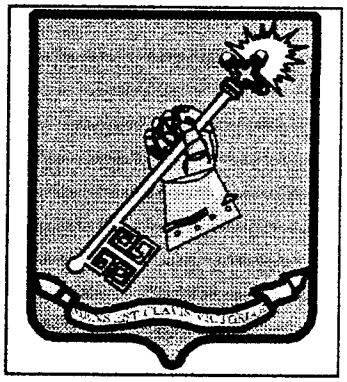
THE BATTLE COMMAND SUPPORT SYSTEM:

A COMMAND AND CONTROL SYSTEM FOR FORCE XXI

A Monograph
by

Major Michael I. Prevou
Armor



School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

First Term AY 94-95

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE
THE BATTLE COMMAND SUPPORT SYSTEM:
A COMMAND AND CONTROL SYSTEM FOR FORCE XXI.

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJOR MICHAEL PREVOU

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Advanced Military Studies.

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Unlimited:
APPROVED FOR PUBLIC RELEASE:
DISTRIBUTION UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

[illegible]

14. SUBJECT TERMS
Battle Command Support System, C2, C4I, Staff Force XXI, Command and Control, Command Posts, CP

15. NUMBER OF PAGES
81

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements***.

Block 1. Agency Use Only *(Leave blank)*.

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C	- Contract	**PR**	- Project
G	- Grant	**TA**	- Task
PE	- Program Element	**WU**	- Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. *(If known)*

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."
DOE - See authorities.
NASA - See Handbook NHB 2200.2.
NTIS - Leave blank.

Block 12b. Distribution Code.

DOD - Leave blank.
DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
NASA - Leave blank.
NTIS - Leave blank.

Block 13. Abstract. Include a brief *(Maximum 200 words)* factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code *(NTIS only)*.

Blocks 17. - 19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

★U.S.GPO:1991-0-305-776

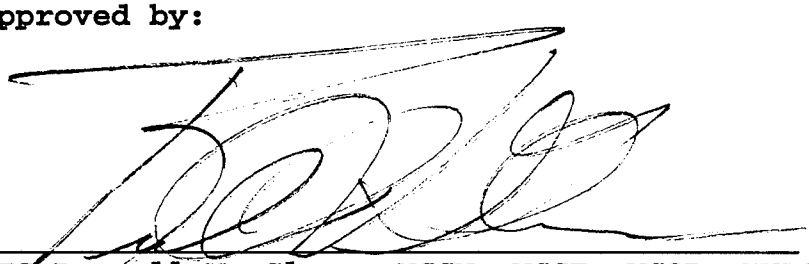
SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

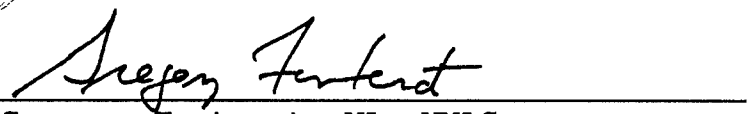
Major Michael I. Prevou

Title of Monograph: The Battle Command Support System: A Command and Control System for FORCE XXI

Approved by:



Monograph Director
LTC Russell W. Glenn, MSSM, MSCE, MSOR, MMAS



Director, School of Advanced Military Studies
COL Gregory Fontenot, MA, MMAS

Director, Graduate Degree Program
Philip J. Brookes, Ph.D.

Accepted this 17th day of December 1994

Abstract

THE BATTLE COMMAND SUPPORT SYSTEM: A COMMAND AND CONTROL SYSTEM FOR FORCE XXI by Major Mike Prevou, USA, 81 pages

The current command and control system (C2) will not enhance command and control in the twenty-first century. Since the inception of the American staff system, the US Army has increased the number of personnel and command posts within the division structure. This top heavy organization requires "rethinking" to make it adaptable for the new environments expected in the next century.

Initially, this monograph will review the evolutionary development of staffs and CPs, then the doctrinal development. By using established criteria and examination of historical development, this paper will establish a command and control system model for Force XXI and compare it with current systems.

The monograph concludes that the current heavy division command and control system would benefit from a modular approach for both staff and facilities. The concept recommends the adoption of a battle command vehicle (BCV) for commanders that has the mobility and survivability of other heavy division vehicles. Enhanced use of the command and control vehicle is explored as a forward or assault CP capable of fighting both close and deep battles, while a main or rearward CP of high mobility, multiwheeled vehicles with shelters, provides a mobile, deployable facility capable of split-based operations. Concepts for integration of technological enhancements will enable staffs to be more efficient and improve situational awareness in a future C2 system.

In the twenty-first century Force XI must have a command and control system that is deployable, versatile, survivable, agile, mobile, and supportive to the commander. The Battle Command Support System (BCSS) provides a possible solution.

Table of Contents

Figures, Charts and Sketches

I. Introduction

The best system of command, to characterize Clausewitz's famous dictum on strategy, is to always have a genius in charge.[1] The practicality of this principle is of little use unless the genius has the information needed to make decisions. The essence of Third Wave warfare is knowledge power or information warfare:[2]

> Success in combat can be attributed to the commander who has the clearest picture of the battlefield. Digitization of battle command is one of the tools used to achieve dominance on the battlefield.[3]

One of the most important means of achieving technological superiority on the battlefield is the exploitation of information to permit commanders to out-think, out-maneuver, and out-shoot the enemy.[4]

Force XXI is the United States Army's institutional response to the information age. As the army upgrades its capabilities for intelligence, maneuver, fire support, and sustainment with advanced technologies, changes to command and control systems, as well as platforms, must also be addressed. Requirements for commanders and soldiers of the information age will differ from those of their industrial age predecessors.

To perform at a higher tempo than is possible today, commanders will need a command and control system to gather, sort, share, and distribute information and provide the operational versatility to respond to a wide range of crises and opposing forces with equally deadly capabilities.[5]

For tomorrow's army to be capable of "simultaneous application of complimentary capabilities"[6] it must have an effective C2 system consisting of a network of people, equipment, facilities, and operating procedures focused on the fundamental goal of reducing uncertainty, which in turn increases the probability for making good decisions.

"The information age is about leadership not gadgets."[7] The revolution has begun and we are moving from an army where people are organized around weapons systems to one where people will be organized around information.[8] Technology will provide an enabler to do things in different ways, while the command and control system of the future provides a commander the tools needed to make timely decisions. The desired end result is combat effectiveness.

