Teaching Command and Control Systems at West Point

Presented at 12th International Command and Control Research and Technology Symposium

SE490 Command and Control Systems
‘The Army’s Systems Engineering Department’

Educating cadets, officers and the Army leadership on Systems & Engineering Management concepts vital for success in a complex and uncertain world.
A Changing Military Environment

SE490 Command and Control Systems
Course Overview

• Purpose – Better prepare cadets for command and control challenges they will face as company grade Army officers.

• Course Hypothesis:
  A trained and cohesive organization enabled by well-designed collaborative command and control systems will be able to apply decentralized command and control processes in order to increase unit agility and gain a tactical advantage as compared to units that are less collaborative and more centralized.
Course Objectives

- Analyze the information age hypothesis that a trained and cohesive organization enabled by well-designed collaborative command and control systems will be able to apply decentralized command and control processes in order to increase unit agility and gain a tactical advantage as compared to units that are less collaborative and more centralized.

- Apply information age command and control concepts to the design and implementation of a command and control system. These include globalization, mission command, agility, self-synchronization, and power to the edge.

- Using available technology, design information based command and control systems to maximize mission effectiveness.

- Apply network, data, and interoperability engineering concepts to the design and implementation of a command and control system.

- Identify specific decision processes and define command and control capabilities which best support those decisions.

- Estimate the value gained by using a specific command and control system with specific capabilities.

- Re-engineer unit organization and processes to best take advantage of capabilities provided by a command and control system.

- Become familiar with the use of Army Battle Command Systems to command and control Army and Joint tactical operations.
Approach

• Hands on experience
  – Command and control lab exercises
  – Simulation software
  – In-class collaboration exercises
  – Command and control portal design

• Critical thinking and analysis
  – Analysis of Army and Marine command and control approaches in Operation Al-Fajr (Fallujah)
  – Topic briefings
  – Command and control case study
  – Synthesis paper
# Textbooks

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>David Alberts and Richard Hayes</td>
<td>Power to the Edge: Command and Control in the Information Age</td>
</tr>
<tr>
<td>David Alberts and Richard Hayes</td>
<td>Understanding Command and Control</td>
</tr>
<tr>
<td>Atkinson, Simon Reay and James Moffat</td>
<td>The Agile Organization</td>
</tr>
<tr>
<td>Headquarters, Department of the Army</td>
<td>FM 6-0, Mission Command: Command and Control of Army Forces</td>
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**SE490 Command and Control Systems**

7
Course Structure

1. C2 Theory
   - C2 Functions
   - Network Centric Operations
   - Network Science
   - Social Networks
   - Complexity
   - Mission Command

2. C2 Design Concepts
   - Interoperability and Collaboration
   - Data standards
   - Communications Standards
   - Service Oriented Architectures
   - Information Assurance
   - Edge Organizations

3. C2 Practice
   - Visit C2 Headquarters
   - FBCB2 Hands On
   - CPOF Hands On

4. C2 Design Experience
   - Cadet Summer Training Collaborative Portal

SE490 Command and Control Systems
C2 Theory

- Command and control functions
- Industrial age command and control
- Complexity and self organization
- Swarming on the battlefield
- Mission command
Agent-Based Modeling Exercises

