



Joint Framework for
Measuring C2 Effectiveness

23-26 January 2012 | JHU Applied Physics Lab, Laurel, MD



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Working Group 2

Analytic Support to C2 Acquisition

Chair: Suzanne Beers, MITRE
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26 JAN 2012



WG Participants

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- Jerry Baird, BAH
- Pat McCormick, Alpha Informatics
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WG Objectives

- Identify examples of analysis tools and methods successfully used to quantify the effectiveness of C2 systems.
- Identify analysis methods applicable to phases of the acquisition cycle.
- Report findings and actionable recommendations for promoting adequate analysis of C2 systems to inform acquisition decisions.



WG Approach

- What are the decisions that need to be informed during the acquisition process?
- What types of analyses need to be performed to inform these decisions?
- What tools (models, simulations, etc.) can be used to perform these analyses?

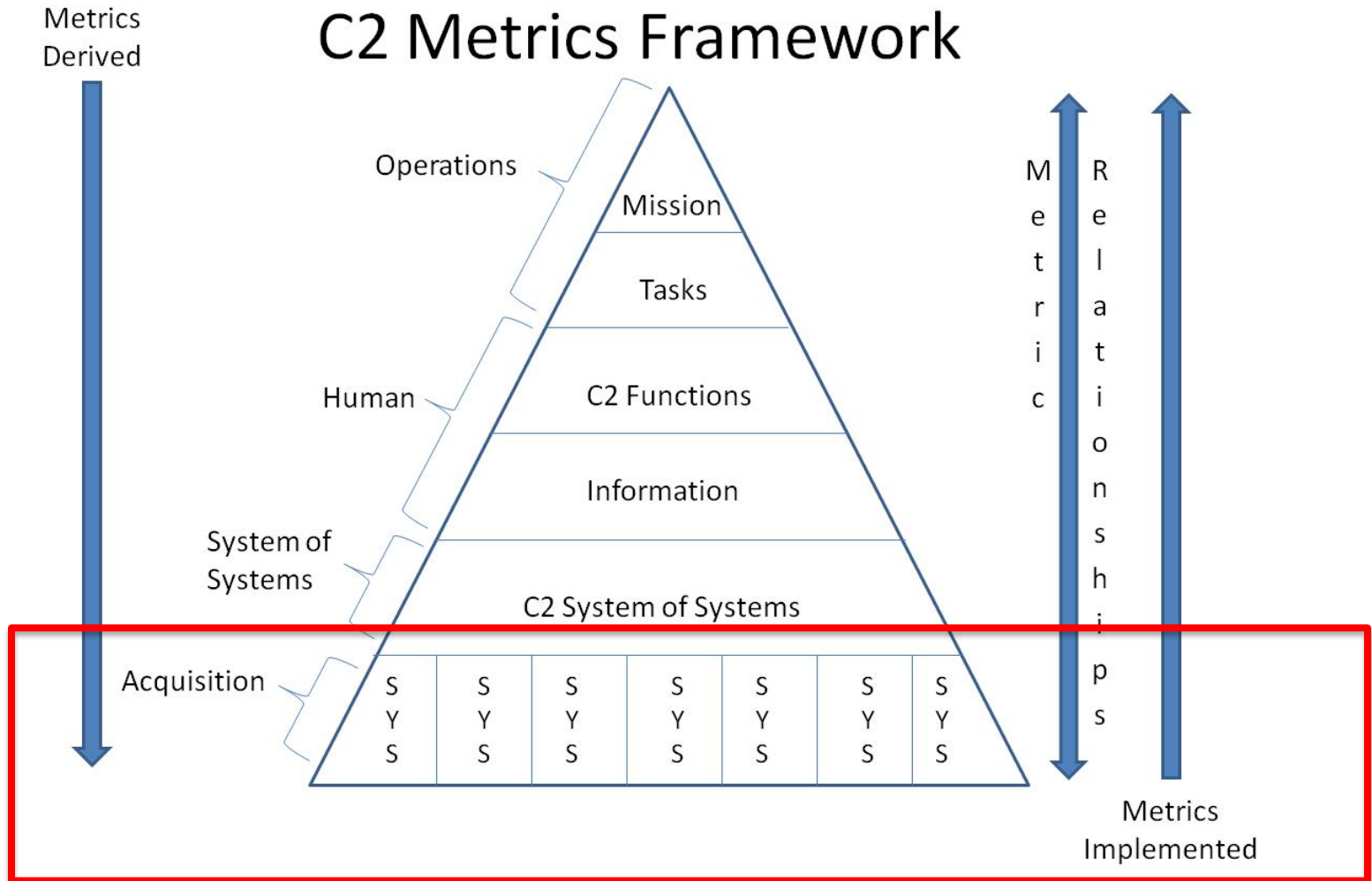


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Analyses

- Cost
- System Performance
