Insights Into Optimum TOC Environments

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Abstract

As the Services continue toward fielding automated C4ISR systems, it is important that the leadership integrate cognitive engineering insights bearing on decision making into the doctrine and training components of the systems.

Observations of seven command posts during three projects suggest certain command groups are better organized than others to receive, assess, and act upon large volumes of tactical information, and that the internal organization affects their performance. Differences appear to be attributed, in part, to the layout of the spaces, the location of staff personnel within the CP, and the manner in which the groups interacted on information presented by the C4ISR system. Historically, however, the Services have been loath to prescribe detailed procedures for the layout of CPs and for executing tasks related to command and control.

Two C4ISR systems have been observed. One, the Army Battle Command System is close to achieving full operational capability. The second, the Mounted Maneuver Battle Lab's simulation/command and control system, configured around the modular semi-automated forces (ModSAF) system facilitates experiments in the 2015 timeframe.

The paper identifies seventeen "insights," irrespective of C4ISR system, for commanders to consider in laying out their CP and revising their unit SOPs for command post operations.

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1. **Introduction**

This paper summarizes insights developed during four Advanced Warfighting Experiments (AWEs) relative to the optimum environments for *efficient*, *proficient* Battle Command in digitally supported Army Tactical Operations Centers (TOCs). The discussion is arranged in three sections. Section 1, after a brief background, presents the insights as a set of premises. Section 2 describes the TOCs observed during the AWEs and provides amplifying comments related to the insights. Section 3 reviews the role of expertise in decision-making and relates the discussion to the insights as well. The insights, outlined in par. 3.0, are intended as input to the development and training communities as the Army (and Marine Corps) presses on with the development of robust digital systems for command and control of tactical operations.

For purposes of this paper, a TOC environment includes two elements. The first is the commander's leadership style: a combination of the commander's values, behavior, personality, and communications style. It includes the commander's capacity for grace under pressure and presence of mind in combat. The second element is the combination of TOC layout and TOC SOPs for Internal Operations, particularly with respect to manning, information flow, and current operations decision-making. As a working definition, an optimum TOC environment is a combination of commander's leadership style, TOC layout, and SOPs for internal operations that results in *efficient, proficient* current operations decision-making.[1]

The objective of efficient, proficient decision making, in the frequently quoted phrase, is to "get inside the enemy's 'OODA' loop." Thus, an embedded purpose for this paper is to relate the OODA terms—observe, orient, decide and act—to the processes that actually occur within a TOC during current operations.

A second purpose is to highlight the necessity for the commander to ensure that he taps the tactical and technical proficiency available to him from the other officers and senior non-commissioned officers within the TOC. Observations during the AWEs confirm what most readers would consider obvious, that the placement of key staff members in a TOC is important. The observations also suggest that there appears to be no consistency in the manner in which they are placed, and this should not be the case.

1.1 ***Commander's Leadership Style***

Recommendations pertaining to the commander's leadership style are well beyond the scope of this paper (although commander's expertise is discussed in section 2). It is important to acknowledge at the outset, however, that the commander's leadership style has a profound influence on the climate within a TOC. The influence can be positive or negative or both. Leadership style is highly variable. No two officers conduct themselves in exactly the same manner when commanding American military units. The range of acceptable, effective styles is remarkably broad. Styles are manifest in the commanders' preferences for receiving and discussing

[1] "Efficient, proficient current operations decision-making" is a conceptual goal, not a rigorous term. Treating it as a concept for the moment permits the writer to generally describe it while excusing him from committing to a rigorous definition. A rigorous definition is possible, but is best left until a consensus begins to develop as to exactly what the detailed components of decision making during current operations should be.

information, providing guidance to subordinates, making decisions, and supervising the execution of the decisions. The commanders' leadership styles are also evident in other *behaviors* during these processes. Some styles generate confidence, initiative, and selfless team effort among subordinates. Some styles inflict undue stress on subordinates and result in sub-optimum performance. In this light, the rhetorical question is whether the range of differences in style (the first element of a TOC environment) should continue to influence the degree of variability in the second element: the TOC layout and SOPs. That is, with the increasing levels of digitization and speed of information, should the Army and Marine Corps continue the tradition of allowing each commander to prescribe the layout of his TOC, or is it time for some degree of standardization of critical functions?

1.2 ***TOC Layout and SOPs for Internal Operations***

This paper presents the view that guidelines should be observed in the layout of a TOC to optimize input to the commander during current operations from key staff and liaison officers. The guidelines, referred to at this point as "insights," stop short of recommending standardized TOC layouts. Service custom and tradition probably is not ready to surrender this prerogative of the commander, but some degree of common layout makes sense for two reasons. First, as this paper describes, certain configurations appear to facilitate quicker, better decision-making (which, in turn, generates more efficient *tempo*). Second, more uniform TOC layouts and SOPs for Internal Operations facilitate standardization in training. Neither of these worthy ends impinges on the substance of Battle Command, that is, the commander knowing ***if*** to make a decision, then ***when*** and ***what*** to decide.

1.3 ***Relating OODA Terms to the Actual Commander-Staff Process***

"Get inside the enemy's OODA loop!" This means that during the execution phase of an operation—when the carefully crafted operations order begins to become frayed due to the initiatives of a thinking adversary—the decisions necessary to keep the friendly concept of operations on track must be made **faster and better** than the enemy's decisions. If the friendly unit commander is consistently able make necessary decisions faster and better (that is, more efficiently and proficiently) he will achieve the actions captured in this definition of "maneuver warfare:"

> ". . . action that seeks to collapse the enemy's cohesion and effectiveness through a series of rapid, violent, and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot adequately cope."

Fortunately, the natural inclination among commanders, and much of the effort the Army invests in the preparation of its officer corps, places in command officers who are attitudinally prepared to make faster and better decisions. So, how do commanders make decisions during current operations?

Extensive research and observations indicate that once an operations order commences execution, decision making rarely reflects the formal procedures described in the Military Decision Making Process (MDMP). Research shows a strong orientation by commanders to identify a single course of action (COA), and direct their staffs to flesh out the details. Generally, as the friendly force moves from the abstractions of the pre-D-day, H-hour planning process to the realities of contact with the enemy in a fluid situation, the commander tends to shift to a style of decision making that has been described as "naturalistic," thus the term "Naturalistic Decision Making."[2] This style has been described in a series of articles and books in recent years, the most prominent by Dr. Gary Klein. Dr. Klein coined the term "recognition primed decisions (RPD)" to describe this natural inclination among decision-makers. The RPD model is a general framework considered to be applicable to most decision-making situations, regardless of domain. The model commences at a point where the decision maker is experiencing the current situation in a changing context.

RPD decisions are composed of four key <u>cognitive</u> processes, that is, thought processes in the mind of the decision maker.[3] The RPD processes paraphrased to a TOC environment are:

1. <u>Recognizing the Situation</u>. Once execution commences, and the situation begins to develop, the decision maker recognizes the situation, and understands the implications of the information flowing into the TOC with respect to his concept of operations.

2. <u>Envisioning a Single COA</u>. The decision maker typically tends to generate a single course of action to address the situation, not multiple courses of action.

3. <u>Simulating the COA Mentally</u>. The decision maker evaluates the course of action by mentally simulating the action-reaction sequence of the COA. The decision maker rarely uses a formal analysis to support the evaluation

4. <u>Deciding based on Acceptability, not Optimality</u>. The commander may refine the COA based on problems identified during simulation, but will accept the COA once it is satisfactory, not optimal.

While RPD tacitly recognizes that other cognitive factors influence decision making, to include plans prepared before the action, it does not speak to them. Others have commented that in a military context, other cognitive processes that influence current operations decisions include the following:[4]

1. the role of education and experience in shaping "values" that a decision maker has in mind during the decision process,

2. the influence that goals and prior planning have in shaping the cognitive approach to the changing situation,

3. the implications of situation monitoring in decision making, and

4. strategies decision makers use to cope with uncertainty.

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[2] The writers are not clear when the term was coined, probably in the 1980s. An excellent source of insight into the community of persons actively involved in research on NDM is Zsambok and Klein, 1997.

[3] This discussion does not do justice to the content of Dr. Klein's seminal work. The reader is strongly encouraged to read any one the Klein papers cited in the references.

[4] " Others" refers specifically to Beach, 1990, 1993; Rouse & Valusek, 1993; and Lipshitz & Strauss, 1997.

Leedom *et al.*, June 1998, contains an "integrated cognitive model" of the decision making process at the Army brigade and battalion levels. It features RPD at the core of the process, and is buttressed by the four additional cognitive elements. In addition to the cognitive model, this document describes the *de facto* "commander-staff group process" model of the current operations decision process, as well. The *de facto* model was useful as a sounding board during the development of the cognitive model, because at the time the study was being conducted, the Army did not have an explicit doctrine for decision making during current operations. Parenthetically, the observations of actual decision-making in brigade TOCs necessary to develop the process model were largely completed by a military SME prior to his having studied the various papers on RPD decision-making. These observations were reported to the ARL Program Manager for Cognitive Engineering in a trip report after the 1997 FORCE XXI Division Advanced Warfighting Experiment (DAWE). Although the observations described a commander-staff group process (analogous to the Military Decision Making Process (MDMP) used in planning), the activities reported were consistent with behaviors representative of RPD decision-making at work.

Similar decision making activities were observed in subsequent exercises. It was noted repeatedly that in time-constrained situations, commanders tend to size up a situation, then describe a single COA to their staff, discuss it briefly, then direct the staff to wargame the COA to work out the detailed coordination. The wargame is normally very truncated. Major problems are reconciled, and the staff completes the fragmentary order.

The *de facto* commander-staff group process for the current operations decision sequence has five steps:

1. Monitor. The commander and staff monitor the overall situation, specifically enemy operations in their area of operations and the progress of the subordinate and supporting units in achieving their assigned tactical tasks.

2. Assess. As one or more variances between the plan and the reported ground truth begin to be evident, the commander and staff assess the implications of the variance on the plan, and identify actions to deal with the variance.

3. Decide. Based on the assessment, the commander either announces a clear decision or describes a single COA to the staff to be wargamed. The commander has the latitude to describe two or more COAs, and the staff has the latitude to propose a COA(s), as well, but normally only one COA is prescribed.

4. Direct. With the wargame complete or not conducted, the decision is issued to subordinate units verbally or in writing. The staff normally completes the written fragmentary order for approval by the CO or the S3.

5. Execute. Subordinate units receive and execute their portion of the fragmentary order. The commander and staff revert to monitoring the situation.

Figure 1 is a graphical representation of the process. In this case, the OODA terms are superimposed over the appropriate steps in the decision process.[5]

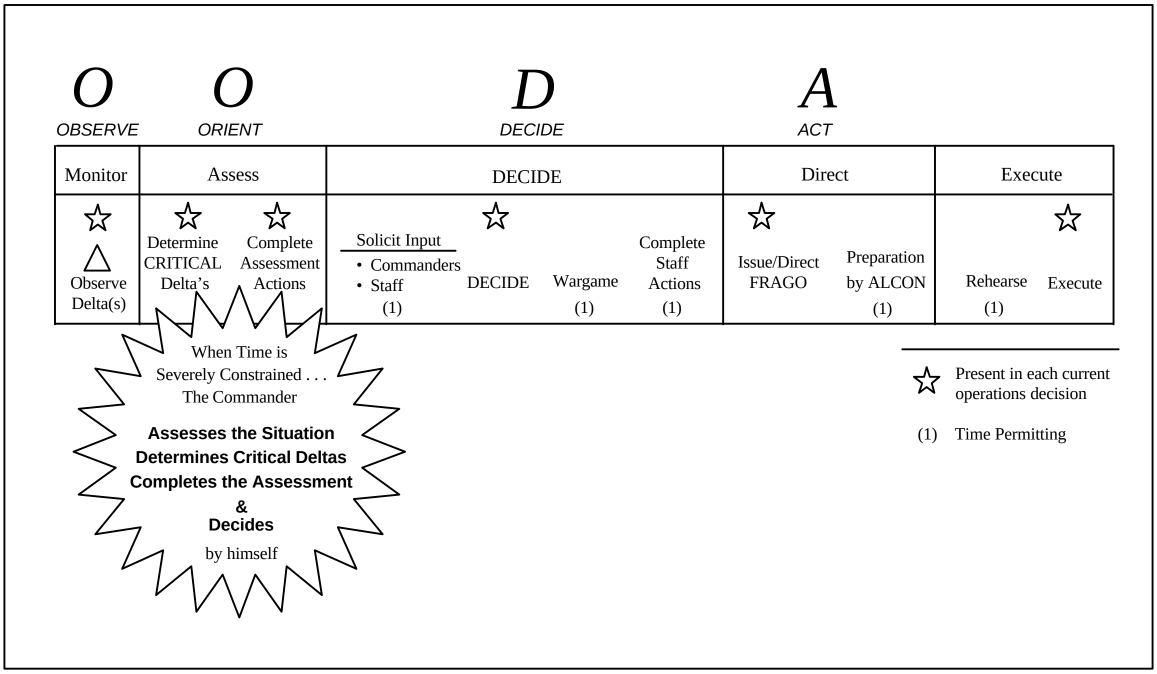

Figure 1. OODA Loop and the Commander-Staff Group Process Model

The importance of marrying up the OODA cycle to the commander-staff group process is that it links current operations decision processes—processes that can be developed into tactics, techniques and procedures (TTP)—to a widely accepted Art of War philosophical construct. Now, if we were to define the TTP, we would have the basis to measure performance within a TOC. The performance measures would be linked to the friendly commander and staff being faster and better in decision-making, and more efficient and proficient than an equally committed thinking adversary.

1.4 *Experience, Expertise, and Information* [6]

It is logical to expect that a relationship exists between efficient and proficient TOCs, and the experience and expertise of its members. Allowing for personnel rotation, the Army's officer development system is designed to place the best mix of educated, experienced officers and senior non-commissioned officers into operational units. Within the many constraints placed on the manpower system, the Army does an excellent job preparing, selecting, and assigning commanders and staff officers to the units.

[5] The integration of the OODA cycle into the basic commander-staff group process flow is the insight of Mr. William Connor, a doctrine writer at the U.S. Army Command and Staff College. He saw this obvious connection during his writing of the draft FM 100-34, Command and Control. Prior to seeing his crosswalk of the OODA terms to the diagram, OODA had been an appealing idea to the writers, but too abstract to be understood in terms of what actually occurs in a TOC. Mr. Connor neatly cross-walked the OODA concept to a decision making model.

[6] See par. 5.1 for a brief review of two papers from the cognitive science literature addressing the development of expertise and decision-making expertise of commanders.

