



# Synthesis Group

## Final Report

24 March 2011



# Synthesis Working Group

**Synthesis Working Group is a strategic body that helps the workshop achieve its objectives by:**

- Synthesizing the products of the four WGs
  - Identifying takeaways from the tutorials and presentations
  - Determining Common Themes
  - Offering Synthesis Perspectives
- Developing overarching workshop recommendations
- Facilitating working group deliberations



# Synthesis Group Members

Greg Keethler, InquisIT: Chair

Dr. Jerry Diaz, AF/OAS: Co-chair, MORS Director

LTC Tim Lawrence, TRAC/WSMR: Roamer

Mike Tavares, TRAC/FLVN: Working Group 1 Synthesis member

Dr. David Signori, EBR: Working Group 2 Synthesis member

Dr. Sheilah Simberg, USA/AMSAA: Working Group 3 Synthesis Member

Dr. Elizabeth Bowman, USA/ARL: Working Group 4 Synthesis Member

## Adjunct Members:

Terry McKearney, The Ranger Group: MORS Past President, Workshop Chair

Dr. Lee Lehmkuhl, MITRE: Workshop Co-chair

Dr. Mike Kwinn, USMA: MORS Past President

Trena Lilly, JHU/APL: MORS President



# Agenda

Joint Framework  
for Measuring C2  
Effectiveness

- Context
- Insights from
  - Tutorials, Plenaries
  - Themes from the Working Groups
  - Synthesis Group Perspectives
- Summary



# Context

- What?
  - Measuring C2 Effectiveness
  - Four working groups
    - Operations
    - Acquisition
    - System of Systems
    - Human Decision Making
- Where?
  - JHU/APL, Laurel, MD
- When?
  - 23-26 January 2012

- ***Mission Command Measures Framework Tutorial (LTC Gerry Benard)***
  - TRADOC Analysis Center developed an analytical framework to enable Mission Command (MC) system analysis
  - The framework is a standing set of nested measures with the following construct:

System  
Performance

Sys of Sys  
Operation

MC Task  
Performance

Operational  
Effectiveness

- The Army, like all the services, need to developing measures that captured the contribution of networked information systems to analyze the
  - Execution of Mission Command, and the
  - Resulting contribution on operational effectiveness
- This framework is a starting point



# “Take-aways” from Tutorials (2 of 2)

- ***Warfighter Associate: Decision Aiding and Metrics for Mission Command*** (Norm Geddes, Norbou Buchler)
  - Warfighter Associate is software that offers assistance to users based on a model of tasks and task performance in a complex, dynamic environment
  - It is an intent interpretation engine that observes actions and the state of the battle-space to infer user goals and needs
- ***Planning, Design, and Analysis of Networked Systems: An overview of techniques used to design and assess C2 networks*** (Dr. Susmit H. Patel)
  - Given the complexity of C2 Networks, analysts must understand underlying C2 functions and network depiction
  - It is critical to convert requirements into key parameters (Quantitative and Qualitative Measures)
  - Use proper analytic techniques to develop Course of Actions (COAs) and present these appropriately



# “Take-aways” from Plenary (1 of 2)

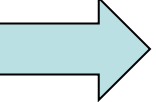
- **Mr. Carl Porter, Dep Director, C4 and IT Infrastructure, DoD CIO, *Improving IT Efficiency and Effectiveness in the DoD***
  - POTUS: “DoD will be Agile” ... C2 will be essential to being agile
  - DoD CIO is leading DoD to
    - Move from stovepipes to a Joint Information Enterprise Architecture
    - Pursue IT Reform – Agile, Secure, Efficient and Effective IT
  - The anticipated benefits of the future DoD IT Environment
    - Reduced costs, faster/more responsive, and faster adoption of commercial IT breakthroughs
    - Improved – interoperability, user satisfaction, security
  - Challenges to Workshop...*How does*
    - Measuring of C2 fundamentally change in the “Information Age?”
    - An “Agile” DoD C2 enterprise impact the ‘decision topology’ of Defense operations?



