



Calhoun: The NPS Institutional Archive
DSpace Repository

Faculty and Researchers

Faculty and Researchers' Publications

2018-04

**Battle Management Aids Concepts,
Definitions, and Terms of Reference
Necessary to Define Navy Requirements**

Johnson, Bonnie; Green, John M.

Monterey, California. Naval Postgraduate School

<https://hdl.handle.net/10945/60523>

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

<http://www.nps.edu/library>

Battle Management Aids – Concepts, Definitions, and Terms of Reference Necessary to Define Navy Requirements



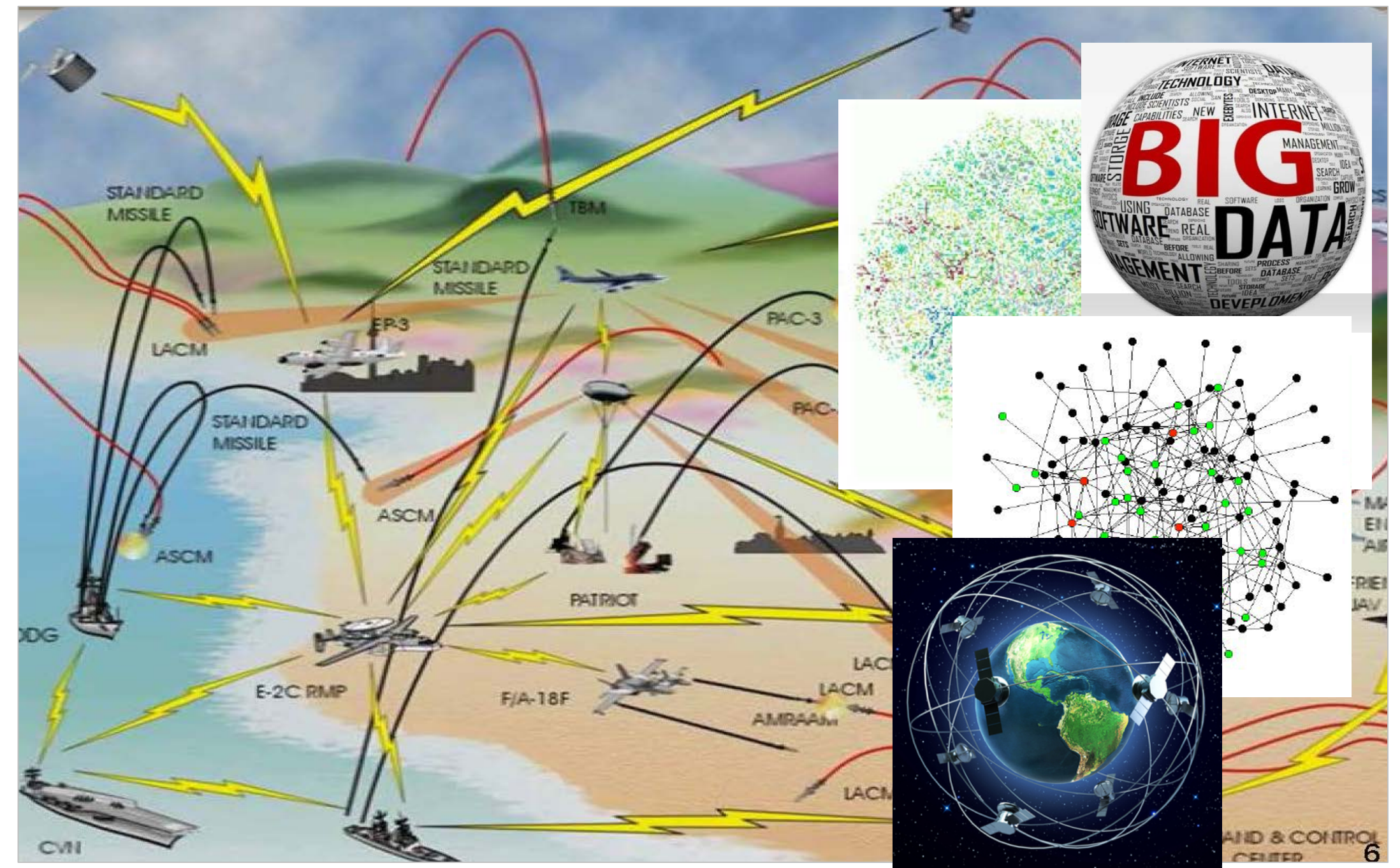
NAVAL
POSTGRADUATE
SCHOOL

The Age of Interactions

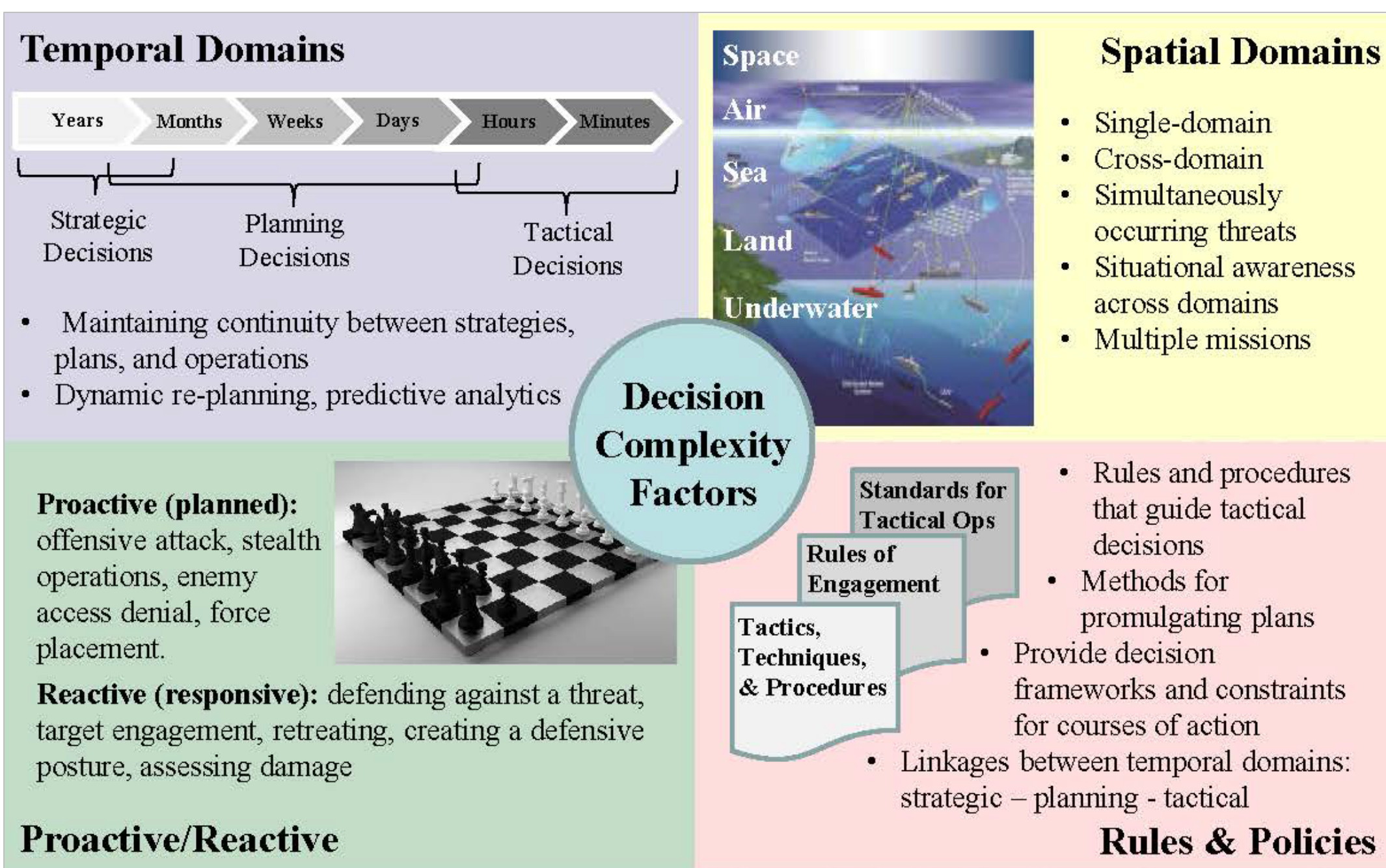
We have entered the “Age of Interactions” (David Alberts, CCRP, 2011) in which heterogeneity and the ubiquity of technologies introduce highly dimensional problems that are unlike any other before seen.

