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The Future of C2

Managing Dynamic Collaborative Action Teams

In a Net-Centric Environment

Policy

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ABSTRACT

The U.S. Department of Defense (DoD) wants to improve Command and Control (C2) by leveraging advances in computation, networking, and information technologies. "Agility is increasingly becoming recognized as the most critical characteristic of a transformed force, with network-centricity being understood as the key to achieving agility easily." (Alberts and Hays 2003, 126)

The DoD Net-Centric Data Strategy outlines a vision for managing data in a net-centric environment that includes the concepts of Communities of Interest (COIs) and collaborative groups.[1] While collaborative groups and teams are not new concepts, new technologies will transform collaborative C2 and how warfighters interact in the same way that the internal combustion engine combined with the concept of the horseless carriage to transform how we traveled. The technological capabilities envisioned for the Global Information Grid (GIG) will literally enable anyone to engage anyone else in a decision-making process irrespective of distance, time, organization and organizational structure. This paper applies the term Dynamic Collaborative Action Team (DCAT) to a dynamic and to some degree ad-hoc grouping of organizations or personnel for a specific mission or operational task irrespective of command echelon. The GIG environment will enable a DCAT to utilize new data and include members outside routine organizational and command structures. To do so effectively, the DCAT will require a management framework that accommodates its dynamic membership and processes.

This paper describes a ubiquitous framework for the effective management of DCATs. Operational examples are provided to illustrate how DCATs would be employed to conduct net-centric C2 and how the DCAT concept may close the seams between the national, strategic and operational echelons of command and shape future C2 Policy for a net-centric environment.

Keywords: Agile Command and Control, Dynamic Collaborative Action Teams, Communities of Interest, Collaborative C2

[1] Communities of Interests (COI) is the "inclusive term used to describe **collaborative groups** of users who must exchange information in pursuit of their shared goals, interests, missions or business processes and who therefore must have a shared vocabulary for the information they exchange". (Department of Defense (DoD) Net-Centric Data Strategy, May 2003, John Stenbit) The DoD Data Strategy characterizes COIs as institutional or expedient, functional or cross-functional. Institutional COIs, whether functional or cross-functional, tend to be continuing entities with responsibilities for ongoing operations though they do lend support to contingency and crisis operations. By comparison, **expedient COIs** are more transitory and ad hoc, focusing on contingency and crisis operations.

Managing Dynamic Collaborative Action Teams in a Net-Centric Environment

1.0 Introduction

The U.S. Department of Defense (DoD) wants to improve Command and Control (C2) by leveraging advances in computation, networking, and information technologies. "Agility is increasingly becoming recognized as the most critical characteristic of a transformed force, with network-centricity being understood as the key to achieving agility easily" (Alberts and Hays 2003, 126). With the net-centric operational environment enabled by technological advances and new policy and doctrine, current C2 processes are expected to improve and evolve. The real promise of net-centricity, however, is that Command and Control processes will be revolutionized into leaner, more agile capabilities.

The Joint Staff's vision for Joint C2 places great value on collaboration: "Joint forces, interagency, multinational partners, and non-governmental organizations will be able to rapidly respond and decisively execute commander's intent in a complex, uncertain, and dynamic operating environment. C2 processes will be performed collaboratively to improve the speed and quality of the individual decisions and allow for the rapid and continuous synchronization of multiple decisions to achieve unity of effort. Commanders will rapidly tailor their C2 capabilities to any situation and will be able to exploit the benefits of decentralization—initiative, adaptability, and tempo—and achieve flexible synchronization without sacrificing unity of command. This will be achieved through a collaborative information environment that enables cohesive teams, regardless of location, to develop a shared understanding of commander's intent and the battlespace, thereby enabling superior decision-making" (Joint Staff 2004, vii).

Collaboration is a critical component of warfighting today, but the promise of net-centricity is that broader access to data, people, and new opportunities for collaboration will transform and improve how C2 is conducted. This paper explores the concept of Dynamic Collaborative Action Teams (DCATs) as a potential instrument for transforming C2. A DCAT has operational and temporal elements to its formation; a DCAT is a dynamic and to some degree ad hoc grouping of organizations or personnel activated for a specific mission or operational task irrespective of command echelon. While the concept of collaborative groups or teams is not new, new technologies combine with the DCAT concept to transform how we interact in a dynamic situation. While collaborative and networked approaches to C2 are common within the DoD, the technological capabilities envisioned for the Global Information Grid (GIG) will literally enable anyone to engage anyone in a decision-making process irrespective of distance, time, organization and organizational structure.

The first section of this paper provides operational examples that illustrate how DCATs would be employed to conduct net-centric C2. The second section describes an approach to achieve effective management of DCATs through the use of a common framework. The framework outlined in this paper spans DCAT phases of operation from pre-initialization through archival and identifies key issues for each phase. When a DCAT is activated to address operational problems, the Global Information Grid (GIG) environment will enable the team to utilize new data and include members outside routine organizational and command structures. To do so effectively, the DCAT framework requires the ability to find the right people, define roles for its dynamic membership and customize Tactics, Techniques and Procedures (TTPs) for the employment of people, processes and technologies. The technical and cultural challenges associated with implementing a DCAT capability are addressed in this paper.

DCATs have the potential to be a primary mechanism for transforming C2 by closing the seams between the national, strategic and operational echelons of command and shaping future C2 Policy for a net-centric environment. Potential benefits of the DCAT concept are addressed in the final section entitled "Can DCATs Improve C2?"

2.0 Understanding Dynamic Collaborative Action Teams

Before presenting the framework for managing DCATs, we must first explain the term DCAT itself. The concepts of net-centricity, agile C2 and collaborative C2 form the basis for the DCAT concept.

2.1 Key Concepts

2.1.1 Net-Centricity

"Net-centricity is the realization of a networked environment, including infrastructure, systems, processes, and people that enables a completely different approach to warfighting and business operations. The foundation for net-centricity is the Department's Global Information Grid (GIG). The GIG is the globally interconnected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating, and managing information on demand to warfighters, defense policymakers, and support personnel. Net-centricity, by securely interconnecting people and systems independent of time or location, supports a substantially improved military situational awareness, better access to business information, and dramatically shortened decision cycles. Users are empowered to better protect assets; more effectively exploit information; more efficiently use resources; and create extended, collaborative communities to focus on the mission" (Stenbit 2004, 1).

2.1.*2* Command and Control (C2)

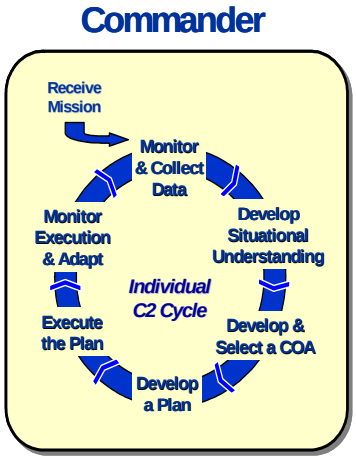

Figure 1 Basic C2 Functions

Joint Publication JP1-02 defines C2l as follows: **"**The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces operations in the accomplishment of the mission."

The basic C2 processes performed at each echelon level are depicted in Figure 1 (Joint Staff 2004). As previously stated, agility is increasingly becoming recognized as the most critical characteristic of a transformed force. Agility itself is defined as the ability to move quickly and easily (Joint Staff 2004) and an agile C2 system is described as having a synergistic combination of the following six characteristics: responsive, resilient, robust, flexible, adaptive and innovative.

