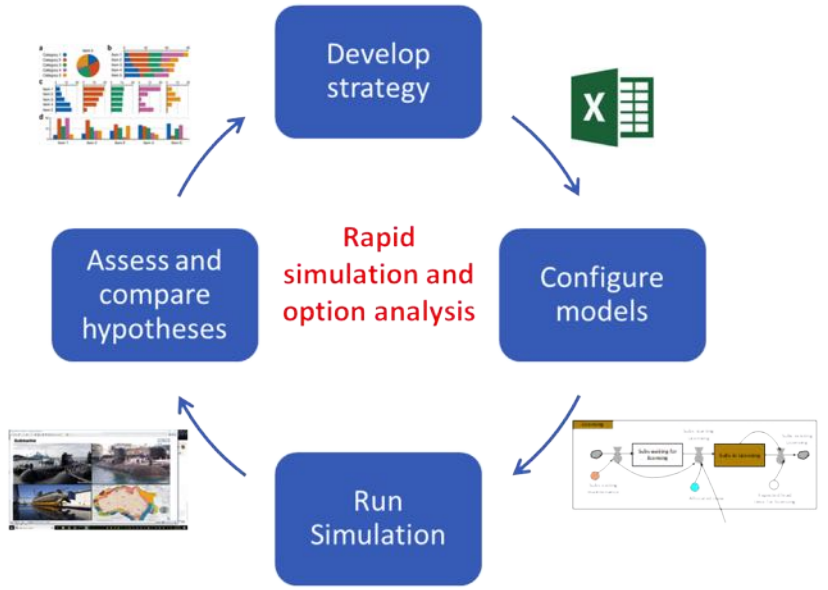
- Model capability to represent the spatial complexity.
  - Distributed resource allocation
- Model flexibility, so that it is easily adaptable to examine new user questions.
  - Object-oriented modular design