The problem space is behaviorally unpredictable, rapidly changing in time, comprised of heterogeneous distributed interrelated entities, and presents dire consequences.

A new approach is needed to maneuver this complex decision space that enables intelligent adaptive behavioral responses and courses of action to tackle this complexity.



Complex Threat Environment & Technology Growth



Decision Complexity Factors

Battle Management is Complex

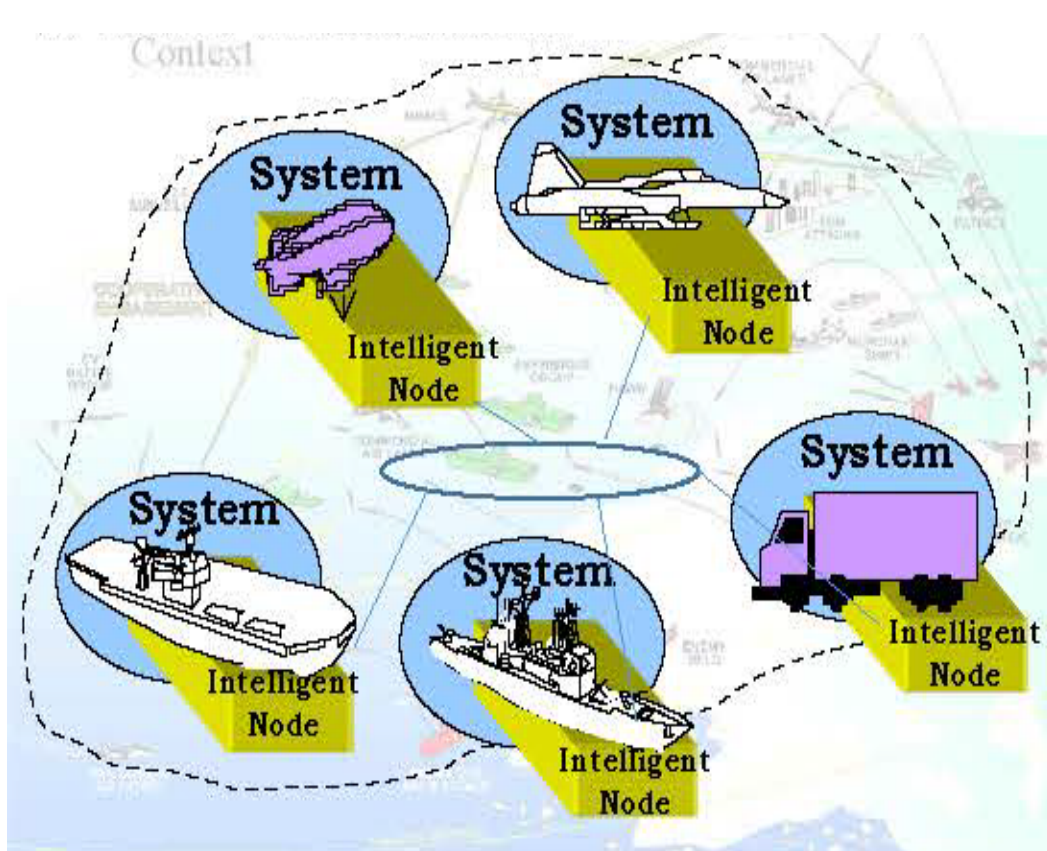
Battle management is the effective management of distributed warfare resources (sensors, weapons, platforms, communication, data management, data processing, emissions, etc.) to address the complex environment.

Automated decision aids can:

- Manage the complexity factors posed by the decision domains: temporal, spatial, proactive/reactive, and rules/policies.
- Support human decision-makers by managing information overload.
- Develop effective decision alternatives at both the force level and system level – creating desired emergent behavior.
- Provide predictive analytics for estimating consequences of actions.