# “Take-aways” from Plenary (2 of 2)

- **Dr. Richard E. Hayes, President, Evidence Based Research, Inc.,**  
***Measuring Command and Control (C2) Effectiveness***
  - Measuring C2 effectiveness means measuring the impact on the operating environment (C2 is never an end in itself)
  - How do we separate C2 performance from commanders’ decision making
  - Today’s 21<sup>st</sup> Century complexities challenge C2 analysis
    - Adversaries are more diverse
    - Battlespaces contain more dimensions
    - Conflicts cut across national boundaries
    - Missions have expanded to include greater emphasis on OOTW
    - Coalition operations dominate
    - Complex endeavors are commonplace and imply performance that may be very difficult to measure empirically

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# Themes Across Working Groups

(1 of 7)

Joint Framework  
for Measuring C2  
Effectiveness

- All the working groups struggled with the vastness and ill-defined boundaries of the C2 domain
  - The literature and other venues often confound C4ISR, Net-Centric Operations, C3 and other related domains with C2
- Observation/Recommendation:
  - There are a number of overlapping and sometimes redundant domains, often used interchangeably
  - There is a very precise joint definition of C2, but there is not a definitive description of what belongs in the C2 domain
  - Recommend the community develop and publish a definitive description of the terms associated with these domains and what is contained within them



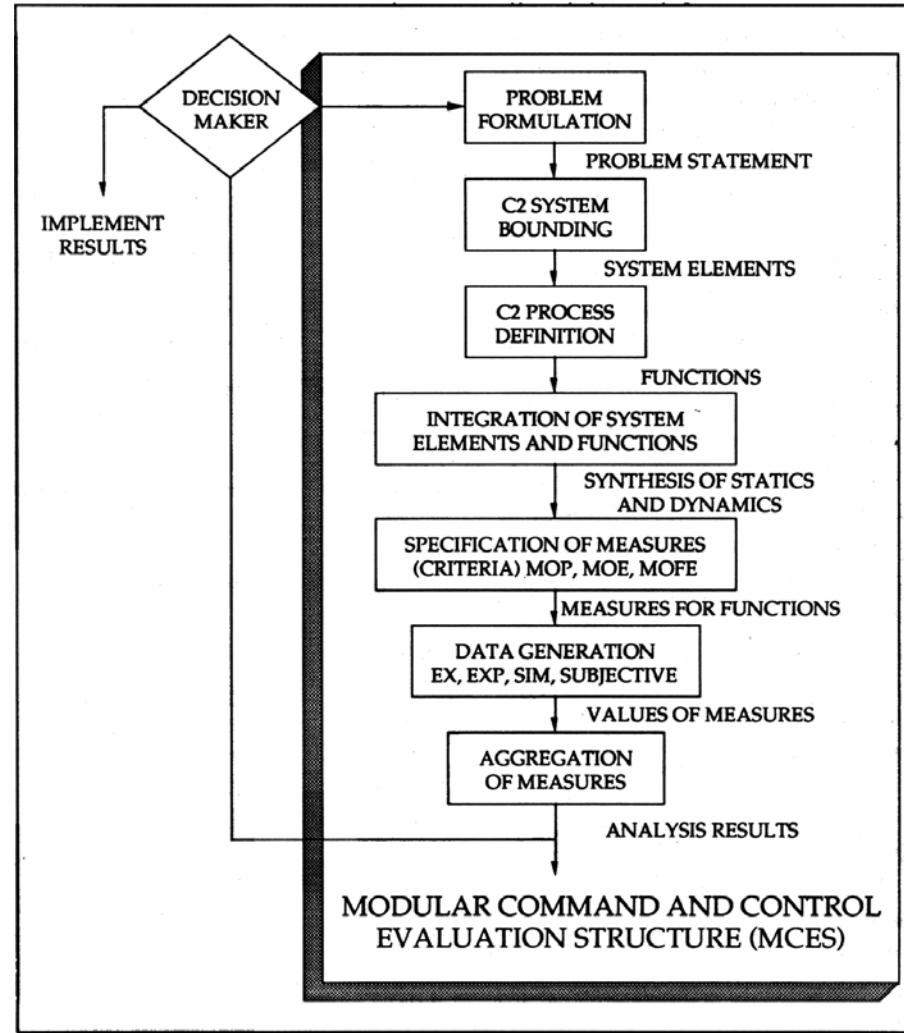
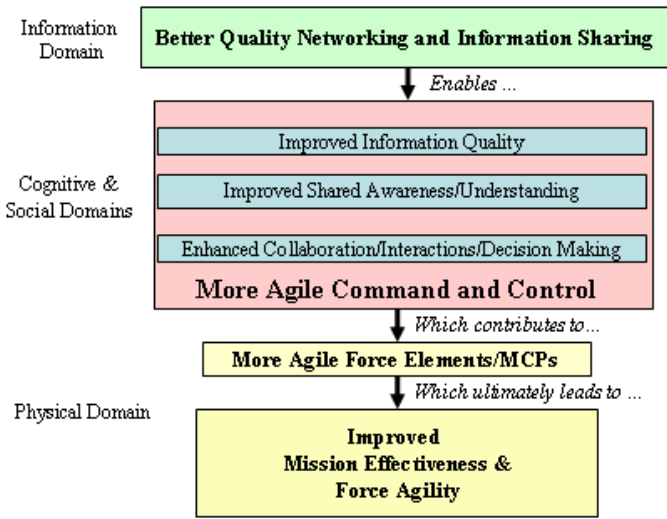
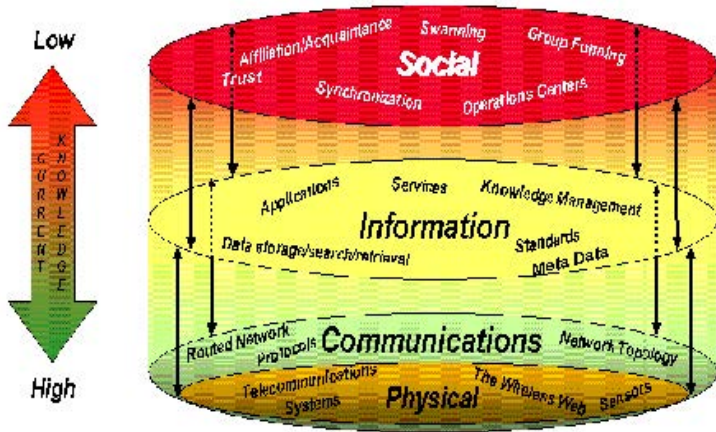
# Themes Across Working Groups

