Command and Control (C2): Adapting the Distributed Military Model for Emergency Response and Emergency Management

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ABSTRACT

The military use of Command and Control (C2) has been refined over centuries of use and developed through years of combat situations. The C2 framework described in this paper posits process, function, and organization, as its main components. The paper further suggests that emergency response organizations and their management structure their C2 and subsequent response scenarios within the military C2 framework established in this paper.

Keywords

Command and control, emergency, response, emergency management, HRO.

INTRODUCTION

This paper investigates the adaptability and use of military Command and Control (C2) to Emergency Response. Further, the extension of C2 to Emergency Preparedness and Emergency Management is both suggested and explained. In researching C2 and its potential in organizations other than the military, recorded organizational data was accessed and analyzed as well as ethnographic data collected through interviews.

The pressing question is can the C2 model, so effectively used in the military, be lifted from that organization and gently placed within the Emergency Planning, Response, and Management frameworks at the Federal Level to include the Department of Homeland Security (DHS) and the Federal Emergency Management Agency (FEMA), at the State Level, at Local and Municipal levels, and at the level of special entities such as the Port Authority of New York and New Jersey?

This paper is an initial attempt to answer that question and does so in the following manner. C2 is decomposed into three basic dimensions which are initially addressed individually and then in its totality. The three distinct dimensions are:

1. C2 as process
2. C2 as function
3. C2 as organization

These dimensions are represented as sections to this paper and at the end of each section are suggested implications to emergency response and emergency management.

C2 AS PROCESS

The first dimension of C2 that surfaces is its similarity to a process where there is a beginning and end as well as a reason for the process itself. In (MPDP6, 1996) Boyd's LOOP is posited as the basis for a successful C2. It is also suggested as the stepping off point for C2 theory. The four steps or process elements in Boyd's LOOP (Boyd, 1987) are listed as follows:

1. Observe
2. Orient
3. Decide
4. Act

Each step is described below:.

Observe

To observe suggests both a sensing of information and a focusing on the information that matters. Sensing of the objects around us normally occurs visually but all of the senses become involved. At the individual level we have the ability to quickly scan a field of vision and then focus upon objects in that field of vision that warrants attention. The concept of the smallest deployable unit (SDU) is introduced here and is expanded upon in this paper. A SDU is the smallest operational unit in C2 and Emergency Response. A SDU can be an individual, a collective, or both an individual and collective in symbiotic relationships with technology. The (SDU) becomes, to a large degree, the eyes and ears of C2. When coupled with electronic sensing devices to include GPS, remote cameras, infra red technologies, microscopes and geo-spatial technologies the information sensed may be transmitted to different C2 functions (explained in the next section), properly configured, in order to view the different objects and gain a sense of the situation that may be rapidly unfolding. Any SDU, given to day's technology, can become an observer and transmit information to those involved. In the days of OEP (Office of Emergency Preparedness) observers were trained to be part of any team that went out to a disaster site and the training of observers is important in order to recognize what is important. The SDU can be partially virtual today as in virtual teams with it being composed of people on the site and those remote from the site.

The field of cognitive neurosciences provides insight into how humans sense and what they attend to within a field of vision. Both become important to the C2 process. Humans are much better than technology in areas such as feature and figure detection. Humans often times focus effortlessly on objects in a field of vision often identifying objects based upon the detection of key features or components. When confronting rapidly changing conditions external to them SDUs must be trained to identify and communicate what is observed to various C2 functions for further assessment.

Orient

The human is the most complete "signal processor" ever devised. No technology currently in existence can come close to a human in sensing visual, sound, tactile, scent, taste, vestibular, and kinesthetic data in parallel and then integrate all the sensed data into a holistic view of reality. This integration occurs in the "orient" step of the Boyd's LOOP process at the SDU level as well as the levels of other C2 functions. Once sensed then "sense" must be made of the data quickly. Weick (1988, 1993, 1995) has researched sense making at the organizational level providing insight into factors that surface as organizations address either uncertain or ambiguous situations. Dervin (1992, 1996), a communication scholar, has investigated individual sense making, developing theories underlying the "cognitive gap" that individuals experience when attempting to make sense of observed data. To Dervin the bridging of the cognitive gap becomes salient to an information seeking component that underlies the ability to "orient", especially at the SDU, to data that is continually being sensed.