Rapid simulation and options analysis

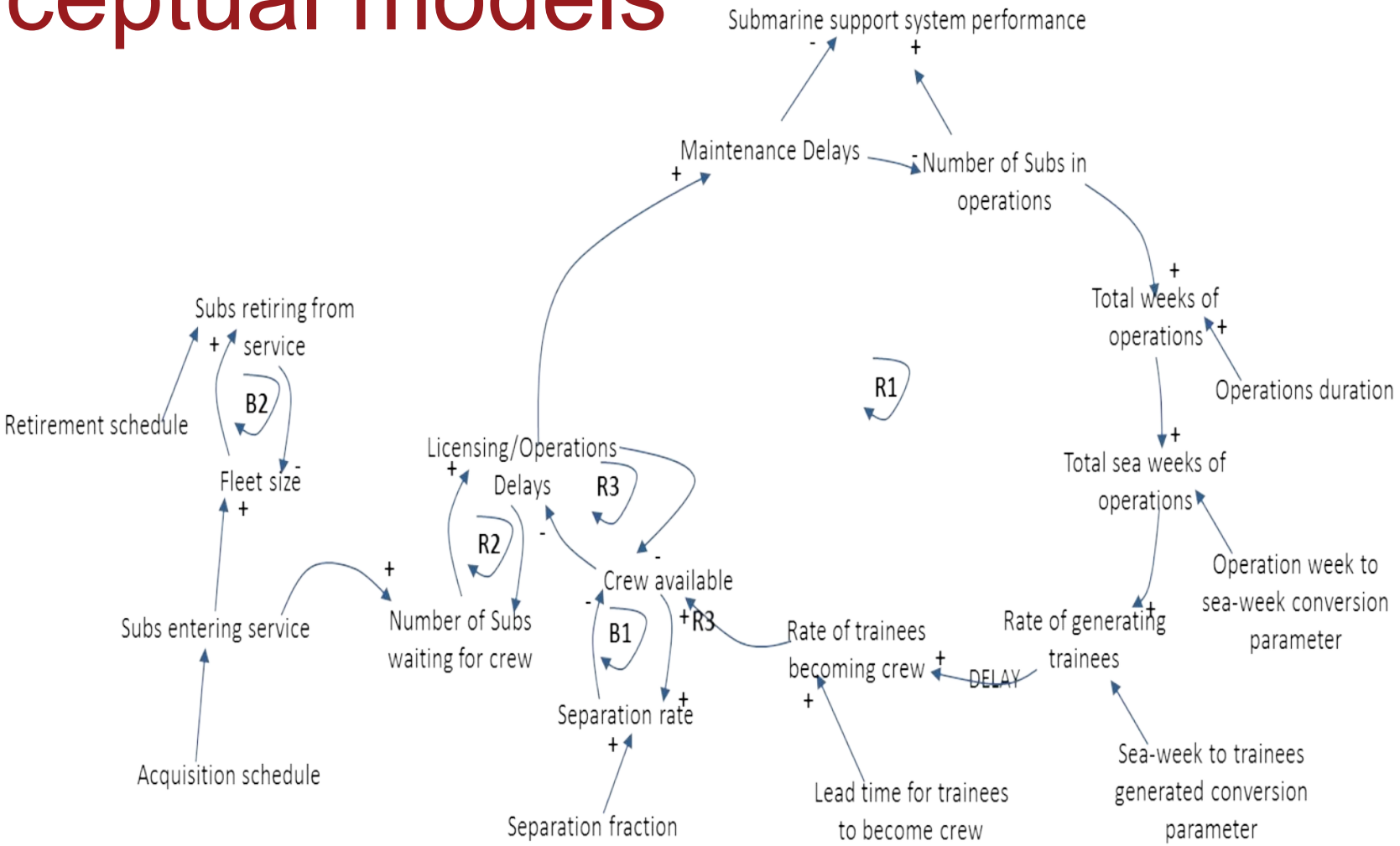


Rapid Model Adaptation

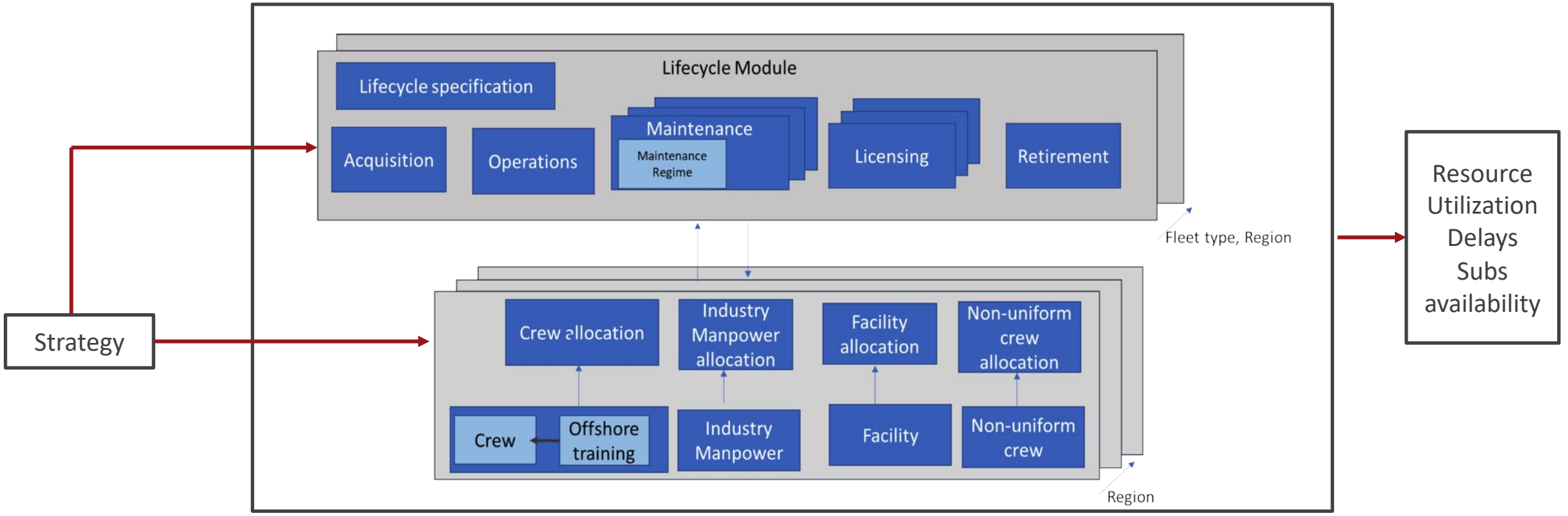
- Business rules
- Activities
- Resources types
- Interrelationships
- Indicators

