

# Using Enterprise Modelling to better manage the UK submarine programme



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# Agenda

- Background
- Challenges
- Model benefits
- Model functionality
- Model outputs
- Final thoughts



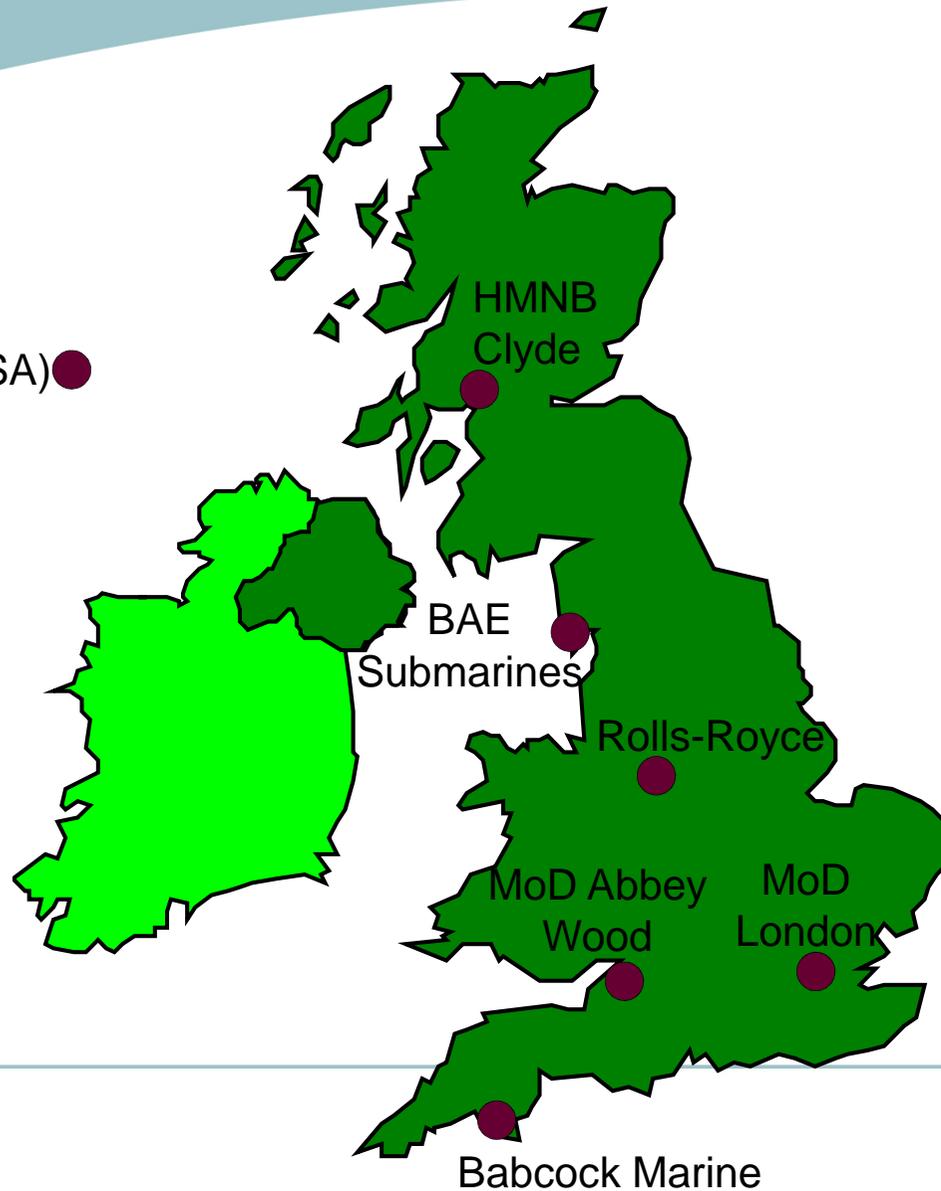
# Operating submarines is a complex business ...

- The Submarine Operating Centre within the UK Ministry of Defence is responsible for acquiring and maintaining the UK submarine flotilla
- This fleet is all nuclear powered and made up of attack and deterrent submarines
- It is current government policy to maintain a continuous at-sea deterrent submarine presence and to retain indigenous capability to design, build, and support UK submarines



.. which involves multiple stakeholders and sites ...