Notwithstanding, a colonel's tactical and technical proficiency will carry his command only so far during current operations.[7] A colonel is not so much an expert as he is the most broadly experienced person in the command and is the single person vested with decision-making authority. More than anyone else in his command, the colonel understands how all the pieces fit together, but normally he has less proficiency in the combat support and combat service support units comprising his command, than in his own basic branch. He does not have the comprehensive expertise to fully understand the implications of each element of information that comes into the TOC during current operations, particularly when the information bears significantly on one or more supporting units. During current operations, the colonel **needs** both the tactical and technical proficiency that the "battle staff" officers possess across all operating systems, and their detailed knowledge of the plan.[8] And he needs much more. He needs their help in understanding the situation and providing input with which to shape his decisions. They, in turn, need to be present when information is received. They need to see or hear the information in order to provide appropriate comment on it from their perspective. In this context, our premise is: "The ideal decision making environment is comprised of . . .

- the experienced and competent colonel,
- experienced and competent battle staff officers,
- a Relevant Common (Visual) Picture (digital or analog or both), and
- the commander and all battle staff officers[9] having access to, that is – **hearing** –the same Relevant Common Verbal Information **at essentially the same time**."

[7] "Colonels" meaning colonels at brigade and regiment, lieutenant colonels at battalion and squadron.
[8] This paper is written with a brigade or battalion task force staff in mind. References to the battle staff and include the XO, S3, S2, S4 (or an S4 rep), S1 rep, signal officer plus the appropriate representatives from each unit attached to the command, or in direct support of it, plus all liaison officers from attached or adjacent units.
[9] And senior non-commissioned officers.

The Insights

2. *Source of the Insights*

During the period October 1, 1997 to August 31, 1998, the U.S. Army Research Laboratory's Cognitive Engineering Team conducted two projects to develop greater understanding of the decision making process in the digital environment within Army brigade and battalion level tactical operations centers.[10] The team worked in support of the TRADOC Program Integration Office – Army Battle Command System (TPIO-ABCS). The team's purpose was fourfold:

1. to describe the actual process of commander-staff interactions used to reach decisions and issue orders during current operations,

2. to develop a cognitive model of the decision making process at the brigade and battalion levels,

3. on the basis of the commander-staff interaction and the cognitive model, to recommend systems engineering approaches to the design of the human-computer interface for ABCS, and

4. to identify additional decision support tools and tactical displays not already planned for follow-on development and integration into ABCS.

The team participated as observers in the four Army Advanced Warfighting Experiments (AWEs) listed in Figure 2 and developed its insights and final report based, in part, on these observations. See Leedom *et al.*, June 1998.

AWEs and Exercises	TOCs Observed	Dates
FORCE XXI DAWE	Brigade "A," 4th Infantry Division Brigade "B," 4th Infantry Division	Oct-Nov 1997
TOC Reengineering CEP (BCR I) (AWE)	Hypothetical 1st Bn, 5th Infantry (Mech) (Bn Task Force)	December-97
Prairie Warrior 98 (AWE)	CGSC "1st Squadron, 10th Cavalry"	May-98
Battle Command Reengineering (BCR II) (AWE)	3d Bn, 66th Armor (Bn Task Force)	June-98
Prairie Warrior 99 (Not an AWE)	Brigade "C"	May-99

Figure 2. TOCs Observed During AWEs and Prairie Warrior 99

[10] The team was comprised of the ARL Program Manger for Cognitive Engineering, three ARL scientists, a George Mason University professor, and two research associates from Dynamics Research Corporation.

In a subsequent phase of the cognitive engineering effort, the team employed a data collection instrument developed by the ARL program manager to collect empirical data on decision-making. The intent of this phase was to refine the instrument such that it could be used as the basic data collection tool in subsequent advanced warfighting experiments (AWEs). The ultimate purpose of collecting the data from many AWEs is to move the analysis and discussion of decision making from a largely anecdotal basis to an empirical basis.

The first four AWEs occurred within a nine-month period. Prairie Warrior 99(PW 99) occurred eleven months after the final AWE. In the interim, the many observations recorded by the team, supplemented with additional reading, was the substance of continued discussions and analysis among the team members. Thus, PW 99 presented the environment to tie together loose ends from the previous AWEs, and apply insights that percolated over the months. Unexpectedly,
PW 99 also highlighted two obvious elements of commander-staff interaction that had not been discussed earlier to any appreciable degree. One is that the flow of verbal information between the commander and his battle staff is as critical as the display of visual information. Two, it is relatively easier to bring all visual information to a central point than it is to bring all relevant verbal information to the same area.

Prior to PW 99, when comparing observations made during the first four AWEs, five general elements stuck out that were common to each experiment and bore on decision-making. The AWEs had other elements bearing on decision making that were either taken for granted in the earlier exercises or simply did not come to mind. The following are the decision process elements that appeared to be most salient in the four AWEs:

1. Each had a commander supported by a staff; all with the requisite level of training in current Army decision-making process(es).[11]

2. The commander, supported by the staff, made all decisions within a TOC or a C2V, and the commander had access to each member of the staff throughout the exercise, though certain members were not always in close proximity (conversation range) to the commander.

3. Each had digital systems with which to visualize the battlespace and the friendly and enemy situations. In the case of the DAWE and the two PWs, each had redundant analog “systems” comprised of paper maps, and acetate overlays (and doctrinal procedures for depicting operational graphics and unit locations).[12] Due to the futuristic focus of the two Battle Command Reengineering (BCR) experiments, paper maps were used very little (if at all) during the planning phase, and were not used at all during the rehearsal and execution phases of an experimental trial.

[11] This is an obvious element, but it is necessary to state it in order to make comparisons among the different configurations in which commander-staff groups were organized, particularly when comparing the DAWE staffs to the BCR I and II staffs. See Section 2.

[12] During the DAWE, Brigade “B” appeared to use its analog situation map “system” as a back-up, relying to a considerable extent on MCS for current situation information. Conversely, in Brigade “A,” the analog current situation map was essentially the primary system, and MCS was the back-up.

4. Each had tactical radios linking the commander to senior and subordinate commanders.

5. Each had informal, commander-directed procedures for decision-making, but no written SOPs as such.

In effect, at the commencement of PW99, the importance of battlefield visualization and the potential for automated systems to provide it was well established, as were capabilities and limitations of the ATCCS systems. Also understood was that due to the inherent latency in the flow of unit location data in the Maneuver Control System (MCS) component of ATCCS,[13] commanders could be expected to rely on the tactical radio to keep abreast of the situation at the subordinate unit level.[14] The importance of internal procedures to keep the entire staff pulling in the same direction were certainly understood, but at that point no consideration had been given to the relationships among the following:

1. Years of experience among the commander and the battle staff officers,

2. Tactical and technical proficiency of the commander and each battle staff member within his basic MOS,

3. Verbal communications within the TOC,[15]

4. The necessity of **all members** of the commander-battle staff group to be prepared **to filter certain pieces of information** AND **to interact within** the battle staff based on combat information which passed the staff's filters, and

5. The necessity for the TOC layout to facilitate each battle staff member's ability to monitor and assess all relevant **visual** and **verbal** tactical information flowing into the TOC (this includes the data filtering function delegated to each battle staff member by the commander).

The five items in this second list are also foundation elements of a good TOC environment, and had been present in varying degrees in the earlier exercises. They simply were not appreciated in quite the same way until the series of observations during PW 99 and the discussions among the ARL Cognitive Engineering Team members during the exercise. The second five elements plus the first five are the starting point in the insights for a good TOC environment.

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[13] ATCCS: Army Tactical Command and Control System, is comprised of five component C2 systems (MCS, ASAS, CSSCS, AMDPCS, and AFATDS). ABCS, a larger system, is comprised of GCCS-A, ATCCS, and FBCB2. See Appendix A for long titles)

[14] The battalion commander in BCR II possessed near perfect situational awareness due to the unique capabilities in the ModSAF simulation. He could see the friendly and enemy situation in each company area of operations just as clearly as the company commanders could. Notwithstanding, he relied extensively on tactical communications with his company commanders to maintain a sense of the battle from their perspectives.

[15] This includes verbal communications flowing into the group via tactical radios as a well as communications among the group members.

2.1 *Insights First; Description and Discussion of TOC Environments Second*

It would be logical to describe the TOC layouts and the activities within the command groups before listing the insights. In this case, the insights are provided first, in paragraph 3, trusting that when the logic is not immediately apparent, the reader will press on to the observations and discussions of the TOCs in paragraph 4.

3. **Insights into the Optimum TOC Environment**

Optimum TOC environments were defined in the introduction as the combination of commanders' leadership style, TOC layout, and SOPs for internal operations that result in *efficient*, *proficient* current operations decision-making. The following paragraphs list the insights in terms of the overall objective, the major insights, and other insights.

3.1 *Objective*

The objective is to achieve the highest level of situational awareness possible among the commander and battle staff in order to facilitate efficient exchange of tactical information and to generate timely decisions. Included in the objective is to ensure that, in addition to the commander, <u>all</u> <u>battle</u> <u>staff</u> <u>members</u> . . .

1. Have access to the same Relevant Common Picture (RCP)—digital and analog (paper map and acetate cover, with operational graphics and unit symbols).

2. Have access to the same Relevant Common Tactical Information (RCTI)—digital and analog, written, and verbal.[16]

3. With respect to staff officers, that they complement the commander's broader experience with their expertise in their staff functional area and their knowledge of the synchronization details of the plan pertaining to their staff functional area.

4. With respect to supporting unit liaison officers, that they complement the commander's broader experience with their expertise in their BOS area and their knowledge of their unit's specific tasks, the role of the tasks in the overall synchronization of the plan, and their unit's specific capabilities and requirements.

5. Are able to synchronize operations <u>extemporaneously</u> once the current situation exceeds the synchronization described in the current operations order.

[16] RCTI appears only in this paper; it is not a recognized acronym.

3.2 ***Major Insights***

Commander's Leadership Style

While not a specific insight, it is necessary to acknowledge that a major determinant of TOC environment is the leadership style of the commander, and that no two officers conduct themselves in exactly the same manner. Notwithstanding that these styles are different, the remaining rules of thumb apply across all leadership styles. The reason is that at some point, the command and control system has to be designed to optimize the ability of the staff to support all command and control activities during current operations.

Visualization

The basic ideas are:

1. In cases where the commander has the latitude to make a selection, it is recommended that the primary "battlefield visualization" system—digital or analog—be determined based upon the speed with which the unit's friendly situation can be updated. The widespread impression is that due to inherent system latency problems, ATCCS is currently slower in up-dating friendly unit locations than an efficient TOC battle captain, supported by a competent communications officer. Once the digital system begins to approach the analog methods in speed of up-dating friendly unit locations, commanders should shift to digital systems as the primary system for battlefield visualization—BUT, retain the analog system as back-up.
2. That all battle staff members must be able to (1) see the same information at the same time, and (2) focus at the same time on specific information being pointed out by a speaker. A simple pointer focuses attention on an analog map. As digital capabilities improve, and a staff can be distributed across several command and control vehicles (C2V), each key staff member needs an electronic pointer that can be seen on all map displays and white boards in the distributed network. The electronic pointer could be colored in order to differentiate between two or more persons pointing to areas at the same time. Also, the pointers could be coded to identify persons by position.

Verbalization

The basic idea is that all battle staff members must be able to hear all *relevant verbal tactical information* at approximately the same time. Verbal tactical information flows into a TOC through multiple channels, primarily radio nets and telephones. It is also inserted by visitors and persons returning to the TOC from visits elsewhere on the battlefield. Some is introduced by persons in the TOC after watching visual information, listening to and discussing other verbal information, analyzing it, then speaking their insights. To avoid overload, verbal information needs to be filtered. Information passing through the filters

is considered to be "relevant tactical information." The filtering process occurs both formally and informally according to unit SOP.
Appendix B contains a graphic and a brief paragraph describing the general approach to filtering of verbal information.

Monitoring Operations — Chapter 6 of FM 101-5, Staff Organization and Operations, provides a basic list of enemy and friendly activities and statuses that must be monitored during current operations. The list is too large for each staff member to monitor all activities and statuses at all times, but, at all times, at least one person needs to be monitoring each activity and status. The activities and statuses must be assigned to one, preferably two persons, to monitor throughout each watch in the TOC. It follows that these persons must inform the other members of the command group when an activity is outside the range expected at that point in time and when a new enemy activity is detected.

3.3 ***Other Insights***

Situation Map — Commanders should consider arraying their situation map horizontally. One brigade commander did so during the FORCE XXI DAWE, and as described in paragraph 4.1.3, appeared to achieve better commander-staff interaction. Figure 3 in paragraph 4 is an example of a horizontal arrangement. On reflection, the principal reason for displaying a situation map vertically is to conserve limited floor space in a TOC. Notwithstanding, discussion in paragraphs 4.1.1 and 4.1.2 permit the hypothesis that a horizontal arrangement may contribute to more efficient, proficient decision making during current operations.

Assigned Places in Current Operations Area — The CO, the battle staff principals, and the supporting unit liaison officers should have assigned places around the situation map. This permits all officers with responsibilities for portions of the plan to assess tactical information being discussed at the map, and to contribute to the discussion as appropriate. This assigned spot is the officer's principal place of duty within the TOC during periods of ongoing contact with the enemy and preceding planned or anticipated contact with the enemy. Clearly, the battle staff member is not anchored to the spot. He should be able to move about to get a clearer view of the situation as necessary, but in the main, he should be at the assigned spot in order to participate in the sharing and discussion of information.

Location of the CO — Assuming a horizontal arrangement of the situation map, then generally, the CO and the S3 should be located looking obliquely on the map in the direction of the attack (or if in the defense, looking in the direction of the enemy). If the map is arrayed vertically, the CO needs to be able to see the map, but he also needs to allow staff members to step in front of him to check and confer on details.

Aligning Maps and ATCCS Monitors	If the TOC is equipped with ATCCS systems, the monitors should be directly across from the CO so that he can look down at the map then up on the monitor by simply raising or lowering his eyes. The map and the screens should be in the same orientation with respect to direction. He should not have to turn his head to the left or right to see one of the principal screens.
Location of the S2	The S2 should be assigned a spot to view the map from the direction of the enemy.
Location of Command Nets	Handsets and speakers for the unit command net and the higher headquarters command net should be close to the commander, the S3, and the battle captain.
Headsets	Staff members at the situation map should have headsets with microphones. They should be able to monitor the current situation on the unit command net. Supporting unit liaison officers should be able to monitor the current situation on the unit command net, and they should be able to monitor their own unit's nets (artillery, combat engineers, ADA, etc.) They should be able to switch to a designated intercommunications channel to speak with other persons working in their staff or liaison section workspace.

This ends the insights; the following section provides a brief narrative and graphic description of each TOC observed.

