Analysis for Network Centric Warfare in the Navy

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Dr. Michael Bell

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10th ICCRTS
13 June 2005
Outline

• FORCEnet analysis framework

• Examples
  – M&S and Campaign Analysis
  – Experimentation
  – Science and technology

• Conclusions
Naval Transformation

- Stability Ops
- GWOT
- Major Combat Ops
- HLD/HLS

- Stability Ops
- GWOT
- Major Combat Ops
- HLD/HLS
“FORCEnet is the operational construct and architectural framework for Naval Warfare in the Information Age which integrates Warriors, sensors, networks, command and control, platforms and weapons into a networked, distributed combat force, scalable across the spectrum of conflict from seabed to space and sea to land.”

Source: CNO Strategic Study Group XXI, definition from 22 July 02 CNO Briefing
FORCEnet Analysis Framework

FORCEnet Capability Description

Conceptual Framework for Network Centric Warfare

FORCEnet Attributes & Measures

- M&S and Campaign Analysis
- Joint/Allied/Coalition Interoperability
- Science and Technology
- Operational Experiments and War Games
- Architecture and Standards
- Human Systems Integration

M&S Plan

TTCP Studies

S&T Roadmap

Budget (POM/PR) Proposals

IT/IM Capital Plan

Compliance Checklist
FORCEnet Capabilities

1. Provide expeditionary, multi-tiered sensor and weapon information
2. Conduct distributed, collaborative command and control
3. Provide dynamic, multi-path and survivable networks
4. Provide adaptive/automated decision aids
5. Provide human-centric integration
6. Provide information effects

Source: Sea Power 21 and Naval Transformation Roadmap
Collect, Process and Distribute Organic sensor and weapon Information

Collect, Process and Distribute Non-organic Sensor Information

Provide precise navigation and time (PNT) to integrate weapons and sensors

Collect, Fuse and Disseminate Operational Intelligence within naval and joint forces

Provide automated, timely access and exchange of Operational intelligence with Allied / Coalition forces

Assess, characterize and disseminate environmental (atmospheric, oceanic, terrestrial) information

Collaborate with civil / law enforcement agencies

Provide common geospatial and temporal referenced battlespace awareness

Conduct, Manage and Control Operational Information within naval and joint forces

Provide detailed, multi-path and survivable command & control

Provide Dynamic, multi-path and survivable networks

Provide Adaptive / automated decision aids

Conduct Battle Management / C2 among Naval forces

Conduct Battle Management / C2 with Joint forces

Conduct Battle Management / C2 with Allied/Coalition forces

Manage information transfer among Naval forces

Manage information transfer with Joint forces

Manage information transfer with civil / law enforcement agency networks

Provide operational and tactical Planning

Conduct netted, prognostic logistics

Organize, synchronize and integrate fires and maneuver to enable massed effects

Dynamically allocate and control sensors and sensor platforms

Establish networks with synchronized position and time

Provide tactically relevant and consistent environmental and PNT data to mission planning and TDAs

Protect Friendly Information Outside the Network

Provide tactically relevant and consistent environmental and PNT data to mission planning and TDAs

Defense, Influence, and Disrupt Adversary Information

Protect Friendly Information

Establish networks with synchronized position and time

Source: FORCEnet Report to Congress, May 2003
NCW Conceptual Framework

- **Quality of Organic Information**
  - Quality of Individual Information
  - Quality of Individual Sensemaking Awareness Understanding
  - Quality of Individual Decisions

- **Degree of Networking**
  - Degree of Information “Share-ability”
  - Degree of Shared Information
  - Degree of Shared Sensemaking Shared Awareness Shared Understanding
  - Quality of Collaborative Decisions

- **Degree of Decision/ Plan Synchronization**

- **Degree of Actions/ Entities Synchronized**

- **Operating Environments**

- **Degree of Effectiveness/ Agility**

**Domains**:
- Physical Domain
- Information Domain
- Cognitive Domain
- Social Domain
Attributes, Measures, and Metrics

• Terminology based on
  – OASD(NII)/OFT Framework for NCW
  – CCRP and NATO Codes of Best Practice (C2 Assessment & Experimentation)

• Attribute: some aspect of an event, situation, person, or object considered important to understanding the subject under study

• Measure: a standard by which some attribute of interest is recorded

• Metric: the application of a measure to two or more cases or situations
Sample Attributes and Measures

