Modelling Decision Making to Support NetCentric Warfare Experimentation

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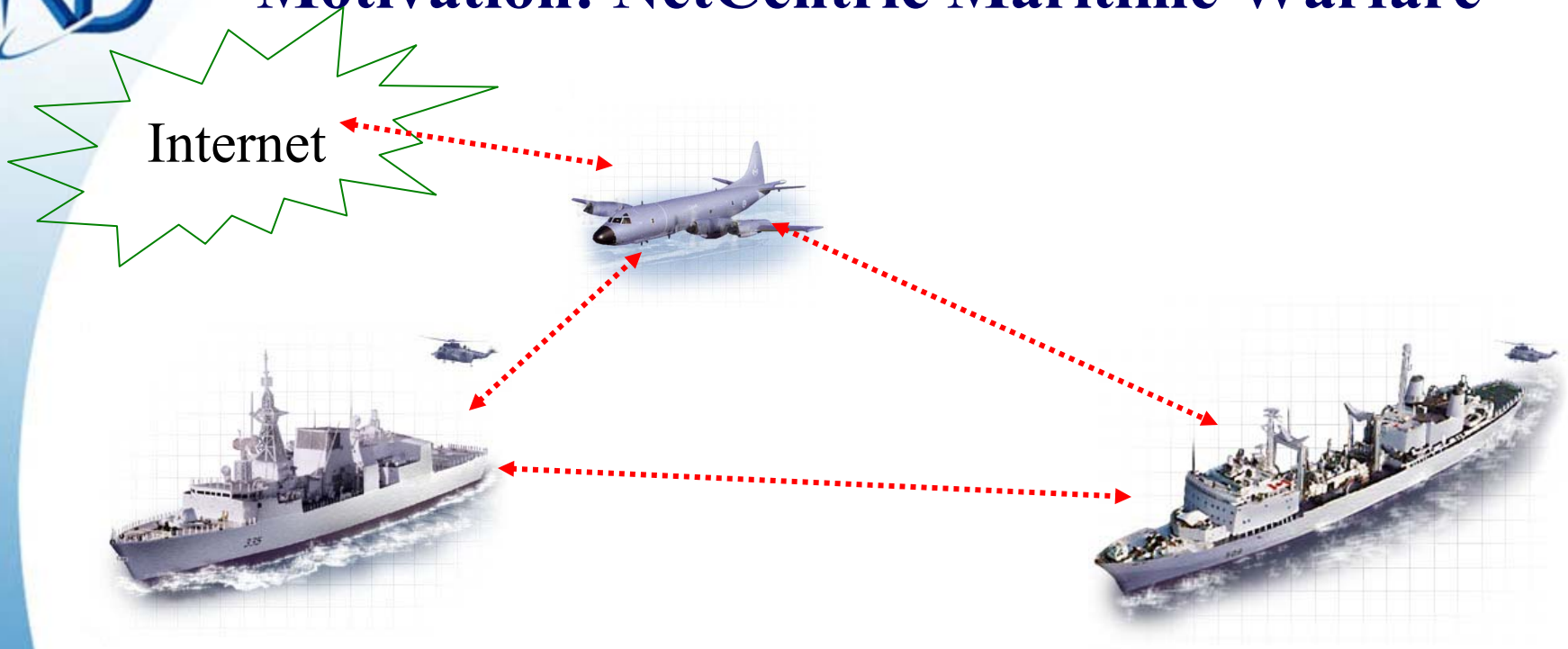
Outline

- Motivation
- A bit of history
- Decision Making: What is involved?
- Conceptual model of decision making
  - Implementation issues
  - Caveats
- Conclusions

Motivation: NetCentric Maritime Warfare



Net Working → Information → Decision Making

Simple model

- Two aspects of decision making appear to be important, to first order,
  - Decision speed
  - Decision quality

- So for net-centricity the question becomes, how will these two qualities be effected?