The “orient” step in higher level C2 functions suggests both an individual as well as collective “cognition” orientation to data that is sensed and communicated. Visualization technologies assist in higher level C2 functions more so than data mining and other methods that reduce data streams to meaningful components

The area of Human Computer Interaction (HCI) especially “Geo-spatial Collaboration” (Brewer, 2002; Brewer and McNeese, 2003) and Web interfaces that integrate text, graphic, video, and sound provides a real-time “situational awareness”. Witness the effective interface used presently at the Port Authority of New York/New Jersey where a textually submitted incident is indexed to a camera location. Both the text and the visual representation of the camera appear at the same time on a computer monitor. This level of integration helps an “incident commander” gain a holistic view of the situation as it exists and then unfolds.

Decide

This step suggests that once orientation to the data (or the lack of it) occurs then a decision is made, ultimately resulting is the final step which is “act”.

The decider is always striving or struggling to gain a sense of what is reality to be able to feel that he or she can make a decision that is the "best possible" given the circumstances.

I will focus on the “decide” step of Boyd’s LOOP now. Much has been written about models within which decisions are made. For example Brierly, Gallagher and Spender (2005) when researching the decision making process of High Reliability Organizations (HROs) draw on the work of Allison (1971). Allison, when researching decisions made in the Cuban Missile Crises identifies three distinct decision making models.

1. Rational Actor (to include bounded rationality)
2. Organizational Model
3. Political Model

In addition Brierly, Gallagher, and Spender (2005) identify a fourth emerging model from Actor Network Theory (Law, 1992, 1999). (important to be clear about the problems with each of these methods

Rational Actor Model

This model suggests that a decision is made based upon the “rational” assessment of all alternatives. Once identified, possible risks are assigned to the alternatives and various metrics are used to identify the best alternative resulting in the best decision. Emerging from this model is the concept of bounded rationality suggesting that all possible alternatives are not realistic but a relevant sub set might be. In fast moving situations the applicability of this model needs careful scrutiny. The chief problem with the rational actor model is that it can inhibit timely decision processes and the execution of coordinated response among all those involved.

Organizational Model

Weick (1988, 1993, 1995) astutely suggests that organizational behavior today results from what seemed to work in the past. Given an emerging set of environmental components from a situation external to an organization, the organization will decide what to do based upon what worked in the past. This only works if one (or the organization) is careful to discover the mistakes of the past and correct them. It is also very dependent upon clear responsibilities among organizational units and for the role for each in the coordination processes.

Organizational memory becomes important in this model suggesting that training at all levels (SDU and different C2 functions) will have positive effects on future performance. This training is occurring in the annual TOPOFF exercises as well as RIJAN and CWID.

For examples a former FEMA Undersecretary when reflecting on what worked in the past mentioned the following:

"I was the senior FEMA official in a short lived National Truckers strike in 1984 or 1985. We appointed the Transportation Department to the senior leadership position and the FEMA regional offices were alerted to the potential crisis as a support arm for Transportation assets in the states. It was determined that FEMA communication assets were more useful as "FEMA personnel" had practiced and exercised under crisis conditions whereas Transportation had not. Secretary Dole was the Senior Federal Official, a title that had meaning within the confines of the national Emergency Response Plan. She led the Command structure and FEMA led the Communications structure."

Important in the above quote is the idea that training especially under "crisis" conditions prepares an organization in the identification and response to an emerging "crisis". A "what has worked before mentality" develops which is what underlies the organizational decision making model.

One cautionary note here. In (Turoff, et al., 2004) we mention the "threat rigidity" response which in turn suggests that organizational memory is useful l but should also allow for adaptability in decision making when emerging situation components do not exactly meet expectations.

Political Model

Decisions that take the interest of various "stakeholders" into consideration before acting underlie the basic approach of the "political" model. In Katrina the "politics of local control" may have prevented the timely use of the US Northern Command resources during the period of time immediately following Katrina. Power, politics, interest, and control often times best characterize the components of this form of decision making. For an explication of this see (Clegg,1989; Lukes, 1974). Very dependent upon the talents of the individuals involved and the cooperation of the stakeholders. Too often the resulting decision is a compromise that does not reflect the best solution that the more talented members might have contributed. It is an average result.