2.1.2 Collaborative C2 Functions

The Joint Staff (JS) Joint C2 Functional Concept Document outlines a model for how in 2015 the basic command decision cycle depicted in Figure 1 is extended and transformed through collaboration. "The collaborative C2 functions tie together the basic C2 process loops

across echelons and functions through collaboration. The collaborative C2 functions give the C2 system its agility and give the commander flexibility in choosing a command methodology. They support the basic C2 functions by providing the commander with access to the observations, understandings, decisions, and actions of other friendly force commanders" (Joint Staff 2004, 14).

Of the collaborative C2 functions depicted in Figure 2 (networking, interacting, sharing, information, sharing awareness, sharing understanding, deciding, and synchronizing), interacting is considered the "heart" of collaboration and is the focus of the DCAT framework. Collaborative C2 functions "help a large dispersed group that is governed by explicit rules and procedures to behave more like a small close group whose relationships are implicit and informal. The collaborative C2 functions allow teams, such as communities of interest, to be formed quickly from across the echelons and functions to work on specific issues" (Joint Staff 2004, 14).

Figure 3 depicts commanders who continue to operate according to their individual, "basic" C2 process loops, but use the net-centric information environment to collaborate and synchronize their decision cycles as required or desired. In the example, Commanders A and B activate DCAT A and DCAT B respectively. The six collaborative functions correspond one-for-one to the six basic C2 functions, essentially allowing each of the basic functions to be conducted in a collaborative mode and so linking the decision cycles of the two commanders. Figure 3 shows the collaborative C2 functions complemented by three additional functions that enable individual commanders to access the GIG, create and interact with other DCATs and share information. DCAT A-B represents a more radical option where both C2 process loops are conducted as part of a larger collaborative team. Participation and interactions of sub-teams A and B evolve as mission operations unfold.

2.2 What are Dynamic Collaborative Action Teams?

We've used the term DCAT liberally throughout the previous discussion, but what are DCATs? A Dynamic Collaborative Action Team is defined as a dynamic and to some degree ad hoc grouping of personnel activated for a specific mission or operational task irrespective of command echelon. A DCAT spans echelons, functions and organizations and frequently supports more than one commander's decision cycle.

A DCAT is dynamic in terms of membership, processes and tools. For a given operational situation, these components will to some degree be pre-defined based on previous planning, training, and operations. During activation of a specific DCAT, membership, processes and tools are dynamically tailored to the unique operational situation. In the case of a new, unexpected crisis, all three components can take on a more ad hoc nature.

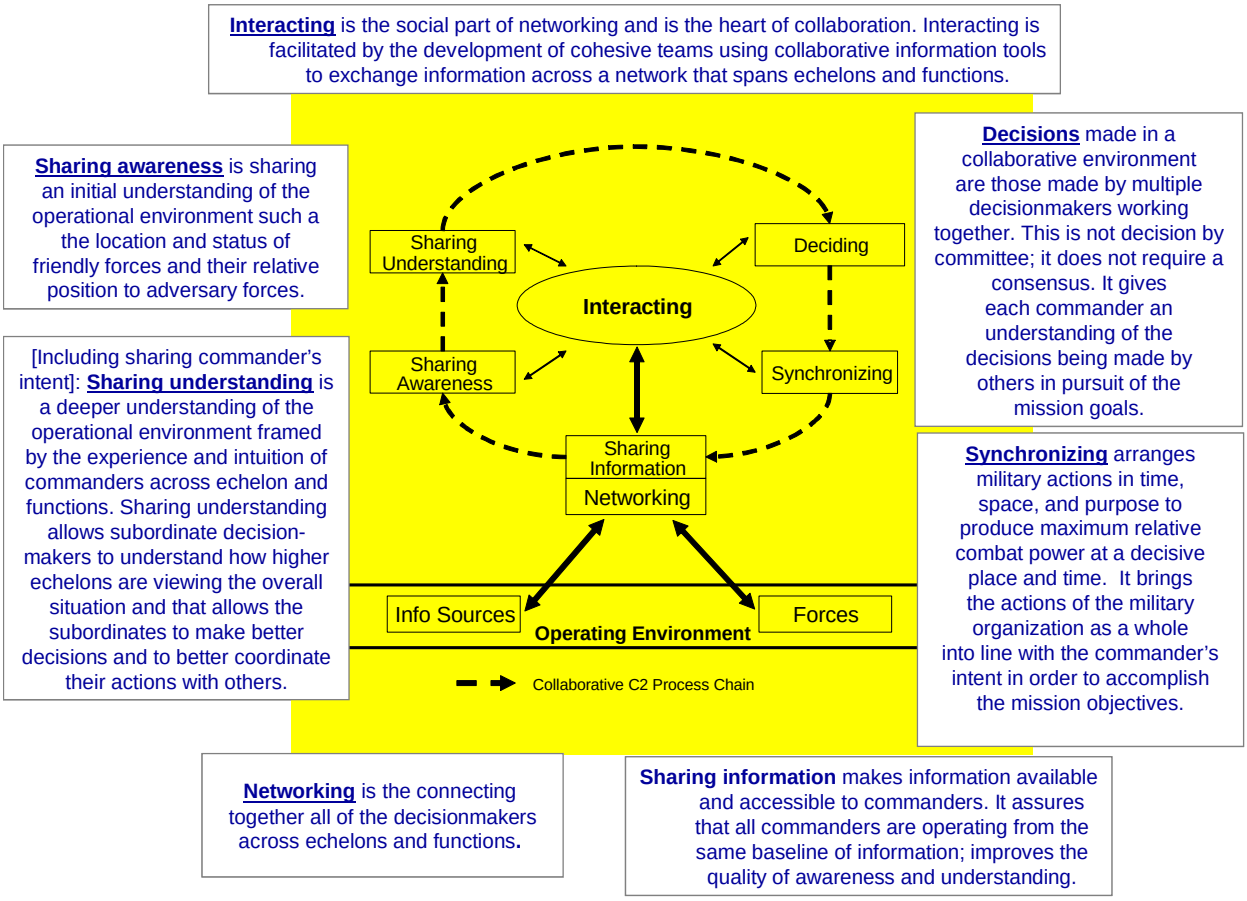

Figure 2 Collaborative C2 Functions (Joint Staff 2004)

Two examples are provided to illustrate the kinds of DCAT that might be activated in a net-centric environment. The first example, a Global Strike DCAT, depicts a time-critical Global Strike crisis situation spanning initial assessment and planning through execution. Membership is dynamic, and changes in DCAT leadership reflect the progression of the response from strategic decision-making and guidance to tactical execution of the plan selected to achieve strategic objectives. Wherever possible, the team leverages the resources and structure of standing collaborative teams. The second example, CONUS Threat Maritime Interdiction DCAT, assumes that a 9/11-like terrorist event requires the U.S. to close or more closely monitor airports and harbors. Military and non-military entities collaborate to protect U.S. harbors and airports.