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Notional Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>Correspondence with ground truth-correlation coefficient ( (0 = \text{no correspondence with ground truth, } 1 = \text{full correspondence with ground truth}) ). Data matrix comprised of relevant information items estimates (for instance: detection, ID, velocity, location, heading, etc.)</td>
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<tr>
<td>Consistency</td>
<td>Degree of lack of ambiguity with previous information</td>
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<tr>
<td>Completeness</td>
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</tbody>
</table>

Capability: provide expeditionary, multi-tiered sensor and weapon information
FORCEnet Capability Growth

- Dynamic, multi-path and survivable networks (.35)
- Distributed, collaborative C2 (.33)
- Expeditionary, multi-tiered sensor and weapon information (.15)
- Information weapons (.03)
- Human-centric integration (.05)
- Adaptive / automated decision aids (.09)

♦ = Desired “end state” for each capability
(value) = Weight in warfighting outcomes (N6/N7 PR-05 scenarios)
-------- = notional status of capability
Naval Capability Development Process

CONOPS N3/N5

Warfighting (Campaign) Analysis N81

Force Capability Regmts N6/N7

SYSCOM Analysis

Mission Area Analysis

S & T Assessment

Mission Capability Plans

Naval Capability Plan

FORCEnet Analysis

Transformation Roadmap

Other Resource Issues

N6/N7 Program Guidance

N6/N7 SPP

N6/N7 Program Guidance

Source: CNO N704

Cooperative Engagement

• Investment Priorities
• Capability Balance

ISCP

Source: CNO N704
Campaign Analysis Questions

• Template:
  – “What is the impact of [selected capability] on the outcome of the campaign”

• Chief of Naval Operations:
  – What is the impact of Joint and Navy unmanned and/or autonomous systems (sub/surface/air) on the number and type of naval forces needed to provide levels of ISR required to achieve a successful warfighting outcome?
  – How much bandwidth, and over what transmission modes (e.g. single channel, multi-channel terrestrial and SATCOM), will U.S forces require to support combat operations, and how does this compare to available bandwidth? What operations would not be conducted within bandwidth constraints?
  – What is the impact of varying levels of network attacks on the successful outcome of combat operations? What types of redundancy, backups, and alternative paths are necessary to ensure successful warfighting outcomes?

• Sea Strike:
  – Are planned ISR assets sufficient to support the required rate of strike missions? If not, would additional assets mitigate the shortfall, and how many would be needed?
Measuring a “Pound of C4ISR”

- Previous work assumed “perfect” C4ISR
- Models should provide a more realistic assessment of:
  - System capabilities
  - Performance limitations and bottlenecks
  - Impact of new systems
- Integrated multiple mission-level models:
  - C4ISR Space and Missile Operations Simulator (COSMOS) – ISR
  - Naval Simulation System (NSS) – C4I
- These feed our campaign models:
  - General Campaign Analysis Model (GCAM) – maritime campaign
  - Integrated Theater Engagement Model (ITEM) – air land battle
- Models federated by “sneaker net”
- Combat outcomes determined by campaign level models
Campaign Analysis Process

Campaign Scenario (Major Theater War)

ITEM
GCAM

ISR Excursions
COSMOS

Result Comparisons
Target Detections

Red IO/CNA Effects

IA/CND War Game

FORCEnet Vignette (Amphibious Assault)
NSS

Other FORCEnet Excursions

PB-04 vs. PB-04+ C4ISR Systems
Trident Warrior Intake / Exhaust

Joint Capabilities / Requirements

Assessed by N6/N7

Naval Capabilities Development Process (NCDP)

Capability Gaps

S&T Community PEO, SYSCOMS, Industry, Academia

Deployment To the Fleet

Trident Warrior

Capability Update

Experiment Priorities

Design Improvements

Experiment Initiatives

Military Utility Assessment

Speed to Capability

Capability Update

Military Utility Assessment
Giant Shadow Objectives

• Technology demonstration for new SSGN class
  – 4 SSBNs to be converted to support TLAMs by 2007
  – Advanced Payload Capability would allow support of SOFs (ASDS) & uninhabited vehicles (UUVs, UAVs)

• FORCEnet experiment to examine layered C2ISR network requirements to support SSGN/SOF ops
  – Clandestine clarification of ambiguous HUMINT
  – Persistent comms & ISR for time-critical activities
**Current Metrics**