History of Decision Making Modelling

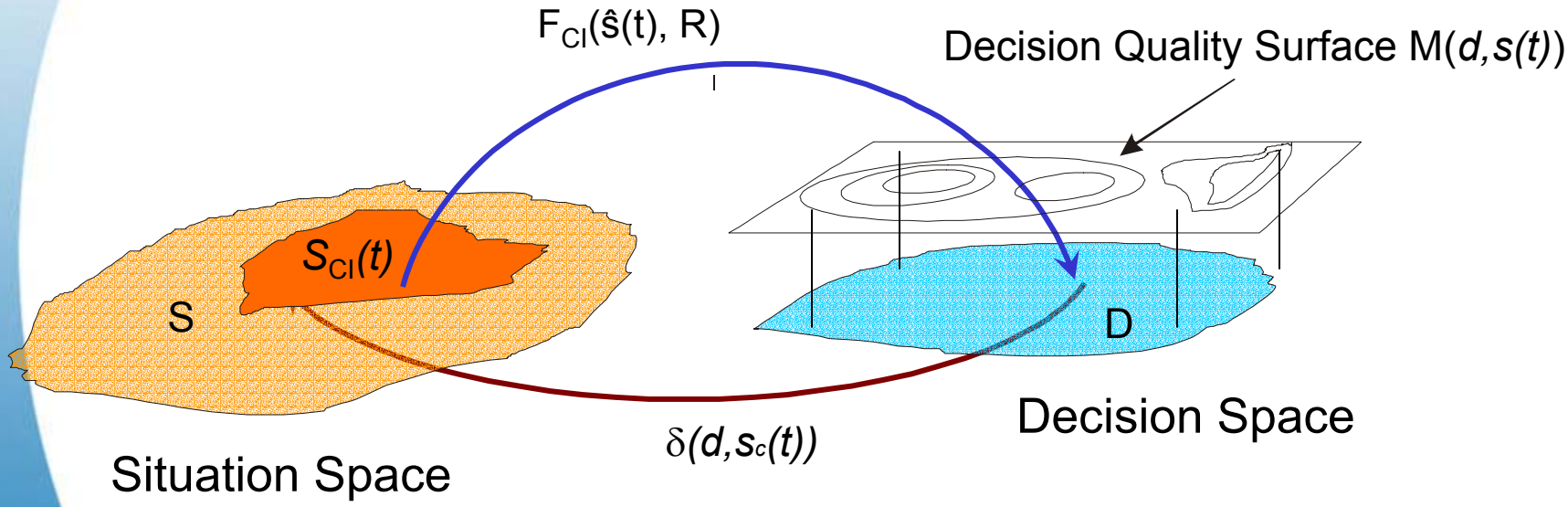
- Bayes Theorem
- Utility Theory – Von Neumann
- Naturalistic
- Cognitive Task Analysis

- Two approaches
  - Determine the best way to do it
  - Model how it is actually done

Decision Making

1. **Decision Cycles**
2. **Context**
    1. Situational Awareness
    2. Commander's Intent
3. **Biases**
    1. Experience
    2. Attention
4. **Option Generation and Creativity**
    1. Recognition or Analytical
    2. Satisficing
    3. Time constrained

Conceptual Model



Characteristics of F_{CI}

Characteristics of δ

- Applies a decision to a situation to generate a new situation.
  - Always operates on the “true” situation
  - May have a random component
- Similar functions may be used in the Soundness measurement and the decision maker’s options assessment.

Modelling Biases

- a shift in $F_{CI}(s(t),R)$—i.e. in the decision-making function
- a shift in $\hat{s}$ —i.e. in the understanding of what the situation is
- a shift in $S_{CI}(t)$ and R—i.e. in understanding of the commander's intent.
- a shift in R—i.e. in the understanding of promulgated ROEs or other constraints.

Option Generation

- Genetic or Evolutionary algorithms
- Initial population is based upon CI and experience.
- Fitness measures are based upon option assessment and allow for decisions that do not quite fit.
- Cross-over takes parts of two fit members of the population and combines them
- Mutation covers the random change to a fit member and covers creativity
- Satisficing can be instituted by the termination of option generation when assessment finds a fit.

Measuring Soundness

True Situation

$$M_{abs}(d, s_c(t)) = \left\| s_c(t) + \delta(d, s_c(t)), S_g \right\|$$

$$M_{rel}(d, s_c(t)) = \left\| \hat{s}(t) + \delta(d, s_c(t)), S_g \right\|$$

Commanders Understood Situation

1. $$\left\| s, S_g \right\| = \sum_{i=1}^{n} \left| s_i - S_{g_i} \right|$$

2. $$\left\| s, S_g \right\| = \frac{1}{P(\text{path from } s \text{ to } S_g)}$$

Summary

- The main operational impact of NCW is dependent upon its impact on decision making. Analysis of NCW effects therefore requires models of decision makers.
- Developed a conceptual model of decision making that includes cognitive aspects and is linked to the ideas of situational awareness and commander's intent.
- Developed initial decision soundness metrics
- Work is not meant to be definitive but to provide a framework within which the community can progress the analysis of NCW effects.

Acknowledgements

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