The power of technology is not that it will make our old processes work better, but that it enables our organizations to break paradigms and create new ways of working.[9] Inflexibility, unresponsiveness, an absence of focus, an obsession with process rather than product, bureaucratic paralysis, and high overhead are all legacies of our current system.

II. Historical Evolution of Command and Control

IIa. Historical Evolution

The art of generalship, from antiquity through the time of Napoleon, demanded that generals be tactical leaders, soldiers, diplomats, strategists, and politicians.[10] As Martin van Creveld

so aptly reminds us in his book Command In War, the genesis of the staff under Napoleon was but the beginning of a living organ which continues to grow.

> . . .to maintain the continuous flow of information that alone made possible the endlessly flexible combination of maneuvers characteristic of Napoleonic warfare--all this required an apparatus of command, control and communication more advanced than anything previously attempted. While staffs and organizations made a great leap forward, horses were still horses and orders still had to be copied out by hand, laboriously and without the benefit of anything as sophisticated as carbon paper.[11]

One man could not control such a large number of personnel and activities on the battlefield or administer to their needs in camp. Although not standard throughout the force structure, many American Civil War commanders had chiefs of staff and a number of other staff officers and aides. These staff officers had far fewer tasks than today, but they represented a major development in the American staff system.[12]

During World War I, staff procedures gained clearer definition as specific responsibilities were assigned to a staff section. As a result of the WWI experience it was not unusual for a division staff to double in size.[13] Warfighting became more scientific as technology was introduced to the battlefield.

As the size of military forces grew and weapons increased in lethality and range, the distances separating commanders from the front increased.[14] According to van Creveld, commanders from the fifteenth century on began to do less fighting and more

commanding. Radio reversed this trend. Once again, commanders could be found far forward.

The structure of the American staff was codified by World War II. FM 101-5 described a staff as consisting of the G1, G2, G3 and G4. The staff was divided into forward and rear echelons for the convenience of operations. The forward echelon was to be comprised of the staff immediately required by the commander for assistance in the tactical operations. The rear echelon consisted of the remaining staff who had administrative duties.[15] Unencumbered by the wires that tied him to his command post in the previous wars, the commander often went forward to see the battlefield for himself. "A hefty pair of binoculars slung over one's chest was elevated into a status symbol that no commander could afford to be without."[16]

In the Post-World War II years, the staff and its associated facilities grew once more with the addition of the G5 and the fire support coordinator. Concern over nuclear war in the 1950s lead to echelonment of the CPs into a command group, a main CP, and an alternate CP.[17] In 1959, a tactical operations center was established within the main CP. The technically-oriented special staff increased as an unprecedented explosion of electronic communications and automatic data processing equipment and a need for a failproof positive control system to prevent an outbreak of nuclear war caused the armed forces to undergo a process of centralization.[18] Complexity, specialization, organizational instability, and centralization caused an inordinate increase in

the amount of information needed to make any given decision. The US Army responded by functionally grouping staffs within the CP to enhance coordination. With this specialization, van Creveld notes, more and more personnel belonging to different specialties were required. As the number of skills grew, the amount of information needed to coordinate "increases geometrically, creating even more demand for information." By 1963, the amount of information necessary to control US forces increased to approximately twenty times that of their 1945 predecessors.[19]

The quality and availability of communications equipment increased exponentially during the same period. In 1963, 20 percent of all division personnel in Vietnam consisted of radio telephone operations.[20] Communications equipment had increased 565 percent by 1971. (Figure II-1)

Divisional and corps CPs in Vietnam were typically fixed or semipermanent. Reduced CP mobility led to larger and more elaborate facilities. This trend continued until the 1973 Yom Kippur War reemphasized the importance of CPs as targets and renewed efforts to restore survivability.

Today's US armored division appears rather similar in composition to its 1940s predessor with one glaring exception--the extraordinary increase in both human and machine command and control resources.[21] (Figure II-2 and II-3) Since then, the increased information available, specialization, requirements of peacetime training, day-to-day complexities and commander idiosyncrasies have merged gradually to increase CPs to a size

	1943 Regiment	1971 Brigade	Change (%)
Personnel	3,135	2,553	- 19
Weapons			
Rifles	2,725	2,119	- 22
Machine guns	74	129	+ 74
Anti-tank weapons	153	396	+ 159
Radio sets	81	539	+ 565
Vehicles	205	415	+ 102

Source: Z.B. Bradford and F.J. Brown, The U.S. Army in Transition, Beverly Hills, Ca., 1973. p.138

Increase in communications equipment from 1943 to 1971

Figure II-1

		1942 TOE	1990 TOE	% Change
Troop Strength:	Officers	966	1539	+ 57%
	Enlisted	15052	15488	+ 3%
	Total	16018	17027	+ 6%
Tanks		390	348	-12%
Vehicles		2476	4970	+101%
Aircraft		8	125	+1463%
Maneuver * battalions		11	13	+18%
Communications equipment		1498	11643	+677%
Division signal:	Officers	10	32	+220%
	Enlisted	292	649	+122%
	Total	302	681	+125%
Division signal vehicles		70	214	+206%
Division communication nets		14	38	+171%
Minimum Messages to division per day		219	924	+322%

* The 1942 tank battalion (599 men, 59 medium tanks) compares to todays version (522 men, 58 tanks). The 1942 Infantry battalion (700 men, 82 armored vehicles) compares to todays mech infantry battalion (844 men, 106 armored vehicles). Cav squadrons differ due to aviation. The 1942 had no equivalent of today's aviation battalions, although the 1942 units regularly employed an attached tank destroyer battalion.
Source: *Command or Control,* Military Review, July 1990.

US Armored Division Comparison 1942 to 1990

Figure II-2

		1942 TOE	1990 TOE	% Change
Division HQ & Staff	Officers	55	99	+80%
	Enlisted	247	177	-39%
	Total	302	276	-9%
	Vehicles	37	64	+73%
Subordinate staffs and headquarters	Officers	87	257	+195%
	Enlisted	1160	1036	-12%
	Total	1247	1293	+4%
	Vehicles	204	352	+73%
Total C2	Officers	142	356	+151%
	Enlisted	1407	1213	-16%
	Total	1549	1569	+1%
	Vehicles	241	416	+73%

Subordinate headquarters include maneuver combat commands (1942) brigades (1990), division artillery, division support, and the separate battalion headquarters for each type of division troops.