- **Capacity:** Throughput (1) effective systems capacity = maximum data rate - system overhead rate (2)
  
  \[ \text{bandwidth utilization} = \frac{\text{available data rate}}{\text{effective systems capacity}} \]

  - ✤ ✤ Approximations of capacity of a channel can be inferred from the sniffer logs
  - ✤ ✤ Max data rate required during the experiment
  - ⇐ Not all of the links were sniffed => difficult to get an indication of capacity across channels
  - ⇩ Non-operational setting => non-realistic usage of tactical systems

- **Connectivity:** Percentage of time that all required nodes are connected to the network
  
  - ✤ ✤ Can extrapolate from packet traffic between MS and HB
  - ⇐ Only available on days when significant traffic
  - ⇐ Not all nodes were sniffed => cannot get timed connection info. on all nodes

| ✤ ✤ Quantitative | ✤ Qualitative | ⇐ Not collected | ⇩ Could not be collected | ⇩ ⇩ Difficult to address |
Trident Warrior

• Major annual FORCEnet Sea Trial Experiment (NETWARCOM sponsored)
• Goals:
  – Rapid fielding of improved capability to the Fleet, with full supportability and maintainability.
  – Supporting Tactics/Techniques/ Procedures (TTP) and concept of operations (CONOPS)
• Trident Warrior 03
  – 25-30 Sept 03, USS ESSEX with the FDNF Expeditionary Strike Group (CTF 76) off Okinawa
• Trident Warrior 04
  – Fall 2004, TARAWA ESG off SoCal (COMTHIRDWLT host)
• Trident Warrior 05
  – Fall 2005, CSG (TBD) off East Coast (COMSECONDWLT host)
TW03 Metrics
USS Ft. McHenry Network Improvements

<table>
<thead>
<tr>
<th></th>
<th>Before (satcom only)</th>
<th>After (satcom and IBGWN)</th>
<th>Percent Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Throughput</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inbound</td>
<td>20.0 kbps</td>
<td>25.8 kbps</td>
<td>29%</td>
</tr>
<tr>
<td>Outbound</td>
<td>59.0 kbps</td>
<td>67.1 kbps</td>
<td>14%</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inbound</td>
<td>87.7%</td>
<td>99.4%</td>
<td>13%</td>
</tr>
<tr>
<td>Outbound</td>
<td>86.0%</td>
<td>99.2%</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total Outage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inbound</td>
<td>2 hrs 57 min</td>
<td>9 min</td>
<td>95% reduction</td>
</tr>
<tr>
<td>Outbound</td>
<td>3 hrs 22 min</td>
<td>12 min</td>
<td>94% reduction</td>
</tr>
<tr>
<td><strong># of Outages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>2</td>
<td>91% reduction</td>
</tr>
<tr>
<td><strong>Time to Reconnect</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>12 min 16 sec</td>
<td>3 min 12 sec</td>
<td>74% reduction</td>
</tr>
<tr>
<td>Max</td>
<td>2 hrs 19 min</td>
<td>6 min</td>
<td>96% reduction</td>
</tr>
</tbody>
</table>

99+% Network Availability; 91% Reduction in Outages; 74% Reduction in Average Network Outage Times
FORCEnet Focus Areas

1. Common, Persistent Maritime picture - improving shared situational awareness across the force
2. Computer Network Defense and Information Assurance - assured info
3. Ubiquitous communications and network infrastructure - bandwidth management, IPv6, etc.
4. Data link management & architecture - improving data link throughput
5. Joint Combat ID - IFF and Blue Force Tracking
6. Persistent and pervasive ISR
Trident Warrior 04

- Continues “speed to capability” via LOE to *Trident Warrior* series
- Builds upon *Trident Warrior 03* baseline
  - Improve traffic management and efficient use of bandwidth
  - Increase shared situational awareness
  - Contribution of mature TTP to both
  - Processing and exploitation of imagery ashore, in a networked environment and product pushed to Expeditionary Strike Group
- Alignment of *Silent Hammer* and *Trident Warrior* provides efficient use of Fleet assets, enhances both experiments
  - *Silent Hammer* demonstrates how a *network of forces* consisting of Ground Forces Sea Based on an SSGN can fill Joint Gaps (*ISR and Time Sensitive Strike*) by conducting a *large scale clandestine* operation, aided by advanced unmanned systems to reduce risk and increase capabilities.
Undersea Dominance FORCEnet Analysis Thrusts