Actor Network Theory Model

This is emerging from the field of sociology (Law, 1992, 1999). It suggests that humans in their interaction with objects (technology, etc.) form hybrids (Latour, 1993). Decisions are made through a process of hybrid "mobilization" that differs from the rational actor, organizational, and political models. Very clear recognition of the individual roles in the process and the distribution of authorities and responsibilities among those roles. It requires careful definition of the roles below the actual decision authorities. This includes the various types of analysis that must be done to synthesize the input flow of data into evidence to guide decisions at all levels of a single problem area like the treatment of casualties.

Act

This is the last step in Boyd's LOOP. It is begun after a decision is made at the SDU or a higher level of the C2 function. Integral to the "act" step is the ability to communicate the action suggested and then monitor the action in order to determine whether it resulted in the expected change to the situation. In the conclusion the concept of the "commander's intent" is addressed. It is important to mention this here because any change in the situation should

be related to expectations established within the framework of the "commander's intent". With today's technology this is the Virtual Unit dynamic that has to be included.

Boyd's LOOP can function at the individual level or level of the collective. It is not unusual in military operations where the SDU could be the individual Army soldier or squad, the Marine Rifleman or Fire team, the Air Force Pilot or Flight, the Navy Sailor or ship, when each is confronted with a combat situation they iterate almost effortlessly through the loop in order to gain an advantage over the enemy. However a local situational awareness at the level of the SDU is relative to that unit itself. If the local view of the situation is not shared with different C2 functions (see C2 as Function) in turn providing a more global view of the situation then local action may not result is as positive a change in the situation as when a collective response is invoked. Conversely in rapidly moving situations local action may pre-empt collective responses when the time to act becomes vital.

Implications of C2 as Process to Emergency Response and Emergency Management

The military focus on Boyd's LOOP as process components within C2 has been expanded upon by Haeckel (1999). Haeckel developed a variant of Boyd' LOOP called SIDA (sense, interpret, decide, act) and further suggested that adaptive organizations, such as those found in emergency response should be designed around SIDA. This represents a movement to incorporate military C2 process components within non military organization structures.

C2 AS FUNCTION

The second dimension of C2 is its construction as a function, one that exists in some physical and/or virtual form such as an "Emergency Operations Center" or "Command Center" either at the Federal Agency level, State level, Port level, and/or local (Municipal level). The basic premise is that as a function it assumes both physical and virtual characteristics. In the sections that follow I address Physical C2 and Virtual C2. I also explain the "Node" concept of C2 and within that address redundancy and Node distribution. Closely related to C2 as function is the concept of Network Centric Organization (NCO) in the DHS and non-military sector (Wesenstein et al., 2005) and Network Centric Warfare (NCW) in the military sector (Alberts and Hayes, 2003; Atkinson and Moffat, 2005; Moffat, 2003). It is mentioned here because of its potential use in the connection of physical C2 nodes providing for both Node redundancy and Node distribution. However proponents of NCO and NCW (Alberts and Hayes, 2003; Atkinson and Moffat, 2005; Moffat, 2003) implicitly assume that the network so formed and the various technologies that are connected are the enablers of the "decide" component of Boyd's LOOP operating in the "C2 as function" dimension.. Critics of NCO and NCW suggest that the network and its IT and IS components are tools in the decision making process and not the ultimate decision authority. In other words decisions and situational awareness appear to be in tension in NCO and NCW constructs which center both in the network (technology) rather than the human.

Physical C2

As a physical entity it becomes the center or hub of communication, information technology, information systems, and the people who make certain decisions using the technology that surrounds them about the positioning and allocation of resources required during an Emergency Response to an unfolding situation. Situational awareness addressed in "C2 as process" becomes vital at the physical command center. Since a command/emergency operations center is not at the "edge" of the Emergency it relies upon the data and information of others as it cycles through Boyd's LOOP. Data transmitted by the SDU (in the case of natural or man made disasters the SDU becomes the first responders along with others who are interfacing directly with the emergency situation) to different C2 functions is integrated along with other forms of data to assist the C2 function.