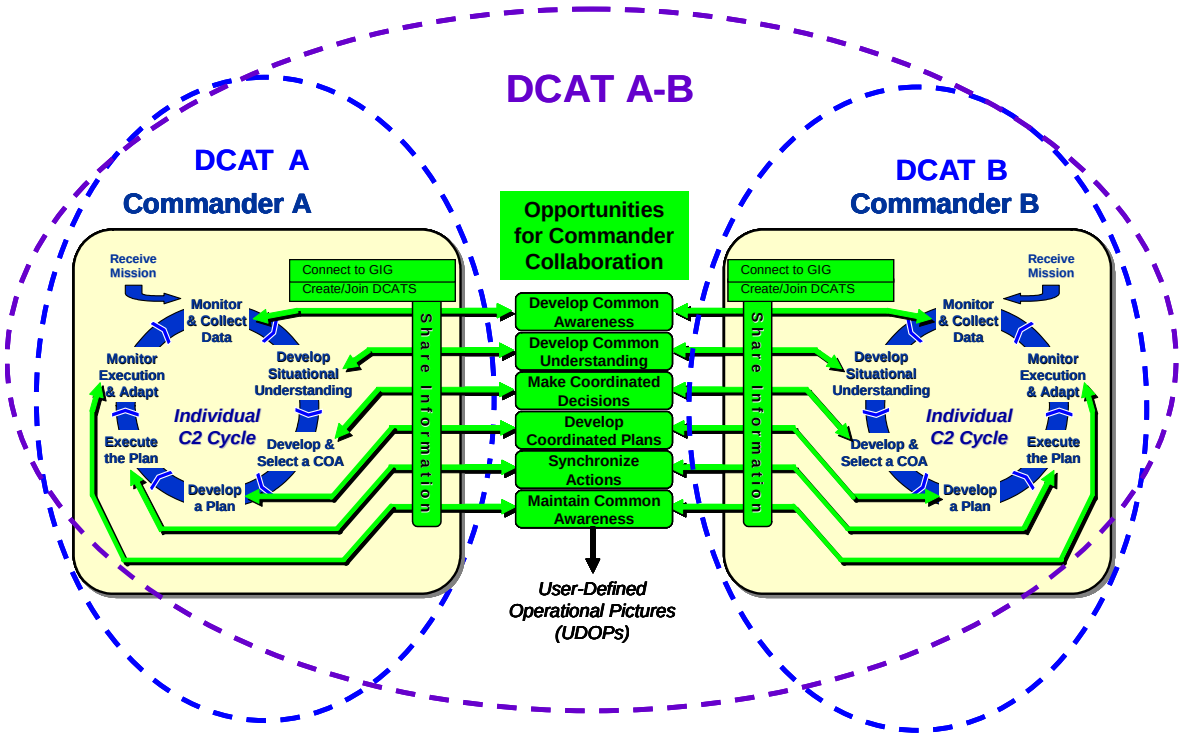

Figure 3 Dynamic Collaborative Action Teams Mapped to C2 Cycles

Figure 4 depicts, in a clockwise fashion, the dynamic composition of the Global Strike DCAT activated to respond to a potentially serious and imminent threat to national security. A core team based in USSTRATCOM, the Targeting Board, is tasked to formulate the broad scope of targets, potential actions, and systems to be used to achieve operational objectives. Led by intelligence experts, the team relies heavily on operational experts to address a wide range of factors.

As the Targeting Board is developing a comprehensive list of targets associated with the designated adversary, another group whose core is comprised mostly of planning experts is conducting mission analyses and developing courses of action (COAs). The participation of representatives from (Geographic) Combatant Commanders (GCCs) is key to synchronizing the COAs prior to their submission to the Secretary of Defense (SECDEF) and the President of the United States (POTUS) for approval. The planning team needs to address strategic effects across trans-regional or global boundaries and be tightly synchronized with diplomatic and economic efforts and possibly even Non-Government Organizations (NGOs). Consequently the team employs a broad group of planners with diplomatic, regional affairs, public affairs, and consequence management expertise not present on the established

Figure 4 Dynamic Global Strike DCAT

COCOM planning staff. This tight coupling of the GCCs, Department of State (POLAD), and possibly defense threat reduction or counter-terrorism expertise across the United States Government (USG) or Coalition partners enables the team to plan a Global Strike that is both effective and proactively ensures unintended consequences are avoided. Throughout this and subsequent processes the Targeting Board continues to discover and employ all information sources to increase understanding to the adversaries status, target complexity, and defensive measures all coupled with the planning teams COA development and desired effects. This refinement requires engaging an equally diverse and expanding team of experts including the USG intelligence community, our coalition partners and perhaps private industry. An additional degree of complexity and coordination is added when non-kinetic effects and Information Operations are integrated (rather than being purely supportive) to a primarily kinetic global strike activity.

As a COA and execution order (EXORD) are issued and execution of the plan commences, primary leadership of the Global Strike DCAT shifts into an operational or battle management mode where the strategic commander is now operating in a supporting role to commanders responsible for mission execution. The strategic commander monitors deployed forces and actions taken to compare against those planned and monitors a diverse set of global indictors to determine if the actions taken are producing the desired effects. If conditions change, alternative directions will need to be quickly coordinated and disseminated to operational units. These directions are supplemented with the requisite Commander's Guidance and Intent as well as updated intelligence information. Changes to operations in progress continue to require access to an ever increasing set of information and expertise if Decision Superiority and mission success is to be achieved. Finally, as the operation progresses to its stability phase with a return to peacetime conditions, the primary issues, planning decisions, and lessons learned (along with the environment and conditions observed) are captured to ensure effective measures (for a given set of conditions) are documented and improvement actions taken.

Admittedly, the DCAT outlined in the previous example dramatically transcends current command structure and suggests an extremely agile and flexible approach towards C2. An alternative structure is a series of DCATs activated and synchronized over the course of the mission.

The CONUS Threat Maritime Interdiction Operations (MIO) DCAT depicted in Figure 5 assumes a 9/11-like terrorist event which requires the U.S. to close or more closely monitor airports and harbors. Several DCATs comprised of military, federal, state and local partners are activated to conduct MIO. Though deployed in different geographic areas and involving different jurisdictions, the DCATs share comparable tasking and guidance and must synchronize to achieve mission success.

USNORTHCOM is designated as the lead commander for the military component of crisis response while overarching command is assigned to the Department of Homeland Security (DHS). The Navy, tasked to support the Coast Guard in Maritime Interdiction Operations at key ports on the East and West Coasts, dispatches CRUDES ships (Cruisers and Destroyers) to key U.S. ports. Prior to arrival on location, each vessel integrates into the local command structure to form a geographic Maritime Interdiction Operations (MIO) DCAT (e.g., Atlantic Shield DCAT deployed near Baltimore, Maryland). The membership of the MIO DCATs includes among others, USNORTHCOM, US Coast Guard, local harbor control, air traffic control, Defensive

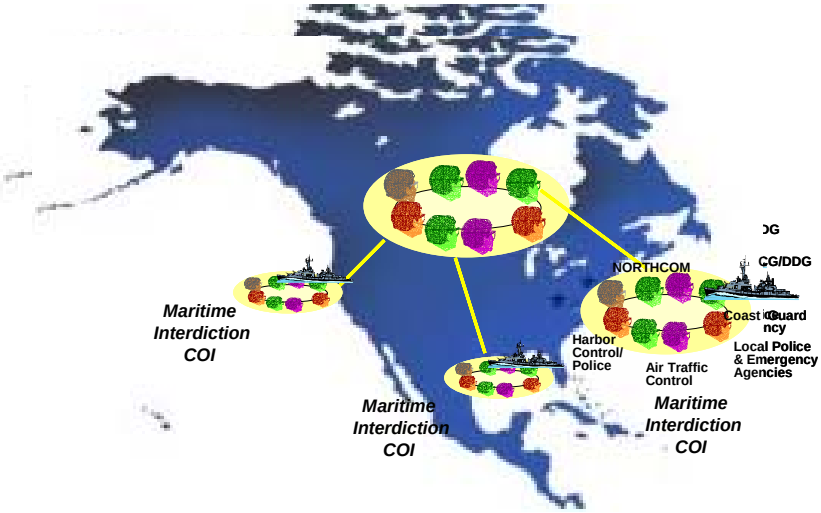

Figure 5 Maritime Interdiction Operations DCATs

Close Air Support (CAP) from United States Air Force (USAF) or Air National Guard (ANG), and local police and emergency agencies.