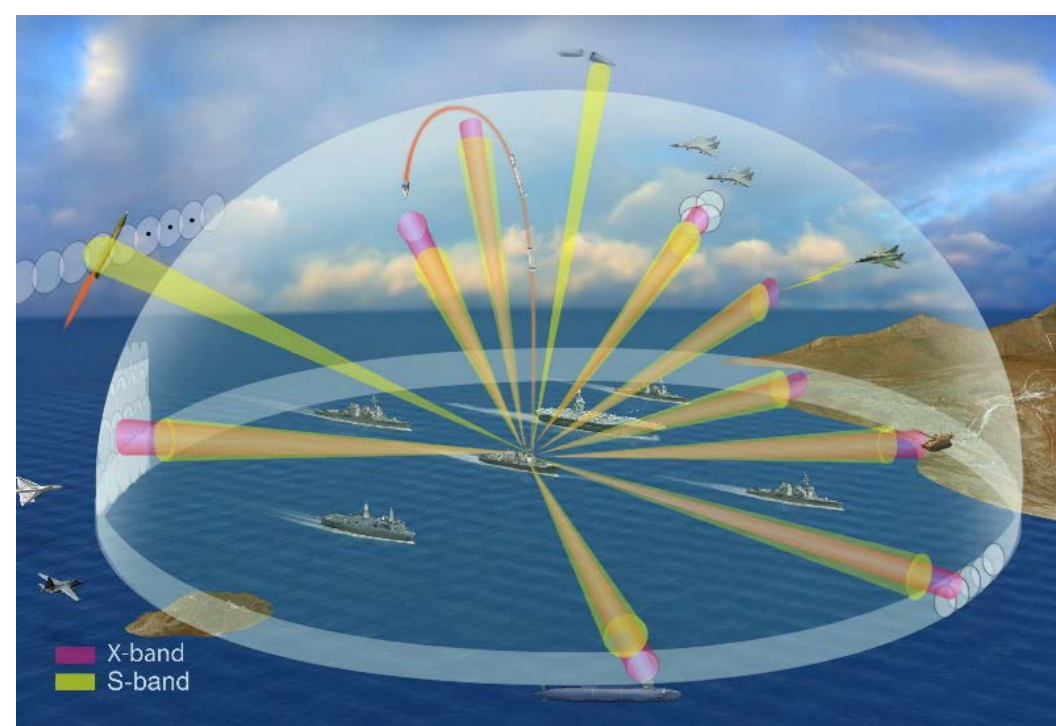
A Systems Approach to Battle Management Aids