Description of the TOCs and Discussion of the Internal Procedures

4. **TOC Descriptions and Discussions**

The TOCs listed in Figure 2 are described in this sequence:

FORCE XXI DAWE [17]	Brigade A Brigade B
BCR I and II	BCR II, 3d Bn, 66th Armor
Prairie Warrior 98	CGSC "1st Squadron, 10th Cavalry"
Prairie Warrior 99	CGSC Brigade "C"

4.1 ***The FORCE XXI DAWE***

The DAWE highlighted more clearly the relationship between efficiency of TOC layout and proficiency in decision making than other operational or training situations seen in thirty-five years of being in and out of Army and Marine Corps battalion and brigade/regimental level operations centers. Long accustomed to, and unquestioning of the traditional TOC layouts, it was a remarkable coincidence that not until the DAWE did we see a configuration so markedly different from any seen before.

The differences between the Brigade "A" and "B" TOCs during the DAWE were as opposite as two arrangements could have been. Brigade "B" had a traditional, tried-and-true look to it. Situation maps were arrayed vertically against tent walls and vehicle sides. Staff and liaison sections were arranged to minimize the overall footprint, yet facilitate as much synergy as possible among them. Brigade "A's" arrangement was totally different. The situation map was arrayed horizontally in the center of the TOC. Except for war movies with scenes of theater level headquarters, the writers had never before seen a ground operations situation map arrayed horizontally. As the DAWE progressed this brigade's rhythms became increasingly interesting to observe. For this reason, it is first in the series of TOCs described in this section.

4.1.1 ***Brigade "A"***

Figure 3 shows the interior layout of Brigade "A's" TOC.[18]

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[17]The Team's charter during the DAWE was limited to performing a detailed human factors analysis of the Maneuver Control System (MSC). The combination of the focused charter and the extraordinary pace of the experiment, which demanded the commanders' full attention, did not permit structured interviews with the brigade commanders. For this reason, the writers state reasonable assumptions with respect to the situation in several paragraphs related to the DAWE TOCs.

[18] The TOC is comprised of M-113 tracked vehicles and HMMVV vans backed-up to one another leaving a small area between them which is covered entirely by canvas. Within the space are field desks and tables with ATCCS monitors on them, and a variety of map and status boards arrayed on the vehicle and tent sides. The sketches are approximately to scale.

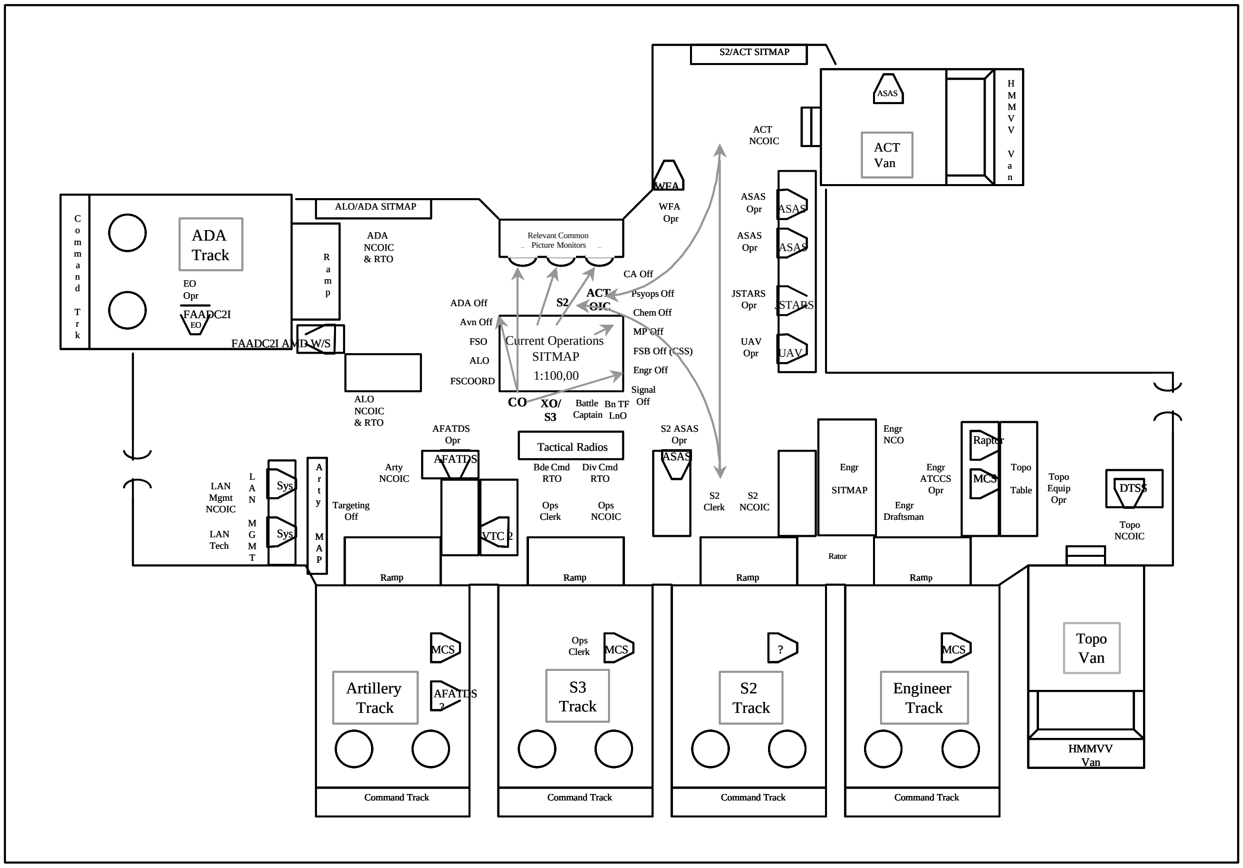

Figure 3. Interior Layout of Brigade "A's" TOC During FORCE XXI DAWE

Figure 4 focuses on the current operations area of the TOC.

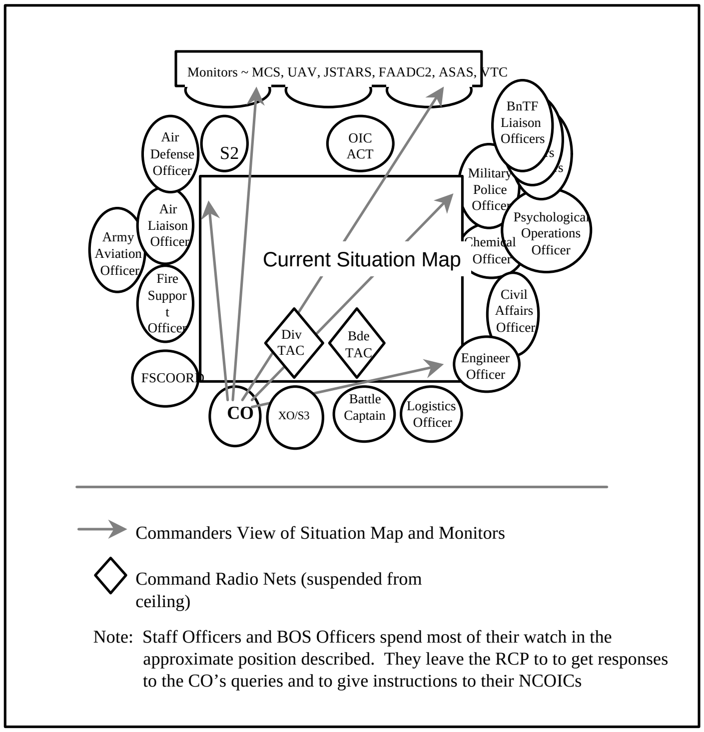

Figure 4. Current Operations Area in Brigade "A's" TOC During FORCE XXI DAWE

The commander and battle staff literally surrounded the situation map during periods of on-going contact with the OPFOR, and during periods prior to planned or anticipated contact. The top of the graphic indicates six monitors arranged in a rack. Five monitors facilitate the relevant common picture (RCP); the sixth is the video teleconference monitor. The five RCP systems in the rack were:

1. Maneuver Control System (MCS)

2. All Source Analysis System (ASAS)

3. Forward Area Air Defense Command and Control System – Engagement Operations (FAADC2S EO)

4. Unmanned Aerial Vehicle Surveillance Television Monitor (UAV Monitor)

5. Joint Strategic Targeting and Reconnaissance System Moving Target Indicator (JSTARS MTI)

Features of the current operations area that were noteworthy with respect to the optimum TOC environment include:

1. The CO had a clear view of both the digital and analog situations maps.

2. The key members of the battle staff were in easy speaking distance of the CO and equally important, one another.

3. All persons in the current operations area could hear the transmissions on the brigade tactical net.

4. The key staff members had back-up personnel monitoring combat information flowing into the section work area. These persons would bring the incoming verbal information forward to be filtered by the staff principal member who, when the information was relevant to the current situation, would announce it to others at the map.

5. Persons who had to lean over the map to assess detail could do so, and persons who needed greater detail generally had smaller scale maps readily available.

6. Information overload did not appear to be a problem. The group appeared to have a tacit, but effective information filtering process in place. One analyst's impression of the process, reconstructed eighteen months after the fact, is depicted in Appendix B

In practice, appropriate discussion appeared to be on-going throughout the periods of intense situation monitoring. During the most intense periods the discussion was always commander driven, yet officers were expected to speak up as they sensed important dimensions of the situation which to that point had not been addressed verbally by someone around the situation map. In retrospect, it does not appear that the Brigade had an explicit policy of the battle staff maintaining positions around the analog situation map. This positioning became the norm by the end of the first full day of the exercise. The result was that Brigade "A's" commander-battle staff group demonstrated the two most essential baseline criteria for an *efficient*, *proficient* TOC: the officers shared a common **visual** understanding of the situation, and they all had access to essentially the same relevant **verbal** tactical information.[19]

4.1.2 ***Brigade "B"***

In formally, we estimate that 98% of the colonels on active duty would have arranged their TOC similar to the manner chosen by the commander of Brigade "B." Brigade "B" was the first unit in the division to be equipped with the ATCCS systems, and as such was the Division's test bed. Because the DAWE was the first division-level test of the ATCCS, it is reasonable to assume that

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[19] Parenthetically, it is interesting to look at the diagram of Brigade "A's" TOC's current operations area, and think of analogies. It looks like a high tech scan of a human brain. The analogy to a human brain is apt given that the diagram depicts all the experience and expertise among the commander, his staff, and the supporting unit liaison officers, and understanding that they are sharing and discussing visual and verbal tactical information—all functions of a human brain.

Brigade "B" was expected to command and control its operations to the greatest extent possible using the digital systems, and using manual "systems" only as back-up. For this reason, it was unlikely that a visitor would find an acetate covered map as the centerpiece of Brigade "B's" battlefield visualization system. Figure 5 shows the interior layout of the Brigade "B" TOC.

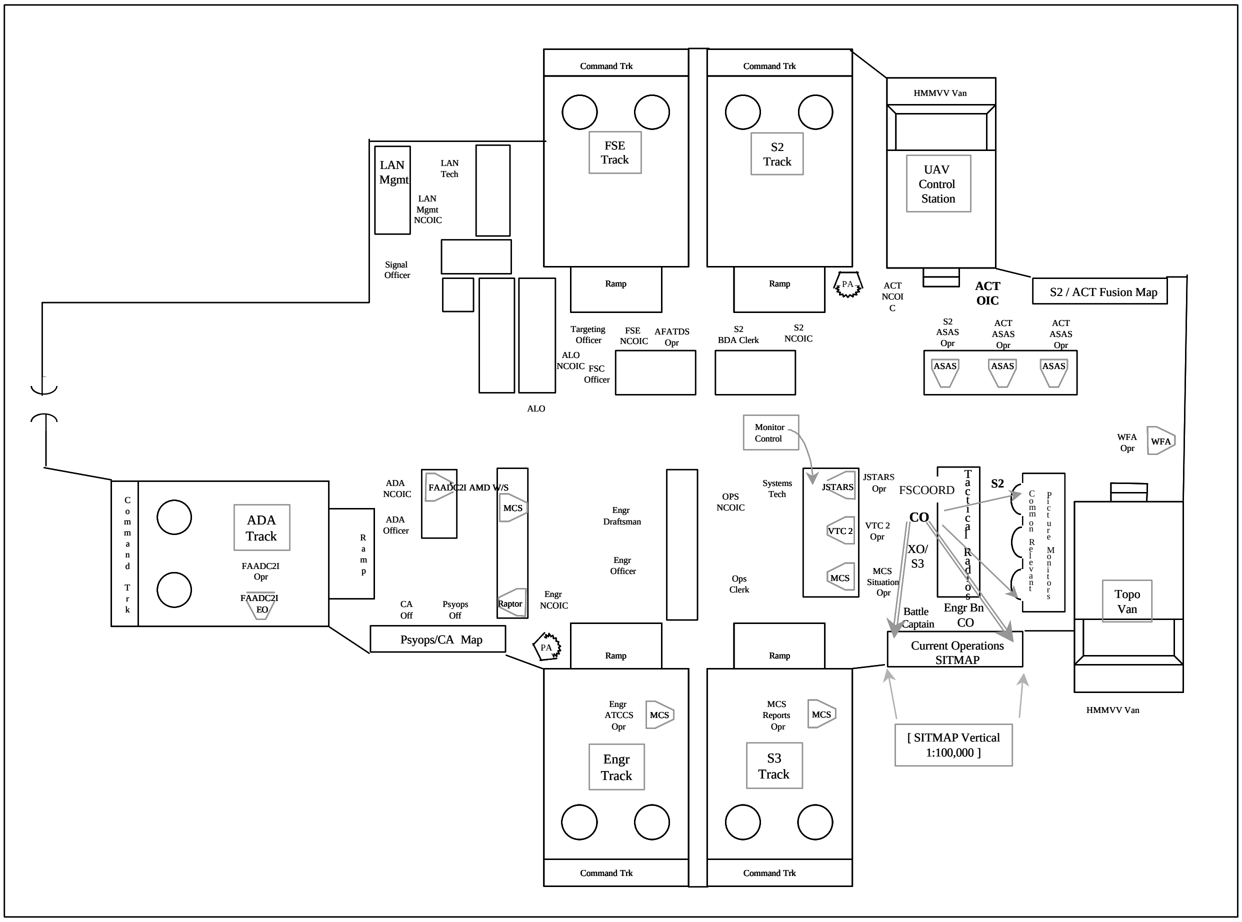

Figure 5. Interior Layout of Brigade "B's" TOC During Force XXI DAWE

Figure 6 focuses on Brigade "B's" current operations area.