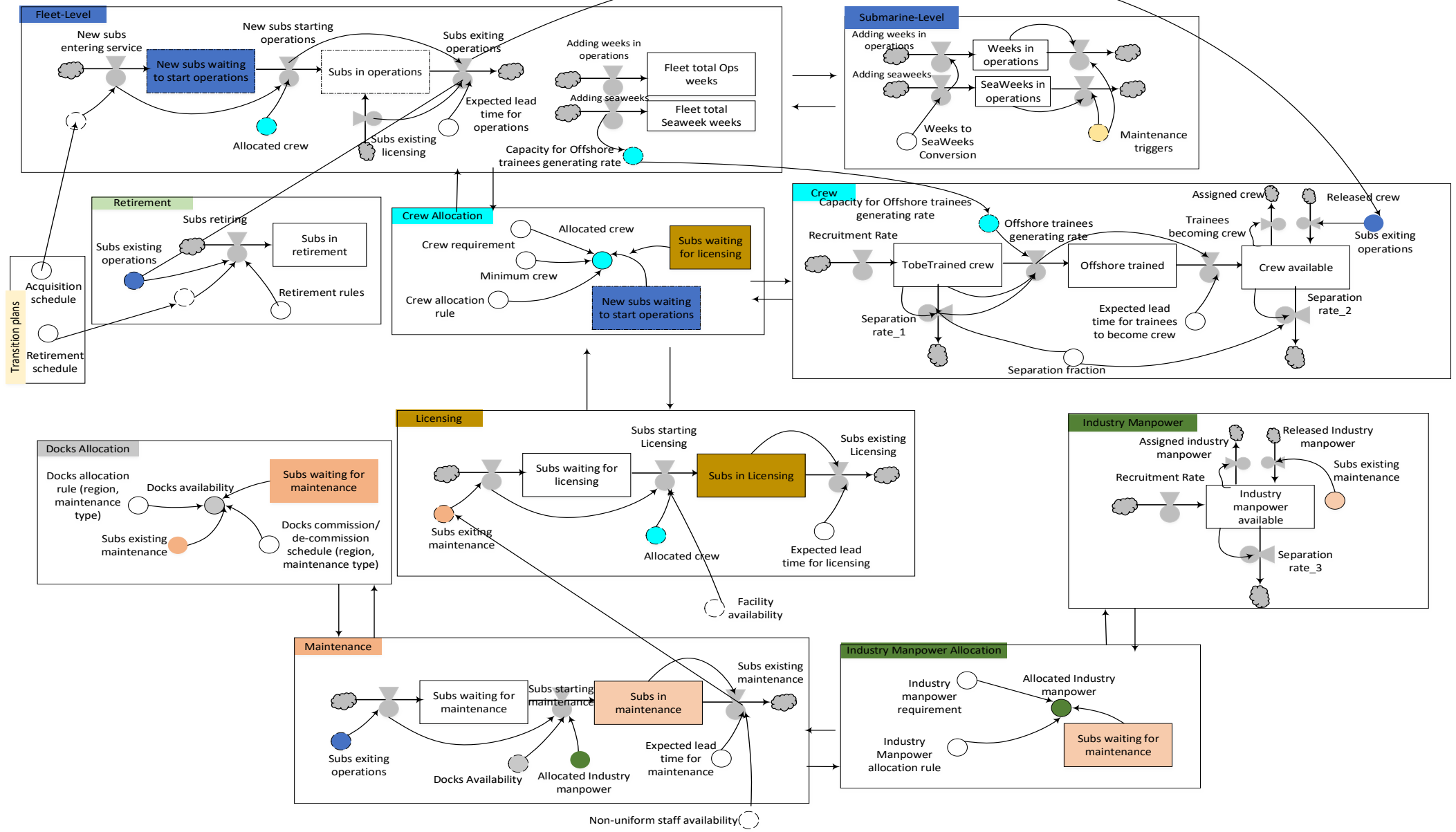


Conceptual models



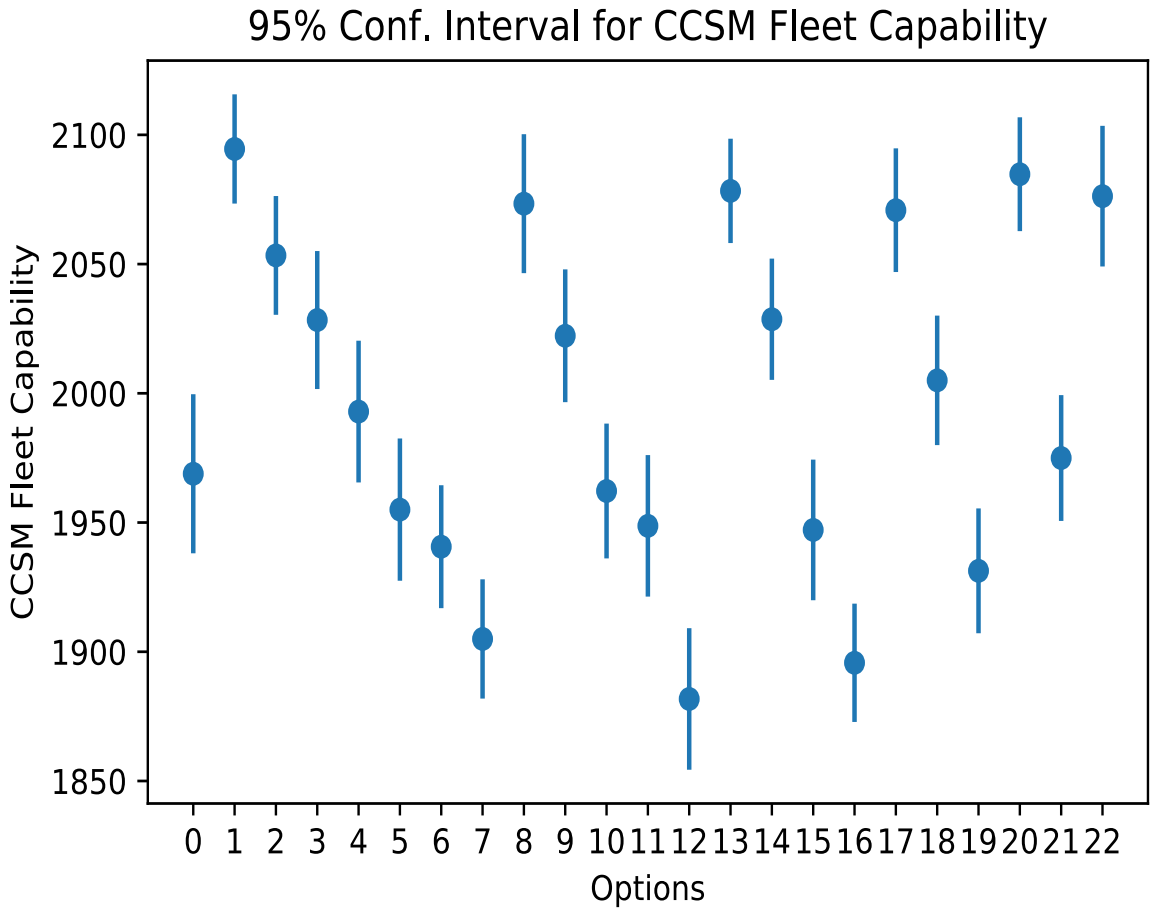
Model design




Fleet-Level
New subs entering service
New subs waiting to start operations
New subs starting operations
Subs in operations
Subs exiting operations
Allocated crew
Subs existing licensing
Expected lead time for operations
Adding weeks in operations
Fleet total Ops weeks
Adding seaweeks
Fleet total Seaweek weeks
Capacity for Offshore trainees generating rate
Submarine-Level
Adding weeks in operations
Weeks in operations
Adding seaweeks
SeaWeeks in operations
Weeks to SeaWeeks Conversion
Maintenance triggers
Retirement
Subs retiring
Subs existing operations
Subs in retirement
Retirement rules
Crew Allocation
Allocated crew
Crew requirement
Subs waiting for licensing
Minimum crew
Crew allocation rule
New subs waiting to start operations
Crew
Capacity for Offshore trainees generating rate
Offshore trainees generating rate
Recruitment Rate
TobeTrained crew
Offshore trained
Crew available
Assigned crew
Released crew
Trainees becoming crew
Subs exiting operations
Separation rate_1
Expected lead time for trainees to become crew
Separation rate_2
Separation fraction
Transition plans
Acquisition schedule
Retirement schedule
Licensing
Subs starting Licensing
Subs waiting for licensing
Subs in Licensing
Subs existing Licensing
Subs existing maintenance
Allocated crew
Expected lead time for licensing
Facility availability
Docks Allocation
Docks allocation rule (region, maintenance type)
Docks availability
Subs waiting for maintenance
Subs existing maintenance
Docks commission/ de-commission schedule (region, maintenance type)
Industry Manpower
Assigned industry manpower
Released Industry manpower
Recruitment Rate
Industry manpower available
Subs existing maintenance
Separation rate_3
Maintenance
Subs waiting for maintenance
Subs starting maintenance
Subs in maintenance
Subs existing maintenance
Subs exiting operations
Docks Availability
Allocated Industry manpower
Expected lead time for maintenance
Non-uniform staff availability
Industry Manpower Allocation
Industry manpower requirement
Allocated Industry manpower
Industry Manpower allocation rule
Subs waiting for maintenance