1. Identify Systems



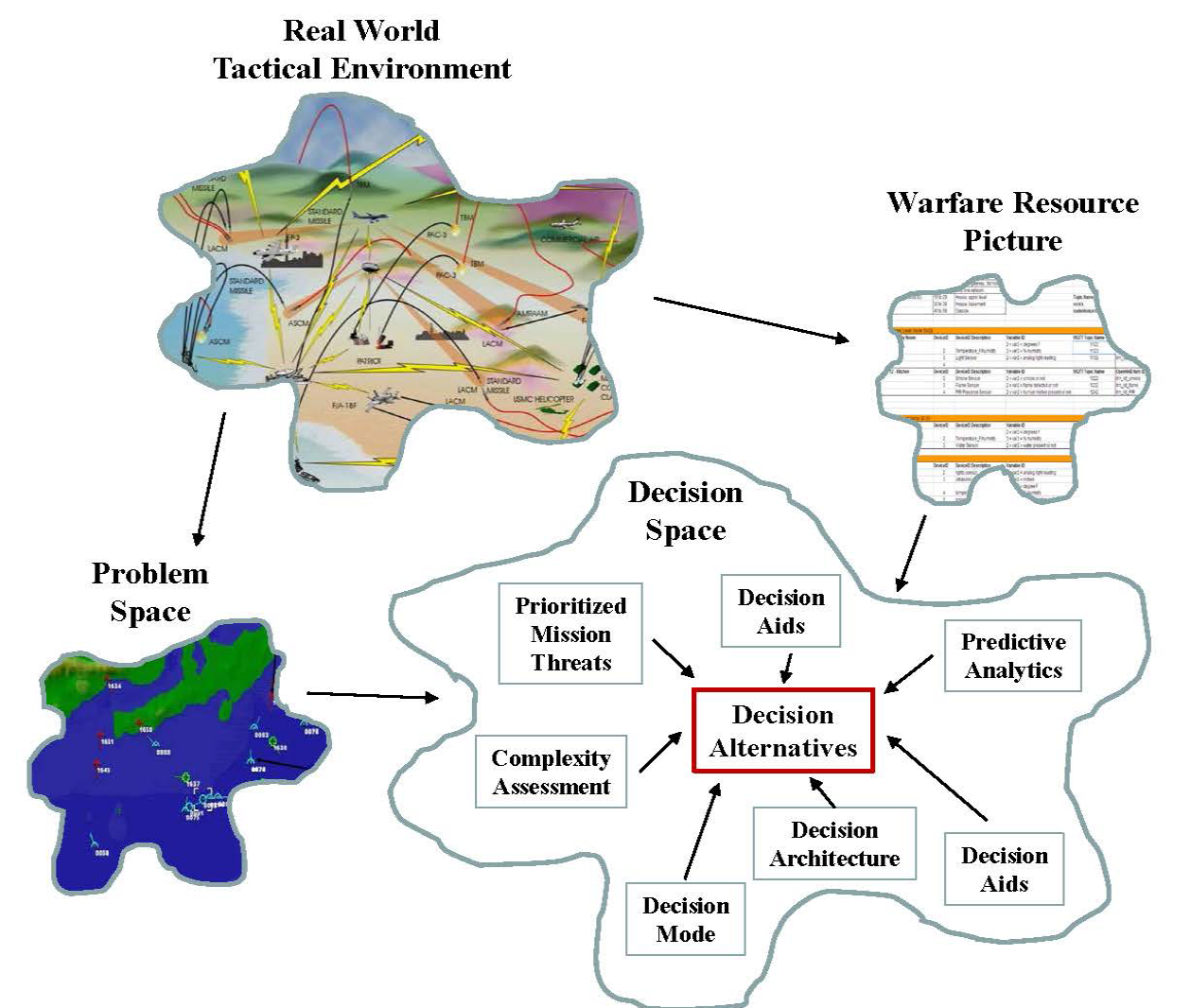
- View each warfare resource as a “system”
- Collaboration among distributed resources become “systems of systems”
- Adaptive architecture enables collaboration
- Data and information is shared among the systems

2. Establish Decision Scope



- Establish boundary around the problem space
- Decision scope includes all threats and warfare resources in the defined geospatial area
- Decision scope changes as threats and assets enter and exit the boundary
- If scope is too narrow it loses its overall force-effectiveness by leaving out decision options

3. Develop Decision Space



- Develop problem space situational awareness
- Develop warfare resource picture: status, health, readiness, and projected capabilities
- Develop decision alternatives using data analytics

4. Identify Solution Characteristics

- Complex
- Adaptive architecture
- Self-organized behavior
- Emergent behavior
- System autonomy
- SoS collaboration
- Distributed decision-making
- Predictive abilities for exploring consequences of actions
- Shared situational awareness among distributed systems
- Levels of confidence in decision alternatives
- Ability to shift seamlessly from simple to complex operations

Conclusions

- Battle management will continue to grow in complexity with more threats and advances in technology
- A complex solution space must be conceptualized and eventually realized to facilitate fast-acting and highly responsive warfare utilization
- A systems approach addresses the multidimensional and adaptive decisions required
- The solution will require holism, adaptive relationships, intelligence at the system level, shared knowledge, and predictive analytics

Future Work

- Holistic force-level battle management decision aids orchestrating lower-level decisions with a platform or course of action focus
- A “system of decision systems” approach
- Adaptive architecture, “taskable” warfare resources, supportive command and control culture
- Artificial intelligence and machine learning for decision aids
- A complex systems engineering framework to enable design, development, and evaluation



Researchers: Bonnie Johnson and John M. Green
Graduate School of Engineering & Applied Sciences,
Systems Engineering Department
Topic Sponsor: Mr. William Treadway, USN, OPNAV N2/N6

NRP Project ID:
NPS-N17 N18-A