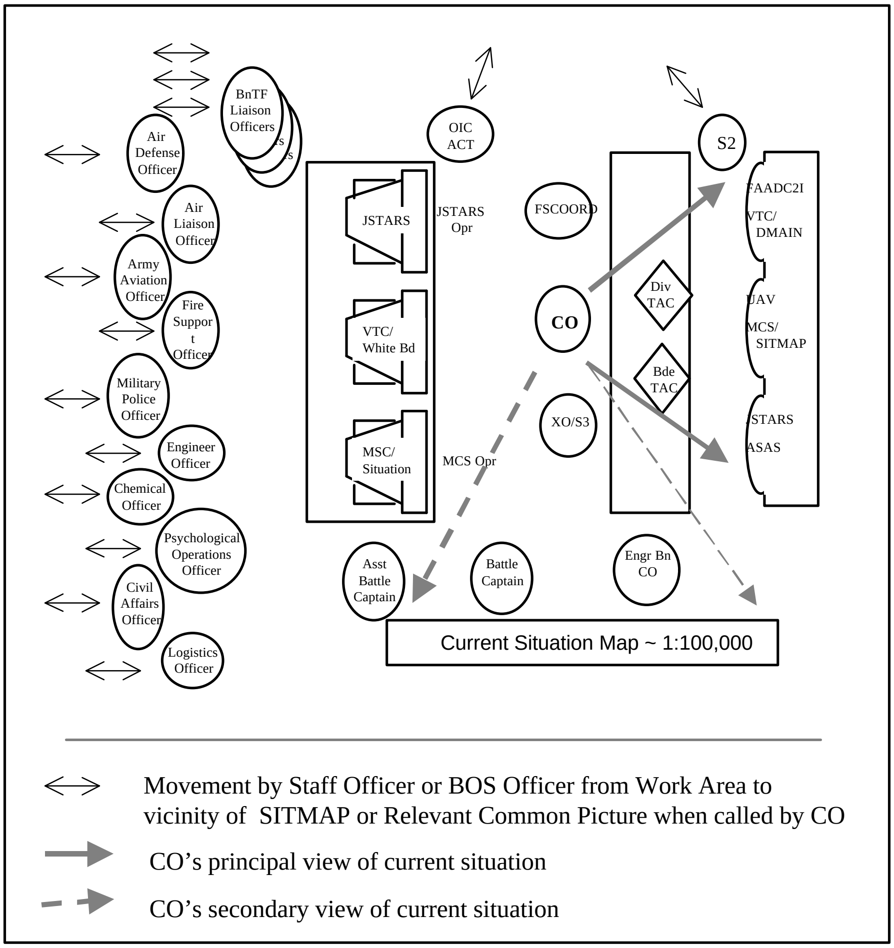

Figure 6. Current Operations Area in Brigade "B's" TOC During FORCE XXI DAWE

Again, it is useful to scan Figure 5 to see the layout of the full TOC. Then, looking at Figure 6, it can be seen that only four battle staff officers had positions close enough to the CO to see the same RCP and hear the same verbal tactical information. The remaining members monitored the situation essentially from their assigned section areas, but walked forward to the situation map area when contact became either imminent or on-going.

This arrangement appeared to have several disadvantages:

1. The CO had to turn his head to see the paper map, and thus had to reorient his view each time he switched back and forth.

2. The CO had to turn to speak with those key staff members who did not have places at the table. On occasion, key staff or liaison persons he wished to speak with would have to be summoned from their section work areas.

3. All persons in the current operations area could hear the transmissions on the brigade tactical net, but not all key persons, or their alternates, were present in the current operations area at all times. When not present, they were in danger of not overhearing key incoming tactical information that might easily bear on their specific functional area.

4.1.3 *Anecdotal "Results" and the OODA Loop*

The interesting aspect of these two TOC layouts is that in the informal "tallies" of combat results, Brigade "B" acquitted itself well, but Brigade "A" was thought to have achieved consistently better results. Again, many factors account for this unsubstantiated assertion. Nonetheless, it is interesting to hypothesize that the concentration of decision-maker, principal staff officers, and supporting unit liaison officers enabled them to make **better decisions** (due to all available experts assessing the information as it arrived) **faster** (due to the experts' input being instantly available to the CO).

This introduces the possibility that the Brigade "A" TOC environment might be an example of the much discussed OODA Loop in actual practice. The idea is that Brigade "A" might have enjoyed better combat results because their TOC environment enabled them to consistently *observe, orient, decide, and act* more quickly than Brigade B, and presumably more quickly than the OPFOR. Again, this is totally anecdotal. No data collection plan was in place to capture data linking decision situations to combat results.

4.2 *The Mounted Maneuver Battle Lab (MMBL) "Battle Command Reengineering" Experiments (BCRs)*

As background, the Mounted Maneuver Battle Lab at Fort Knox, Kentucky looks forward five to fifteen years in time to examine the combined effects of advanced command and control systems and advanced weapons systems on future doctrine and organization. Their lens for peering into the future is the "Battle Command Reengineering (BCR)" series of experiments. The objectives for the BCR experiments that bear on TOC environments are:

1. To obtain insights into the effects of improved Battlefield Visualization on Battle Command.

2. To evaluate implications of near-perfect situation awareness on Doctrine, Training, Leadership, Organizations, Material, and Soldiers.

3. To develop a more effective Tactical Operations Center through reengineering.

4. To determine the optimum staff design to meet the commander's information needs.

5. To determine automation hardware and software capabilities to best enable the staff to gather and present information to the commander.

By imaginatively integrating "soldier-in-the-loop" simulators with the Modular Semi-Automated Forces (ModSAF) system, the MMBL creates credible scenarios to test concepts for organization and tactics in the period 2010-2015.

In BCR I and II, the MMBL examined a reengineered battalion task force headquarters in which the commander and battle staff group was comprised of fourteen officers and senior non-commissioned officers. The commander and battle staff operated out of four advanced concept vehicles depicted in Figure 7.

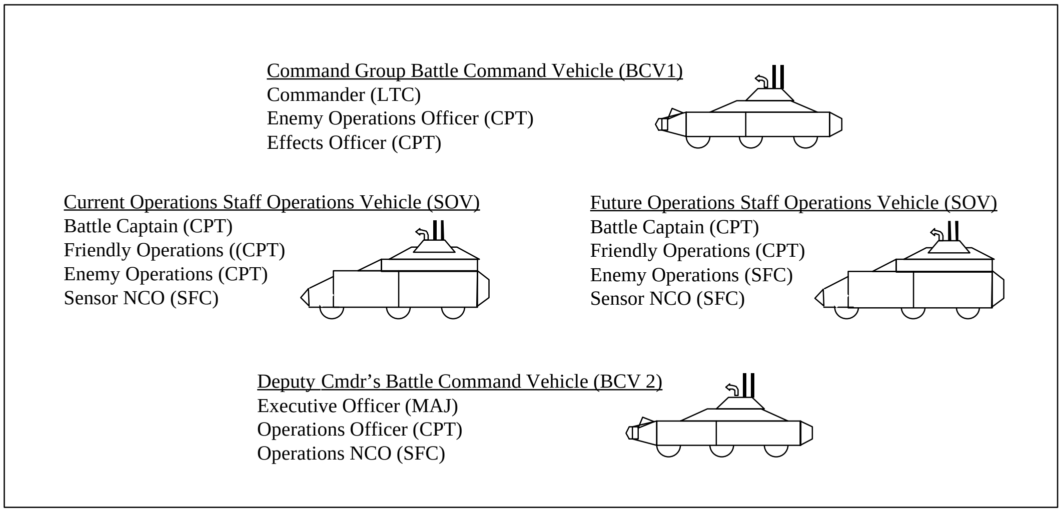

Figure 7. BCR Concept for Tactical Operations Center

The arrangement of personnel inside the vehicles and the command and control displays in front of each person are depicted in Figure 8.

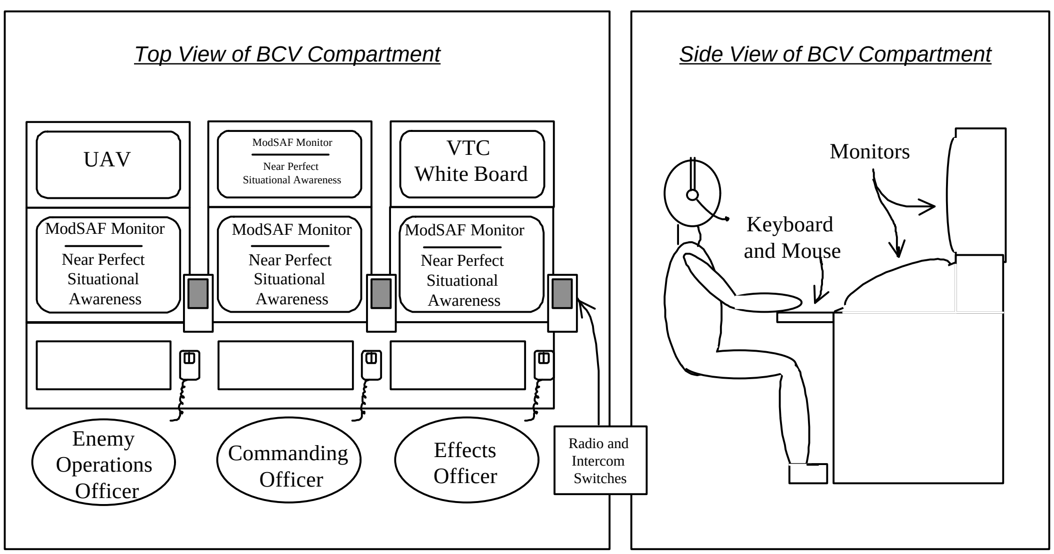

Figure 8. Internal Configuration of MMBL Battle Command Vehicles (BCV)

BCR II is the more useful AWE to describe for several reasons. First, collectively, the ARL Cognitive Engineering Team was further along in understanding both the integrated cognitive model (Execution Decision Cycle) and the pure process model(s) which describe commander-staff group decision making. Also, unlike BCR I, in which the participants were soldiers from the Armor Center assigned temporarily to the MMBL for the experiment, the soldiers executing the experimental trials in BCR II were members of a regular Army battalion task force—the 3d Battalion, 66th Armor from Fort Hood. This permits the assumption that the interpersonal relationships and verbal communications among the officers and enlisted soldiers were representative of such relationships in units throughout the Army. Finally, in addition to directly observing the officers in the commander's BCV intermittently during the experiments, one of the writers subsequently studied the videotapes of three BCR II experimental trials, and transcribed the transmissions heard on the battalion command net during one of the trials.

4.2.1 ***ModSAF Provides Near Perfect Situational Awareness***

For the reader unfamiliar with ModSAF, the system has a number of simulation and display capabilities which give the observer an overhead view of the battlefield and show the simulated movement and firing of individual vehicles. The display shows a small icon of each vehicle in the simulation database. The icon, a rectangle with a small line out one end to represent the main gun, howitzer barrel, or missile/rocket launcher, is scaled as much as possible to match the map scale on the screen at the time. The observer is able to watch as friendly vehicles move across the landscape in platoon and company formation. The simulation can be calibrated to show on the friendly unit screens the location and activities of enemy vehicles from the time they are acquired by an observer or by electronic sensor.

The simulation has visual effects to indicate the firing of main guns and the firing of indirect fire weapons. It also portrays battle damage on each vehicle from the moment of impact; the icon bends slightly, and darkens in color. As opposing units move into direct fire range of each other, the operator can see the engagement unfold on the screen. Main guns fire; targets "bend" showing they were hit. This all occurs automatically (within the semi-automated forces) based on commands entered into the system by a unit controller responding to orders from the unit commander. Using the mouse and cursor, and the PowerPoint technique to outline elements of a graphic with a temporary rectangle, the observer can circumscribe units or areas on the screen and get current material status reports for all the icons in the area. Using this technique, a friendly unit S2 can get instant battle damage assessment (BDA) on an enemy unit by simply circumscribing the unit on the vehicles on the screen. Configured in this manner, ModSAF delivers an extraordinary level of situational understanding. Finally, operational graphics can be drawn on the screen, saved, and distributed to the other stations on the network.

4.2.2 ***Tactical Activities Within a Three Hour Experimental Trial***

Each BCR was comprised of a two-week train-up period for the unit to become familiar with the simulation and the procedures, followed by approximately nine experimental trials. Each experimental trial lasted approximately three hours. One was executed in the morning; the other one in the afternoon. The MMBL developed the trials such that the tactical situation at the conclusion of one trial was generally the starting situation for the following trial.

Because the MMBL was exploring the impact of advanced weapons and sensor systems, the experiment design called for the friendly unit to be committed against forces far larger than are recommended in current doctrinal force ratios. The area of operations was at least twice as large as would normally be assigned to a battalion task force, and the force ratios were:

Blue in the Attack	Blue **:** Red **::** 1 **:** 2 (normally, the ratio is 3 **:** 1)
Blue in the Defense	Blue **:** Red **::** 1 **:** 6 (normally, the ratio is 1 **:** 3)

The events within each trial normally unfolded with the unit receiving an order from brigade at the outset. The tentative time of attack was normally one hour later. Within the first hour, the commander and his staff had to make hasty estimates of the situation, begin to deploy reconnaissance elements, develop an operations order, engage enemy units with indirect fire that their own reconnaissance had detected, and conduct a rehearsal—a very taxing mental effort.

The planning staff followed the commander’s guidance in preparing operations overlays which were then distributed electronically. The commander gave verbal operations orders for the entire battalion task force, an interesting challenge in its own right. The commander’s goal was to issue the order at H-40 minutes, and to conduct a radio rehearsal at H-15, that is, to discuss the plan step-by-step via radio with the company commanders. The rehearsals tended to be “chalk talks” using the VTC and laser pen pointers. The unit would normally cross the line of departure (LD) on time, one hour after receipt of the brigade order.

The ModSAF system enabled the commander and staff to “see” their entire AO. If they had emplaced their sensors well early in the first hour, they could see the enemy units and vehicles throughout the AO as well. In each experimental trial the enemy would commence deploying reconnaissance and advance guard units shortly after the trial commenced. This meant that from the time the Blue commander received his order from brigade to the time of attack, he and his staff could literally watch the OPFOR situation changing on the ModSAF monitor. This posed a very challenging and somewhat unnerving situation.

The abbreviated planning phase, the extended frontage and depth, and the large numbers of OPFOR units and vehicles invariably led to situations where the basic scheme of maneuver was in jeopardy before the time of attack. Invariably, the commander had to adjust tasks he had assigned in his operations order before the Blue units crossed the line of departure (LD).