Source: Division and Corps Command Posts in World War II, Army Center Of Military History, Washington D.C.. B. R. Pirnie 27 Mar 86 and TOE Handbook 87004L-CTH, DA, 15 May 1990 and associated TOE Handbooks for artillery, support units and separate battalions.

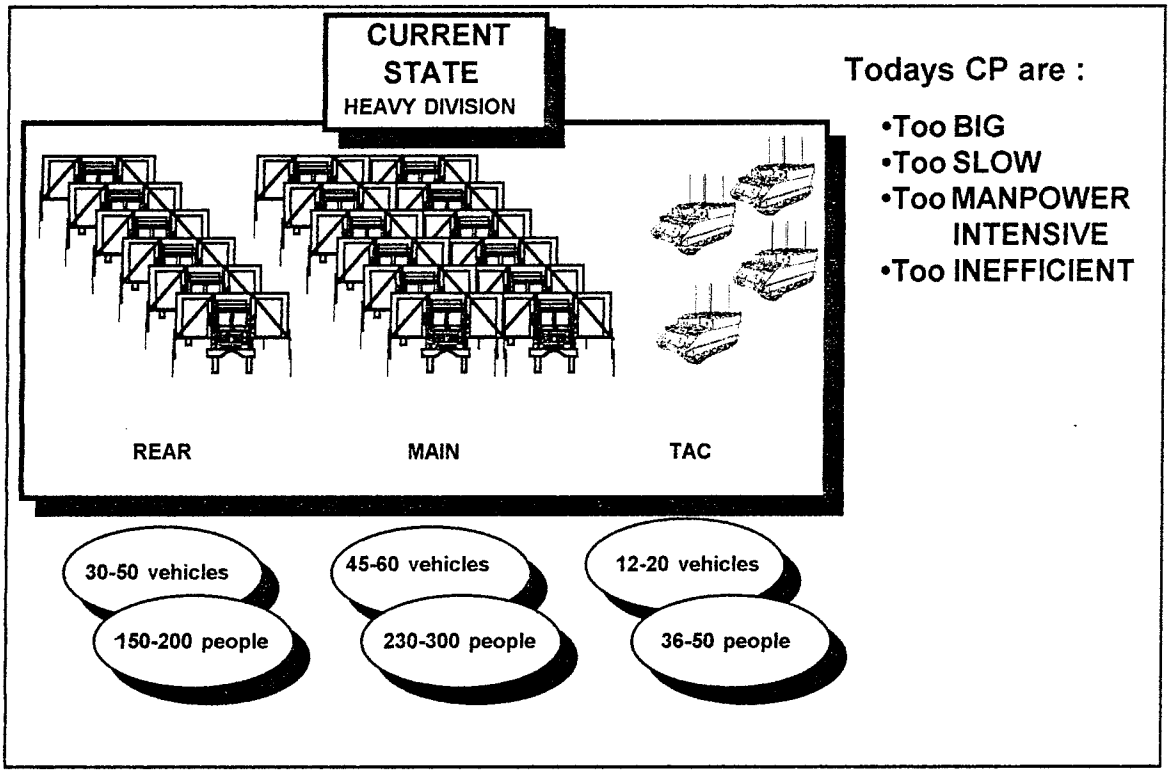
Changes in command and control personnel & vehicles - 1942 to 1990

Figure II-3

that they may now be so large as to be dysfunctional rather than supportive to the command. Battle Command Training Program (BCTP) representatives routinely see heavy divisions deploy 250-300 personnel to support the operation of the main CP while 30-50 more operate from or support the Tactical (TAC) CP.[22] (Figure II-4)

According to the 1989 RAND study Understanding Commander's Information Needs, division commanders estimate they need about twenty-four pieces of critical information to make most tactical decisions.[23] As a result of the division's communications capability, a staff has the opportunity to search for the 24 'golden nuggets' from over 12,000 lines of information.[24] van Creveld concluded:

> "Taken as a whole, present-day military forces, for all the imposing array of electronic gadgetry at their disposal, give no evidence whatsoever of being one bit more capable of dealing with the information needed for



Current Command Posts

Figure II-4

the command process than were their predecessors a century or even a millennium ago."[25]

As the US Army prepared for mobile war in Europe, it expected to face an enemy capable of sustained rapid movement using a multitude of weapon systems. The evolution of command and control systems reflects an increasingly complex and dynamic battlefield. Current command and control systems are a product of the Cold War era and are designed to act as the central nervous system in this environment. Evolution of command and control systems is anything but new, but their dimensions, according to van Creveld, have grown exponentially in modern times.[26]

IIb. Theory and Doctrine

The renowned military theorist Carl von Clausewitz believed that the best system of command was to have "a genius in charge".[27] Baron Antonie de Jomini believed that the commander must not only be at the decisive place; he also needed a command and control system to assist him in commanding his units.[28] The U.S. Army's command and control theory is built on the principle that the only purpose of a command and control system is to implement the commanders' will in pursuit of unit objectives. The system must be reliable, secure, fast, and durable. The ultimate measure of a command and control system is whether the force functions more effectively and more quickly than the enemy.[29]

One cannot successfully command through a staff. Commanders perform C2 by orchestrating personnel, equipment, and procedures

to plan, direct, coordinate, and control the battle. It is the arrangement of these resources that provides the commander the tools with which he needs to make decisions.[30] The most important thing about command is that it is personal.

The Joint Staff Officers Guide (AFSC Publication 1) describes a staff as "an aid to command. It serves to ease the commander's workload by furnishing basic information and technical advice by which he/she may arrive at decisions."[31] According to FM 101-5, Command and Control for Commanders and Staff, the staff assists the commander in his search for certainty by providing better, more relevant, timely, and accurate information; making estimates and recommendations preparing plans and orders; and monitoring execution.[32]

In addition to the staff, the heavy division commander has a command group and three command post facilities to assist in commanding and controlling operations. They are the division tactical (TAC) CP, division main (MAIN CP),and division rear (REAR) CP.[33] The August 1993 edition of FM 101-5, recognizes two additional CPs that may be used at the commanders discretion. They are the alternate CP and the assault CP.[34] According to FM 71-100, Division Operations, each of these CPs should be designed and configured to maintain flexibility, redundancy, reliability, survivability and mobility to sustain continuous combat operations.