(2 of 7)

- There are numerous purported efforts to define a framework for C2 assessment and associated metrics
  - NATO COBP cites a framework developed by MORS in 1985, called Modular Command and Control Evaluation System (MCES)
  - MORS has had at least 6 workshops/mini-symposia on the topic or closely related topics over the years
  - Bottom line: There is a proliferation of constructs (see next slide)
- Observations/Recommendations:
  - Much has changed since this seminal work—net centrality, computational capacity, communications capabilities, social aspects
  - An updated, modernized framework is needed; recommend:
    - Reviewing all previous MORS and related research efforts
    - Comparing and contrasting to the output of this workshop
    - Merging into an up-to-date C2 Assessment Framework

# Various "Frameworks"

Command and Control  $\rightleftharpoons$  Collaborate and Connect





# Themes Across Working Groups (3 of 7)

- It is difficult to assess any aspect of C2 without considering the human element
  - WG 4 (Analysis of Human Decision Making in a Networked Environment) focused on the human element
  - The other three Working Groups found themselves repeatedly addressing how to address the human element within their assigned areas
- Finding:
  - This is the classic paradox of assessing C2: the process of command and control has been exercised by humans since long before modern C2 systems existed; the effectiveness of the humans exercising command and control is comingled with the effectiveness of the systems they use to do it, the complexity of which only make the analysis even more difficult