The attack or defend mission was executed over the next one and a half to two hours. In each experimental trial the commander had to make a series of current operations decisions very early in order to keep his basic plan focused on his higher headquarters commander’s intent. In one experimental trial that was transcribed to record the content of all decisions, the battalion commander made 29 decisions that involved a change to the task or purpose or both that he had previously assigned his subordinate commanders. The distribution of the decisions is shown in Figure 9:

	Co A	Co B	Co C	Btry A		TOTAL
Preparation Phase	3	4	1	0	=	8
Execution Phase	10	5	4	2	=	21
TOTAL	13	9	5	2	=	**29**

Figure 9. Decisions Made by Battalion Task Force Commander During One BCR Experimental Trial

Near perfect situational awareness facilitated the "battlefield visualization" for this unusual series of decisions to unfold. In the absence of formal doctrine and tactics, techniques and procedures (TTP) for such an environment, the CO performed remarkably. He was successful in eight of nine experimental trials.

His "success" appeared to be due to two factors. First, obviously, the "near perfect situational awareness" helped him and his staff "see" what the enemy was doing throughout the AO. Equally important, in retrospect, were the layout of the BCV and the placement of key assistants on his left and right. This allowed them to talk among themselves during the monitoring and assessment activities. The inter-vehicle communications system allowed the staff members in other vehicles to monitor specific activities and information—CCIR, PIR, IR, EEFI, FFIR, etc. As they acquired the information, they would alert both the commander and his two key assistants early enough that they, in turn, could then focus on that element of information and assess the situation before it became a crisis.

4.2.3 ***Videotapes of the BCR***

The videotapes yield interesting information bearing on the discussion of the optimum TOC environments.

The video recorder was located in a fixed position behind the commander's right shoulder looking obliquely down at the monitors in front of him. The audio portion captured only the transmissions over the battalion tactical net. It did not capture the discussions on the vehicle intercom between the commander and the two officers on either side of him. Notwithstanding, the tapes show a remarkable amount of talking among the commander and his two key assistants during the monitoring and assessment phases preceding a decision. In a post-experiment report, one of the writers described the tapes as follows:

> ". . . one of the things that bothered me last Fall when I was transcribing the videotapes is that at various stretches in the tape, the tactical net would be silent, but I'd see "Lancer 6" talking to the "Effects Officer" then to the "Enemy Operations Officer."[20] Or I'd see the arm of the "Enemy Operations Officer" or the "Effects Officer," or both stretched across "Lancer 6's" monitor pointing to something and would see a discussion ensue. Then "Lancer 6" would come up on the battalion

[20] The "Effects Officer's" role combined the duties currently performed by the FSCOORD, the combat engineer, the air liaison officer, the electronic warfare officer, and the chemical officer (for smoke). The Effects Officer was able to handle this range of duties largely because of the near perfect situational awareness provided by the ModSAF monitors, the capabilities given to the advanced sensors, the range and lethality of the weapons, and the fact that the engineer portion of the system appeared to be somewhat under developed at this point.

> tactical net, and assign one of the company commanders a change to his task(s). I had no way to playback the discussion between the CO and his two staff officers, because the intercom discussions were not recorded by the MMBL. But the information in those discussions would have been as "informing" as the actual decisions. We would have heard exactly which "tactical delta(s)" he was monitoring. We would have heard the degree to which all three "assessed" the delta. It would have been <u>solid cognitive data</u> !!!"

The tapes also support the assertion that the commander needs the active participation of his entire battle staff during the intense monitoring and assessment phases of an anticipated or ongoing engagement or battle.

One of the unique aspects of the BCR "distributed" TOCs is the degree to which the commander can still be supported by staff members in adjacent vehicles. The transmissions on the tapes of the adjacent vehicles reflect that the staff members in the other vehicles who had specific monitoring functions frequently entered the net to apprise the commander of a developing situation. "Lancer 8" continually apprised the commander of the ammunition and fuel status of the company teams. As did each of the other staff members, "Lancer 8" understood the commander's concept of operations, and had been monitoring the current situation closely. For this reason, he was able to recommend the timing and location of resupply for the company teams and the artillery units that was least likely to interrupt the continuing series of engagements. Similarly, transmissions on the tapes of the artillery battery commander's vehicle (monitoring the "effects coordination" net) confirmed that the battery commander kept the "Effects Officer" continuously apprised of which firing units were on the move or were receiving resupply and were therefore in a degraded firing status.

The videotapes show that the commander and his staff do not have to be gathered around a horizontal situation map similar to the Brigade "A" commander and staff to have an optimum TOC environment. Key members of the battle staff can be in different locations if they have the same timely RCP, and if their inter-vehicle communications systems are as good as or better than the DAWE Brigade "A's" unique horizontal map RCP and dynamic, integrated communications milieu. While the MMBL's surrogate "2015 C3I system" was superior in producing high quality RCP to Brigade "A's" battle-captain-on-the-Tac-Net, both TOCs functioned well due to the verbal communications protocols established by their commanders. But we also know that a battlefield visualization system similar the near perfect situational awareness view provided by the ModSAF system is many years in the future. In the meantime, many, many commanders have the challenge of achieving an optimal environment in their TOC as the Army moves incrementally along the path to ABCS full operational capability.

4.3 ***Prairie Warrior 98 and 99***

The Prairie Warrior (PW) series of exercises have been conducted at the U.S. Army Command and General Staff College each spring for many years as the final major training event for the students before graduation. The students are organized into command groups to role play the sequence of command and staff action at corps, division, brigade and cavalry squadron levels. Because it is a school environment, senior non-commissioned officers (NCOs) and soldiers who perform many of the essential support tasks within a regular unit TOC are not available. The number of officer students assigned to each headquarters is normally fewer than are in a regular Army unit of the same size. The students invariably perform additional officer tasks and key NCO tasks in order to keep the flow of information steady within their TOCs. For all these reasons, observers have to be careful when observing a Prairie Warrior exercise not to generalize observations made in this truncated environment to the Army at large.

In this context, the ARL Cognitive Engineering Team observed PW 98 and PW 99 primarily because portions of the ATCCS systems were being used by the students to familiarize them with the system. In short, it was an opportunity for the team to observe portions of ATCCS in a semi-operational setting. With respect to the insights described in this paper, however, the use of ATCCS and the opportunity to observe and later reflect on the TOC layouts and the flow of tactical information among the officers made the two exercises very valuable.

4.3.1 ***"1-10 Cav" - PW 98***

PW 98 was actually a better exercise than PW 99 for two reasons. First, the ASAS system operated correctly throughout the exercise. This reliability enabled an outstanding Military Intelligence officer, acting as the "1-10 Cav's" S2, to learn as much as he could about the ASAS. He became proficient with each of the system's functions to include the analysis tools. As a result, everyone in the group received a tutorial on the system's impressive capabilities. Second, the "1-10 Cav," made a concerted effort to use the truncated ATCCS system to monitor and assess the current situation. They had an analog situation map for back-up, but they used it only to see the detail on the map, and to plan future operations. They did not attempt to keep their current situation on the paper map.[21] Also, the student CO setup the TOC in a very simple but instructive way. Figure 10 depicts the "1-10 Cav" layout.

[21] Circumstances may have imposed this virtue on them. They had not been assigned an officer to act as a battle captain or Operations NCO, the persons who would normally update unit locations on the map.

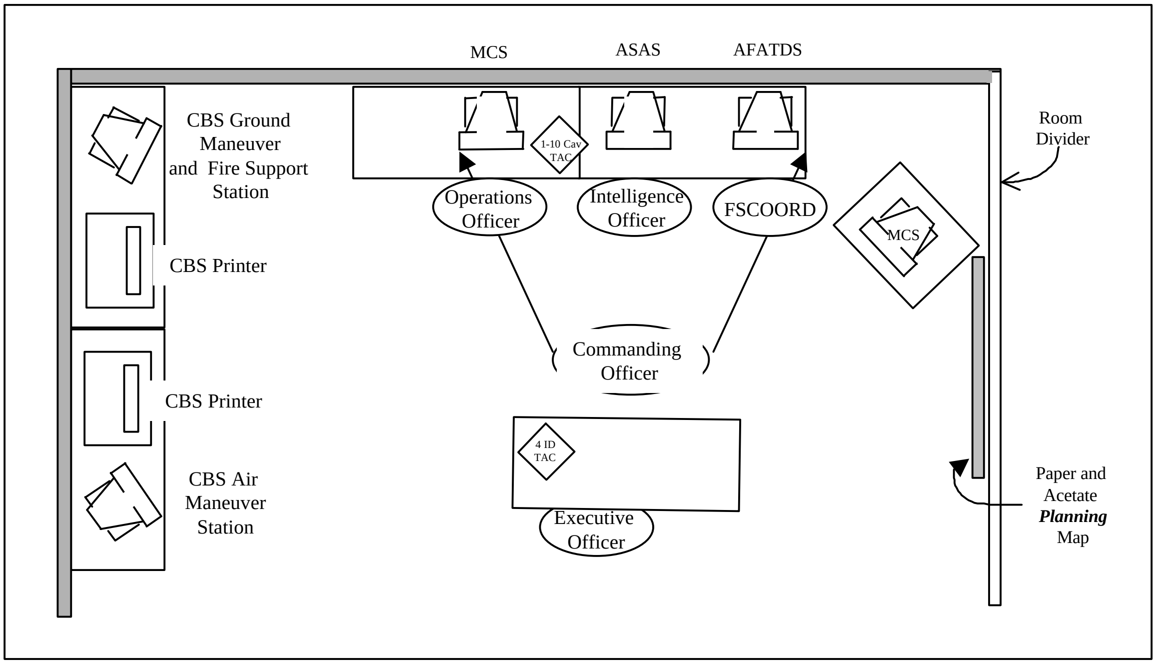

Figure 10. Prairie Warrior 98 CGSC "1-10 Cav" TOC

This arrangement has several "optimum TOC environment" qualities. The commander and battle staff achieved a relatively high level of shared situational awareness and Relevant Common Picture. The CO was able to see each ATCCS screen. Also, he had the small battle staff literally shoulder to shoulder facing the screens. While the S3 and the FSCOORD could not see each other's screens, the CO positioned himself to facilitate their coordinating with each other. Most importantly, he placed the ASAS screen in the middle so that the S3 and the FSCOORD could see the S2's enemy situation, and the S2 could easily apprise them of each important change in the enemy situation. By placing the squadron command net radio between the S3 and the S2, and within hearing of the FSCOORD, the group received and shared the incoming verbal tactical information. The placement of the tactical radio allowed the S3 to speak to subordinate commanders and the S2 to listen to SPOT and SALUTE reports. The S2 would apprise the FSCOORD immediately of the enemy-related information.

System latency in the updating of friendly and enemy unit locations on the MCS monitor presented a problem tracking the current locations of the fast moving cavalry units. They "solved" it by simply looking at the Corps Battle Simulation (CBS) screen, which was located approximately five feet to the left of the S3. They rationalized this "work around" to their CGSC faculty advisor by the fact that they had not been assigned an officer to be the battle captain (with the task of continuously up-dating the analog situation map). The group performed well. The four officers had an innate sense of how to handle each situation confronting them. They were singled out by the senior retired general officer mentor for the exercise as having performed consistently better than the Opposing Force. Clearly their TOC Environment facilitated OODA Loop decision-making and maintaining a high tempo in operations.

The group had one significant advantage. Unlike the majority of their peers who were assigned to brigade, division, and corps headquarters—echelons at which few had served—the officers in the

"1-10 Cav" had all served in battalion level TOCs, and were comfortable with their duties. The student CO, for instance, had spent a year as a cavalry squadron S3. In addition to individual talents, they had the requisite level of experience for the duties to which they were assigned.

4.3.2 ***Brigade "C" - PW 99***

Brigade "C" was staffed with a hard-working, serious group of majors. The student selected as CO was clearly a capable, high-energy officer with a bright future in the Army. He generated a very positive, constructive interpersonal climate within the TOC throughout the exercise. The challenges he and his staff faced in information flow were essentially structural:

- Shortage of personnel to play the necessary support roles,
- Shortage of digital and analog systems (and short of space for the few systems they had),
- Limited training on the ATCCS systems (MCS, ASAS, and AFATDS),
- Shortage of communications capabilities with higher and subordinate commanders,
- Absence of internal procedures for information flow (SOPs for TOC Operations are very difficult to develop; perhaps the CGSC faculty could obtain examples of such SOPs currently in use in the 4ID as a set of references for the students),
- And, critically, the ASAS system did not work correctly, making the task of updating the enemy situation almost impossible.

Figure 10 shows the layout of the CGSC Brigade "C" TOC. This analyst did not ask the student CO why it was laid out as depicted. The answer would probably have been that he and his staff had some control over the siting of the ATCCS systems and the analog situation map, and that the layout made sense to him at the time. The sketches made by members of the ARL Cognitive Engineering Team of the other brigade layouts show that although assigned comparable space, each layout was distinctly different. This permits the inference that the students had some choice in the matter, and that the layouts were not entirely dictated by technical limitations (cable lengths, etc.).

It is interesting to note in Figure 11, below, the XO, the FSCOORD, the ALO, and the brigade engineer were located across a table from the SITMAP. The FSCOORD, the ALO, and the combat engineer account for the lion's share of the combat multipliers available to the brigade commander. Only the CO, the S3, the S2, the assistant S2, and the Battle Captain had stations close to either the large screen digital situation map (which was not used) or the paper and acetate situation map.[22]

[22] The CO did not use MCS to monitor the current situation. The problem was that ASAS was either not working correctly, or the officers simply didn't know how to operate the system. For whatever reason, once an enemy unit was posted to the enemy situation screen, it could not be removed. Thus enemy units that had been destroyed remained on the screen. In a relatively short time, the screen was cluttered with the icons of enemy units that no longer existed. The enemy situation depicted on the screen was entirely unrealistic, so the CO determined to work off the paper map and acetate overlay.