UD04 ASW Concepts
- Battlespace Prep (BSP)
- Hold at Risk
- Maritime Shield

UD04 Mission Analysis
- Mission Capability Analysis
- Campaign Analysis
- FORCEnet aspects:
  - Battlespace Preparation
  - Situational Awareness
  - ASW Timeline Reduction
  - Cueing (Deployed Sensors)
  - C4I (Sub Comms, USW-DSS)

UD04 Systems Analysis
- System Assessment
- Technical Analysis
- FORCEnet aspects:
  - Comms & Networks
    - Latency, Data Rate, Range, Availability, Covertness
  - C2
    - Effectiveness & coherency of Plan
    - Uniformity of situational awareness
    - Improved utilization of multi-sensor types
    - HSI attributes
  - ISR
    - Improved BSP through bottom mapping

N61F UD04 FORCEnet Analysis
- Goal
  - Provide analysis of Fn capabilities employed in UD04
- Approach
  - Network Thrust & C2 Thrust
  - Leverage UD04 Mission & Systems analysis
  - Identify C4 capabilities necessary for new ASW technologies

FORCEnet Enabling Capabilities
- Comm & Networks
- ISR
- COTP

System
- USW-DSS (CUP)
- T-USWC
- WebCOP
- Composable Fn
- SEAWEB
- ACOMMS
- BLOOM
- Special Radio
- HAIL
- LFACOMMS
- U/K ACOMMS
- Deep Siren

USW Fn Implementation Working Group (IWG)
- Requirements
- Arch & Standards
- Implementation Plan
- Technologies / System Comparison

FORCEnet MCP/NCP
- Requirements Validation
- Assessment of Technologies
- Budget Recommendations

Rigorous C4 analysis to feed USW development efforts, IWG & MCP/NCP
**FORCEnet Innovation & Research Enterprise (FIRE)**

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**FORCEnet Measures**

This section contains information to help form basis for analysis of the initiatives. The MOE definitions are drawn from the SPAWAR final report. The attributes and notational measures are drawn from N71.

**MOE/MOP**

**Fn1: Expeditionary**

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Fn 1: Provide expeditionary, multi-tiered sensor and weapon information

The expeditionary, multi-tiered sensor and weapons grid capability uses a full spectrum of manned and unmanned vehicles, platforms, sensors and weapons to provide the Force Commander with what is needed to locate targets and attack them across the depth and breadth of a theater-sized battlespace. Sensors must determine their position, time and movement at the precise time they are reporting their target or other intelligence information. The time and position information of the track provided by sensors in the grid must be properly attributed (e.g., linked to a standard reference frame with uncertainty (error) and confidence levels) for it to be accurately understood, represented and fused with other data/ information. Many modern weapons are also dependent on precise time and position (including uncertainty) for effective operation.

**Metrics or Data (Notional Measures)**

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<thead>
<tr>
<th>MOE or MOP (Attributes)</th>
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Source: N71
Trident Warrior
Goal: Fleet Driven Speed to Capability

Sea Trial

Process
Organization
Technology
TTP

OPNAV / NETWARCOM / MCCDC / SPAWAR / PEO / Industry

Military Utility Assessment DOTMLPF
Sea Trial Executive Steering Group

Quicklook & Analysis influencing programmatic decisions

Fully supportable Fleet leave-behinds

OPNAV
Acquisition

26
Trident Warrior Evolution

TW 03
Essex ESG
Oct 2003
- Fn Integrated Prototype Demonstration, ESG LOE & JTF WARNET PDX

5 Focus Areas
17 Specific Initiatives
7 Rapid Acquisition Recommendations
- Bandwidth Management (ADNS)
- Integrated Supporting Arms Control Center – Automated (SACC-A)
- Intra BG Wireless Network

TW 04
Tarawa ESG
Nov 2004
- End-to-end process established
- Objectives mapped into NCDP capability gaps

9 Focus Areas
28 Specific Initiatives
16 Rapid Acquisition Recommendations
- EHF TIP
- Dynamic Bandwidth Process (ADNS II)
- Bandwidth Managed Voice
- Doctrinal support to Fires
- Afloat Electromagnetic Spectrum Operations Program (AESOP)

TW 05
Iwo Jima ESG
Dec 2005
- CFMCC focus, GWOT scenario, extensive Coalition, Joint and Industry participation

11 Focus Areas
108 Measurable Objectives
- CFMCC C2
- Cross Domain Solutions
- Five-Eyes Coalition Network
- Information Management Plan
- GHMD CONOPS
- Human Systems Integration
- ADNS II with ECP
Trident Warrior 05