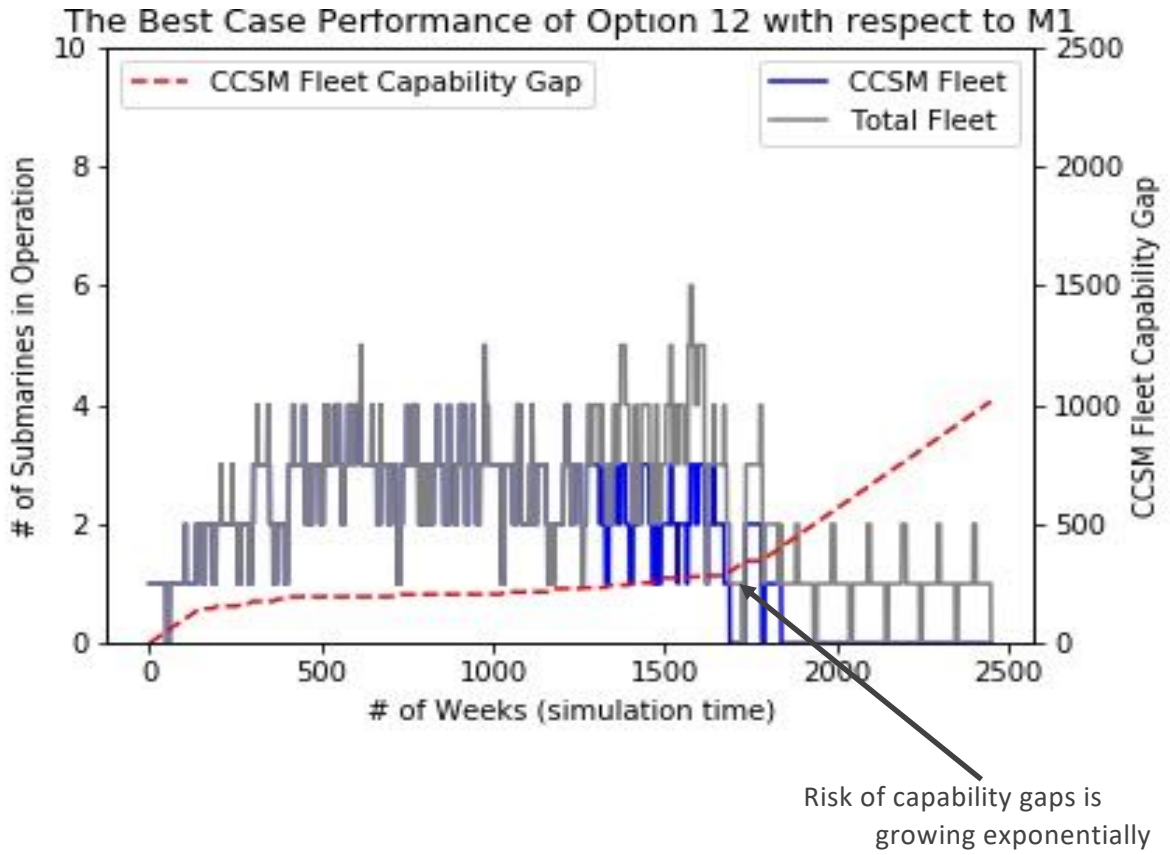
Model use: Options evaluation

- Fleet capability is the total number of weeks where the fleet size is less than 2.



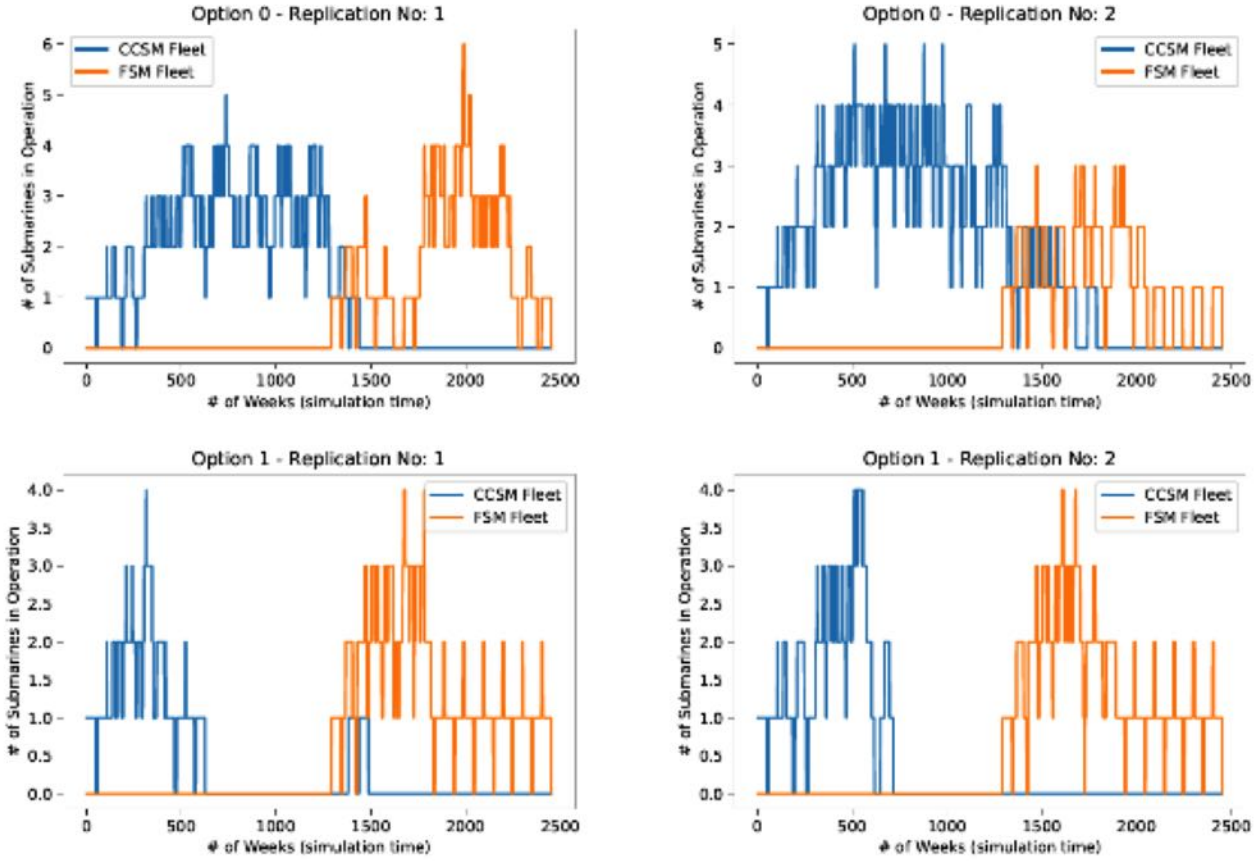
Model use: Options evaluation

- Investigation of options performance overtime.