- Risk
 - Cost
 - Schedule
 - Technical
- Trade Space

Metrics

- Timeliness (time of arrival, latency)
- Accuracy (data, representation)
- Completeness
- Range
- Robustness
- Capacity
- Cross Domain Information
- Responsiveness
- Architecture
- Scalable
- Trainability/Usability (ease of use)



Four Major Decision Points

- Materiel Decision Document (MDD)
- Milestone (MS) A
- MS B
- MS C





MDD Tools/Methods/MS&A

- SME Panel
- Break mission down to tasks and supporting capabilities/assets
- Map capabilities to task sets, available assets to capabilities
- Break capability gaps into required attributes
- DOTmLPF assessment
- Map available and developmental technologies to capability gaps/tasks





MS A Tools/Methods/M&S

- Item-Level M&S
- SME Panels
- Qualitative Assessments
- Vendor Specifications





MS B Tools/Methods/MS&A

- Engineering- and Item-level M&S
- Component Testing
- Prototype System Demonstrations
- Experimentation





MS C Tools/Methods/MS&A

- Forward Operational Assessments (FOA)
- Developmental/Operational Testing with Military Personnel
- Physics/Engineering-level M&S





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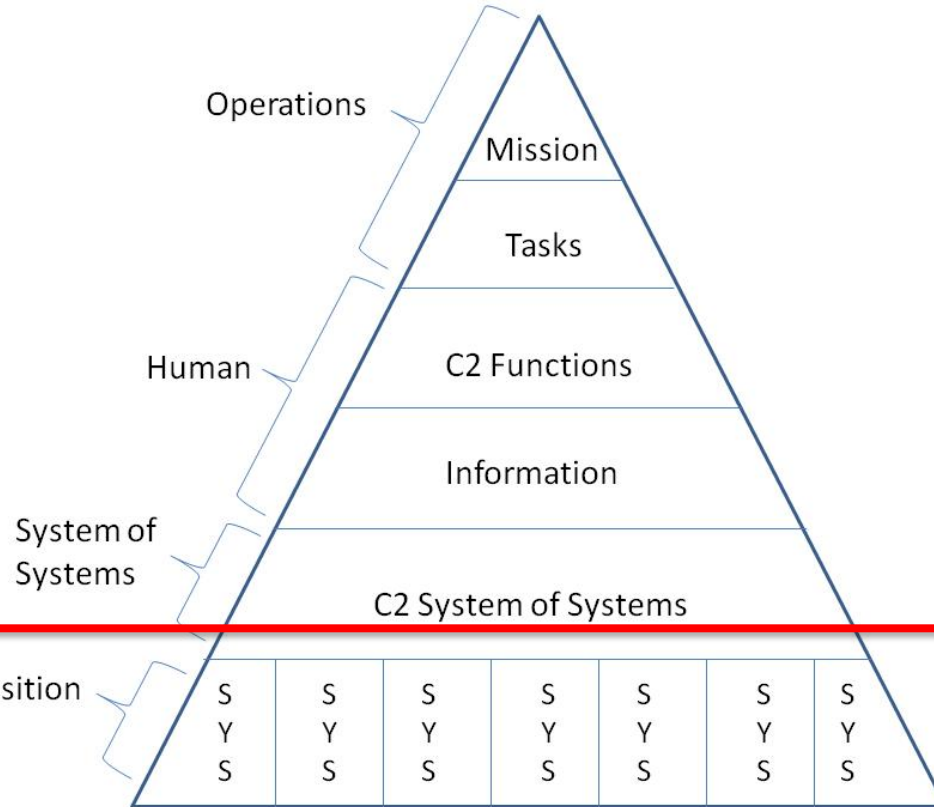