In the case of the Port Authority of New York/New Jersey a total situational awareness is enhanced through the use of Web based HCI (Human Computer Interaction) interfaces that integrates different Media sources (live camera video, Face to Face Video conferencing, text data) and displays these different data sources in one cohesive interface. Geographical information is also displayed as required suggesting a type of collaboration at the C2 function best described by Geo-spatial collaboration. This type of collaboration research is occurring at Penn State by Carroll through their Geo Vista initiative as described by (Brewer, 2002: Brewer and McNeese, 2003). Since the goal of C2 as "process" is the decreasing of Boyd's LOOP cycle times, Geo spatial collaboration research appears to be a promising means to that end when used within C2 functions.

In a much broader sense the field of CMC (Computer Mediated Communication) and CSCW (Computer Supported Cooperative Work) provides insight into cooperative work and its underlying collaborations. Major contributors along with some key references are (Hiltz, 1978, 1984; Hiltz and Turoff, 1993; Lea, 1992a, 1992b; Rice, 1987; Spears, et al., 2001; Turoff, 1991; Walther,2002). The last section of the "C2 as function" topic explains Johansen's Classification of Groupware (Johansen, 1991). I mention this classification grid because it provides a framework for thinking about the role that technology plays in collaborations. The nature and success of collaborations underlies the nature and success of C2. When C2 is viewed as a physical entity it becomes integrative of both humans and technology in a physical space and understanding how this integration affects communication underlying "meaning making and sense making processes" becomes salient.

Though technology has been increasing in importance for a variety of organizational issues (decision making, behavior, and communication to name a few) there are still concerns in its pervasiveness and positioning (Castells,

2001; Gergen,1991; Kaghan and Chumer, 2005). More will be said about organizational issues in the section of this paper that addresses “C2 as organization”.

During 9/11 the physical Command Center that would have been actualized as a C2 hub was located in the World Trade Center and was destroyed along with the World Trade Center Towers. This in turn suggests that the location of a physical C2 node, a specific location, should be carefully considered. Also suggested as part of this consideration is the planning for virtual, redundant, and distributed functions to ensure that C2 can be performed if a physical C2 node is destroyed.

Virtual C2

Virtual C2 has the potential of adding expertise that may be necessary in obtaining a consensual view of an unfolding reality resulting in better situational awareness by drawing on expertise not located at a physical C2 site. The thinking is that knowledge required to respond to certain situations my not reside with all who are physically present in a specific C2 location. The ability to integrate expertise at a distance leads to the concept of virtual C2. General C. Krulak as part of his remarks for The Council on Foreign Relations, 17 November 1997 stated the following:

“In other words, we must consider expertise, knowledge, and information as National Resources and Strengths, as force multipliers. An example might be the creation of a "virtual" command and control organization at the National and CINC level. One that has the ability to network with industry, academia, laboratories, and other non-governmental organizations as well as with the more traditional elements of national power such as found in DOD (Department of Defense) and DOS (Department of State). This virtual capability would allow decision makers to leverage skills that are not found nor should be found in military organizations. This is not new. The Marine Corps is doing it right now on a miniature scale with the Chemical Biological Incident Response Force. We have tapped into the expertise of Nobel Laureate, Dr. Josh Lederberg and others to include laboratories, hospitals, and medical schools to assist in the event of a Chem/Bio attack. As the head of our Chem/Bio "reach back" staff, Dr. Lederberg and his team join us on the scene of response via telecommunications and provide valuable diagnostic and treatment information. It is not difficult to visualize the expansion of this concept to bring the expertise of chemical companies, computer and software firms, banks and environmental groups onto the 21st Century battlefield. We will be globally aware and regionally savvy.”

The idea of virtual command and control flows directly from General Krulak’s comments. Yet there is something that is implicit to his comments that I will mention here and then carry on in the “C2 as organization” section. A virtual C2 component allows for the integration of operational knowledge (often times located with the SDU), tactical knowledge (spread across the SDU and various C2 nodes), and strategic knowledge (at certain C2 nodes with a virtual component). This requires leadership that understands the need to coordinate across the operational, tactical and strategic C2 spectrum. All emergencies, disasters, and battlefield operations require this kind of integrative thinking.