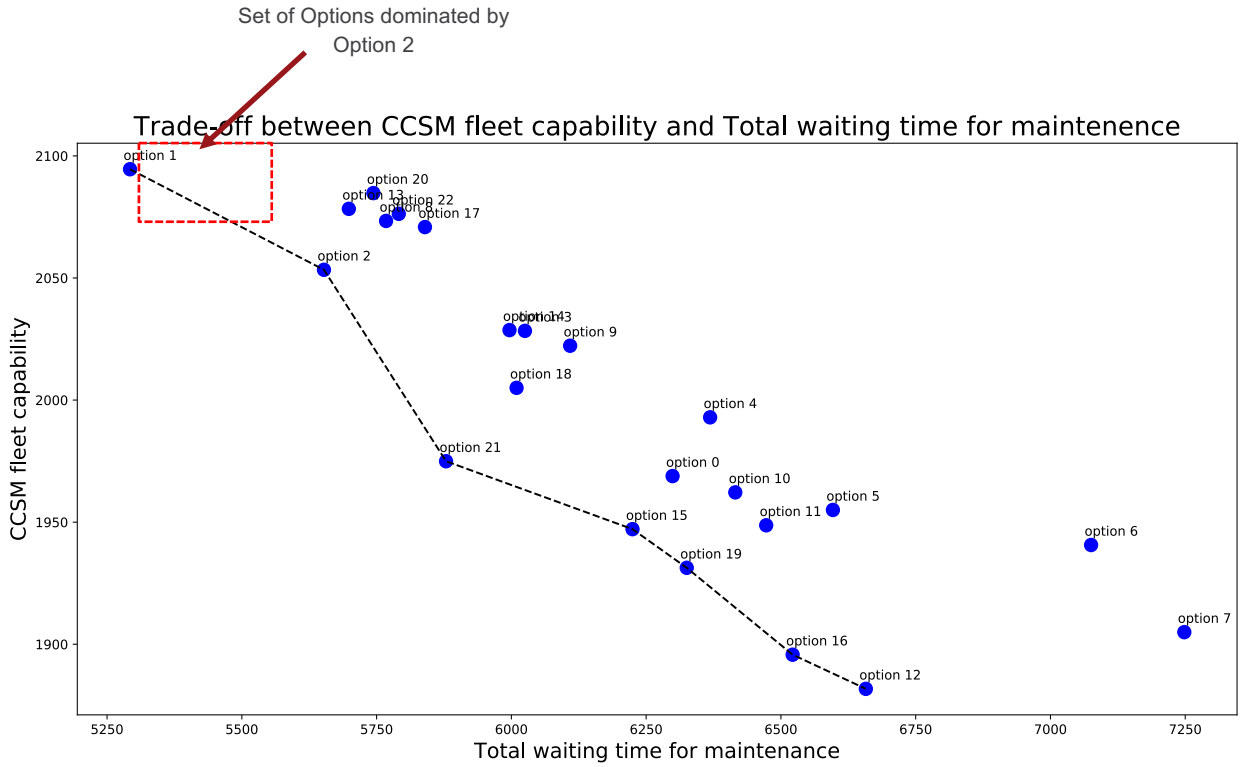
Model use: Options evaluation

- Investigate and quantify the effects of uncertainty about resource availability, and vulnerability of options to this uncertainty.