In comparison to army doctrine, the U.S. Marine Corps (USMC) views command and control and information management as one

system which can: facilitate the commanders influence, adapt to the situation, support information requirements, and exploit MAGTF capabilities.[35] The goal of the C2 system is to assist the commander in seeing the battlefield so that he has the proper information by which to make decisions.

The 1993 version of FM 100-5, Operations, clearly defines a vision for our army and the systems that make it operate. New concepts such as battle command and battle space, force enhancement, and force projection present new challenges for a command and control system. "Doctrine is the engine of change and intellectual change leads physical change."[36] FM 100-5 may be the beginning of the doctrinal revolution. The army's road map for modernizing C2 is outlined in the Army Command and Control Master Plan (AC2MP) which provides guidance needed to formulate solutions for current and future battlefield environments (See Appendix C). Emerging doctrine characterizes the superiority of army ground forces on the integrated battlefield. In this respect the doctrine states:

> Micropressing, miniaturization, communicators and space technologies have combined to permit almost real time intelligence and information sharing, distributed decision-making and rapid execution of orders from a wide variety of forces and systems for concentrated effect. The horizontal integration of digital electronics results in a network linking weapon platforms with C4I systems. The result is real-time force synchronization, shared situational awareness and the capability for swift, decisive maneuver.[37]

III. Essential Characteristics of an Effective Command & Control System

IIIa. See the Battlefield

To help us develop a model of an "effective" command and control system we must analyze the myriad of characteristics (Figure III-1) outlined in our doctrine and the desires and experiences of commander in the field. An effective command and control system is first and foremost an arrangement and orchestration of personnel, procedures, facilities, equipment and management systems to move and process information to facilitate the commanders decision and execution process. These requirements are further described in Appendix D. The fog of war prevents commanders and staffs from being certain about what is really happening. Any C2 system must assist the commander by collecting, processing, analyzing, and sharing the volumes of information available. Any effective command and control system must allow a commander to position himself wherever the situation demands. The commander must be totally mobile and must not depend on a fixed site to exercise his responsibility.[38] The commander on the ground must be relied upon to seize the opportunity. As van Creveld reminds us: "Napoleon's presence on the battlefield was worth a corps of forty thousand men."[39]

IIIb. Survivability

A recent survey of serving and former division commanders found that survivability was high on their list of priorities for their command and control system.[40] If the command posts do not

- Survivable
- Supports the decisionmaking process by facilitating the collecting, processing, analyzing and sharing of information.
- Mobile enough to move with combat elements
- Ease of displacement (set up and break down)
- Facilitate the flow of information inside and between CPs
- Interface with available communications equipment
- Standardized in process and type of equipment to ease training of personnel
- Capable of continuous operations
- Facilitates security of information and communications
- Capable of automation insertions
- Simple to operate
- Locate at least a portion of the system forward on the battlefield
- Fast, reliable communications
- Sustainability
- Deployability
- Allows the commander to position himself to see the battlefield.

Characteristics of an Effective C2 System

Figure III-1

survive, they fail by definition. Mobility was the method most used to provide survivability. Armor protection, signature reduction, and redundancy respectively provided the next highest assessments. The survivability factor listed as austerity, meaning "less is better than more," drew special attention to those who commanded in combat during Operation Desert Storm. They also noted that austerity could greatly enhance a command group's ability to support operational speed during operations and may imply a more direct, input-oriented structure for passing information to the commander. With fewer people in the command group, information paths are closer to the commander.[41]

IIIc. Mobility

Mobility is critical not only for survivability but to keep pace with today's modern weapon systems. During Operation Desert Storm, one glaring lesson learned was that the M577 cannot keep up. A number of division main command posts, consisting mainly of eight to ten 5-ton trucks and expandable vans, never attempted to move. Under current tables of organization and equipment (TOE) mobility requirements, a heavy division main CP is approximately 85% mobile while the rear CP is only 50% mobile using organic assets.[42]

IIId. Situational Awareness

A review of the tasks that a division staff is required to perform in accordance with ARTEP 71-100-1 MPT and FM 101-5 establishes four broad categories: gather, analyze, provide, and share information; develop and recommend plans; communicate; and

coordinate and monitor execution. However, the majority of the personnel assigned to a heavy division headquarters, especially those in the command posts, are involved in the gathering, analyzing, providing, or sharing of information. Many of these personnel, from primary staff officers to their assistants, analysts, map posters, message takers, and radio operators, have little to no responsibility in the other three broad catgories. According to the Battle Command Concept paper, very few people in command posts interact with the commander or possess the situational awareness needed to make recommendations.[43] (Figure III-2)

IIIe. A Model System

An effective command and control system has characteristics required to meet our earlier stated objective of facilitating the commanders decision and execution process. They are:

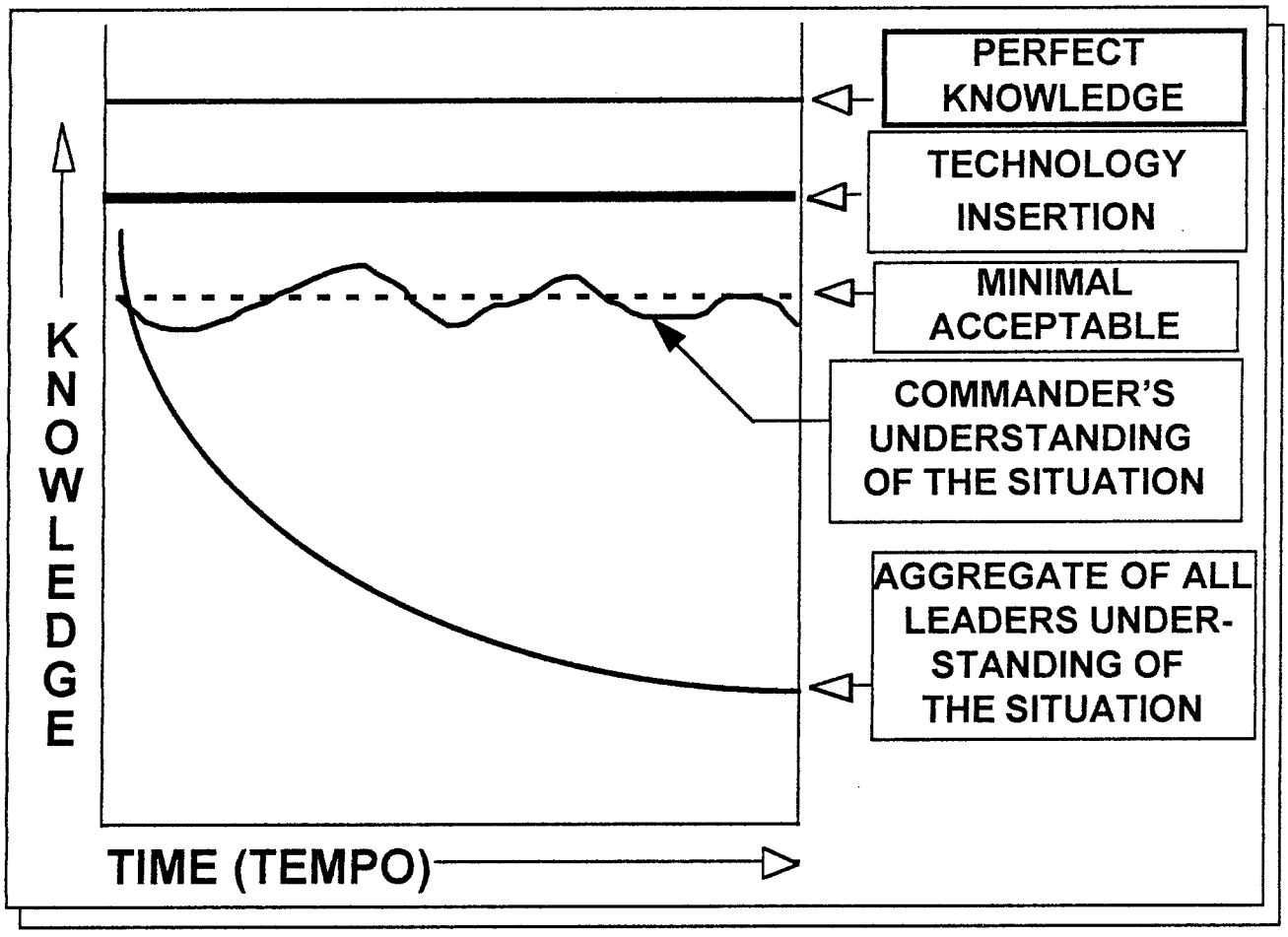
Deployability: The C2 system must support the division during all stages of deployment regardless of mode of deployment (for example during airlift, sealift, land movement).

Versatility: The C2 system must have the ability to meet diverse mission requirements. It must be multifunctional, tailorable, and flexible enough to change as the situation changes. It must also provide for C2 interface with forces external to the division.

Survivability: The C2 system must survive lethal and nonlethal attacks and continue to operate.

SOLVING THE INFORMATION GAP

INFORMATION TECHNOLOGY COUPLED WITH TRAINING CAN REDUCE UNCERTAINTY AND AMBIGUITY FOR LEADERS



Source: Battle Command Concept briefing, BCBL.

Solving the Information Gap

Figure III-2

Agility: Ability is the ability of the C2 system to plan, decide, and act faster than the enemy can react. This characteristic implies short command and communications paths and a level of situational awareness which will reduce uncertainty. Agility is in part accomplished through the integration of all staff members to achieve unity of effort. Synchronization of combat power will depend on the agility of the staff.

Mobility: Listed separately from the factors under survivability, the C2 system must be as mobile as the division itself. While current tactical CP's are designed for mobility, main and rear CP's are not. The rapid emplacement, displacement and the ability to operate on the move are critical factors of mobility.

Supportive to the commander: Above all else, a C2 system must facilitate the flow of information that effectively supports the decision and execution process. This characteristic infers that the system can support current operations and plan future operations simultaneously while maintaining a reliable communications link between commander, staff, subordinates and higher echelons. It must also allow the commander the freedom to command while not tying him to a specific CP or vehicle. Variations in command style, not technology, should dictate where the commander will be on the battlefield. The C2 system must be robust enough to operate twenty-four hours a day, conduct coordination and internal as well as external liaison to the

division, and maintain the personnel and equipment that operate the system.

IV. The Future Battlefield Environment

IVa. Information Warfare

The future army--Force XXI--looks forward fifteen to twenty years and envisions this nation's land component facing a full spectrum of operational environments from high intensity warfare to operations other than war (OOTW). Tomorrow's army, as outlined in TRADOC Pamphlet 525-5, must be rapidly tailorable, expansible, strategically deployable, and effectively employable as part of a joint and multinational team to achieve decisive results in all operational environments.[44] Amidst this revolution, information technology is transforming capabilities and requirements at every level. Winning the Information War, one of five thrusts around which the army is building its modernization,[45] will enable rapid battlefield decision making based on real-time shared situational awareness.[46]

These future roles have serious implications for the army's command and control system. The need for global employment of smaller, more agile, and more capable forces will require that supporting command and control systems be built with enhanced deployability, mobility, flexibility, and operational capability. At the same time, these systems must decrease their current reliance on short-range surface communications, perishable critical nodes, information chokepoints, and complex networks of support systems.[47]

Inherent requirements of this information age method of warfighting are two new operational concepts; that of ***battle space***, which FM 100-5 defines in part as the "maximum capabilities of a unit to acquire and dominate the enemy" and includes "breadth, depth, and height in which the commander positions forces over time" and ***battle command***, defined as "assimilating information to visualize the battlefield, assess the situation, and direct military action required to achieve victory."[48] "Battle command is commander-centered rather than staff-centered."[49] Control is inherent in battle command and serves its purpose if it allows the commander the freedom to operate, delegate authority, lead from any critical point on the battlefield, and synchronize actions across his entire area of operation.[50]

While information technology drives much of this revolution, the changes are far more vast in scope and effect than mere technology insertions. The anticipated "thousand fold advances" in information technology over the next 20 years will revolutionize how nations, organizations and people interact. Organizational and procedural changes will challenge our traditional hierarchical management models and force us to examine the relevance of current methods. Military operations will involve the coexistence of both hierarchical and internetted, nonhierarchical processes. Order will be less physically imposed than knowledge-imposed.[51]

The Army Command and Control Master Plan supports the premise that information technology will provide an improved capability for commanders and staffs to speed up the process of acquiring, processing, and analyzing information, deciding what action to take and directing subordinate organizations. While current and near term hardware and software are far from perfect, they provide an interactive solution that will serve a training vehicle for future digitized command and control systems and serve to inculcate young officers and non-commissioned officers with the idea that computers will be essential elements on tomorrow's battlefield.[52]

IVb. The Digitized Battlefield

The Army's visualization of the digitized battlefield portrays a ground force operating in a combined-arms, joint-task-force setting. The integrated ground force C4I and weapon systems information network would operate as an integral part of the joint network and in turn be linked to a global network. The digitized battlefield will support rapid, decisive placement of combat power in the right place and the right time to overwhelm and destroy enemy forces.