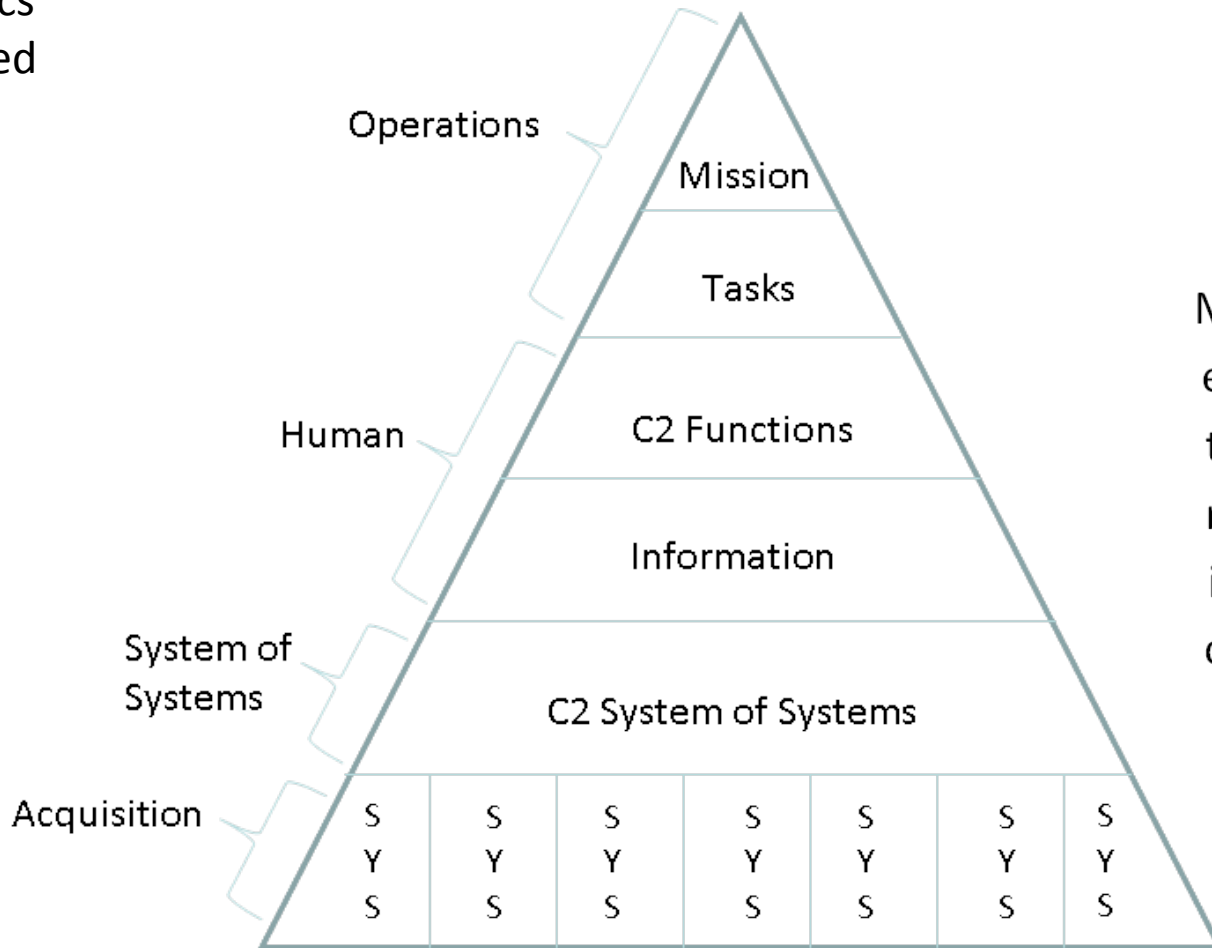
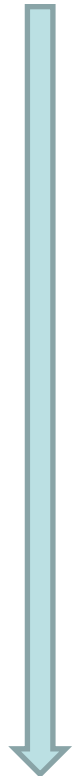


# Themes Across Working Groups (4 of 7)

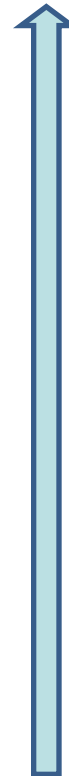
- An assessment framework did not naturally emerge from the separate deliberations of the working groups
  - There were few observable structural similarities among the WG's approaches to their tasks
- Determination: Workshop leadership leveraged a construct that emerged from working group 2 to serve as the Workshop's metrics framework
  - Working Group chairs were asked to frame their results within this construct (attached)
  - It is not necessarily the finding of the workshop that this framework should be preferred over all others; it was chosen as a device to capture and integrate the Working Group deliberations