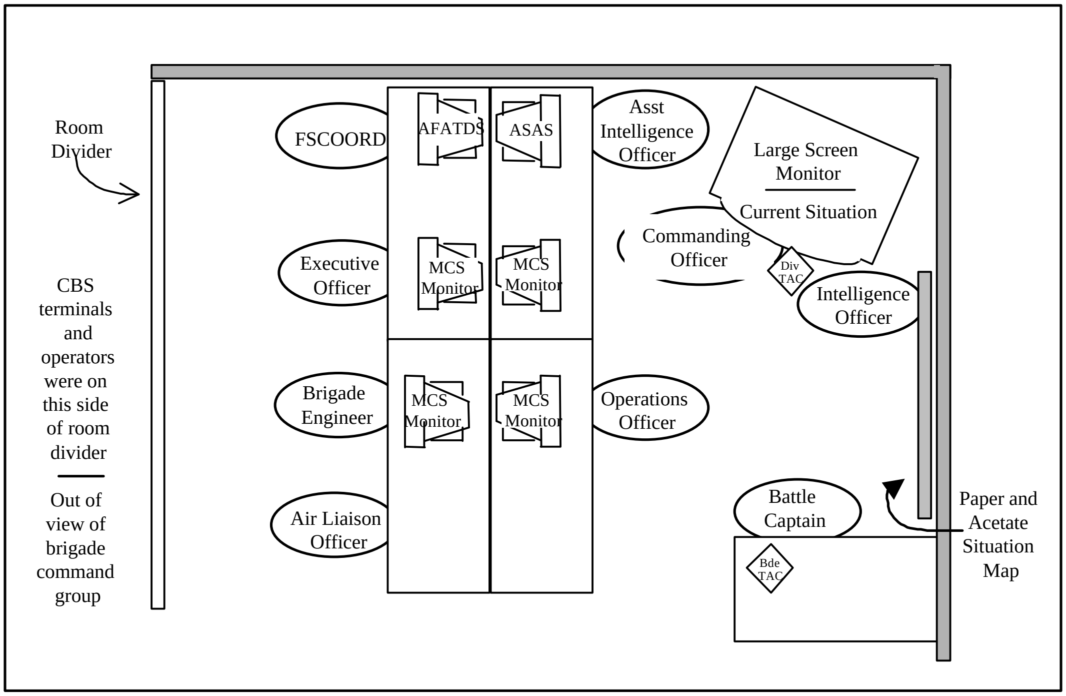

Figure 11. Prairie Warrior 99 CGSC Brigade "C" TOC

4.3.3 ***Noticed for the First time: Key Officers Missing Critical Information***

On at least three occasions during a developing situation, the following was observed: the commander, the S3, and the S2 would cluster in front of the analog map. The commander would have a question related to artillery, engineers, or fixed wing air. The FSCOORD, the engineer, or the ALO, or all three would maneuver around their workstations and the table to move over to the situation map. They would listen to the question, and if they needed information from their workstation, they would go back to get it. In the meantime additional information might be received over the surrogate tactical radio. The "battle captain" would pass it verbally to the CO, the S3, and the S2, still clustered in front of the vertical map. Frequently, the information was of interest to two or more supporting unit officers. If the supporting unit officers were in the second ring of the cluster in front of the situation map, they would receive the information and assess it with respect to their on-going support tasks and the current capabilities of their units to provide the support. But one or two others would not receive it. Thus, their input was missing and the capability of their units to support the decision did not appear to be factored into the assessment.

At no time did all "battle staff" members share the same RCP. More interesting, at no time was the situation observed where all "battle staff" members were able to hear, or be apprised by the "battle captain" of information coming over the tactical net from subordinate unit commanders.

On two occasions, the CO faced away from the map, looking across the space at the battle staff and supporting unit representatives to ask in a loud voice for combat information. One or more of the battle staff officers would be so intent on their ATCCS screens that they would not hear him. The configuration of the TOC (aggravated by the short-handedness) prevented the CO from having easy access to the specific knowledge the supporting unit officer had of his field. The configuration precluded the CO asking for it easily, or the supporting unit officer volunteering it upon hearing a particular item of critical information.

While the CO was a relatively junior major, he was above average in experience level among his peers, and he was clearly above average in talent and general warfighting acumen. He handled himself with grace, and was clearly appreciated by his peers on the Brigade "C" staff. He was frustrated by the challenges he had in getting input from his staff who in turn were frustrated by their lack of proficiency in extracting information from the truncated ATCCS system. By the time the 3d Brigade became heavily committed to the series of engagements, it was too late to reconfigure the TOC.

The two PW exercises underscored three points:

1. Timeliness of Situation Updates. Placement of digital and analog "current situation" systems must be complementary. The primary system in a given situation probably ought to be the one that provides the most timely information on friendly and enemy locations, with the current friendly locations normally being more important than the current enemy situation.[23] Fire support coordination requirements and avoidance of fratricide make this absolutely essential at battalion task force and brigade levels. The responsibility for clearing fire missions mandates the TOC having the most current positions of friendly units. More abstractly, latency in updating unit locations that is inherent in the current digital systems is incompatible with the OODA Loop principles—observe, orient, decide, act, and do it faster and better than your adversary. If a battle captain can update an analog situation map faster than the digital system updates the MCS screen, we expect commanders will continue to rely on the analog system, particularly when the training event is considered in any way to be "competitive."

2. Verbal Information is as Key as Visual Information. Verbal information flow is as important as the relevant common picture (RCP). Unit symbols on a digital screen or an acetate overlay are inanimate, conveying little information other than general location. Verbal information is essential to imparting an understanding of the otherwise ambiguous picture of current actions in the battlespace. The entire group should have access to verbal tactical information at essentially the same time, recognizing that verbal information arriving at the TOC needs to pass through at least one filter before being disseminated to others in the "Current Operations Area."

[23] Hypothetically, it is conceivable that the capability of ASAS to feed the current enemy situation to MCS, the channel through which enemy unit locations are updated on the digital situation map, could improve at a faster rate than MCS's internal capability to update the friendly situation. Assume ASAS improved enough to provide enemy situation information faster to the digital screen than the battle captain could update the friendly information on the analog map. In this case, the enemy situation on the digital screen would always be more current than the friendly unit situation on the analog map. The question raised is whether the analog system should continue to be the primary source of RCP. It should due to the importance of knowing exactly where friendly units are at all times.

3. Staff is Essential to Decision Making. The commander must have all his staff and supporting unit experts, or their representatives available for immediate participation in "sensemaking" discussions, particularly during ongoing engagements or in the period leading up to planned or anticipated engagements.

The Prairie Warrior exercises have contributed significantly to the insights listed in paragraph 3.0. They were a catalyst to more careful consideration of a number of the perceived strengths and weaknesses observed in the DAWE and the BCR experimental trials. They were particularly useful in appreciating the sizable task facing the TPIO-ABCS in readying the Army for the insertion of the ATCCS systems.

5. Components of Decision Making - Why the Battle Staff is Essential

At no point in any AWE did a commander suggest that he could handle the current operations decision-making entirely by himself. The situations remained fast paced throughout each event, and in general, the staff officers were solidly focused on their piece of the overall action. Three key questions are: how were they monitoring the situation, what exactly were they assessing, and what caused the commander to make a decision?[24] Put another way, in the context of the earlier discussion of the Recognition Primed Decision model (par. 1.3), it is important to ask exactly what a decision-maker sees or hears in a TOC that he or she recognizes, and then decides to issue a change to current orders. It is clear the commander and the battle staff personnel recognize something. The question is: "what?" The responses to this question, as alluded to in the "Comment" at the beginning of the paper, depend upon which part of the elephant's anatomy the speaker is grasping. The following offers a cognitive science view and a military SME view. The views are meant to be complementary. They do not actually answer the question "what do the TOC officers recognize," but they shed light on it, and may be useful background in design of an experiment to answer the question definitively. The views address *expertise*; *recognition*, *mental models*; and *variances* (or as the analyst prefers to label them, tactical deltas, situational deltas, and critical indicators).

5.1 *Expertise*

Expertise was introduced as a concern in par 1.4. This paragraph addresses the concept in more detail. It provides a five-stage framework within which to understand exactly how a person becomes an expert decision maker in an intellectual or physical activity. The five stages were developed 20 plus years ago by a University of California scientist, Dr. Hubert L. Dreyfus, and his brother, an instructor at Berkeley, as part of an Air Force project. It is useful to have an idea in behavioral terms of the developmental stages a person goes through to become a domain expert. The reason is that if a Service's professional development process is currently able to place persons in command who are certifiably expert (by "five-stage" development process definition), then this fact should influence the manner in which brigades and battalions are staffed and their TOCs configured. The converse is also true. If the Service, in spite of its best efforts, is able to place in command officers who are very competent, but still not "fifth-stage experts," then that has a different implication for organizational staffing and configuration within the TOC.

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[24] "What caused him to make a decision" is intended as a process question, not a cognitive question. It is intended to highlight the military factors that caused the decision, not the thought process through which the decision was made.

The five-stage model of skill acquisition is:

1. Novice
2. Advanced Beginner
3. Competence
4. Proficient
5. Expert (Dreyfus uses the word "Expertise")

In terms of the model's strict definitions, our perception, based on experience and observation, is that most commanders commence battalion level command at the "competence" level. Those who go on to brigade command may accrue enough experiences to advance to "proficient" *by the end of their tour* as a brigade commander. Few become "expert." Ground combat is just too complex, and the number of training opportunities to develop the expertise is too few. Read the following abbreviated descriptions of the five stages, and consider how many persons come to mind who are genuinely expert (a complete description of the stages is at Appendix D):

Novice	Instruction process begins with the instructor decomposing the task environment in to context-free features that the beginner can recognize without benefit of experience in the task domain. The beginner is then given rules for determining actions on the basis of these features, like a computer following a program.
Advanced Beginner	Novices gain experience actually coping with real situations. They begin to note, or are shown examples of meaningful additional aspects of the situation. After seeing a sufficient number of examples, students learn to recognize them.
Competence	With experience, the number of relevant elements of a real-world situation that the learner is able to recognize greatly increases. To achieve competence, people learn to adopt a hierarchical perspective. First they devise a plan that determines which elements of the situation are to be treated as important and which ones can be ignored. Restricting themselves to a few of the vast number of possibly relevant features, decision-making becomes easier. The person seeks new rules and reasoning procedures to decide on a plan or perspective. The rules are not as easily come by as the rules given beginners in texts. The problem is that there are a vast number of different situations that the learner may encounter, many differing from each other in subtle ways. The person has to decide for himself what plan to choose without being sure that it will be appropriate in the particular situation.

As the competent performer becomes more and more emotionally involved in his or her tasks, it becomes increasingly difficult to draw back and to adopt the detached rule-following stance of the beginner.

Proficient — Proficiency seems to develop if, and only if, experience is assimilated in this theoretical way and the performer's theory of the skill, as represented by rules and principles, is gradually replaced by situational discriminations accompanied by associated responses. Thus intuitive behavior gradually replaces reasoned responses.

As the brain of the performer acquires the ability to discriminate between a variety of situations entered into with concern and involvement, plans are intuitively evoked and certain aspects stand out as important without the learner standing back and choosing those plans or deciding to adopt that perspective. Action becomes easier as the learner simply sees what needs to be achieved rather than deciding, by a calculative procedure, which of several possible alternatives should be selected.

The involved, experienced performer sees goals and salient facts, but not what to do to achieve these goals. <u>Proficient performers simply have not yet had enough experience with the wide variety of possible responses to each of the situations they can now discriminate to have rendered the best response automatic</u>.(Emphasis added) For this reason, proficient performers, seeing the goal and the important features of the situation, must still decide what to do. To decide, they fall back on detached rule-based determination of actions.

Expertise — The expert not only knows what needs to be achieved, based on mature and practiced situational discrimination, but also knows how to achieve the goal. A more subtle and refined discrimination ability is what distinguishes the expert from the proficient performer. The expert distinguishes, among situations all seen as similar with respect to plan or perspective, those requiring one action from those demanding another. With enough experience with a variety of situations, all seen from the same perspective but requiring different tactical decisions, the proficient performer gradually decomposes this class of situation into subclasses, each of which share the same decision, single action, or tactic. This allows the immediate intuitive response to each situation which is characteristic of expertise."

The fact that few commanders ever become expert should not be cause for concern. It should, however, shed additional light on the importance of the battle staff providing appropriate input to the commander in a highly articulated but flexible sequence during the current operations decision process.

Regardless of skill level, the commander and the battle staff clearly *recognize* militarily significant elements in the situation. The word "recognition," (with its root word "cognition") is important.

Knowing what they recognize is the key to improving the procedures with which the staff supports the commander, and of course, the key to designing the training that implements the procedures.

5.2 ***Recognition and Mental Models***

A lay person's reading of the cognitive science literature suggests the predominant viewpoint within the cognitive science community is that experienced officers *recognize patterns* in the information received as the operation unfolds. Two recent publications provide clear descriptions of what the cognitive scientists mean by the term. A 1996 ARI technical report, "*Training Strategies for Tactical Pattern Recognition*," contains a pure psychology definition of the term:

> In memory based models of human information processing, pattern recognition is the point where information in a sensory register is matched to information in long term memory (LTM). The information may be presented in any type of medium (tactile, auditory, visual, etc.), which is then compared to stored information. When a stimulus had been analyzed, compared to the contents in memory, and a decision about its identity is made, it is said to be recognized. The central premise of pattern recognition is that when a pattern is recognized its meaning is derived through its identification and classification (Fisher and Geiwitz, 1996).

Recognition is not the actual decision. It is one of the first elements in the monitoring and assessment process.

A second study, "*The Decision-Making Expertise of Battle Commanders*," links (1) the idea of "mental models" to (2) the concept of "patterns" to (3) a theory of expertise that predicts the behaviors that should be observable when an expert, supported by a staff, is in the process of making a decision (Serfaty *et al*., 1994). The study had two purposes. First, the researchers wished to determine if domain experts (in this case, retired *lieutenant generals* and *generals*) could determine the level of domain expertise of officers (captains through brigadier general) by observing the officers performing decision processes and by reviewing examples of written intent and orders prepared by the officers. Second, the researchers had hypothesized that a "theory of expertise" might be at work during the experimental trials, and that it would be evident in decision makers' behaviors as they worked through the decision process. In this context the researchers' purpose was to determine if a non-military domain researcher could successfully observe and identify these behaviors during the experiment.

With respect to the first purpose, the generals were given a seven point range—novice (1) to expert (7)—with which to classify the 46 officers in the study. The authors of the study did not include in their paper appearing in Zsambok and Klein, 1997 the definitions of each level on their expertise scale. It is interesting to note in Figure 12, however, that the generals did not rate any of the subjects at the two highest levels, 7 and 6, and rated only 4 of 46 subjects at level 5.[25]

[25] It would be interesting to compare the narrative descriptions of the seven-point scales in Serfaty *et al*., 1994 with the descriptions of the five-stages in the Dreyfus model. It will be important to do so should the material in this paper be used as input to a future research project.