In digitizing battlefield systems, a network interlinks weapon systems, aerial platforms, surveillance, and communications systems, allowing the exchange of vast amounts of information. Communications networks transfer data between each battlefield functional area--combat, combat support, and combat service support.

IVc. Technology

Any given technology has very strict limitations; often the critical factor is less the type of hardware available than the way it is used. Success on past battlefields has resulted not so much from technology advances but from innovative ways of considering and combining available and new technologies as they apply to warfighting.[53] Since decisive technological advantage is "fairly rare and always temporary," victory often depends not so much on having superior technology but rather understanding the limits of a given technology and finding a way to get around those limitations. "To use existing technology to the limit and at the same time make its very limitations work for you, is the hallmark of genius."[54] Napoleon was able to revolutionize war by employing organizational and procedural means in order to overcome and transcend the limits imposed by the technology of the time." [55]

To achieve a sharp reduction in the time needed for execution of command and control operations, it is not enough to improve only the methods of operation and make adjustments in the organizational structure of our command and control system. It is in need of and necessary to introduce improved technical equipment. Initially, we should be careful not to expect drastic improvements. As history has shown, with each new technology introduction into our command and control systems, additional manpower occurred as well as increased time required to make decisions due to the increased volume of information. Recent 1st

Cavalry Division initiatives to digitize their command and control system resulted in a significant increase of personnel as a result of operating in both the traditional and digitized mode. The requirement to operate in both modes exists due to the need to build confidence in the new system and provide redundancy for what is now a fledgling concept. In the near future, but only after substantial training, technology will lighten the work load, virtually replacing those CP personnel who post maps, record messages, make copies and operate as RTOs. Technology will improve the level of situational awareness to a point where every on in the command will share the same "relevant common picture"[56] and be able to provide clearer information to the commander for decisionmaking.

The inter vehicle information system (IVIS) is the first step toward incorporating technologies in a network of land combat systems designed to give each soldier as complete and common an understanding of the battlefield as possible. In his 1990 article "The Future of C2," Major General Wayne Knudson outlined a number of emerging technologies that offer the most promise in improving C2 support systems in the near future. Those technologies, coupled with the developments of the last few years (Figure IV-1), provide a catalyst that will enable the C2 system to change in a revolutionary manner. Miniaturization will make possible the reduction of large capacity systems to a size that can be easily carried by the individual soldier. Computers, communicators, and cameras will all be small enough and light

SUPERCONDUCTORS	ARRAY PROCESSORS
MODELING	ROBOTICS
ENGINEERING GRAPHICS	LOCAL AREA NETWORKS
SIMULATION (VIRTUAL REALITY)	VIDEO TRANSITION
PROCESS CONTROL AIDS	ELECTRONIC INTERCHANGE
FIBER OPTIC LINKS	WIRELESS INTERCOM
MINIATURIZATION	ARTIFICIAL INTELLIGENCE
TOUCH SCREEN MONITORS	LARGE FLAT SCREEN MONITOR
LIGHT PEN/POINTING DEVICES	SPREAD SPECTRUM TECHNOLOGY
PERSONAL COMMUNICATORS	NEURAL NETWORKS

Emerging Technologies

Figure IV-1

enough to fit on a soldier's helmet, armband or unmanned air/ground reconnaissance vehicle.

Simulation and virtual reality will have a revolutionary impact on the way a staff wargames a course of action, or the way leaders conduct rehearsals. Local area networks (LANs) will improve situational awareness by allowing anyone with a terminal to "pull" from a data base the information, map, or graphics they need for an operation. LANs will provide real time reconnaissance, data for a rehearsal, or surveillance of a remote named area of interest (NAI).

Video-teleconferencing (VTC) will afford an opportunity to disperse command and control systems assets, yet still ***electronically collocate*** them for planning and execution. Artificial intelligence will help sort the volumes of information and wargame courses of action, and will provide projected results and keep track of the logistical status of all our units. Large, flat screened monitors can replace most maps and VGTs in command posts. Touch screen commands or light pens can be used to draw graphics and move icons of friendly and enemy forces.

In fiscal year 1995, the army expects to demonstrate a wireless high capacity network with link distances from 2-10 kilometer ranges and a fiber optic backbone using the fiber distributed data interface (FDDI) to handle voice, data, and video information that will provide connectivity within command posts.

Technology will allow our staffs to perform functions in a fraction of the time it now takes.[57] However, the army may place these new technologies in obsolete M577s and 5-ton vans. Installing them in these old vehicles will only serve to limit the technologies' tremendous potential.[58] Likewise, fielding new carriers such as the C2V and organizing it or equipping it for the way command and control was done in the 60's, 70's, and 80's is just as foolhardy.[59] Appendix E depicts the proposed staff arrangement for the C2Vs that replace the division TAC CP M577s. A key point to note is that the configuration shown implies business as is currently conducted.

Technology has promoted not only a myriad of devices but also placed high demands on mobility, agility and rapid decision making to assist the commander. Information technology acts as an enabler that will allow the army to operate in radically different ways. How we execute command and control will be the key to future success.

IVd. Imperatives of Future Command and Control Systems.

The ultimate goal of future command and control initiatives is an integrated system of distributed C2 subsystems that will permit commanders to exercise superior command. "Commanders are not tailored for C2 systems. C2 systems are tailored for commanders."[60] The C2 process and its tools must remain simple, easy to use, interoperable and quick. They must deliver the product a commander needs to make decisions and issue effective orders. The control process must never cause the command process

to stagnate. "The ultimate objective of C2 is to achieve unity of effort and increase the tempo of operations."[61]

A future battle command support system must be deliberately designed to respond to the constant changes in tempo while maintaining control of the forces assigned to it and processing and analyzing large volumes of information. "Implied is a C4I system that can be deployed with lead echelon forces in which to establish a forward HQ and base of operations."[62] Organizational design must maximize the use of technologies that will allow functions to be performed from a remote location or split base operation. Organizational designers will use technological advances to decrease the size of units while expanding lethality, survivability, and deployability.[63] The requirement to operate en route with tailorable, early entry C2 facilities and to conduct split based operations while decreasing the size of the organization are new imperatives for our Force XXI Battle Command Support System (BCSS). The ability to task organize and tailor the staff and its associated equipment for war and OOTW appears to be another. Our smaller army will require augmentation of non-military personnel; government agencies, non government organizations (NGO), contractors, sister services, allies and host nation supporters in the environments of the future.