Redundant C2

If physical C2 nodes are constructed they should be done in locations that are not in “harms way” and with a high degree of security. The military goes through great pains to ensure that critical C2 locations are physically secure and staffed with individuals who have been pre-screened. Location and access become salient factors.

Coupled with constructing physical C2 nodes is the concept of redundancy. It means that if for some reason physical C2 becomes disabled then control can switch to a backup site developed for that reason. The backup C2 function can be physical or it can be mobile. I have seen mobile sites located in buses, vans, trucks, airplanes, and ships. The reverse can also be true in that a primary C2 site can be mobile with a redundant or backup physical node.

Distributed C2

Distributed C2 is a different way of thinking about redundancy. It suggests that in the normal course of developing a series of physical C2 nodes the ability to use one location for the functional purposes of another, especially within a predefined region such as a FEMA region, should be considered. For example in the State of New Jersey, the State EOC (Emergency Operations Center) functions should be able to be carried out at the Port Authority Command Center and vice versa. The State of New Jersey, Department of Health and Senior Services, HCC (Health Command Center) should be able to function at the State or Port Authority Centers. Underlying the notion of functional distribution is a robust communication switching network capable of switching analog, digital, text and video data from one center to the other as well as in parallel where similar views of a situation are monitored at the same time.

This capability can also allow for the integration of DOD and National Guard C2 functions carried out by US Northern Command and the Joint Task Force-Civil Support. DOD oriented technology "portals" could be built into State, DOH, and Port oriented command centers to provide that extension when required. Conversely DOD Command Centers within US Northern Command could have a series of State and Regional technology portals allowing for a parallel view of an emergency. This would allow for a comprehensive and simultaneous way of approaching situational awareness.

The use of private emergency switching communications rather than VPN would ensure that in the case of natural or man made disasters, communication, voice and data, will not be affected. These privately configured networks should permit the robust use of radio frequencies reserved for emergency purposes. In addition the nature of "switched distribution" suggests that Internet 2 (not the Internet) switching priority should occur for emergency situations. The cellular network as well as the public switched network is totally inadequate for emergency situation communications.

Implications of C2 as Function to Emergency Response and Emergency Management

It becomes quite evident that the C2 function becomes the epicenter for technology integration. It is not unusual when a physical command center is visited that there are large monitors on the walls, PCs, video conferencing and teleconferencing technologies, fax devices and all sorts of related Information and Communication Technologies (ICTs). Information Systems engaged in Online Analytic Processing (OLAP), data mining, and in some instances collaborative filtering are endlessly grinding away as are recommender systems. A framework for thinking about the "sense making communication" of ICTs that enable group decision making was developed by Johansen (1991) and it is still appropriate today especially when thinking about the effective use of C2 technologies.

The military framework of C2 consisting of physical, virtual, distributed, and redundant functions need to be considered when non military command centers are being planned and developed.

C2 AS ORGANIZATION

This is the last of my three ways of viewing C2; process and function being the first two. Organizations by their very nature structure and shape emergency response scenarios. In reviewing the Katrina FEMA press briefings this surfaces when Brown urges the first responders "Not to respond to hurricane impact areas unless dispatched by state, local authorities". This suggests that operational activities should wait until those who understand a bit of tactics and strategy are "all set up" to effect control. This suggests a classical hierarchical and bureaucratic thinking. . It also indicates a complete lack of understanding of the "warfighter" mentality and the role played in emergency situations by the SDU (mentioned in section 1). First responders as SDUs (to include the police, fire fighters, emergency medical personnel and others) are normally trained to respond to emergencies and in the absence of overall command center operations (various C2 functions) should not be put on hold. Rather they must move into action and then as coordinating functions become actualized, broadening "situational awareness", their actions can be adjusted as different views of the situation materialize.

There is a cautionary note here. The fire, police, and other emergency personnel who responded to the WTC during 9/11 did just that and met with tragic results. They thought they should respond as they were taught as trainees to advance to the location of the fire. They were responding, as trained, to a fire when the situation was really a terrorist attack. Situational awareness suggests collaboration which in turn suggests a "no delay" or robust form of communication parallelism so that what the SDUs (the operational units) "see" is communicated to functional C2s for immediate collaborative interpretations in order to respond in a sensible and concerted manner. This in turn can be enabled by a C2 type of organizational structure described in this section. A rapid response C2 parallelism enabled by closely coupled C2 functions assists in developing an awareness of the situation when SDUs need to take action immediately. In an emergency there has to be a clear command and control structure that encompasses all response organizations and responders. What happens when there is not was quite evident in Katrina. C2 needs to exist from the moment the threat is detected until the completion of response activities.