A National DCAT, the CONUS Shield DCAT, coordinates the activities of the supporting MIO DCATs. If the scenario involves a commercial vessel on the high seas, coordinated "target assessment" is required before interdiction will be authorized. Inter-agency collaboration is extended to include US Commerce, US Justice, Department of State (DoS), and possibly even the UN to avoid charges of piracy as the interdiction unfolds. If the threat is weapon of mass effect (WME) in nature, a complex planning process is initiated by the National DCAT to address the interdiction in an end-to-end nature, maintain evidentiary chain of custody, and synchronize the interdiction with global partners. In this way, the DHS is able to synchronize the application of all elements of DIME (Diplomatic, Intelligence, Military and Political) to cause a favorable outcome. The Joint Inter-Agency Coordination Group (JIACG), National Security Council (NSC) and Department of State are key players in the National DCAT.

3.0 Managing DCATs

The Global Strike and Maritime Interdiction DCATs described above are highly dynamic and adaptive entities. C2 entities such as these will need to operate within a Joint C2 framework that allows "commanders and staffs to tailor the C2 system as required by quickly assembling cohesive teams and by adopting C2 procedures suited to each situation rather than relying on "one size fits all" procedures" (Joint Staff 2004, vii). The DCAT framework described below supports the agile, adaptive and collaborative features embodied in the JS Joint C2 vision.

3.1 Collaboration Concepts

Noble, Buck and Yeargain define two collaboration models which mirror key concepts of the DCAT framework. Their dual-feedback collaboration model (see Figure 6) "emphasizes two important features of collaboration. First, collaborating teams work simultaneously in two different domains: team and mission. Second, execution monitoring, feedback, and adjustment are central in both domains" (Noble and others 2004)

According to Noble et al, "in the mission domain teams are working to accomplish the tasks that the team was formed to do. In the team domain, the teams carry out additional activities required to maintain effectiveness as a team. These additional activities are the source of much of the collaboration overhead. They include allocating and adjusting roles, coordination, meetings and negotiation. Note that though teams are not formed to maintain themselves, they cannot achieve their mission goals without doing so" (Noble and others 2004).

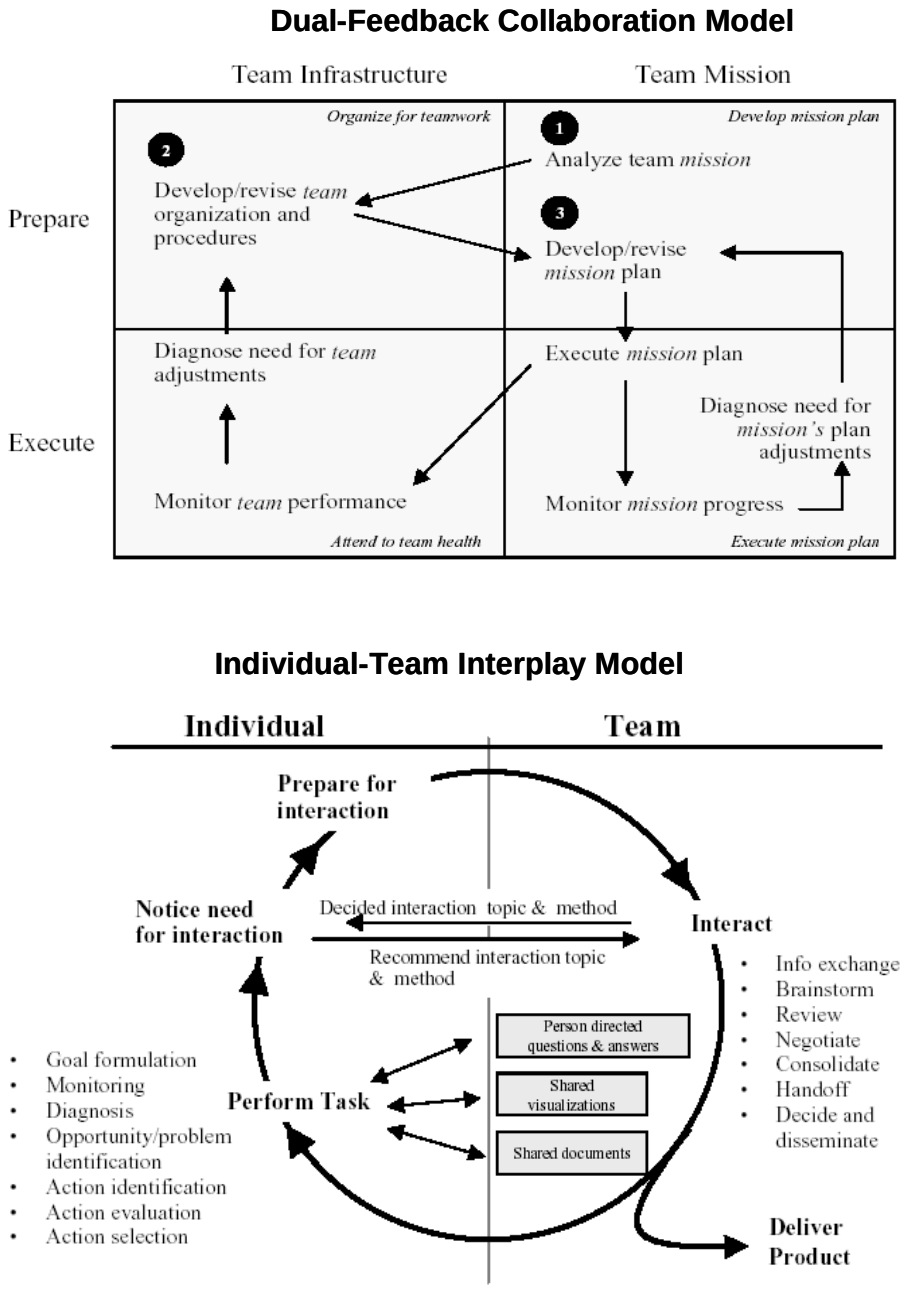

Figure 6 Dual-Feedback Collaboration Model and Individual-Team Interplay Model

The authors also provide a model for individual-team interplay that accommodates both individual and team activities. For decision focused tasks, the team members perform seven types of cognitive functions: information exchange, brainstorm, review, negotiate, consolidate, handoff, decide and disseminate.