By comparing these new requirements to the characteristics listed in section 3, a refined set of characteristics for a future command and control system emerge (Figure IV-2). Current

C2 system capabilities must be compared against the model for a future C2 system to establish whether or not we need to change.

V. Is Change Needed?

Va. Are Old Methods Obsolete?

The first question to address is whether or not the Army's tactical command and control system needs to be changed given current and near-term technological developments and changes in battle command doctrine. C2 today is not radically different from the past. Leaders still command and control forces principally through face to face contact with subordinates, by being where the action is, and by passing directives and orders over some type of communications means when they are away from the command post. Units still use paper maps to navigate and radios to report their situations and locations, although leaders can communicate more reliably over improved systems like MSE and SINCGARS. Computers have been only partially accepted; many commanders do not trust them for the important C2 tasks.[64] "Old soldiers fear they can never trust a computer like they can a map and grease pencil."[65] The truth is that staffs operate computers and not the other way around. Computers are only tools that should enable us to do our business more effectively. Continued use and familiarity with these new technologies will develop our confidence and open our minds to finding new capabilities.

As described in TRADOC Pam 525-5, the ability to move and process information rapidly will likely change the way operations are commanded and controlled, even if change is resisted! It

- SUPPORT THE COMMANDER AND THE DECISION MAKING PROCESS
- DEPLOYABLE
- VERSATILE
- SURVIVABLE
- AGILE
- MOBILE

Characteristics of a future C2 System

will greatly influence force organization, command and control procedures and staff organization.[66] The army's future battle command is reflected in the Army Battle Command System (ABCS) and capitalizes on the power of quality soldiers, enabled by information-age technology.[67] New capabilities may not be able to operate within the confines of old doctrinal patterns if there is a true desire to optimize capabilities and exploit synergy.[68] The inability of the army to fully appreciate the creative possibilities of a new C2 system is attributable to its inability to break with functions and definitions belonging to the old system.

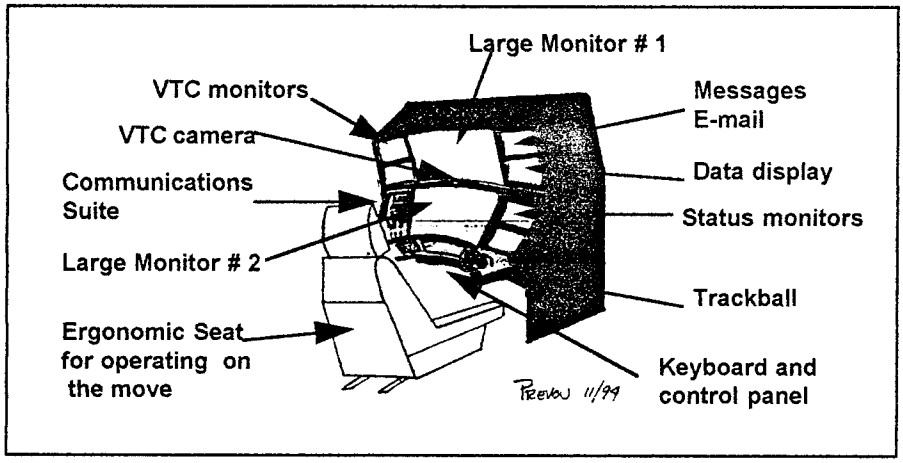
Vb. Breaking the Paradigms

The RAND report Understanding Commanders Information Needs noted that during observations of a number of CPXs, three principles appeared to be prerequisites for effective CP operations: 1) The consolidation of major functions to shorten communications paths. This does not necessarily mean along staff section or BOS lines, but rather close, deep, and rear operations. 2) A single information pool to which people can refer if they need basic situation information in a hurry is required. Currently the tactical operations center (TOC) in the main CP performs this function, generally using a battle board.[69] In the near term, this function can be performed by computers consisting primarily of databases that are automatically updated at a specified time. 3) The chain of command, like a telescope, must be capable of extension and contraction as needed. The

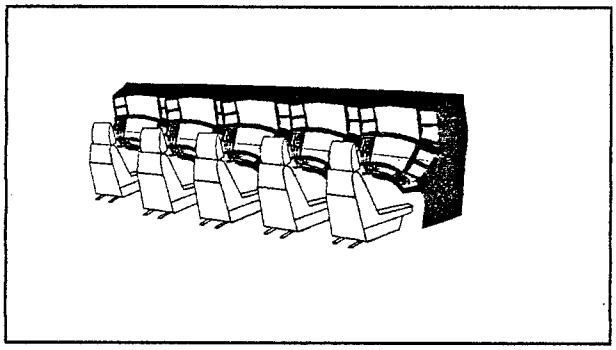
commander needs the freedom to command from anywhere on the battlefield, spending time in his CPs, with subordinate units in the plans cell, or elsewhere as he desires. Current communications capabilities partially provide him this freedom. Emerging near term technology will greatly enhance this capability.

Standardization, many will argue, is another characteristic required of command posts in the future. However, according to the EER Systems Corporation study Battle Command Assessment, "Standardization of Division and Corps CPs was neither achievable nor desirable.[70] Commanders prefer "a set of tools" which will let them build CPs to meet their needs. What should perhaps be standardized are the modular work stations within the CP's that each staff member is responsible for operating. (Figure V-1) These standard modules of computers and displays should be available for day-to-day operations in the headquarters to instill skill in confidence in its use. Why do business any differently in the field than in garrison?