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C2 Metrics Framework

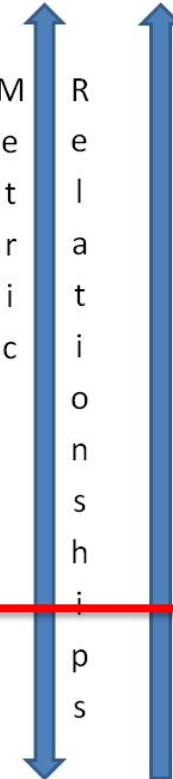
CBA and ICD to Support MDD

Metrics Derived



System-Level Metrics Well-Defined

Metric Relationships



Analysis Needed

Metrics Implemented



WG 2 Findings

- **C2 M&S capability is inadequate.**
- **Concerns**
 - Integration and performance of C2 systems within context of other systems is not addressed.
 - C2 capability gaps are not re-assessed at each milestone decision to ensure that product is still relevant.
 - Are the traditional C2 measures still relevant and agile enough to answer current and future C2 questions?



WG 2 Summary

- Developed set of metrics that can be used to assess system performance.
- Developed set of analytic methods and tools to address system-level metrics at each milestone.
- Discussed need for system-of-system and mission effectiveness metrics within acquisition process.



Final Thoughts

- Recommend the analytic community be involved much earlier in the JCIDS process.
- Quicker timelines for fielding C2 systems.