Scale	Novice 1	2	3	4	5	6	Expert 7
Number Observed	6	11	13	12	4	--	--

Figure 12. Serfaty *et al*., 1994; Distribution of Expertise for Experiment Subjects

In the theoretical framework portion of the article, the authors make several observations bearing on the mental model and pattern recognition:

> "What is the precise nature of battle command decision-making expertise? The underlying premise of the theoretical framework is the cognitive-science concept of *mental models*. Mental models are our internal representation of the external world. The literature on mental models suggests that such models can provide a mechanism for representing the expert's understanding of the situation. The expert's memory consists of an array of "patterns," with information items grouped and indexed by their relevance for problem solving in the domain of expertise."
>
> We suggest that an expert commander has a mental model of the tactical situation that differs in measurable ways from that of a novice. The expert's pattern-indexed memory supports the construction of a better initial mental model of the situation. The expert can retrieve a problem representation structure from memory that is similar to the problem at hand in a way that facilitates a solution. In addition to allowing the expert to organize the available information in a meaningful way, the model allows the expert to detect what essential information is missing." (for the convenience of the reader, the entire theoretical framework is in Appendix D)

Pattern recognition seems to operate at three levels. One is where recognizing the pattern helps the officer in understanding the information itself. For example, Field Manual 100-62, *Armor and Mechanized Based OPFOR Tactics*, prescribes a set of OPFOR doctrine, tactics, equipment and organization for use in Army training exercises. The repeated exposure soldiers receive to the OPFOR forces described in the manual instills in many the ability to recognize elements of the threat force simply by the composition and number of vehicles in a formation. "We're in our movement to contact phase, and scouts have just reported seeing a formation of ten vehicles. There's one BTR-70, some T-80s, a 120 mortar, a couple BMPs, and several BRDM-2s in . . . it must be the MRRs forward security element." In this case, understanding the military significance of the information is a necessary step in assessing the information, and then deciding what to do about it. Soldiers are specifically trained to know this type of information. This use of the term "pattern recognition" makes sense.

A second use of the term implies that the decision maker both recognizes the nature of the information and automatically makes a decision what to do about it. It may make sense some very abbreviated situations not involving the articulation of a COA. For instance, in PW 98 the CO of the "1-10 Cav," upon hearing that one of his two Commanche helicopter reconnaissance troops was receiving ground fire, immediately ordered the troop commander to break contact and return to friendly air space. This was a special case involving a high value asset. He probably would not have made the instant judgment if a ground reconnaissance troop had reported receiving small arms fire. Also, the vignette involved only a “go-no go” decision. It did not involve developing a COA with several key moving parts.

A third use of the term implies that the commander can size up the entire engagement by the emergence of several linked elements of information which portend a developing pattern. The idea is the commander recognizes this pattern, and understands from his past experience the best method to deal successfully with it. He then directs specific, immediate, preemptive action. This deserves a measure of skepticism. Common experience, buttressed by the criteria implicit in the five-stage skill acquisition model, suggests that soldiers no longer (if they ever did) see sufficient iterations of any single type of operation that major tactical patterns may emerge.

The fact is, each movement to contact operation unfolds differently from the preceding experiences, just as each attempt at a penetration unfolds differently, etc. Certainly officers learn from each iteration of a tactical maneuver and carry that learning forward. An officer has to participate only once in a penetration that fails due to insufficient combat power to reinforce the shoulders of the penetration to know that a penetration requires three maneuver elements, not two. The next penetration he plans differently. But learning from a previous experience is not the same as recognizing a pattern.

Even in cases where the end result of an attempted maneuver is similar to an earlier experience, it is seen to be similar only at the end of the event, not during it. Long before the similarity is seen in the rear view mirror, the commander and staff had been monitoring the situation for variances from their expectations, and almost invariably had to assess and decide actions to address a number of the variances.

Two last comments on the study related to expertise and the distribution of officers in Figure 11. The authors concluded that it is possible for non-military researchers to observe the behaviors related to the “theory of expertise” when an expert is participating in a military decision-making event. The reader is left to assume that the officers on the right end of the expertise distribution, though not expert in terms of the absolute scaling, were *expert enough* to be the basis for the authors’ conclusion. Finally, it should be noted that the study was conducted under controlled conditions and did not involve the subjects making current operation decisions in a continuously flowing tactical exercise.

5.3 ***Tactical Implications of Variances***

The “tactical implications of variances” view is that as each piece of tactical information is received in the TOC, or as clusters of information are received almost simultaneously, the officer recognizes essentially two elements. First, he recognizes that the information is, or is not, at a variance with his expectations or forecast. He sees that a delta exists between the information in the report or on the current situation monitor, and what he had planned, expected, or forecast to be occurring at that point. The commander’s expectations with respect to the enemy force are shaped by his intelligence estimate and by his IPB (Intelligence Preparation of the Battlefield) analysis. His expectations of the friendly force are framed by his higher headquarters commander’s intent and operations order, and by his own intent and concept of operations. Second, by virtue of his experience to date, the officer understands the implications of the delta with respect to his mission, to his concept of operations, or to the tasks assigned to subordinate units.[26]

The commander and his staff tend to deal with the information as it becomes known in an essentially serial process. Frequently, the TOC will receive a cluster of important tactical information that the commander and staff have to address as a more complex package of implications.

This view assumes that the commander will have more tactical experience than any single staff officer. It does not necessarily equate experience to expertise in either the Dreyfus, 1994 or Serfaty *et al*., 1994 sense. It simply recognizes that the Army attempts to place the best prepared officers who are next in the queue for assignment to operational units into the positions of commander and staff officer. It assumes that the system has trained these officers to recognize the information contained in the Tactical and Situational Deltas. It assumes the officers are sufficiently trained and experienced to understand the implications of the information with respect to their basic plan. Finally, this view is embedded the Commander – Staff Group Process outlined in Figure 1 (par. 1.3).

Figure 13, below, suggests exactly what the commander and his staff are monitoring and assessing in the Figure 1 process. At the heart of the monitoring and assessment sequence is *recognizing* at any given time—through the reported locations of units (friendly and enemy) and the current situation of the unit(s)—that the plan is on track, off track, or overtaken by a totally different set of facts on the ground than those expected. At the risk of greatly oversimplifying a complex environment, it is as simple as that—unit location and situation. The commander and staff primarily monitor unit locations by moment in time, and the unit's situation at the time the location is reported. They understand the implications of that particular unit being at that location and in that situation at that time vis-à-vis the content and details of their plan. If the appropriate unit is in the appropriate or expected location (and in the case of enemy units, the projected or forecast location) at the appropriate time, then at least that portion of the plan is okay. But if the location, time, or situation is at a variance from what was expected, projected, or forecast, they commence to assess the implications with respect to their plan—and decide what to do about it.

[26] This view is our view. It is a process interpretation of the monitoring and assessment portion of the Commander – Staff Group Process model of current operations decision-making. It does not address the decision step. The actual decision step occurs, we believe, essentially as described in the "Execution Decision Cycle" (an integrated cognitive model of decision-making) described in Leedom, *et al*., June 1998. The "implications of variances" view adds a measure of granularity to the "Monitor Progress" block in the integrated cognitive model.

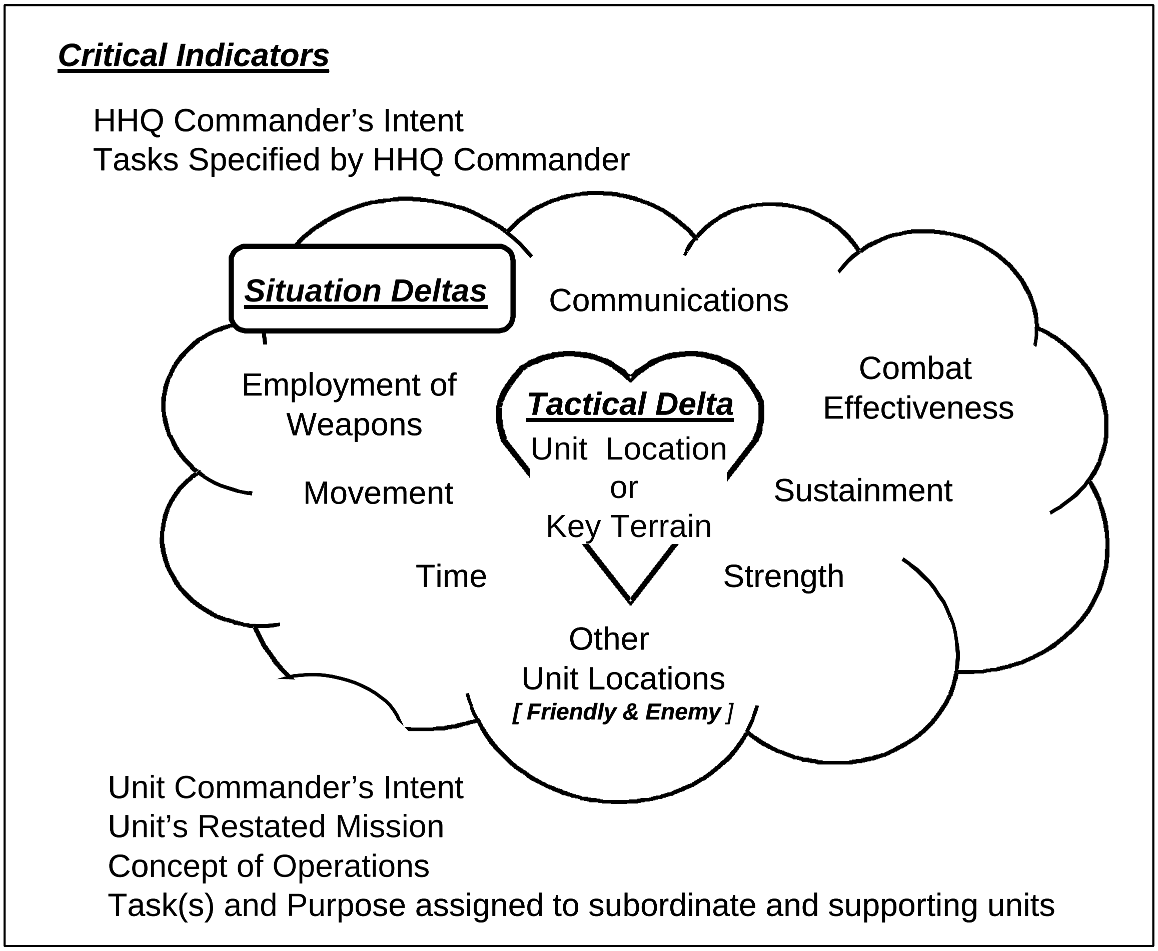

Figure 13. Tactical Deltas, Situational Deltas, and Critical Images

The term, "critical indicators," is intended to imply that the tactical and situational deltas are sufficiently large that they constitute either a conspicuous opportunity or threat to the specific wishes of the commander enumerated in one or more of the directives listed. The deltas can be positive or negative. The deltas are identified while monitoring the situation. They go immediately to an assessment of that delta. In the assessment, the officers are considering the implications of the delta with respect to each element of vision and tasking provided by the commander, and by the higher headquarters commander. Murphy *et al.*, 1999 contains a more detailed discussion of the ideas reflected in Figure 13.

The question whether the officers are recognizing patterns or are recognizing the "implications of variances" is more than a matter of semantics. The answer suggests, in part, how the Army should prepare its officers for duties as commanders and as staff officers. If the commander is essentially recognizing patterns, and making decisions based upon this recognition, he does not need as experienced a staff to assist with information management in the TOC. In any event, it is not clear that the professional development process actually supports pattern recognition. While an officer's professional development extends throughout his or her years of service, the fact is, not nearly enough of this time is spent in training events focused on learning "decision making"—unit field exercises, and computer-assisted command post exercises, primarily. In fact, one of the most frequently heard comments from officers during the AWEs is that they do not get enough tactical training. This has two effects.

The first effect, as asserted earlier, and consistent with Dreyfus's five-stage skill acquisition model, officers see too few exercises to know whether or not patterns are indeed discernible. Second, they see just enough exercises to become basically proficient in their own MOS. Arguably, they are not sufficiently exposed to the capabilities, limitations, and tactical employment of other branches to undertake combined arms operations without the benefit of cooperative planning and decision making by a combined arms battle staff.

To this point, the discussion has centered mostly on single decisions. It is helpful to have a mental model of the entire range of decisions occurring from the time a unit receives a warning order to the point it accomplishes the intent specified by the higher headquarters commander.

5.4 ***Picture the Decisions in Terms of the Plan***

Figures 14 and 15 represent graphically the planning decisions preceding current operations and then a notional range of decisions once the unit crosses the line of departure. Figure 13 shows the conceptual and structural components of the operation order (OPORD) that the unit is attempting to execute. In the conceptual portion of the order, the commander has expressed his intent and his concept of operations. In the structural part, he assigns tasks (with purpose) to his subordinate and supporting units. The battle staff must understand the purpose of each subordinate unit task as well as the subordinate unit commanders. In almost every situation, a tactical delta(s) arises while a unit is attempting to accomplish an assigned task. Thus the assessment must clearly include the implications of the situation with respect to the purpose for which the task was assigned. If one purpose is in jeopardy, other elements of the plan are in jeopardy. In Figure 14, the time is just prior to H-hour. The unit has completed its rehearsal and is poised to attack.

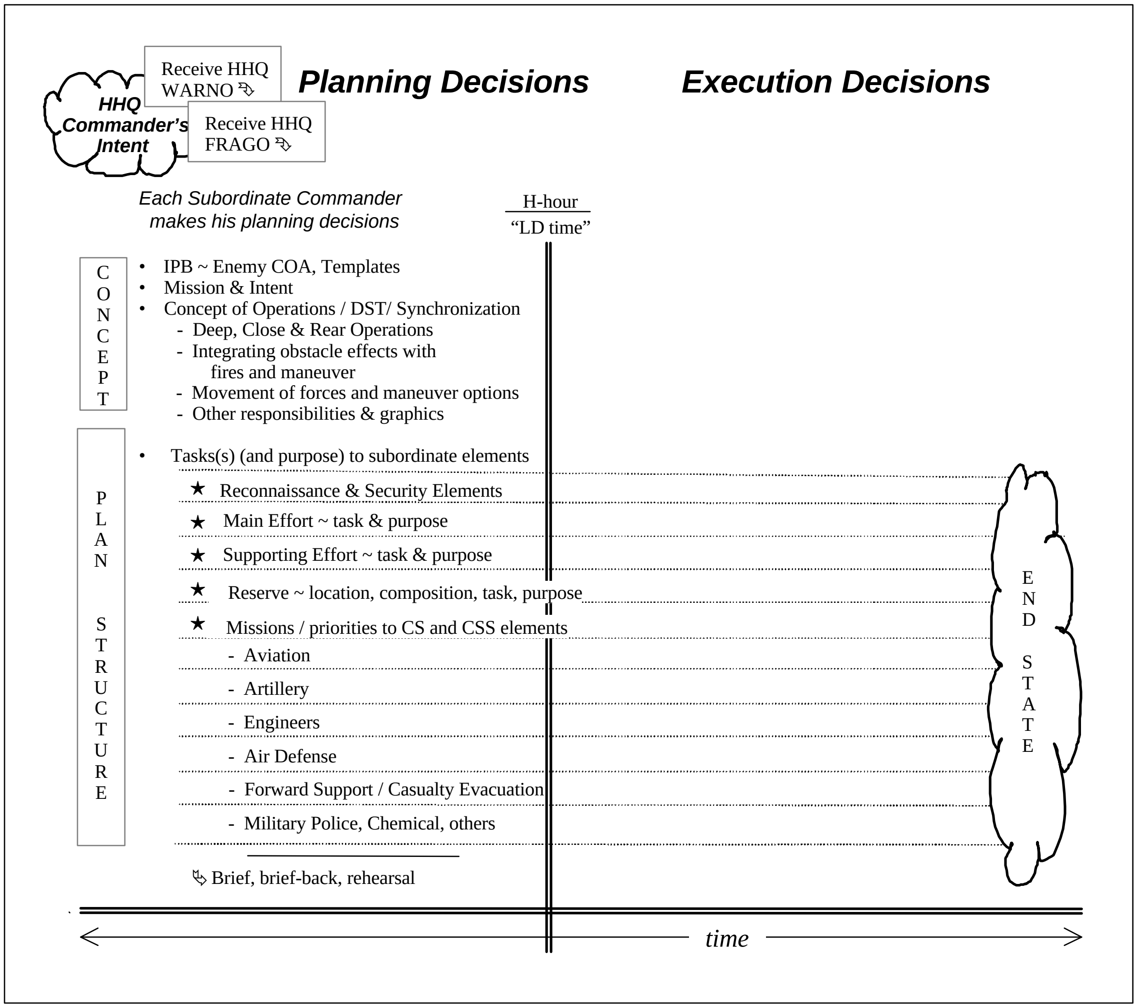

Figure 14. Planning Decisions and the Operations Order

Now complete the graphic by crossing the line of departure, executing the assigned tasks, and achieving the commander's end state. Figure 14 is a notional view of a series of decisions made during current operations affecting portions of the operations order. The small bars on the right side of the graphic represent decisions arrived at through the commander-staff group process pictured earlier in Figure 1. Once the command crosses the line of departure, the plan becomes fluid. The thinking adversary is also flexing his will. Variances—tactical deltas—are beginning to be received in the TOC.