3.2 Proposed DCAT Framework and How It Would Work

The DCAT framework outlines an overarching strategy for managing the collaborative activities of teams activated to respond to crisis situations. The framework reflects the key components of the collaboration models defined by Noble et al. As depicted in Figure 7, the

framework spans the building of DCAT patterns during pre-crisis, activation of a given DCAT, collaborative activities during DCAT operations and finally de-activation and archival of the DCAT. The framework addresses people, processes and technology utilized during the DCAT lifecycle. A key concept for this framework is "patterns" which store information critical to the operations of the DCAT. These patterns could include information on authoritative data sources, TTPs, key personnel, etc (see "Key DCAT Concepts").

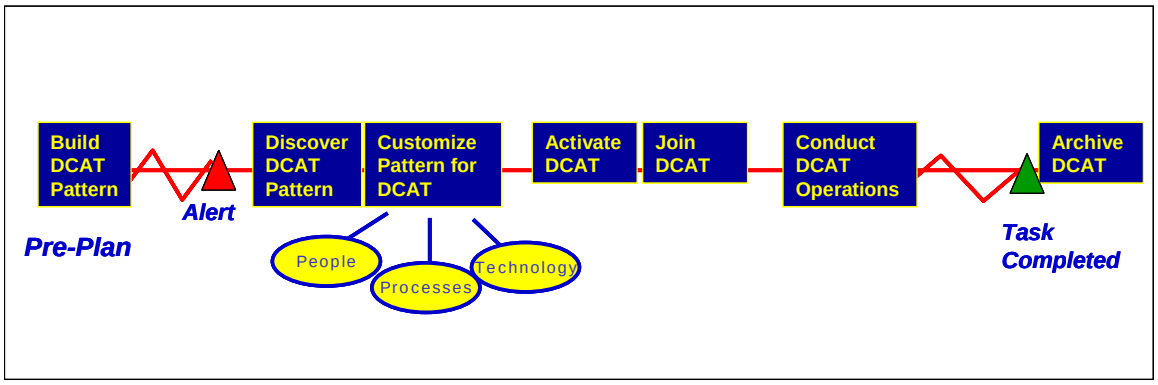

Figure 7 DCAT Framework

The DCAT framework described in this paper does not imply a single implementation of the DCAT capability. This paper outlines a common framework for the management of DCATs that in practice will likely be implemented in a variety of collaborative environments. It is unlikely that a "one size fits all" implementation of the DCAT capability will be promoted or accepted. What the framework does advocate is the use of an *integrated* collaborative environment which supports both synchronous and asynchronous collaboration (as required) and allows access to user-specified services. The cumulative DCAT capability described in the following series of conceptual illustrations is a composeable C2 capability comprised both of components unique to organizations or commands as well as common services used enterprise-wide.

Technical and cultural/policy challenges associated with implementing a flexible DCAT capability are explored in the section titled "DCAT Challenges". Not surprisingly, some of the most difficult challenges to implanting the DCAT concept have to do with cultural resistance and not technology gaps.

3.3 DCAT Framework in Action

A standing collaborative team maintains shared situational awareness and subscribes to alerts relevant to its assigned missions. During a routine watch, an alert is received which indicates to the personnel on duty that a potential crisis situation may be occurring. The standing operating procedure is that an alert of this nature should trigger the activation of a focused crisis action team, a DCAT, for further assessment and planning.

In Figure 8, the command responsible for neutralizing the activities of a terrorist cell with ties to an international terrorist organization becomes aware of suspicious activity at a known terrorist meeting site. This activity is especially alarming given recent indications that the parent organization has been encouraging the use of weapons of mass destruction (WMD) to further terrorist objectives. Action officers are empowered to activate a DCAT to assess the situation and then develop and implement an appropriate response. This DCAT will be dynamic and eventually include representation from all echelons of commands, different functional areas and diverse organizations.

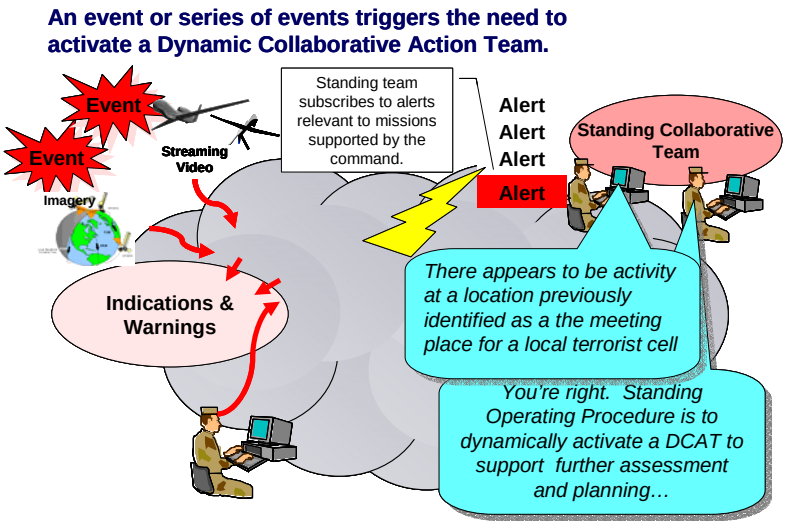

Figure 8 Identify Need to Activate DCAT

Discover Pattern, Customize Pattern

The action officer empowered to activate the DCAT first searches for a previously defined pattern appropriate for this type of situation (Figure 9). The pattern contains both mission and collaboration templates. Each template includes guidance pertaining to Tactics, Techniques and Procedures (TTPs) and DCAT membership. In addition, the collaboration template provides guidance for provisioning the collaborative workspace utilized by the DCAT.

DCAT patterns are a by-product of deliberate planning, training, warfighter exercises, etc. Patterns will be defined by Major Commands to accommodate their unique environment and assigned missions. A common data model for DCAT patterns would allow them to be discovered by many different users. DCAT patterns are discussed in greater detail in the section titled "Key DCAT Concepts".

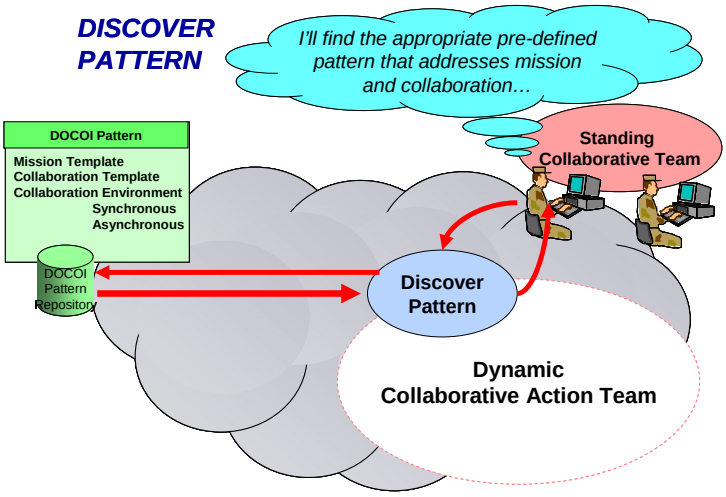

Figure 9 Discover DCAT Pattern

After discovering an appropriate DCAT pattern, the action officer customizes the pre-defined pattern to address the unique operational needs of the current situation. Objectives that reflect current commander's guidance are defined for the team. As the officer prepares to activate the DCAT, membership is adjusted to reflect specific domain knowledge, skill sets, and/or previous deployment experience required by the team to better achieve its objectives. The officer dynamically configures the DCAT workspace, provisioning it with appropriate data services, tools, and management structure for collaboration activities.