- CFMCC C2 Focus
- Exercise Distributed Staff With C2F
- Joint, Coalition & Industry Participation
- GHMD CONOPS Development
- Netted ISR Sensors
- Coalition Naval Forces (CNF) Network
- Laboratory Testing to Minimize Risk
- Wargame to Refine CONOPS & TTP's
S&T (Future Naval Capabilities)

Gaps
- Fusion Engines, Intelligent Agents
- High Data Rate Comms OTM.
- Multi-function, multi-beam apertures.
- Combat ID
- Bottlenecks in Processing, Exploitation, and Dissemination
- Optimum Mix of Airborne Sensors for Persistent and Penetrating ISR
- Leverage National Sensors (Rapid Tasking & Reporting)
- USW Collaboration
- COTP Integration
- COTP to All Users
- Information Assurance
- Gaps from Sea Strike and Sea Shield

Project Successes:
- Transition to Acquisition
- Meeting Cost, Schedule, Performance Goals
- Early Wins:
  - Knowledge Web Technologies
  - Storymaker
  - Dynamic Link-16
  - CMASS
  - IBGWN

Technology Assessment
KSA FNC Successes

Future S&T Needs Resulting from N70/N61 Gaps and FORCEnet Warfare S&T Sponsor IPT

Experimentation and TTP Development:
- FY04 Limited Technology Experiment (LTE)
- FY05 Limited Objective Experiment (LOE)
- FY04 Horizontal Fusion Demonstration
- SA using GIG-ES

New Capabilities in:
- Comms and Networks
- ISR
- COTP
- Information Assurance

Tech Transition to:
- Naval PoRs
- NCES
- Joint C2

Restructured KSA FNC ECs
S&T (Discovery and Invention)

- Information Integration is primary focus
- Program examines critical S&T needs of
  - Automatic association and merger of information for unified presentation
  - Automated recognition and cueing for significant patterns of information, computer-aided reasoning for task-oriented information dissemination
  - Timely, accurate information and sensor fusion from heterogeneous sources
  - Supporting technologies to provide information assurance.
- Specific goals
  - Automated image understanding
  - Automated integration of disparate sources of information
  - Level 2 / Level 3 Information Fusion
  - Information Integrity
Capabilities Based Planning Approach

A top-down, competitive process that weighs options vs. resource constraints across a spectrum of challenges

• Link DoD decision-making to the Defense Strategy
  – Apportion risk across external challenges – traditional, irregular, catastrophic, and disruptive
  – At the level of portfolios and current/future concepts
• Inform risk tradespace – identify joint capability gaps, redundancies, and opportunities
• Facilitate the development of affordable capability portfolios that:
  – Hedge against uncertainty
  – Increase costs to adversaries while suppressing our costs
• Establish a common language that links COCOM capability requirements to Service force development and provider efforts, and integrates the five fundamental Departmental business processes (*Policy Formulation*, *Planning*, *Requirements*, *Resourcing*, *Acquisition*)
Why we created Joint Capability Areas…

An SPG-directed study as a part of Operational Availability (OA) – 05

• Provide a common framework to:
  – define joint capability needs
  – allow Services to map their capabilities into something

• Identify “peer-level” capability categories to:
  – facilitate organizational binning
  – tee-up decision space for cross-Service trades
  – support strategy/senior leader guidance articulation
  – permit gap analysis and evaluation on capability contributions to various capability categories
  – Develop a compatible planning and programming framework

• Foster a “capabilities culture” in support of CBP
### Tier 1 Joint Capability Areas

**As of 15 Dec 04**

<table>
<thead>
<tr>
<th>Joint Capability Area</th>
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</tr>
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<tbody>
<tr>
<td>Battlespace Awareness</td>
<td>Homeland Defense</td>
</tr>
<tr>
<td>Command and Control</td>
<td>Strategic Deterrence</td>
</tr>
<tr>
<td>Network Operations</td>
<td>Shaping &amp; Security Cooperation</td>
</tr>
<tr>
<td>Interagency Integration</td>
<td>Stability Operations</td>
</tr>
<tr>
<td>Information Affairs</td>
<td>Civil Support</td>
</tr>
<tr>
<td>Information Operations</td>
<td>Non-Traditional Operations</td>
</tr>
<tr>
<td>Protection</td>
<td>Access &amp; Access Denial Operations</td>
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<tr>
<td>Logistics</td>
<td>Land Control Operations</td>
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<tr>
<td>Force Generation</td>
<td>Maritime/Littoral Control Operations</td>
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<tr>
<td>Force Management</td>
<td>Air Control Operations</td>
</tr>
<tr>
<td></td>
<td>Space Control Operations</td>
</tr>
</tbody>
</table>
JCA Mapped across Ops/Domain/Functional Views
## JWSTP Example