In table 1 I compare NCO (network centric organizations), HRO (high reliability organizations), and the Bureaucracy against Weber's six features. During the response to Hurricane Katrina the flexibility and adaptability found in the NCO and HRO type of organization was severely lacking in the actual response as well as the planning for the response by City, State, FEMA, and DHS organizations and their decision makers.

In reviewing the press releases from the DOD it was clear that US Northern Command and its Joint Task Force-Civil Support started their planning effort at least 5 days before the Hurricane made land fall. All resources, Navy, Army (National Guard), Air force, and Marine Corps were marshaled well ahead of time and stood at the ready to assist in the Katrina response. There are many reasons for this military preparedness and readiness. One is a C2 focus that has evolved over centuries of battles, wars, skirmishes, "police actions" and the like. The "modern" day business organization is a "modern" day phenomenon evolving into organizational structures over the past 50 years that are not as efficient or effective as the military organizational model. It took the military centuries to develop a robust C2 mentality and to sharpen that focus via a series of embodied "lessons learned" gained through actual combat. The C2 mentality within the HRO nature of military organizations, actualized during actual response scenarios, was indeed evident in planning for the after effects of Katrina. The corresponding C2 mentality in New Orleans, Louisiana, FEMA, and DHS was totality lacking indicating bureaucratic dysfunctionality.

NCO, HRO and the Bureaucracy -

Organization studies contain a wide range of literature about how organizations are structured, how they behave, how they communicate, how they make decisions, how they make sense of and react to environmental cues, but for C2 I will focus on the following two emerging organizational types:

1. Network Centric Organizations (NCO)
2. High Reliability Organizations (HRO)

The NCO is being posited as a potential structure for the military focusing on the enabling of decisions through the technology in the network (Alberts and Hayes, 2003; Atkinson and Moffat, 2005; Moffat, 2003). The NCO is moving some military organizational thinking towards the concept of Network Centric Warfare (NCW) (Alberts and Hayes, 2003; Atkinson and Moffat, 2005; Moffat, 2003) suggesting that the rapid decisions required in fast moving combat situations are best addressed by the technology itself. There are critics of NCO (Smith, 2003) who argue against totally adopting this structure due to its technological determinism assumptions where importance is placed more on the technology and less on the person. The basic critique is that all decisions should not be deferred to network technology but human intervention in decision making is often required. Leaders and commanders obtaining information strictly from the technology miss the important communication cues that can only come by close interaction with SDUs and others through video and teleconferencing as well as physical visits to the various locations in the battlefield or disaster response site.

The HRO as an organizational type recognizes that failure in one part of the organization quickly affects other parts of the organization. In HROs the tight coupling of organizational components (humans and technology) magnifies both error as well as success. The robust training that occurs in the military tacitly recognizes this and seeks to minimize error by constant practice, rehearsal, and simulation. The concept of the HRO was first identified by Perrow (1984) and recently addressed in (Brierly and Spender, 1995; Brierly et al., 2005). Brierly et.al.(2005) suggest the following HRO characteristics:

1. Complexity
2. Technological sophistication
3. Tight Coupling (this is not a decision process, this is one of many methods of coordination and different types of coupling can be used such as slack resources, programmed response, feedback, etc. The underlying network with today's technology can be highly flexible forming up for a particular problem and reconfiguring with a different problem in real time. Coupling is concept as originally defined for fixed networks. We have the flow of authority and feedback in emergency networks and not just decisions and resources.

Items 1 and 3 are found in military organizations especially during times of war and in battlefield conditions. Item 2 has been and is continually being introduced in the military where it is leading to the concept of the "warfighter"(Alberts and Hayes, 2003; Atkinson and Moffat, 2005; Moffat, 2003). The warfighter suggests that an important component of the organization is the SDU (the pilot, soldier, Marine, sailor) whose actions are enabled by and through technology almost like a cyborg. The HRO tight coupling then begins with the human technology interface at the "individual" level and then continues through other organizational components and collectives. The HRO and resulting "warfighter" argues for C2 parallelism in communication and response. A parallelism not found in the bureaucracy.