# C2 Metrics Framework (or Construct)

Metrics Derived



Metric Relationships

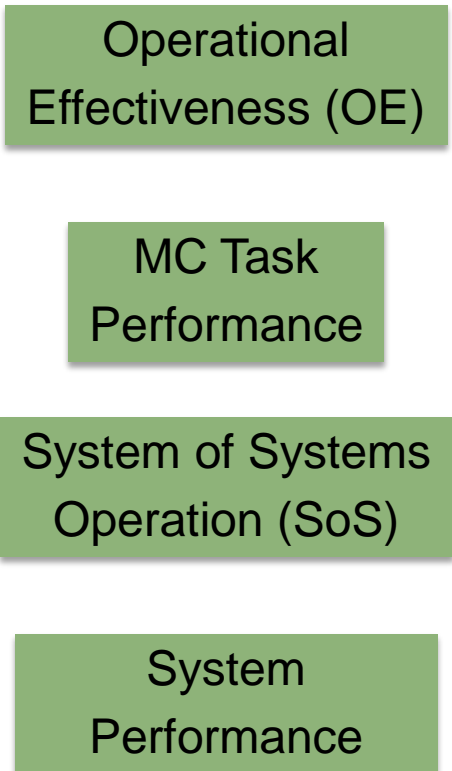


Metrics Implemented

# Framework alignment to Workshop Tutorials/Plenary Session

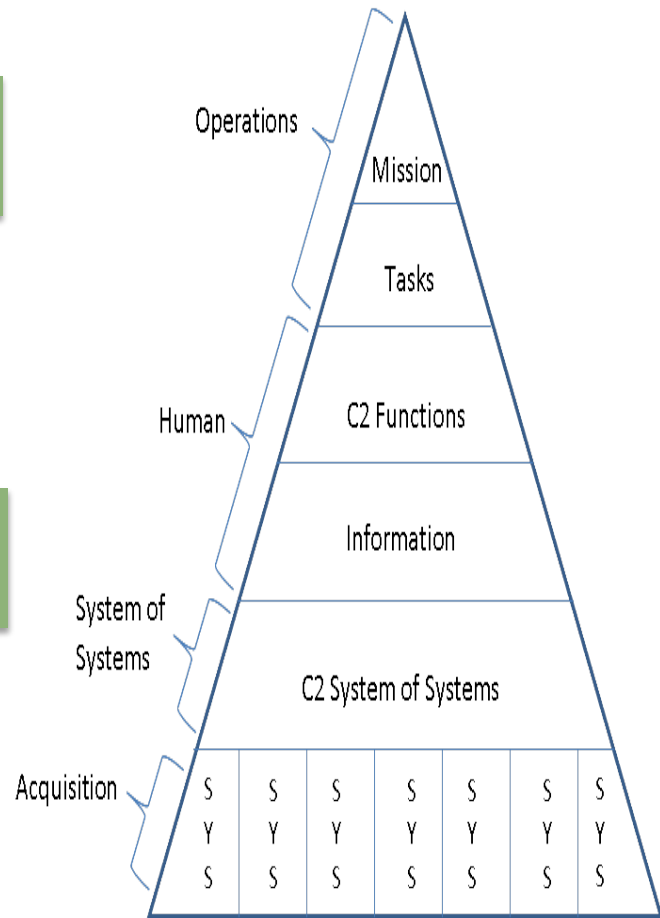


## Mission Command Measures Framework



## NATO Hierarchy of Measures of Merit (MoM)

- Measures of Policy Effectiveness (MoPE)
- Measures of Force Effectiveness (MoFE)
- Measures of C2 Effectiveness (MoCE)
- Measures of Performance (MoP)
- Dimensional Parameters (DP)





# Themes Across Working Groups (5 of 7)

- There was general agreement that missions and their associated tasks are enabled by C2 functions, which are in turn enabled by the information provided by C2 Systems of Systems
- Determination:
  - For purposes of this workshop, the C2 functions were:
    - Organize
    - Understand
    - Planning
    - Decide
    - Direct
    - Monitor



# Themes Across Working Groups (6 of 7)

- It is difficult to define metrics (MOP's and MOE's) without the context of a specific question and/or mission and/or C2 System of Systems
  - Tendency to stop at “attributes” such as availability, timeliness, etc., without more specifics of the problem at hand
- Recommendation:
  - Employ specific cases to develop actual metrics from these attributes, then generalize the knowledge gained

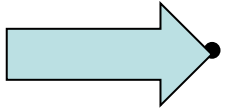


# Themes Across Working Groups (7 of 7)

- “Framework” means different things to different communities
  - Cultural barrier
  - Represents different ways of thinking between fields of endeavor
  - More significant than lexicon problems
- Recommendation:
  - For any particular “framework” endeavor, the precise meaning of the word and it’s intended use should be specified
  - If multiple groups are applying a single definition, strive for common understanding

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# Synthesis Perspectives (1 of 2)

- Canonical Findings
  - We need a common Lexicon!
  - “In God we trust; all others need to bring **DATA!**”
  - Given the speed that the cyber problem is changing, we need to hold meetings more frequently (e.g., every other year)



# Synthesis Perspectives (2 of 2)

- The structured military approach to command and control underemphasizes the social aspect inherent in a net centric environment
  - Experience in the civilian world demonstrates the power of this aspect of the network
  - A significant aspect of Commander's use of information is trust, a major element of which is gained through "social" contact
  - More examination on the role of the social aspects of the network and its impact on the efficacy of C2 is needed
  - Broaden the "processes" examined in C2



# Summary

- We have shared!
  - Operations analysts
  - C2 Experts and Practitioners
  - Human Factors Experts
  - Experts from numerous other disciplines
- Much work has been done in the past on C2 measurement and assessment frameworks
- This workshop revealed that much has changed in the C2 domain since the seminal work of the past
- We have set the stage to establish an updated framework for assessing today's C2 domain