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BACK-UPS

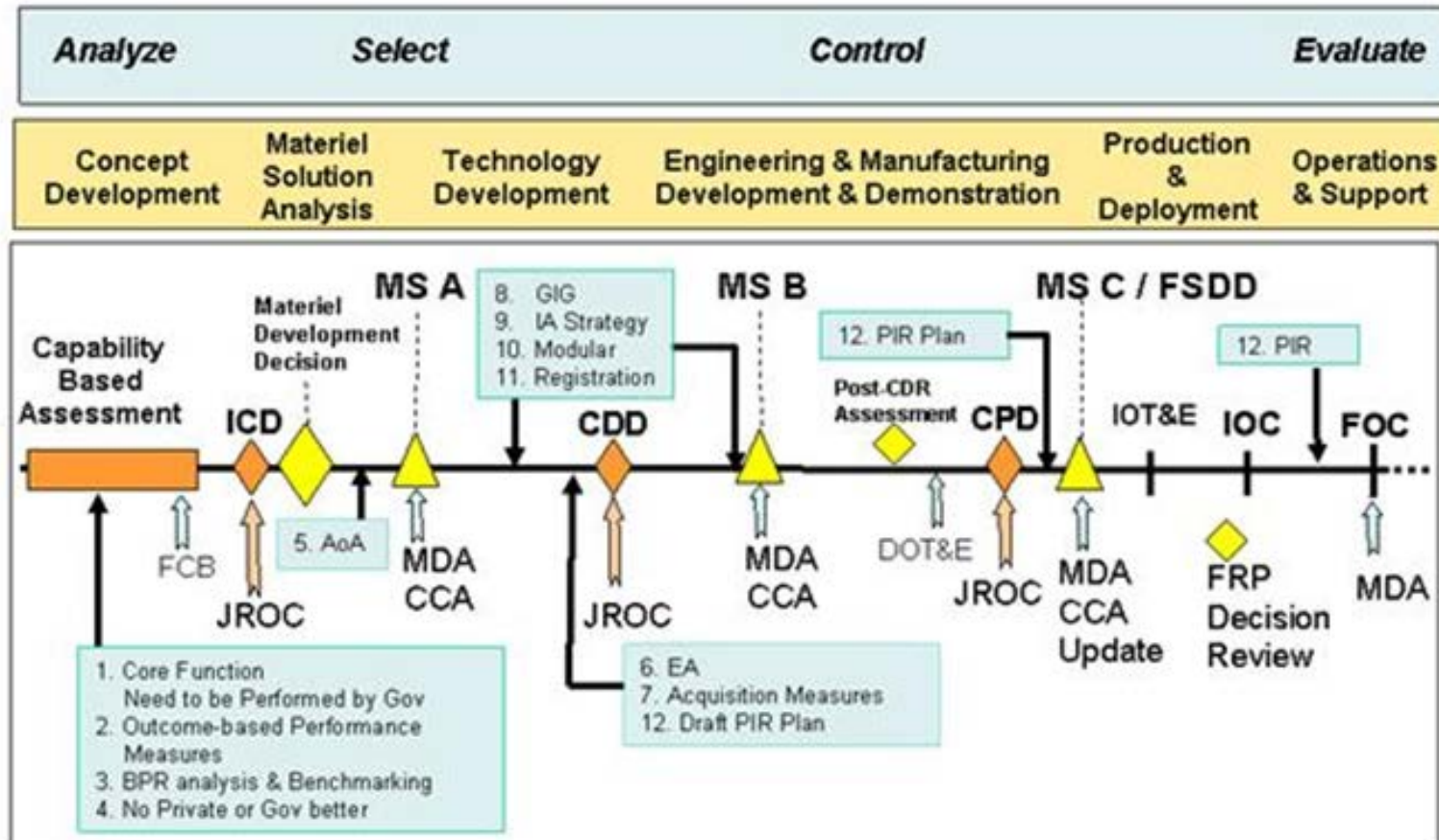


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CCA in Integrated Framework

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Decision	Info Needed	Tools/Methods/M&S
MDD	Requirement Materiel Technology Cost estimate	1
MS A	AoA has to be performed (technology based) Cost assessment	2
MS B	Trade Space analysis	3
MS C	AoA to inform Source Selection	4

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- MDD
- Questions to be answered
 - Does a requirement or gap exist?
 - Does closing the gap require a materiel solution?
 - Is there a feasible technology to close the gap?
 - What would such a technology cost?
- Tools/Methods/MS&A
 - SME Panel
 - Break mission down to tasks and supporting capabilities/assets
 - Map capabilities to task sets
 - Break capability gaps into required attributes
 - DOTmLPF assessment
 - Map available and developmental technologies to capability gaps/tasks
- Metrics
 - Gap criticality
 - Gap size
 - Technical feasibility/schedule (TRL)
 - Projected cost



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- MS A
- Questions to be answered
 - What attributes are capability / mission effectiveness drivers?
 - What attributes are cost drivers?
 - What potential technology solutions are worth pursuing?
 - How much will such a system cost?
- Tools/Methods/M&S
 - Operational considerations:
 - Individual mission threads via scenario simulation (specific parameters)
 - Integrated scenario via military utility analysis simulation (system performance in context of other systems and total mission)
 - Cost analysis:
 - Analogies / SME inputs
 - Monte Carlo simulation
 - Presentation
 - Graphics
 - Statistical Analysis
 - Link capability drivers to cost drivers
- Metrics
 - Cost
 - Base case vs alternatives performance/effectiveness
 - Gap fulfillment by alternatives
 - Uncertainty analysis



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- MS B
- Questions to be answered
 - Is this capability still needed and will it fulfill gaps?
 - What are the trade offs for this capability?
- Decision Metrics
 - Mission effectiveness
 - System performance
 - Cost
 - Uncertainty
- Tools/Methods/MS&A
 - Trade space analysis
 - M&S can be used with experimentation depending on the fidelity of the technical maturity of the system under analysis and available data



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- MS C
- Questions to be answered
 - Revalidate the requirement, is it still needed?
 - Do the KPPs, KSAs, etc. reflect operational relevance?
 - Is there already fielded equipment that is a viable alternative?
 - What value has the materiel solution demonstrated in DT, Customer Test, LUT, etc.?
- Decision Metrics
 - “Reliability growth curve” for C2 effectiveness
 - With NIE like events, user data on system performance/effectiveness
 - Interoperability with other systems
- Tools/Methods/MS&A
 - Network Integration Evaluation (NIE)
 - Forward Operational Assessments (FOA)
 - DT with military personnel



- Models
 - OPNET, QualNET
 - T&E
 - SME input
 - Deterministic, Stochastic, utilization models
 - Parametric regression
 - Statistical analysis