ASC

ANALYSIS SUPPORT CONSTRUCT

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FUEL ENDURANCE PLANNING ENGINE (FENPLE)

ISMOR'19

26th July 2019

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BLUF

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What are we trying to do?

Develop a proof of concept expert system to predict realistic fuel consumption for RN units based on a range of factors

What is new in our approach?

- We will exploit data from a number of sources to conduct trend analysis, taking into account all related factors
- The expert system will take into account the fact that this is not an exact science

What difference could it make?

- Operational efficiencies: Increased accuracy in planning and understanding of drivers to inform Replenishment at Sea planning. Evidence behind fuel reduction targets
- Strategic efficiencies: With more accurate fuel consumption predictions, the requirement for fuel storage (Operational Fuel Depots) could be better defined and deliver evidence for strategic decision-making
- Strategic support: To provide accurate predictions to use in future requirements analysis. WAVE tanker OSD ~2030

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Outline

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Background
- History
- Task
- Approach

Solution
- Data analysis
- Expert System

Challenge
- Current practice
- Current limitations

Benefits
- Operational efficiencies
- Strategic efficiencies
- Strategic support

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Background | History

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Background | Task

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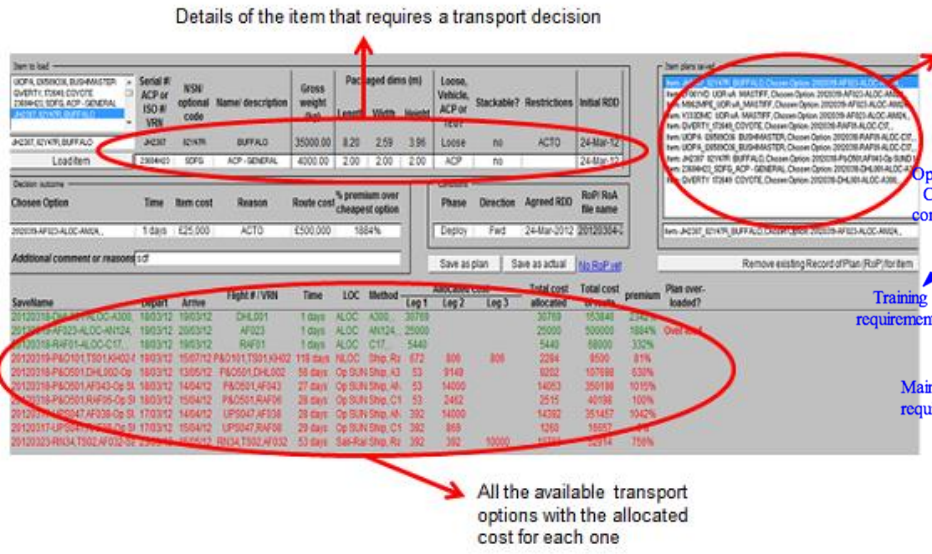
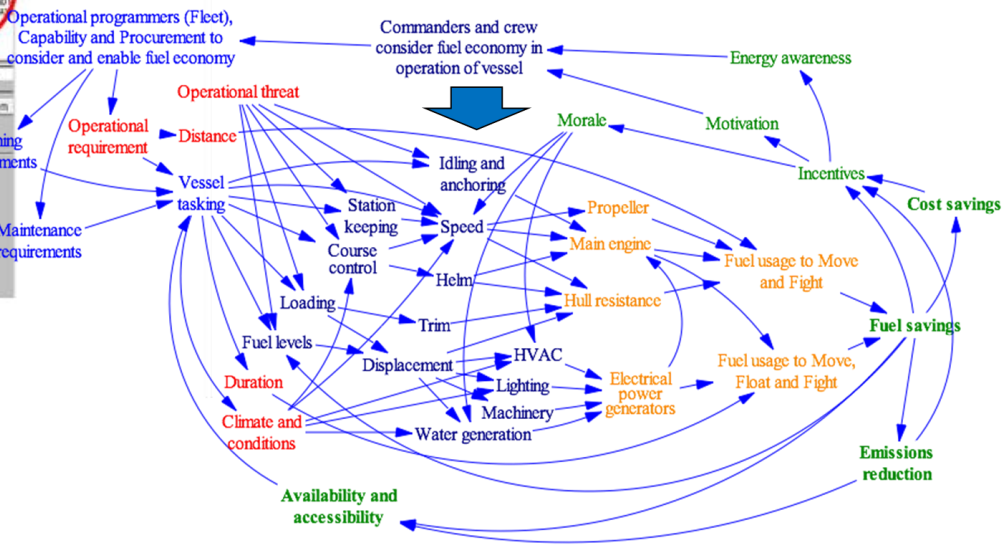
- The ASC260 Defence Efficiencies project aims to deliver either cost savings or more efficient use of resources
- One area which was highlighted at the ASC Supplier day was fuel planning
- We had previous experience of…



