Measuring Command and Control (C2) Effectiveness

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Agenda

• What is Effectiveness?
• What is C2 Effectiveness?
• Key Issues
• Three Classic Approaches
• Examples of Doctrinal Measurement
• Examples of C2 Process Measurement
• Examples of Empirical Measurement
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What is Effectiveness?

• Effectiveness means impact on the operating environment
• NATO hierarchy of Measures of Merit (MoM)
  – Dimensional Parameters (DP)
  – Measures of Performance (MoP)
  – Measures of C2 Effectiveness (MoCE)
  – Measures of Force Effectiveness (MoFE)
  – Measures of Policy Effectiveness (MoPE)
• Military mission accomplishment classically sought to keep selected values in an acceptable range
  – E.g., casualty ratios, territorial gains...
  – Destroy the adversary capability and will
What is C2 Effectiveness?

• C2 Effectiveness focuses on the impact of a system on its operating environment
  – Adversary forces
  – Neutrals
  – Terrain and other environmental factors
  – Friendly forces
• Mission accomplishment is the crucial element in C2 effectiveness
• Command and Control is never an end in itself—it is a means to an end—it only makes sense in a context
Key Issues

• What is the dependent variable?
  – How is it measured?
  – What measurement error is relevant?
• How is time brought into the analysis?
• How to separate Command and Control performance from commanders’ decision making?
• How are linkages across functional areas (logistics, intelligence, operations...) handled in the analysis?
Three Classic Approaches

• **Doctrinally driven C2 Assessments**
  – Requires authoritative doctrine
  – Typically judgmental (observer/controllers, senior mentors)

• **Process oriented measurement**
  – Assumes quality process results in quality C2
  – Requires predetermination of desirable processes

• **Empirical measurement**
  – Requires underlying theory and data collection apparatus
  – Assumes C2 determines effectiveness
  – Only as good as the environment observation or simulation used to adjudicate outcome

• **Analysts must be capable of using all three**
Examples of Doctrinal Measurement

- Preferred application in training and large forces
- Joseph Olmstead (1978) evaluated brigade C2 structures and processes using the results of US Army Training and Evaluation Program (ARTEP)
  - First empirical documentation of the need to change processes and structures as situations changed
  - Relied on doctrine and observer/controllers
- Used in US Army Warfighter Exercises for divisions and brigades
- Adopted by US JFCOM for many of their experiments
- Largely measures of performance (MoP)
Examples of C2 Process Measurement - I

- Separates outcomes from processes
  - Assumes C2 processes determine outcomes
  - Requires definitive link between process and C2 quality
  - Primarily based on small group psychology and organizational research
- Adopted by US Second Fleet for Battleforce In-Port Training (BFIT) at fleet and battlegroup levels
- Built into Adaptive Architectures for Command and Control (A2C2) in US Navy research
- Broadly used in experimentation research as well as training staffs
- Seldom validated for military applications
Examples of C2 Process Measurement - II

• Typical measures
  – How many perspectives were involved in situation assessment or planning?
  – How many alternative courses of action were considered?
  – How many echelons were involved in planning?
  – What was the decision style of the commander (e.g., collaborative, directive...)?
  – How was time allocated across processes and echelons?

• Appropriate processes depend on the quality, training, and experience of the force

• Largely measures performance (MoP)
Examples of Empirical Measurement - I

• Empirical measurement requires an objective metric
• USMC Battalion Combat Effectiveness (1980) used expert opinion about mission accomplishment, which correlated 0.92 across individuals with experience commanding battalions in combat
• HEAT (Headquarters Effectiveness Assessment Tool) used decisions to alter plans (written and oral) to determine the quality and effectiveness of C2
  – Plan life compared to expected plan life (MoE)
  – Time required to accomplish C2 functions (MoP)
  – Includes process measures of performance (MoP)
Examples of Empirical Measurement - II

• Army Command and Control Evaluation System (ACCES)
  – Translation of HEAT methodology into US Army language
  – Focus of analysis on quality of staff performance at division and brigade levels
  – Database generated across several exercises
  – Used to assess prototypes for Maneuver Control System (MCS) and All Source Analysis System (ASAS)

• US Army National Training Center and USMC 29 Palms also allow direct measurement of unit performance
  – Instrumented ranges
  – Databases of comparative unit performance
HEAT
Headquarters Effectiveness Assessment Tool

DEVELOP ALTERNATIVE ACTIONS

UNDERSTAND

PREDICT CONSEQUENCES

DECIDE

DIRECT

QUERY
INFORM

ENVIROMENT:
- OWN & ENEMY FORCES
- PHYSICAL
- POLITICAL & ECONOMIC

Commanders’ Shortcut
What Have We Learned?