Weber (1947) suggested that bureaucratic organizations possess at least 6 basic features and that these features can generalize, in varying degrees, to all organizational types. March (1965) in turn identified a wide range of organizational types showing differences in focus and motivation but certainly suggesting the vital role played by culture. Alvesson (2002) in turn does a very comprehensive analysis resulting in a detailed explication of organizational culture.

NCO and HRO are concepts enabled by emerging and adaptable structures that in turn can be represented by the features suggested by Max Weber (see table 1). In table 1 I compare NCO, HRO, and The Bureaucracy against Weber's features.

Weber's 6 basic features of organizations are as follows:

1. Hierarchy of authority
2. Rules or procedures
3. Division of labor and specialization
4. Systems of impartial and universalistic decision making
5. Employees hired on the basis of professionalism and technical qualifications not personal contacts
6. Principle of efficiency, maximizing output using limited inputs

These six features are enabled within the three emerging organizational constructs with different emphasis being placed upon one feature over another.

Table 1

Features	**NCO**	**HRO**	**Bureaucracy**
1. Hierarchy of Authority	Emerges from the network	Inverted structures often emerge	Traditional hierarchies
2. Rules and Procedures	Emerges from the network	Can be rigid or adaptable	Compartmentalized rigidity
3. Division of Labor and Specialization	Suggested by network	Often in federated structures	Rigid often resembles smokestacks
4. System of impartial decision making	Embedded in the network technology	Can be structured or adaptable (both human and technology based)	Often tightly structured and highly routinized
5. Employees hired impartially	Depends upon organization	Depends upon organization	Depends upon organization
6. Principles of efficiency	Embedded in the network	Embedded in the organizational structure	Embedded in the organizational structure

Table 1 shows that for features 5 and 6 there is little difference across the three organizational types. They begin to look different when compared across features 1 through 4.

Comparison of Features - The first feature, Hierarchy of Authority, suggests that for traditional bureaucracies a structure such as figure 1 emerges.

Figure 1

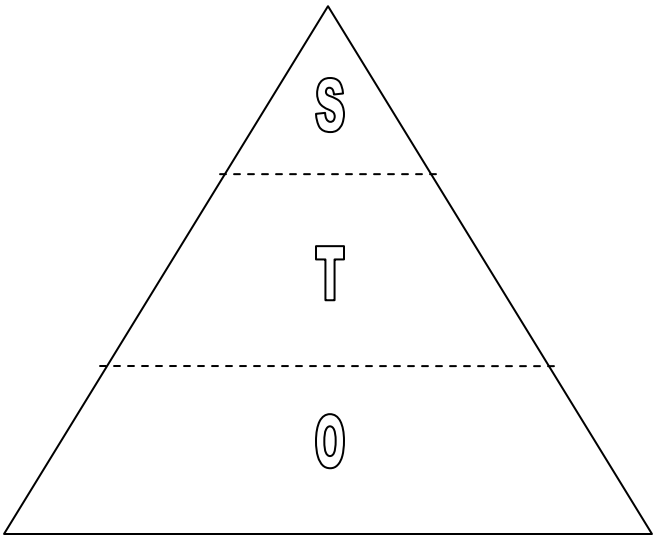

Figure 1, Standard Organizational Model

The S stands for the strategic level, the T for the tactical, and O for operational. This figure shows operational personnel which in emergency situations are the SDUs at the bottom. As one moves up the organization middle level personnel address tactics and senior level personnel strategy. The underlying assumption is that the lower levels support the upper levels.

In the HRO this structure may be encountered as well as an inverted structure shown in Figure 2.