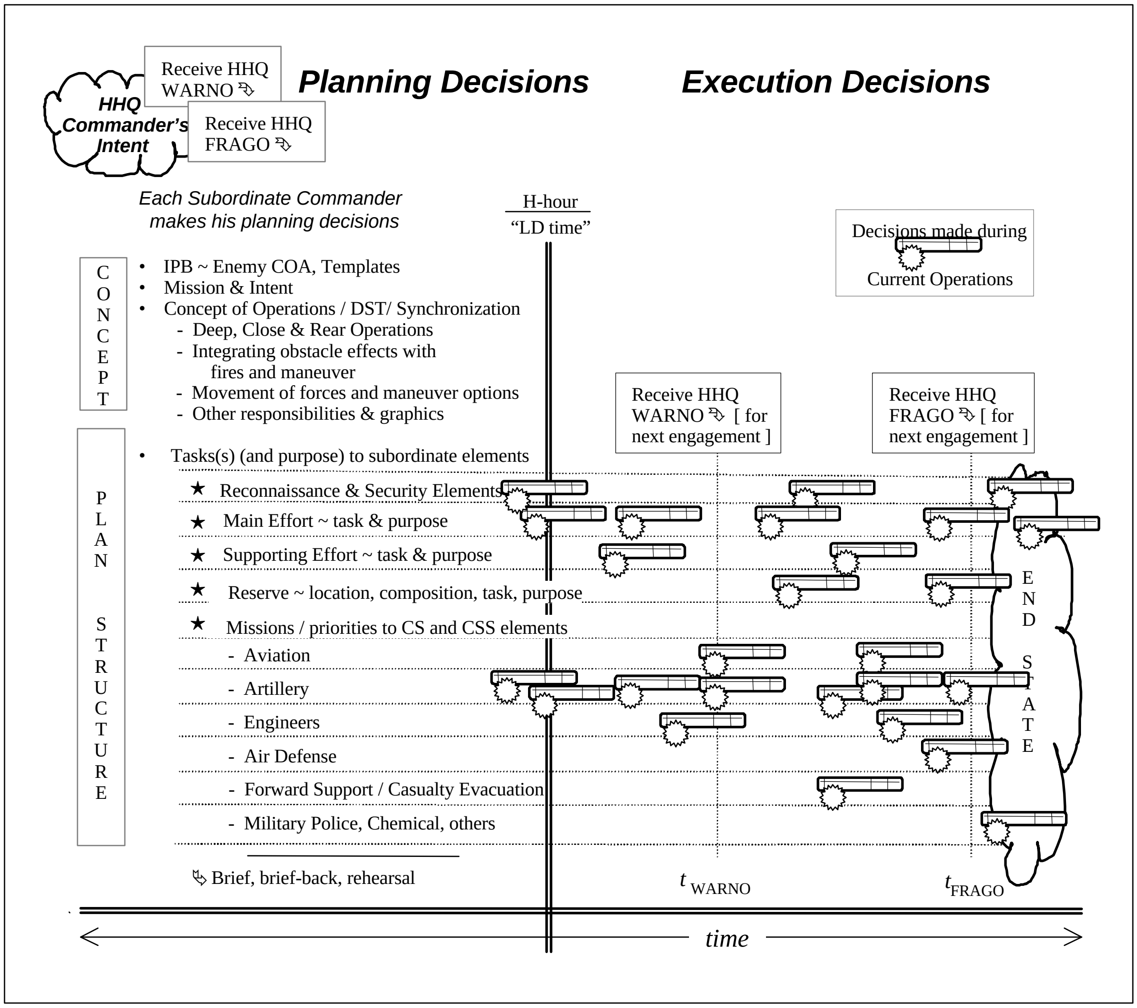

Figure 15. Decisions Made During Current Operations

During the execution phase of the operation, the battle staff monitors and assesses each variance or critical cue, paying particular attention to the implications of the information with respect to the overall plan. The information is assessed for the degree to which it has the potential to affect, or already is affecting the concept of operations. Exactly what action(s), if any, are decided is a function of the information and the expertise of the officers participating in the assessment. Their role is to understand whether the implications of the information are positive, neutral, or adverse to friendly actions currently underway, or planned, and to know what to advise the commander to do. Through this discussion, the commander reaches a progress or adoption decision. Once the decision is made, the monitoring continues. It is not apparent at that point that this entire evolution will unfold essentially like ant event the officers had experienced earlier.

The initial series of tactical tasks in an operations order are normally reasonably well synchronized. Once the operation starts, the tactical information flowing into the TOC can cover each battlefield operating system and every facet of the commander's OPORD—and therefore, each piece of tactical information that passes the data filters bears on the overall synchronization. The commander and staff attempt to understand what each piece of information means in terms of the synchronization. They will determine what must be done with respect to the particular information, how that action affects the overall synchronization, and what must be done to maintain the synchronization that still applies. As the operation continues, the well-choreographed synchronization begins to be overcome by cascading events, and the staff needs to develop subsequent synchronization literally "on the fly."

The hard part is timing the movement and relocation of committed assets—the reserve, artillery batteries, ADA units, engineer platoons, forward support units, tactical bridging, etc.—to ensure they are in position to continue to support the main and supporting efforts, as necessary. This timing frequently needs to be worked out with all interested parties listening to the discussion. Circumstances will determine whether the discussion should take place at the situation map (digital or analog), or off-line.

In effect, the current pieces of tactical information are being assessed for implications of the actions associated with that information—and if left to continue, how the actions will affect the current plan. Clearly, and at frequent intervals, two or more elements of information have to be considered a whole, with one element confirming hypotheses generated by another. But whether the commander deals with single elements of tactical information or clusters of information considered as a complex whole, he tends to make his decisions serially.

These activities do not bring to mind the recognition of a series of patterns setting in motion a grand response. They bring to mind a multifunctional group of competent, proficient persons performing fast-paced, serial problem solving to keep a fluid enterprise on track toward a goal—a goal which in the beginning had been determined to be feasible and acceptable. This is important.

5.5 ***Current Operations Decision Making Requires a Commander and Staff***

Paragraph 5.4 explains why it is desirable—essential—to have not only the colonel, but also the principal staff officers and the supporting unit liaison officers receiving the same visual and verbal information at the same time. The reasons are:

1. The colonel, in Dreyfus terms, is "competent," possibly even "proficient" within his own branch or MOS area. He is the most experienced officer in the command.

2. The colonel is *experienced enough*, but not expert within each combat, combat support, and combat service support functional area (the other branches) comprising his command—and the forces in direct or general support of his command.

3. The supporting unit liaison officers, almost always junior to the colonel and not as experienced in their branch as the colonel is in his, are (probably) more proficient than he in understanding the implications of combat information with respect to their unit's task, purpose, and the capabilities of their particular unit(s).

4. Clearly, the colonel has a better sense of how the entire plan comes together, but he does not have the mental acuity to filter all potentially key information that flows into the TOC, and assess its implications on his plan. The principal staff and supporting unit liaison representatives are essential to filtering non-critical combat information.

5. The colonel, plus the battle staff, plus the supporting unit officers—together—have more capability to understand the implications of combat information on the totality of the plan than if this same group is shorted by so much as one person.

6. When one or more these persons are not present to receive combat information—and listen to, and participate in the discussion of it's meaning—decisions are more likely to be slower (because the missing persons have to be brought into the information flow) or less complete (because they and their expertise are absent). Arguably, these decisions are more prone to failure.

6. **Conclusion**

This paper is intended to synthesize insights gained over four AWEs and one additional exercise into a set of tentative guidelines with which to organize battalion and brigade TOCs as the Army continues its march to a fully operational Army Battle Command System (ABCS). The goal has been to describe the optimum TOC environment—a combination of the commander's leadership style, TOC layout, and SOPs for internal operations that generate *efficient, proficient* current operations decision making.

At the heart of the insights is the recognition that the colonels are *experienced* enough to command, but not *expert* enough across all battlefield operating systems to exercise "battle command" effectively without the support of others. The Army provides the colonel the staff and the supporting unit liaison officers with sufficient competency or proficiency to augment his strengths and buttress gaps in his knowledge.

During current operations, the colonel, in turn, must provide the staff and BOS representatives access to the same relevant visual and verbal tactical information he receives at essentially the same time he receives it. In creating this environment, the colonel increases the likelihood that the whole of the TOC will be greater than the sum of its members.

The commander and the staff will be capable of generating efficient, proficient decisions on a sustained basis. The speed and quality of the decisions, and the reliability of the process will be highly representative of the OODA Loop concept. The unit will achieve the ability "to collapse the enemy's cohesion and effectiveness through a series of rapid, violent, and unexpected actions which create a turbulent and rapidly deteriorating situation with which the enemy cannot adequately cope.[27]"

6.1 ***Recommendations for Future Study***

TOC Environment. A study should be undertaken to determine the optimum configuration of a brigade TOC in the context of increasing digitization and the insights listed in paragraphs 3.0 – 3.2. It should attempt to shed light on the issues of *efficient, proficient* command groups *observing, orienting, deciding and acting* to consistently make *faster, better* decisions than the OPFOR.

[27] From a definition of maneuver warfare

TOC Procedures. A study should be undertaken to determine with a high degree of granularity exactly what the command groups monitor and assess during current operations. The purpose is to lay the ground work of development of an optimum set of appropriately detailed, responsive, and flexible TOC procedures focused on supporting the commander's current operations decision-making process.

Appendix A – Partial List of Army Command and Control Systems

AFATDS	Advanced Field Artillery Tactical Data System
AMDPCS	Air and Missile Defense Planning and Control System
ASAS	All Source Analysis System
AFATDS	Advanced Field Artillery Tactical Data System
CSSCS	Combat Service Support Control System
FBCB2	FORCE XXI Battle Command, Brigade and Below
GCCS-A	Global Command and Control System – Army
MCS	Maneuver Control System
TAIS	Tactical Airspace Information System

Appendix B – Filtering Incoming Verbal and Written Information

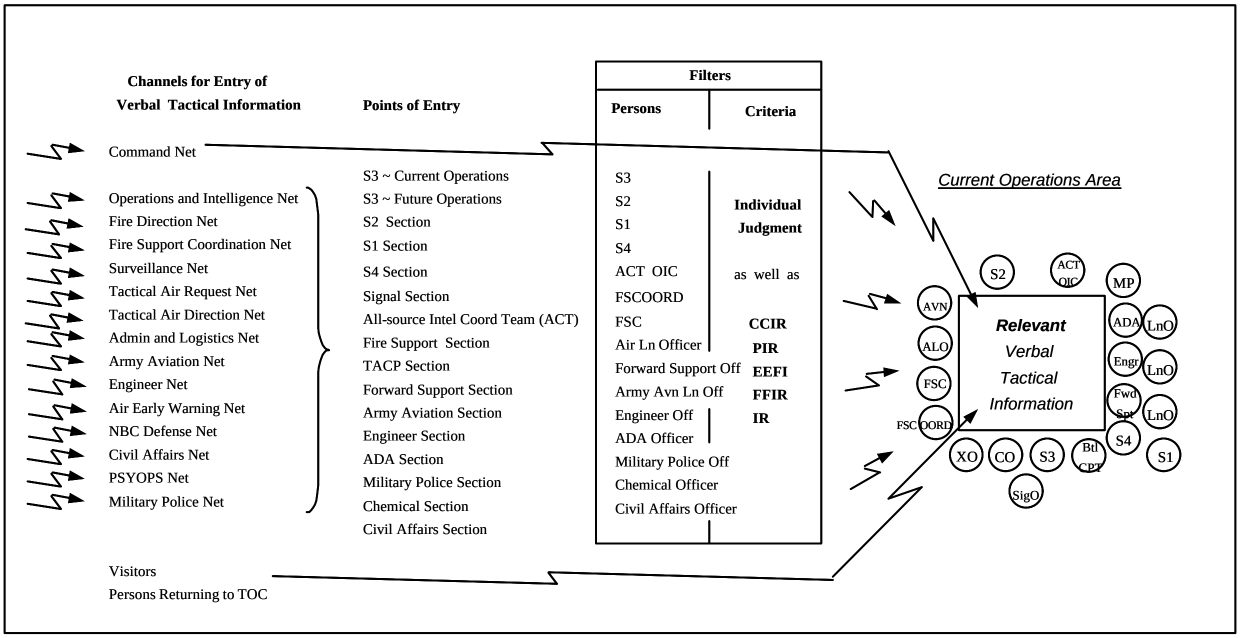

Figure B-1. Information Filters

Verbal and written tactical information flows into a TOC through multiple channels, primarily radio nets and telephones. It is also inserted by visitors and persons returning to the TOC from visits else where on the battlefield. Some is introduced by persons in the TOC after watching visual information, listening to and discussing other verbal information, analyzing it, then speaking their insights. To avoid overload, verbal information needs to be filtered. Information passing through the filters is considered to be "relevant tactical information." The filtering process occurs both formally and informally according to unit SOP.

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