Activate DCAT

DCAT activation includes registering the DCAT (Figure 10). In this instance the designator "AQ-301 Cell" is selected as a reference to the terrorist cell that triggered activation of the DCAT. Warfighers (DoD and non-DoD) with requisite access privileges will be able to discover the existence of the DCAT. Also discoverable is a characterization of the DCAT that could include objectives, critical tasking and information requests and membership.

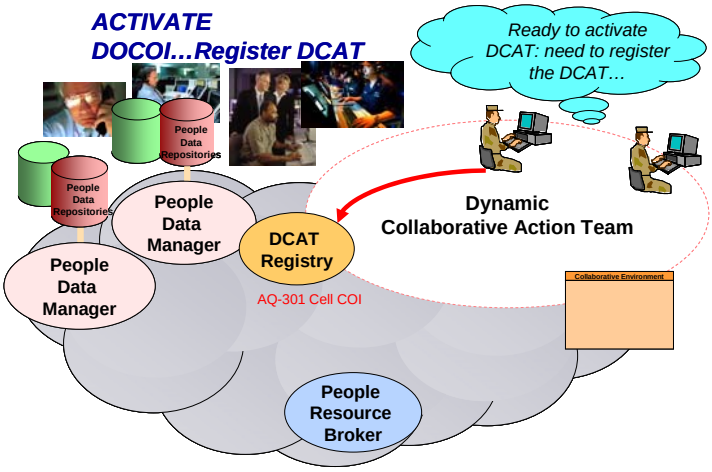

Figure 10 Activate - Register DCAT

To complete DCAT activation the action officer initiates the member invitation process (Figure 11). DCAT membership is based on the tasks to be completed by the team. TTPs contained in the DCAT pattern provide initial guidance for specifying DCAT membership. The action officer generates a request for DCAT support that includes mission-specific billet information derived from the DCAT pattern. Generic billet descriptions are augmented with specific criteria that include desired skills (e.g., language, tools, and processes), training, previous deployment experience (e.g., familiarity with specific organizations, geographic locations and individuals), organizational affiliation, command authority, etc. The request also includes DCAT participation requirements, such as security requirements, infrastructure access, start date and time, and anticipated duration of DCAT support.

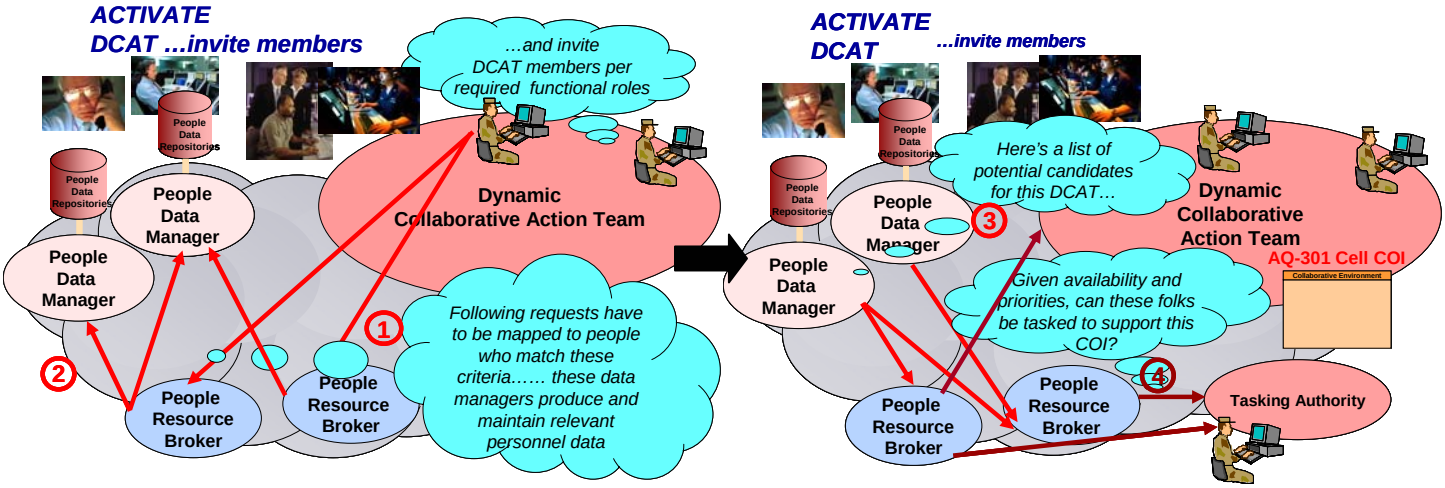

Figure 11 Activate DCAT - Invite Members

The officer forwards the request for support to Resource Brokers. [Use of the terms broker and manager is not intended to imply that these functions are done by a human. More likely, broker and manager functions will be implemented using advanced technologies to facilitate automated interrogation of heterogeneous data sources and implementation of rule sets.] Resource Brokers have knowledge of pre-established agreements for support and interact with the appropriate entities that manage personnel data. A list of potential candidates is provided by the People Data Managers. Resource Brokers continue to interact with the requestor and tasking authorities in order to map DCAT billets to individuals. Direct interaction between requestor and tasking authority is supported. The individuals who are eventually

invited/requested to participate in the DCAT may continue to support other standing collaborative teams. In fact, their participation in certain standing teams may be among the criteria specified in the request for support.

Joint DCAT

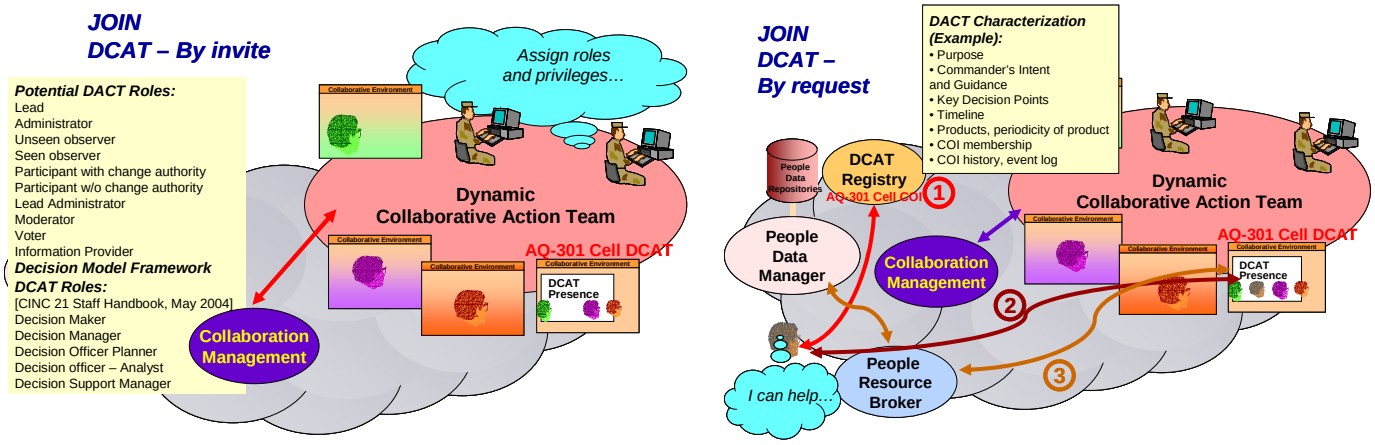

Figure 12 Join DCAT

Individuals join the DCAT either due to a direct invitation or because they request to be allowed to participate after having discovered the existence of the DCAT. Figure 12 depicts both options. Joining the DCAT involves being assigned roles related to mission support and interaction during collaboration. These roles are pre-defined in the DCAT pattern but can also be dynamically customized to better suit the needs of the DCAT.