<table>
<thead>
<tr>
<th>Capability</th>
<th>Related Limitations</th>
<th>Related Technology</th>
<th>Related DTOs</th>
</tr>
</thead>
</table>
| Establish Appropriate Organizational Relationships | Ability to set up and change formal organizational and command relationships in accordance with mission and task needs  
Need flexible organizational constructs  
Need flexible authority relationships | Decision aids  
Visualization technology | HS.42, 47 |
| Collaborate                                     | Doctrinal, cultural, and organizational limits to full collaboration  
Lack of trust in collaborative decisionmaking processes  
Coalition interoperability  
Geographic limitations to collaboration | Collaboration support tools  
Effective user-centric displays  
Geographical information systems  
Automated embedding of geospatial data  
Multilingual translation technology | JF.04, 06; JA.25; JC.54; BE.11; HS.41, 47, 50, 57, 58, 63 |
Plan Collaboratively

Future planning must be conducted with the collective knowledge of the decisions and plans of others. An effects-based approach that directly ties offensive actions to campaign objectives must guide plan development. Planners must be able to focus on exploiting critical adversary vulnerabilities and also must consider friendly critical capabilities and potential collateral damage. Parallel, distributed, collaborative planning capabilities and improved assessment tools are needed to compress process timelines. The ability to assess the suitability of a plan and to rehearse prior to execution is also needed.

<table>
<thead>
<tr>
<th>5. Plan Collaboratively</th>
<th>5.1 Form collaborative planning teams across components, missions, functions, and geographies, and with mission partners</th>
<th>Cohesion Interoperability Understanding</th>
<th>Draft C2 JIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future planning must be conducted with the collective knowledge of the decisions and plans of others.</td>
<td>Develop, coordinate and build effective collaborative teams for specific missions and tasks. Use existing, historical and available staff collaboration structures and processes to develop tailored structures and processes.</td>
<td>Cohesion -- XX% of group or team rewards match or meet unit and individual mission goals</td>
<td></td>
</tr>
<tr>
<td>C2 Capabilities</td>
<td>Fn6</td>
<td>Fn7</td>
<td>Fn8</td>
</tr>
<tr>
<td>-----------------</td>
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<tr>
<td>Basic C2 Capabilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The ability to monitor and collect data</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The ability to develop situational understanding</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>The ability to develop courses of action and select one</td>
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<tr>
<td>The ability to develop a plan</td>
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<tr>
<td>The ability to execute the plan including providing direction and leadership to subordinates</td>
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<tr>
<td>The ability to monitor the execution of the plan and adapt as necessary</td>
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<tr>
<td>The ability to execute the basic C2 process</td>
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<td></td>
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<tr>
<td>Collaborative C2 Capabilities</td>
<td>Fn6</td>
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| Ability to establish appropriate organizational relationships | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to collaborate.                                | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to synchronize actions.                       | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to share situational awareness                 | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to share situational understanding             | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to conduct collaborative decisionmaking/planning| C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Ability to achieve constructive interdependence        | C   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |

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| Command and Control of BA Assets             |     |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Execute Collection                           |     |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Exploitation and Analysis                    |     |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Model, Simulate and Forecast                 |     |     |     |      |     |     |     |     |      |      |      |      |      |     |     |
| Manage Knowledge                             | I   |     |     |      |     |     |     |     |      |      |      |      |      |     |     |

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Capability Gaps

Progress
New systems
Demo “leave-behinds”
DOT_LPF innovations

Effort
New programs
Experimentation
S&T investment
Accomplishments

• Demonstrated value of analytical framework:
  – Connects FORCEnet capabilities and NCW Framework
  – Capabilities under revision
  – Quantitative measures partially successful and improvements proposed
• Improved representation of C4ISR in campaign analysis
• Increased analytical support for PR-05, POM-06, PR-07 submissions
• Provided additional products: S&T Roadmap, M&S Plan, IT/IM Capital Planning Metrics, Compliance Checklist, Experimentation CD&E Plan