- Doctrinal approaches are inflexible and often out of touch with current operations
- Doctrinal approaches may be necessary for training
- Process measurement can lead to false conclusions
  - Gary Klein’s Recognition Prime Decision-making (RPD) demonstrated the weakness and (often) irrelevance of the deliberate planning process
  - Most small group and organizational research is conducted outside the context of military problems, the stresses of military operations, and trained (hardened) groups
- Process measurement can be an effective training tool
What Have We Learned? II

- Empirical measurement requires substantial planning and investment
  - Instrumentation
  - Observer training and inter-coder reliability
- Many organizations are unwilling to make the investments needed to support empirical measures of C2 Effectiveness
- Correctness of situation awareness is the strongest single determinant of successful C2 performance
- Measures of C2 Effectiveness need to be flexible
What’s Different?
21st Century Operating Environments

• Adversaries are more diverse
  – National armies to insurgents, terrorists, religious fanatics, and criminals
  – Adaptive strategies and tactics

• Battlespaces include more dimensions
  – International media
  – Cyberspace

• Conflicts cut across national boundaries
  – Safe havens
  – Global dispersion of cultural and ethnic populations
• Missions have expanded to include greater emphasis on
  – Disaster response
  – Nation building
  – Peace operations
• Coalition operations dominate
• Complex Endeavors are commonplace and imply performance that may be very difficult to measure empirically
  – Attitudes within a population
  – Impact of psychological operations
  – Cultural factors
What’s Different?
Military Capabilities (ours and theirs)

• Enhanced Information Technology (IT) capabilities
  – Communications networks
  – Sensor capabilities
  – Databases and data processing
  – Decision support tools

• Increased pace and integration of operations
  – Collapse of echelons (strategic corporate)
  – Adaptive planning processes
  – Planning merging with execution

• Power to the Edge
  – Broad information distribution
  – Collaborative processes
Solution: Appropriate C2 Approaches

• Edge C2: Self-synchronizing, multi-connected with broad information sharing
• Collaborative C2: One integrating plan, collaborative decision making, broad connectivity and information sharing
• Coordinated C2: Limited cooperation on specific issues, limited connectivity and sharing of information
• De-Conflicted C2: Each entity independent, only boundaries agreed and supported
• Conflicted C2: No connectivity, no C2
C2 Approach Space

- Distribution of Information Among Entities
  - None
  - Broad

- Patterns of Interaction Among Entities
  - None
  - Tightly Constrained

- Allocation of Decision Rights to the Collective
  - Broad
C2 Approaches

- **Edge C2**
- **Collaborative C2**
- **Coordinated C2**
- **De-Conflicted C2**
- **Conflicted C2**

- **Patterns of Interaction Among Entities**
  - Unconstrained
  - Tightly Constrained
  - None

- **Distribution of Information Among Entities**
  - Broad
  - None

- **Allocation of Decision Rights to the Collective**
  - Broad
• Agility is the capability to successfully effect, cope with, and/or exploit changes in circumstances (SAS-085).

• Measurement of C2 Agility requires a variety of cases drawn from properly instrumented or documented:
  – Comparable operational experiences
  – Exercises
  – Experiments
  – Simulations

• Measures of C2 Effectiveness (MoCE) are merging with Measures of Force Effectiveness (MoFE)
Measuring C2 Agility in 21st Century Missions

- **Versatility**: the ability to maintain effectiveness across a range of tasks, situations, and conditions.
- **Responsiveness**: the ability to react to a change in the environment in a timely manner.
- **Resilience**: the ability to recover from or adjust to misfortune, damage, or a destabilization.
- **Innovation**: doing new things or old things in new ways.
- **Flexibility**: the ability to employ multiple ways to succeed and to move seamlessly between them.
- **Adaptation**: the ability to change work processes and the ability to change the organization.
Bibliography: CCRP Literature

• *NATO Code of Best Practice for C2 Assessment* (2002) NATO SAS-026, 039
• *NATO NEC C2 Maturity Model* (2010) NATO SAS-065

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