Logistics decision-aides

Drivers of naval fuel usage



Background | Approach

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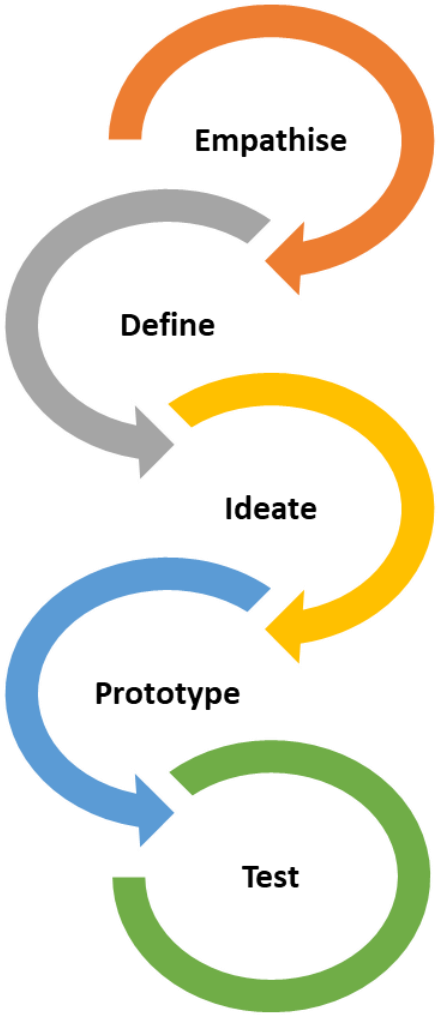

WP1: Data analysis
- Define contributing factors with SMEs
- Develop detailed consumption profiles
- Measure contribution of each factor
- Identification of driving factors

WP2: Development of Expert System
- Consumption profile based fuzzy input sets
- Rulesets based on driving factors
- Testing of predicted outputs against current data

WP3: Deliverables
- Proof of concept model
- Technical report including consumption profiles
- Feedback
- Updates

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Solution | Data analysis

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- Trend analysis per class of ship taking into account
  - Detailed consumption profiles
  - Contribution of each factor
  - Driving factors
    - Fuel consumption per day
    - High level tasking
    - Detailed operational tasking when deployed
    - Quality of fuel
    - Location data and any corresponding environmental data
    - Maintenance data i.e. time since last hull clean
- Variation analysis of platforms within each

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Solution | Expert System

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- Benefits of a fuzzy approach
  - It can deal with imprecise problems
  - It represents natural language descriptions of the situation
  - It allows the planner to easily carry out 'what if' analysis
- Inputs
  - Definition of fuzzy sets based on SME language
  - Consumption profiles and
- Rulesets
  - Driven by the results of the analysis
  - Class specific and based on the drivers of consumption
- Outputs
  - A crisp output figure to use for operational and strategic planning

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Challenge | Current practice

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Operational Planning/Strategic support

- 15kt consumption rate is used as a baseline planning figure
  - The rate will have been recorded when the class entered service
  - It will not get updated routinely
- Where higher or lower periods of consumption are known, these will be added to the plan
  - 17kt rate for higher periods
  - 12kt or 'alongside' rate for lower periods

Strategic Planning

- The total amount of fuel consumed during a deployment will be known
  - The next ship doing the same deployment (if of the same class) will be assumed to use the same amount of fuel
  - A factor may be applied for time of year to taken into account the impact of temperature on consumption rates

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Challenge | Current limitations

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- Using an average figure over a 6-month period, with assumptions based on a previous ship conducting the same tasking or the same ship but under different conditions, does not provide an accurate prediction of fuel consumption
- In higher sea temperatures, is it a linear relationship with the speed that the vessel is operating at or is to right to apply an arbitrary figure?
- Without accurate consumption predictions, strategic assets such as tankers and strategic stocks held ashore cannot be optimised
- Without an accurate prediction of how much fuel a ship may use, imposing fuel reduction targets on units is unrealistic
- With reduction targets not having clear evidence, they are largely ignored

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Benefits | Operational efficiencies

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Scenario 1: The RN needs to meet targets to reduce fuel consumption. They reduce a ship's annual allocation by 10%

Challenges

- What is the 10% based on? Is there any evidence for it?
- Is it achievable?
- What happens if a ship doesn't meet the target?
- What is the incentive for a Commander? They have a job to do

How FENPLE helps

- If reducing consumption = increased endurance, it has an impact on operational freedom. That incentivises Comds.
- Consumption will only be reduced if the drivers are fully understood
- Evidence is key – realistic, achievable goals with justification behind them is the only way targets will be met

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Benefits | Strategic efficiencies

Scenario 2: Operational fuel depots require constant investment to maintain. There is a limited budget – how should it be spent?

Challenges

- The depots have different capacities and are in locations in the UK and overseas. Understanding where and when fuel will be needed is key to informing investment decisions
- These are long term strategic decisions, high level requirements are needed over a long period of time

How FENPLE helps

- Strategic planners can predict the volume of fuel required in the UK/Overseas each year, rather than increasing/decreasing last year's consumption by an arbitrary amount

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Benefits | Strategic support

Scenario 3: The WAVE tankers go out of service in ~10 years. What do we need to replace them with?

Challenges:

- Strong evidence is required before procuring a new platform. Current fuel planning is based largely on consumption rates recorded when platforms first came into service, which do not match the reality
- The tankers will need to support the RN for 20-30 years, the consumption drivers to predict fuel requirements over that time scale do not exist

How FENPLE helps:

- Realistic predictions for today and in the future will contribute to providing evidence to procure a capability which meets the RN's needs

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