Figure 2

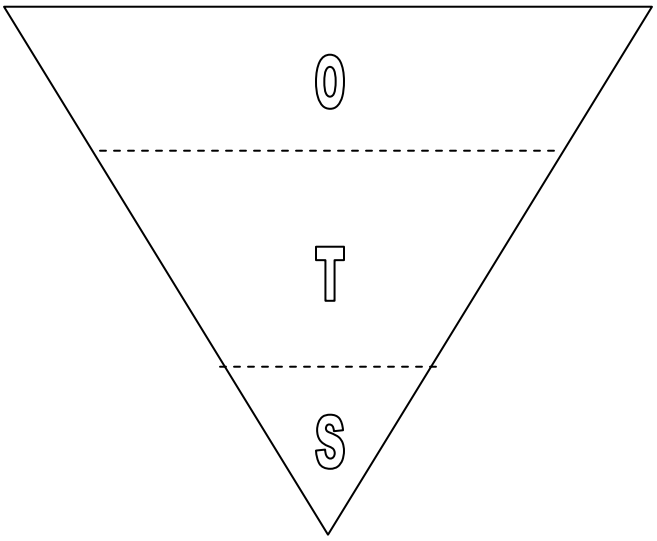

Figure 2, Inverted Organizational Model

It is not just inverted with respect to decision authorities but its operations determine what is tactical and as well as what is strategic at the current time. Even strategy can be changing dynamically like in the anthrax threat with the arguments on policies between the FBI and the CDC.

This inverted structure, when present, reverses the one shown in Figure 1, where tactics and strategy are supported by operations. In figure 2 the opposite is true, strategy and tactics support operations which mean that because it is now placed at the top of the hierarchy, operations becomes the most important and since this is carried out by the SDUs their role rises to a preeminent position. This inverted structure now becomes similar to the military during combat operations where the SDUs as “warfighters” rise to organizational importance.

Both traditional and inverted structures may be present in the NCO as well as HRO.

The second feature “Rules and Procedures” suggest a “compartmental rigidity” within bureaucracies that is in direct opposition to the adaptability and flexibility required in responding to emergencies. The HRO in contrast may be rigid or flexible. This is often times found in the military (Useem et al., 2005) where there tends to be rigidity and hierarchy when not involved in battlefield or other military operations. However when actualized in battle the military as an HRO becomes both flexible and adaptable in following rules and modifying the rules as the situation changes. The NCO leans to adaptation to situations as network elements reorganize to changing situations.

The third feature. Division of Labor and Specialization, indicates again rigidity and specialization in bureaucracies as well as encouraging a “smokestack” mentality that can deter collaboration required during emergency response.

The HRO does show similar tendencies but allows for federation to occur suggesting that organizational structures can be created that are clones of the "parent" organization. This is indicated by military C2 processes and functions that duplicate themselves, each functioning at operational, tactical, and strategic levels and that interact as separate autonomous structures with each other. Within NCO the goal seems to be the replacement of people with technology and when this occurs role structures, so vital in emergency response and battlefield conditions, need to be reestablished and relearned. This too can affect response especially when role uncertainty surfaces.

The fourth feature, A System of Impartial Decision Making, is often very structured and highly routinized in the bureaucracy leaving very little room for adaptability during emergency situations. The HRO realizes that both structure and adaptability is important and leaves room for both to occur. The NCO is very adaptable which as previously mentioned is required during emergencies but not at the expense of roles and role structures.

Implications of C2 as Organization to Emergency Response and Emergency Management

Enabling the edge of the organization, adaptability to changing situations, and high reliability are integral components of military C2 organizational structures. In addition the ability to rapidly "federate" key structural components according to changing emergency situations needs to be developed in emergency response organizations. Scenario development and training that test the ability of emergency response organizations to respond to different scenarios is an area of pragmatic research that needs to be explored further.

OVERALL SUMMARY -

In C2 as process Boyd's LOOP was introduced as a way to obtain situational awareness before your opponent which could be a military enemy or natural/man made disaster. The critical success factor is situational awareness. What it means, how it is obtained, and how it is used.

In C2 as function, leadership decision making (Useem et al, 2005)and the "commander's intent" must be present in all C2 function constructs. Though the "command center" suggests a focus on technology integration, more important are the ways technology as tools are used as parts of leadership decision making and how they can be used to help develop and communicate the "commander's intent".

In C2 as organization, more research is required into the HRO and the emergence of federated organizational structures that can function as autonomous as well as collaborative entities. For non military organizations it becomes important to take a systems view of the part of the bureaucracy that may be enabled during emergencies and then ensure that those entities are organized around an HRO model.

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