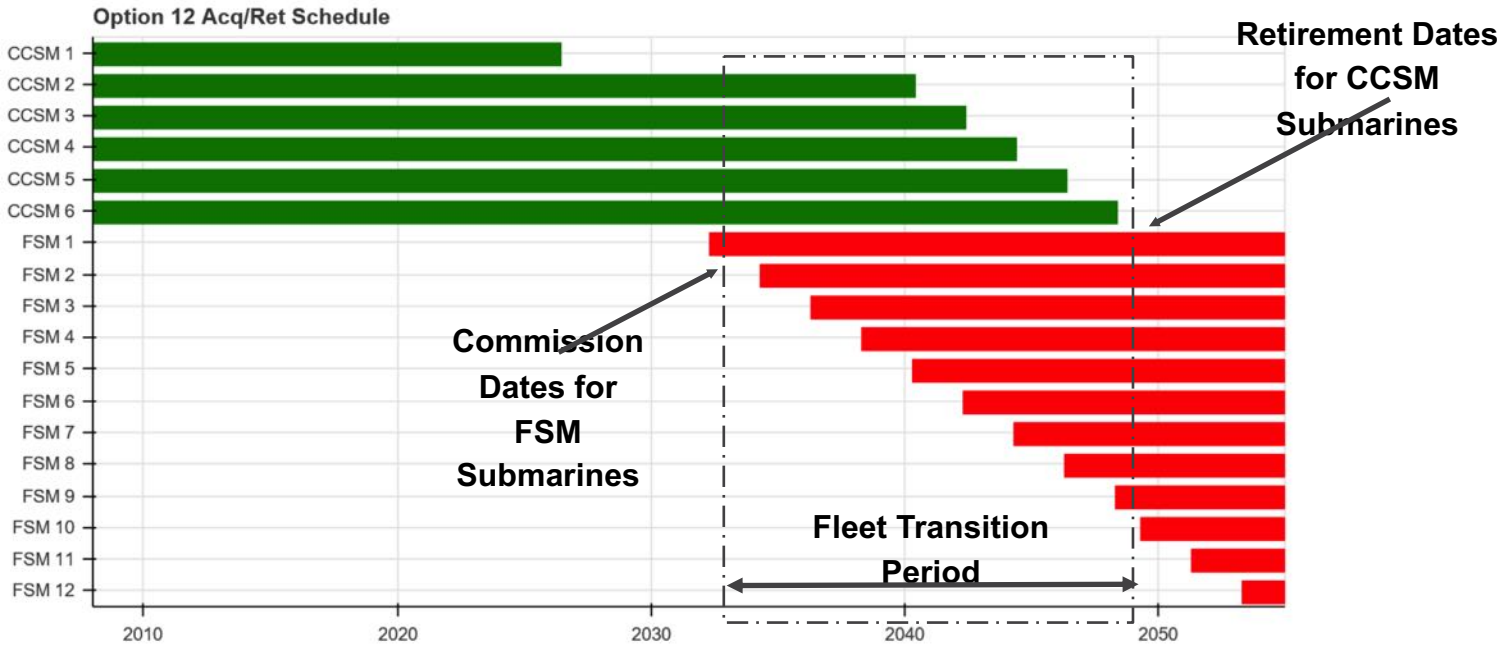


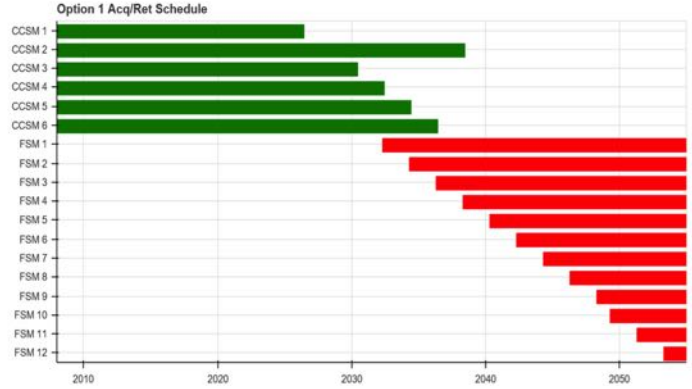
Model use: Options comparison and trade-off

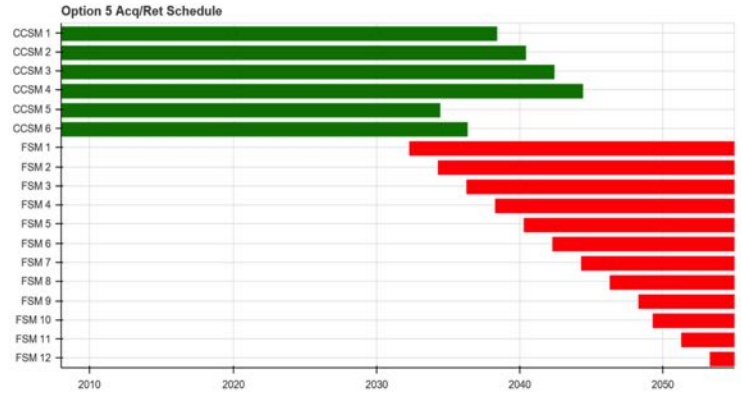
- Options are compared with respect to two metrics: fleet capability and the total waiting time for maintenance.



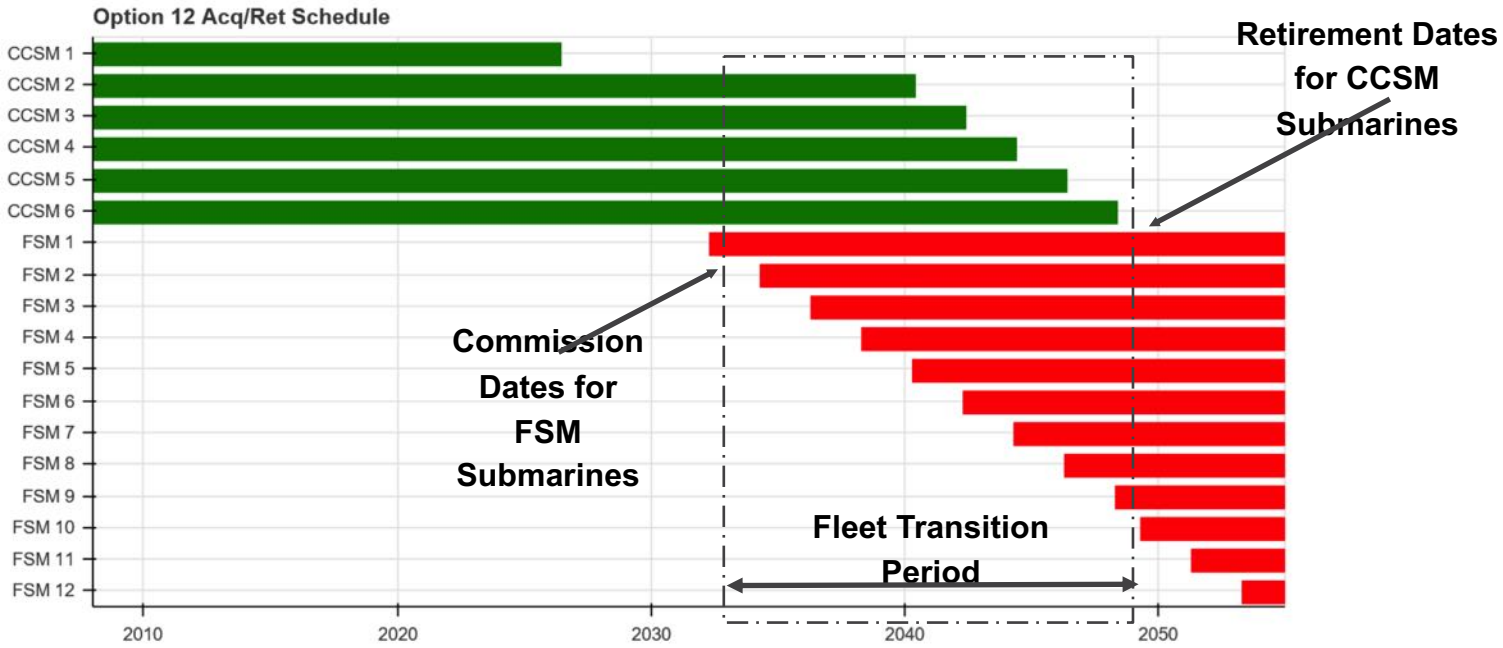
Model use: Options comparison and trade-off