Electric Boat (USA) ●



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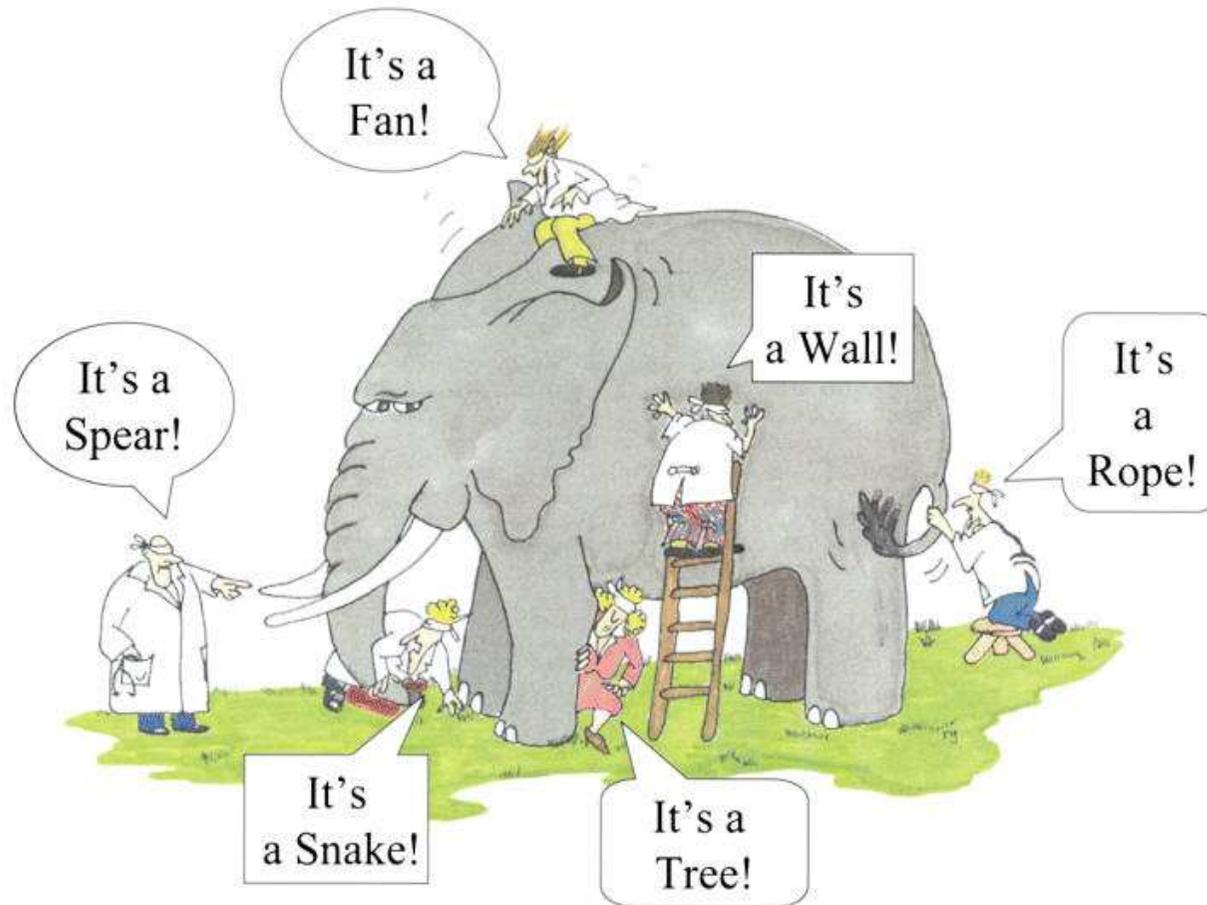


## .. and a complex, low-volume product

- The ASTUTE Submarine is more complex than the space shuttle.
- Advanced nuclear technology means she will never need to be refuelled.
- ASTUTE's Sonar 2076 sonar suite has the processing power of 2000 laptop computers.
- ASTUTE'S 97m length is more than the length of 10 London buses.
- When fully stored she will displace 7,400 tonnes of sea water, equivalent to 65 blue whales.
- There is around 110 km of cabling and pipe work onboard ASTUTE - equivalent to driving from Bristol to Oxford.
- ASTUTE can strike at targets up to 1,000 km from the coast with pinpoint accuracy - equivalent to driving from London to Paris and back twice.
- ASTUTE is faster underwater than on the surface.
- She is able to circumnavigate the world without surfacing
- When deep dived the submarine must resist the equivalent pressure of 400 family saloon cars piled on every square metre of the pressure hull.
- ASTUTE can manufacture its own oxygen and fresh water from the ocean.