Conduct DCAT Operations, Archive DCAT

As previously cited, "Joint C2 will allow commanders and staffs to tailor the C2 system as required by quickly assembling cohesive teams and by adopting C2 procedures suited to each situation rather than relying on 'one size fits all' procedures" (Joint Staff 2004, vii). For the duration of the DCAT, membership, tools and procedures continue to be adapted and modified as required. Many of the management features used to activate the DCAT also support the dynamic operations of the team. Individual and team activities cited in Figure 6 are conducted. Upon completion of its mission tasking, the DCAT is de-activated. Key lessons learned and best practices are captured and used to improve DCAT patterns for use in future operations. Improvements to the collaborative process (e.g., additional skills set to include in DCAT membership, critical information requests, and valuable non-standard data sources) will be captured as part of the DCAT archival process. These improvements are incorporated into defined DCAT patterns so they can be applied during future crisis situations.

3.4 Key DCAT Concepts: DCAT Patterns

This section provides a more-detailed explanation of proposed DCAT patterns. Patterns are intended to jump-start DCAT activation, customize the DCAT environment and provide structure throughout the DCAT existence. Patterns record and organize all aspects of a DCAT and contain information that supports the management of the DCAT. Future DCATs can utilize previous patterns to rapidly configure the collaborative space to achieve their DCAT's mission. This might include authoritative information sources, participants, collaboration rules and procedures, workspace layouts, key documents, product templates, etc. The underlying premise is that if you have a dispersed collaborative team, you don't want to reinvent an effective DCAT

environment when you can learn from past DCATs and use their good ideas to enhance your DCAT. Likewise, DCAT patterns do not dictate how to organize and run a DCAT. They can assist in identifying the key decisions related to organizing and running a DCAT and provide to the DCAT manager past solutions found effective (or perhaps ineffective).

Each DCAT has certain basic processes and characteristics. We have organized these processes and characteristics into a framework to assist in the construction and management of DCATs and their patterns. ***People***, ***processes***, ***technology***, and ***time*** are the four basic dimensions of the DCAT pattern. The military use Tactics, Techniques, and Procedures (TTPs) to understand, describe, and practice the activities needed to succeed in the very dynamic environment of modern combat. DCAT TTPs are associated with each of the four dimensions of the DCAT pattern and are themselves part of the pattern. The time component refers to the phases of a DCAT, pre-activation through de-activation and archival. DCAT patterns record critical information associated with a DCAT. Future DCATs use these patterns to take advantage of previous work that had been done to make DCATs efficient and effective. Research is underway to identify how the DCAT management tools will store these "patterns" and what information can be stored in them.

Clearly, some functionality must be consistent between all DCATs. Standard procedures will dictate certain aspects of starting a DCAT, inviting members, archiving information, etc. Some information will be specific to characteristics of the crisis: geographic regions should automatically add members from appropriate staffs within the AOR, for example. There is clearly a need and an opportunity to utilize some structure to assist in the creation and management of a DCAT. Given the criticality of time, the payoff for DCATs is greater than for other COI where eventually getting an efficient collaborative environment may be sufficient.

Patterns will be generated via different means: they are a by-product of deliberate planning, lessons learned from previously activated DCATs, training sessions, wargames, etc. Wargames and exercises are excellent venues to practice DCATs. Lessons learned from these activities will be used to modify the patterns and improve the library of available DCAT patterns.

3.5 Key DCAT Concepts: People Resource Management

A critical component of activating and maintaining a DCAT is finding the individuals with the requisite experience, skills and authorization needed to support DCAT activities. Criteria specified in the request might include, for example, desired occupational specialties, military rank, length of service, organization affiliation, standing operational team membership, previous operational experience and deployments, previous training, familiarity with tools, and unique skills. Though stored in a variety of different repositories, data of interest are found, correlated and subsequently mapped to individuals who in turn are empowered to participate in the DCAT. The tasking process implied by this "empowerment" is one that allows individuals to support a DCAT for a limited duration of time and still remain stationed at their standing assignment.

To facilitate their participation in DCAT activities individuals are assigned roles and privileges (functional and collaborative that define their functional responsibilities and how they interact with other DCAT members.

3.6 DCAT Challenges

3.6.1 Technical

Many of the technical challenges impacting the implementation of the DCAT framework are common to other initiatives being developed for the net-centric GIG environment. Sufficient bandwidth at the locations hosting DCAT members is critical to effective collaboration. Robust (standardized or interoperable) collaboration services and security services are required to support heterogeneous teams, in particular for inter-agency positions not part of the DoD GIG. New knowledge representation and data models are needed to enable information sharing. In the case of DCAT, this means developing new formats to categorize data needed to support DCAT management. Examples of key types of information and formats include: extended personnel skills, expertise and experience information [to include collaboration skills], Commander's Intent, Strategic Objectives, scope of Operational and Tactical Objectives, Rules of Engagement, inter-agency coordination points and agreements, etc.

The Johns Hopkins University Applied Physics Laboratory is currently prototyping components of the DCAT management framework. This work has provided an understanding of the challenges associated with implementing the DCAT Framework using current tools and services. They include:

- Personnel Resource Management: DCAT functional roles will be mapped to individuals using heterogeneous data sources. At present, military personnel are assigned to billets and are "owned" by units. Different organizations manage their personnel resources with various methods and no single central directory is available for skills and capabilities. The DCAT framework relies on a standardized interface into these repositories to support advanced capabilities such as semantic agent based searches. The internal workings of the various data sources can remain untouched as long as there is a service implementing a standard interface.
- DCAT Characterization: The DCAT framework has to implement its own data model. This includes a schema that can be reused by other services and in most cases this data model will incorporate and extend existing schemas. In addition, a DCAT has to be described with metadata and registered so that it can be discoverable. DCAT Patterns, active DCATs, and archived DCATs will all be discoverable with sufficient metadata. Also, DCAT administrative monitoring will need to be performed at a site or system administrator level. This includes monitoring for error conditions as well as providing tools to communicate the progress and results of the collaboration.
- Collaborative Environment Provisioning: The act of activating a DCAT from a pattern implies creating a collaboration workspace dedicated to the DCAT. This is known as provisioning. Assuming that collaboration suites will expose proper management interfaces, part of activating a DCAT will be to create the workspace, incrementally add custom portlets and tools to it, and allow the participants to access it.
- Incorporation of TTPs: TTPs are military business rules. Participation within virtual team may proceed according to convention, but there may be a long-term desire to formalize and structure team interactions. This may take the forms of TTPs with the assumption that there will be some way to encode these rules in a data structure. In addition, TTPs may influence the structure of a DCAT pattern. The deliberate planners

creating a pattern may choose to make multiple versions of a pattern based on the presumed interactions that will occur at the time the pattern is activated.

