Extending C2 Assessment Frameworks: A Novel Approach to Assessing Technology Insertion

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OUTLINE

- Task Context
- Why A New Framework?
- Multi Disciplinary Approach
- Framework Development Process
- Framework Application Process
- Future Work
Task Context

**GOAL:** To assess the operational impacts of a new Battle Management System (BMS).

**WHY:** BMS advantages are often assumed with little validation

**HOW:** Develop an assessment framework that helps:
- Identify and measure operational costs and benefits
- Provide insights into cause and effects
Why a New Framework?

Existing Frameworks useful:
- NCW Frameworks
- Operational C2 Frameworks
- Architectural Frameworks

But have limitations when applied to operational assessment at Army tactical levels:
- Assessment of performance criteria (from commander’s perspective)
- Breadth of performance outcomes examined
- Explanatory power of assessments
- Limited assessment of complex system interactions
A Multidisciplinary Approach:  
1) Cognitive Engineering

Use of cognitive engineering / human factors techniques & models

- **Simulation Interviews**
  - Applied Cognitive Task Analysis (Militello and Hutton 2000):
    - Soldiers introduced to realistic scenario (video)

- **Emergent Theme Analysis**

- **Contextual Inquiry**

- **Sociotechnical Analysis**
  - Cognitive Psychology
  - Distributed Cognition
  - Evolutionary Psychology
A Multidisciplinary Approach: 2) Complex Systems

Framework based on recent approaches to the understanding of complex socio-technical systems

Assessing the effect of new BMS on BG operations is not straightforward because:

- The effects will be indirect
- There will be multiple negative and positive effects
- Some effects involve feedback loops
- The effects may not be linear
A Multidisciplinary Approach: 3) Modelling & Simulation

Framework supplements observations & measures from ‘Human in the loop’ exercises & experiments with:

Complex Systems Models:
- ie System Dynamics and Agent Based.

Simulations:
- ie Closed Loop Wargame
Framework Development Process

BG Performance Criteria

Critical Issue 1

Critical Issue 2

Critical Issue …

CI 1. Influence Map

CI 2. Influence Map

CI … Influence Map

System Influence Map

Variables & Metrics
Framework Development Process:
Critical Issues

Soldier interviews & Lit review identified the 18 critical issues that may be affected by introduction of BMS

- Anticipation
  - Knowledge of blue and red picture
- Battle preparation
  - Fratricide
- Cognitive workload
  - Integration of vulnerable assets
- Ergonomics
  - Interoperability
- Coordination of CA
  - Planning
Framework Development Process: *Fratricide* Critical Issue Influence Map
Framework Development Process: Metrics

<table>
<thead>
<tr>
<th>BMS Capabilities and Issues</th>
<th>C2 Information</th>
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<tbody>
<tr>
<td><strong>GPS &amp; APLR</strong></td>
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<tr>
<td>Was it functioning? / Usability</td>
<td>Time (update rate &amp; latency) &amp; Accuracy</td>
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<tr>
<td>and frustration</td>
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<tr>
<td>No of Objects on BFPT? And</td>
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<td>frustration</td>
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<td><strong>Blue Picture</strong></td>
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<td>relevant information</td>
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<td><strong>Info Dissemination Mode</strong></td>
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<td>Coordinated messages sent</td>
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<td>about friendly locations &amp;</td>
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<td>intentions to other blue</td>
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<td>elements</td>
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<td><strong>Cognitive Effects</strong></td>
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<td>System Trust</td>
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<td>Information Overload</td>
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<td>Cognitive Fatigue</td>
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<td>Stress</td>
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Identified key variables

Literature review

Identified within Critical Issues
Framework Development Process: “Messy” System Influence Map
Framework Application Process

Critical Issue 1

Critical Issue ...

Lethality
Cost
Survivability
Discrimination
Force Condition

CI 1. Influence Map

CI 2. Influence Map

System Influence Map

Scenario (Context) Analysis
(Key: Tasks; Activities & Actors;)

Data collection plan for direct measures of Mission Effectiveness

Variables & Metrics

Data collection plan for
Framework Application Process: Scenario Analysis
Framework Application Process: Scenario Analysis
Future Work:
Iteration! – Iteration! – Iteration!
Questions