# Understanding the submarine enterprise is difficult when you don't see the whole picture



# This complexity leads to a number of challenges for the submarine enterprise

- One vs. multiple versions of the truth—cost models for each site, project, etc.
- Consistency of assumptions
- Impact of individual project changes
- Impact of changes to industrial cost base
  
- By not looking at the programme and resources in a holistic manner, there is a danger of drawing incorrect conclusions:
  - QEC impact on Barrow overhead
  - JSF FACO line cost to the UK
  - MOD PR11 Successor estimates



# A high-level Enterprise Model can mitigate a number of these challenges

- Examines activity at an enterprise-level
- Accounts for dependencies between activities
- Can identify resourcing conflicts between projects
- Bottom-up resourcing calculations allow for sensitivity analysis
  - Programme/timing
  - Cost base
  - Scenario planning



# FSM cost modelling approach

- Cost modelling integrated into larger 'One Project' concept
- Collaborative working to validate estimates and assumptions when possible
- An agreed data set with industry
- Cost and schedule risk integrated into wider costing activities



# But enterprise modelling is not a cure for poor forecasts or estimates!

- Our approach takes existing forecasts and estimates and combines them in a way which allows for multi-dimensional analysis
- If forecasts/estimates are poor, then the resulting analysis will be as well
- The power of the analysis is 'in addition to' as opposed to 'instead of' good input estimates
- Our current model inputs are a mix of government & industry data which should be validated where possible



# Our Enterprise Model pulls data from multiple sources

- Ministry of Defence
  - Operating Centre
  - Project teams
    - In-Service submarines
    - Production submarines
    - Future submarines
  - CAAS
- BAE Systems
- Babcock Marine
- Rolls-Royce
- USA
  - Government
  - Electric Boat

It is a real challenge to ensure that data is collected using complementary assumptions



# The model is intended to be long-term and strategic

- A long-term strategic and resource management tool which provides:
  - Mechanism to systematically capture Enterprise data to facilitate strategic analysis
  - An Enterprise ‘baseline’ view of workload and costs to give a common picture of all submarine activity within the Enterprise and a ‘single version of the truth’
  - A facility to engage with industry about the issues which are of long-term importance
- Means to produce robust cost and sustainability forecasts and demonstrate the impacts of programmatic change to stakeholders
- Analysis of major programme management options with regard to enterprise sustainment risks and costs



# The model is already paying dividends

- Already used to support:
  - PR11 and PR12 project team projections (FSM and SMP)
  - Sustainability analysis for Successor
  - SDSR options work
  - Fleet Output Mgmt and SSMP modelling requirements
- Able to contribute to:
  - SEPP cost baseline requirements
  - FSM project submissions
  - Other Submarine operating centre initiatives



# We have been able to engage industry in this effort

- Three main industry partners have agreed to provide workload and costs estimates for all Enterprise-wide activities
- Data submission is collected through SEPP-agreed processes
- Could potentially minimise data submissions through provision of single portal of information collection and collation
- Current procedures allow for industry validation of data prior to wider consultation—opportunity for constructive engagement



# The enterprise model also offers a number of practical advantages

- Allows model outputs to be 'cut' in many ways
  - By Project (Astute, Successor, etc.)
  - By Location (with agreement with industry)
  - By Individual Workload Type
- Facilitates internal team assurance through uniform data formats
- Ensures required flexibility by enabling range of programmatic assessment through low-level data storage and roll-up
- Helps build trust and protect required confidences through 'Honest brokers' role of model operators



# The model requires three main categories of data

- Programme Data
  - What activities will the Enterprise be asked to undertake?
  - Activities captured by date, duration, and location
- Workload Data
  - How will these activities tax the Enterprise assets?
  - Activities captured by workforce labour/time estimates and facilities utilisation
- Cost Data
  - How much will these activities cost?
  - Labour rates, overhead structure (both fixed and variable), and other factors are recorded for each key location



# However, this is still a developing process for us

- Model input data needs to be refreshed on a regular basis
- Tension exists between the strategic and tactical functionality of the model
- Data sensitivity can restrict how model outputs are used and disseminated
- Need to optimise how Submarine Enterprise Model interacts with other lower-level models (CAAS, industry, MOD project team)



# Concluding thoughts

- Enterprise modelling enables strategic analysis by looking at the wider picture
  - Allows us to see “the whole elephant” through a holistic view of the submarine enterprise
  - Improves resource management through a flexible structure and scenario development/comparison
- Buy-in from all stakeholders is important
- It is not a substitute for good cost forecasting and estimation
- Success is as dependent on people/process as it is on algorithms and data



# Questions?



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