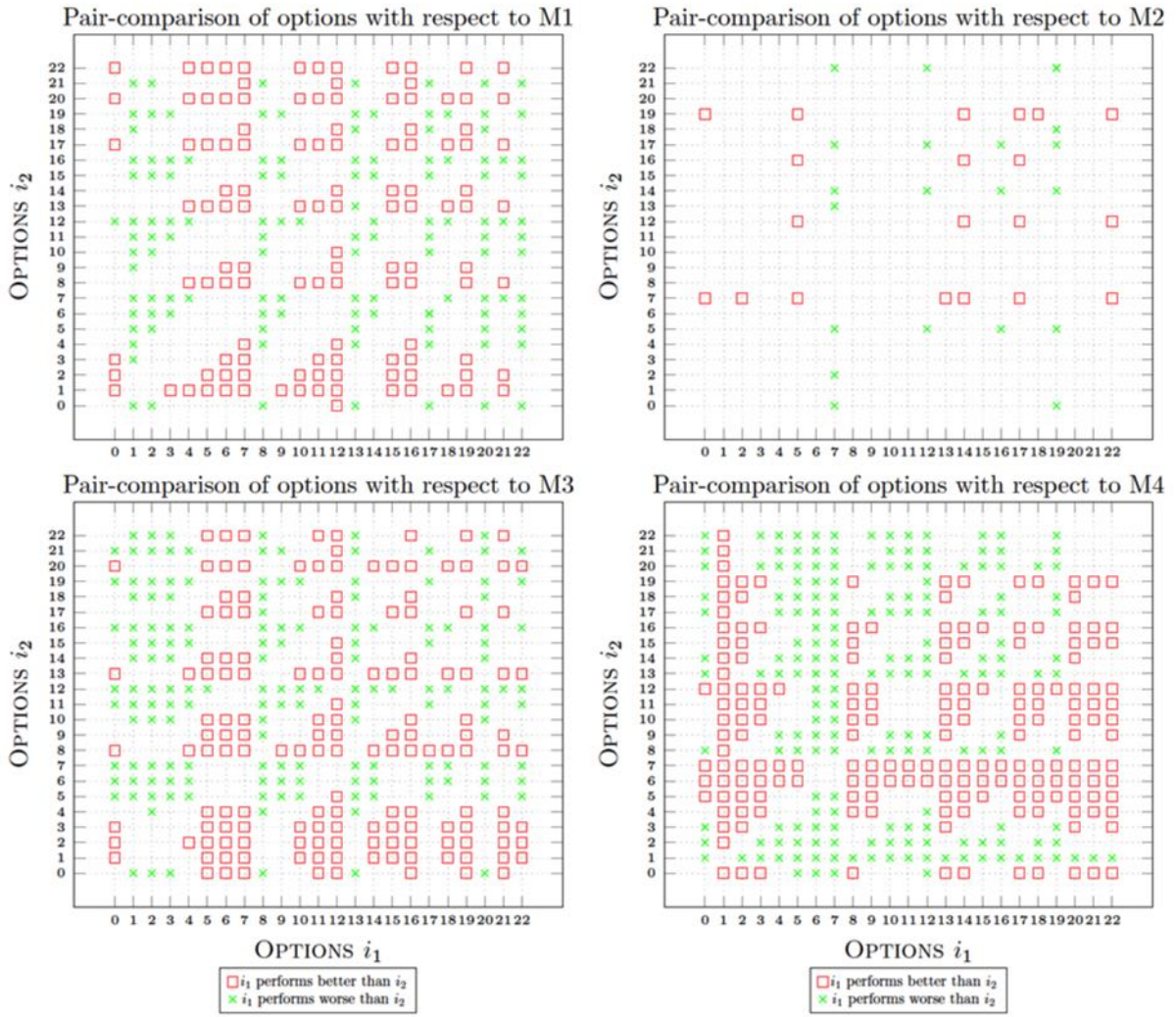


Model use: Options comparison and trade-off



Model use: baseline comparison

- Options are compared to each other based on four metrics.



Next Steps

- Further (vertical) development of the model to include other resources and functions
  - Resource types
  - Activities
- Further (horizontal) development of the model to include other viewpoints and dimensions
  - whole-of-force modelling

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