In summary, the development of a DCAT management framework can proceed with the assumption that technology will continue to progress and that the various collaboration suites will become more net-centric and provide web service programmer interfaces (APIs). The degree to which security services will support dynamic assignment of privileges and heterogeneous DCATs is not yet know, but security limitations are not expected to restrict the operational use of DCATs, just how they are structured. DCAT-unique work to represent DCATs and TTPs and standardized interfaces into personnel data resources needs to be funded.

3.6.2 Cultural and Policy Challenges

While not to trivialize some of the technical developments needed to achieve the vision embodied in the Joint Collaborative C2 Concept, many of the challenges of implementing the DCAT concept will be to move from today's on-site, committed-support way of doing business to one where many members of operational teams (whether for planning or for adaptive execution) are no longer required to have physical presence with the supported commander.

Reachback for specialized expertise and federated support by supporting organizations are done today, but more often core support for planning teams involves team members being physically present to participate in the planning sessions. Commander's Intent and other key "philosophy" positions are promulgated through periodic review and incremental development of the planning group's products – often conducted in person, with minimal visibility within a broadly accessible collaborative environment. This process and the perceived need to directly engage with someone responsible for each portion of the teams' products drives most operational teams to require presence at the location of the commander's staff. Thus when operational tempo requires an increase of either magnitude or scope of normal staff activity, augmentation is required. Typically this is through the Request for Forces (RFF) or Individual Augmentation (IA) process and involves a deployment away from an individual's home station. Even when some of the work can be done in reachback or by federated support by supporting organizations, someone in the planning team is responsible for assigning the work, monitoring the process and integrating the work into the final team deliverable(s), diverting that individual from functional planning activity.

In the net-centric environment, many members will be capable of full, integrated participation in the development of team products regardless of location. Today's developing C2 concepts (e.g. the Standing Joint Force Headquarters and the Joint Collaborative C2 Functional Concept) still tend to be evolutionary in thought and do not yet fully capture the transformational potential of this capability. Current thought involves the need to largely pre-identify the membership of the "cohesive" team and have them well trained via standard training and exercise. This requirement is admittedly very important and certainly would apply to the core membership of any action team for the purpose of task assignment and for in-depth understanding of the C2 environment, and specific assumptions, restrictions and limiting factors involved in the team's specific mission task. However, to assume that even the majority of members will have the benefit of such pre-identification, qualification and training seems contrary to what we understand about the operational challenges facing dynamic collaborative action teams. Such challenges include dynamic threats and associated mission objectives, variable "coalition of the willing" partnerships, and increasing demands for non-military inter-agency collaboration and coordination.

The ability for a DCAT to perform in this dynamic collaborative environment will require adjustments across a broad solution set. Specifically, policy, procedures and culture will need to adapt to address how personnel can be placed within a DCAT and be committed to DCAT support at the level required. These individuals will need to be kept apprised of all DCAT objectives, guidance, and procedures without needing physical presence in the DCAT or a designated individual to relay such items. Likewise, personnel systems will need to develop processes to "assign" a person to a DCAT without the need to re-assign the individual physically to the DCAT's location. This will include tracking and "crediting" individuals for operational engagement and increased ops tempo when directly supporting military operations without the necessity to deploy into specific areas of responsibility where the main DCAT effort is focused. Also, personnel systems will need to define individuals' skills and "DCAT readiness" to a degree not currently available today in order to ensure that good matches of possessed skills to needed skills can be done at a more rapid and effective manner than possible with today's deployment support system. Today's reality is that finding and getting the right person for the job in a quick time frame is highly dependent on personal networks, otherwise known as "bubba nets." One of the benefits of a net-centric opportunity is that all DCAT managers should have equal access to virtual "bubba nets" that can help them find the right people for their teams.

Crucial to all elements of the previous discussion are agreements (and the technical means) on the part of organizations to share or provide managed access to personnel information, support real-time, discoverable visibility into DCAT activity (i.e., DCAT presence) and utilize collaborative environments accessible by DCAT members external to the organization. Other aspects of the DCAT framework that have broad cultural and policy implications include the dynamic customization and sanctioning of TTPs for time critical use and later re-use and the dynamic assignment of DCAT roles and privileges to include security access privileges.

4.0 Can DCATs Improve Command and Control?

DCATs provide unparallelled opportunities for collaboration. How best to harness these capabilities to achieve mission objectives remains to be seen. New technology alone is not sufficient. The French in 1940 had just as many tanks as the Germans. They failed to utilize the new technology effectively and therefore failed to counter the Germans' advantage via the transformation of warfare: Blitzkrieg. Likewise, net-centric capabilities have tremendous promise but we must still harness them appropriately to maximize their benefits. The two key *potential* benefits provided by DCATs are improving the speed of decisions and improving the quality of decisions.

Operating inside the opponent's OODA loop (observe, orient, decide, act) is a key goal of military commanders. Fast-paced modern combat requires command & control systems that can quickly gain a shared understanding of the battlespace and act appropriately in a synchronized fashion. Through the use of DCAT templates the basic function of initiating, defining objectives and populating the DCAT with engaged, effective members will be greatly reduced. Net-Centric empowered DCATs will give members common access to data and knowledge. Key among this data and knowledge are the elements of Commander's Intent and strategic objectives from highest level of military command to the local commander. The rapid communication of information and dissemination of orders within the DCAT and the commander's staff elements will enhance our military operations through increased agility. The ability to orchestrate information into decision-making packages as a machine-level function will improve the speed of C2 processes. As an additional benefit, much of the current C2 workload of moving and organizing data may be automated, thereby reducing the footprint of C2 centers. When

combined with enhanced virtual, collaborative team membership through DCATs, future planning staffs and command centers may require significantly fewer personnel on-site (with all the associated logistical and personnel advantages).

Faster decisions will be the easiest C2 improvement to measure. Improved decisions are also a likely result of DCATs. The productivity enhancements that improve the C2 process speed will allow more time to be spent thinking. Collaboration will result in more alternatives and more comprehensive alternatives being generated. Also, since the DCAT is distributed, a wider review of these alternatives should result in improved alternatives which result in improved decisions. This is also the case when improved inter-agency and coalition participation is incorporated into the C2 processes. The shared understanding of the battlespace and the commander's intent should also enhance alternative generation and analysis. So while it will be difficult to measure, all the factors will be in place for improved quality of decisions in the DCAT and Net-Centric enabled environment.

Simulations, wargames, and exercises will be needed to capture sufficient C2 data to support analysis of the C2 process to quantitatively access the impact of net-centric C2 on decision quality. In the near term, commanders will provide a qualitative assessment of the value of DCATs.

DCATs empowered in the emergent net-centric environment will vastly improve coordination abilities between command structures. This improvement will occur horizontally with information sources and other operational action teams performing at the same level of mission operations. But, as significant, is ability to share knowledge, data and insights vertically. With higher echelons to clearly understand or request clarification of Commander's Guidance/Intent, Mission Objectives, ROE, etc. and with lower echelons to obtain operational or tactical input, refinement, or validation of DCAT activities in a synchronized (vs. linear) fashion.

Overall, DCATs have the potential to improve both the speed and quality of decisions as well as improving clear communications and coordination both horizontally and vertically. How well these new capabilities are planned, integrated, and employed and how well the military adapts to the new net-centric environment will determine the extent to which improved C2 capabilities are actually realized.

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