Netlogo Complexity
Netlogo Network Stats
Mana Self Organization Swarming
Empire Earth II Command and Control Exercises
<table>
<thead>
<tr>
<th>Mission Command</th>
<th>Detailed Command</th>
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<tr>
<td><strong>Probabilistic</strong>&lt;br&gt;<strong>Unpredictable</strong>&lt;br&gt;<strong>Disorder</strong>&lt;br&gt;<strong>Uncertainty</strong>&lt;br&gt;<strong>Decentralization</strong>&lt;br&gt;<strong>Spontaneity</strong>&lt;br&gt;<strong>Informality</strong>&lt;br&gt;<strong>Loose rein</strong>&lt;br&gt;<strong>Self-discipline</strong>&lt;br&gt;<strong>Initiative</strong>&lt;br&gt;<strong>Cooperation</strong>&lt;br&gt;<strong>Acceptable decisions faster</strong>&lt;br&gt;<strong>Ability all echelons</strong>&lt;br&gt;<strong>Higher tempo</strong></td>
<td>Assumes war is&lt;br&gt;Accepts&lt;br&gt;Tends to lead to&lt;br&gt;Communication types used&lt;br&gt;Organization types fostered&lt;br&gt;Leadership styles encouraged&lt;br&gt;Appropriate to</td>
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<tr>
<td><strong>Deterministic</strong>&lt;br&gt;<strong>Predictable</strong>&lt;br&gt;<strong>Order</strong>&lt;br&gt;<strong>Certainty</strong>&lt;br&gt;<strong>Centralization</strong>&lt;br&gt;<strong>Coercion</strong>&lt;br&gt;<strong>Formality</strong>&lt;br&gt;<strong>Tight rein</strong>&lt;br&gt;<strong>Imposed discipline</strong>&lt;br&gt;<strong>Obedience</strong>&lt;br&gt;<strong>Compliance</strong>&lt;br&gt;<strong>Optimal decisions, but later</strong>&lt;br&gt;<strong>Ability focused at the top</strong></td>
<td><strong>Explicit</strong>&lt;br&gt;<strong>Vertical</strong>&lt;br&gt;<strong>Linear</strong>&lt;br&gt;<strong>Hierarchic</strong>&lt;br&gt;<strong>Bureaucratic</strong>&lt;br&gt;<strong>Directing</strong>&lt;br&gt;<strong>Transactional</strong>&lt;br&gt;<strong>Science of war</strong>&lt;br&gt;<strong>Technical/procedural tasks</strong></td>
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**Figure 1-4. Concepts of Command and Control**
Theory Exam
Operation Al-Fajr (Fallujah)

Credited to Lieutenant Colonel John Reynolds
C2 Design Concepts

- Interoperability and Collaboration
- Data standards
- Communications Standards
- Service Oriented Architectures
- Global Information Grid and LandWarNet
- Information Assurance
- Edge Organizations
Advantages of Standards

- Application to application integration
  - 55 integration projects
- Standards based integration
  - 10 integration projects
- Better alignment with C2 processes

Figure 16: An n^2 Problem

SE490 Command and Control Systems
LandWarNet

The Joint Model - Everything over IP

- FIRST … the Joint Special Operations Command - Fort Bragg
- THEN …. the Joint Communications Support Element - MacDill AFB
- NOW!!!

• Everything over Internet Protocol
  • Scalable
  • Flexible
  • Efficient
  • Less cost, smaller footprint, less people.
  • EoIP will converge & reduce training requirements

JOINT COMMUNICATIONS SUPPORT ELEMENT
To address inefficiencies of traditional bandwidth allocations........migrate everything to EoIP
## Edge Organizations

<table>
<thead>
<tr>
<th>Hierarchies</th>
<th>Edge Organizations</th>
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<tbody>
<tr>
<td>Command</td>
<td>By directive</td>
</tr>
<tr>
<td>Leadership</td>
<td>By position</td>
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<tr>
<td>Control</td>
<td>By direction</td>
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<tr>
<td>Decisionmaking</td>
<td>Line function</td>
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<tr>
<td>Information</td>
<td>Hoarded</td>
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<tr>
<td>Predominant Information Flows</td>
<td>Vertical, coupled with chain of command</td>
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<tr>
<td>Information Management</td>
<td>Push</td>
</tr>
<tr>
<td>Sources of Information</td>
<td>Stovepipe monopolies</td>
</tr>
<tr>
<td>Organizational Processes</td>
<td>Prescribed, Sequential</td>
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<tr>
<td>Individuals at the Edge</td>
<td>Constrained, Empowered</td>
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<td></td>
<td>Establishing conditions, By competence, An emergent property, Everyone’s job, Shared, Horizontal, independent of chain of command, Post - Pull, Eclectic, adaptable marketplaces, Dynamic, Concurrent</td>
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Hands on C2

Field Trip
Hudson Valley Transportation Management Center

Artist Rendering of Future TMC Control Room

In-Class FBCB2 Command and Control Exercise
Cadet Summer Training C2
System Design Exercise

- Realistic design exercise
- Elicit requirements from real stakeholders
- Build value model, process model, data model
- Design system as a web portal
- Identify how users can use system to empower individuals in the organization
- Present system to actual users
- Plan for implementation
Cadet Field Training Portal

SE490 Command and Control Systems
The Future

- Course is now integrated into USMA Curriculum
- Planning to introduce Command Post of the Future (CPOF) lab exercise
- Planning to find away to assess C2 designs using simulation
- 27 students enrolled for Fall 2007