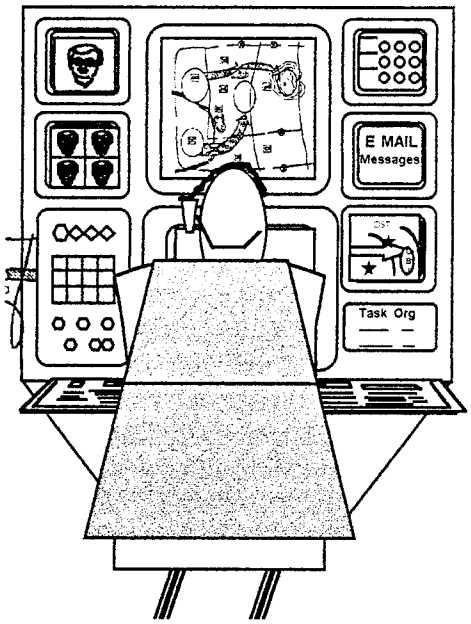
Another question concerns the contribution of technology to improve command and control. In a recent NTC rotation, a Fort Knox task force conducted a battalion-size digitized operation. The chart at figure V-2 demonstrates the improvement in the volume of fire of digitized forces versus their non-digitized counterparts.[71] The improvement, albeit small, was the army's first attempt at digitizing a battalion size force.



SINGLE CONSOLE FOR USE IN BCV AND C2 HMMWVs.



MULTI CONSOLE CONFIGURATION FOR C2Vs.

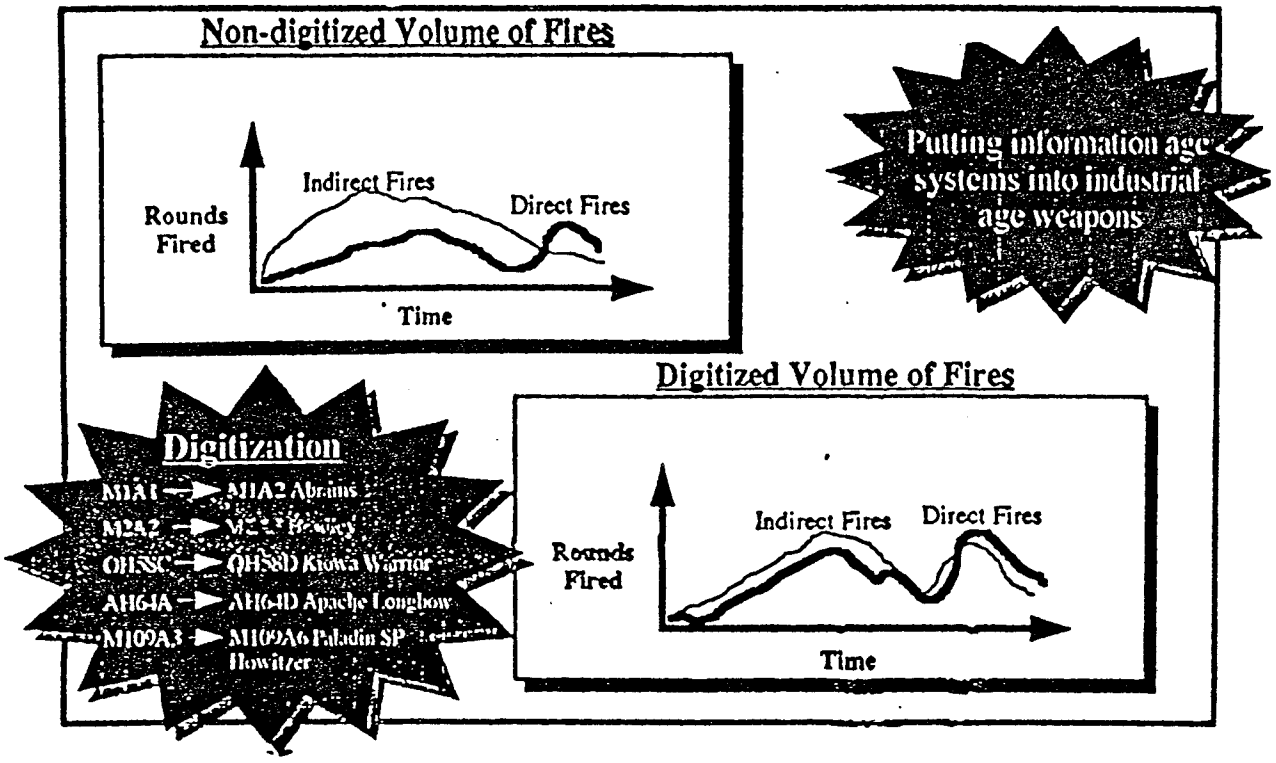


Information needed by the BST officer can be tailored and displayed on any off the available monitors of the C4 console.
Components include:
2 X large monitors for digitized maps.
6 X small monitors for VTC, data, E-mail, status reports, etc.
Audio, video and data recording
Light pen graphics and trackball/ pulldown menues
One touch communications suite and a wireless headset
Automatic back-up and report log
Independent operating capability (off the LAN)
Ergonomic chair and control panel for on-the-move capability

Command, Control, Communications, and Computer (C4) Console

Figure V-1

Digitization -The Effect
Steel on Target



Comparison of Volume of Fire Between Digitized and Non-digitized Forces

Figure V-2

Vc. C2 Systems Compared

Appendix F shows the doctrinal organization and responsibilities for the current TAC, main and rear CPs. Although there is currently no doctrinal organization for the alternate or assault CPs, FM 101-5 outlines techniques for employment of both. These sketches and responsibilities provide a quick reference as we compare the current C2 system to our model of a C2 system for Force XXI (Figure V-3).

Deployable. Today's current system of expando vans and tractor trailer rigs is unacceptable in a force projection army. Staffs and CPs must be rapidly deployable. Inherent with force projection, commanders will be faced with constrained strategic air lift, long distance deployments and unfamiliar and immature theaters of operation. Future command posts will not be able to afford scores of vehicles and hundreds of officers, noncommissioned officers, and soldiers. Power projection will require that commanders and soldiers be updated enroute. Current CP vehicles lack the ability to operate and communicate enroute or conduct video teleconferencing (VTC).

Versatile. Our current system gives the commander very few choices for task organizing an assault CP or echeloning for an early entry or OOTW scenario. Todays CPs must be static to be fully operational and setup and march times are excessive.

Survivable. While TAC CP's in M577s provide a fair level of protection, the main and rear must rely on means other than armor for their protection. Main or rear CPs are too big and easily

- The Battle Command Support System is an arrangement of personnel, equipment, facilities, communications and procedures employed by a commander in planning, directing, coordinating and controlling forces and operations for a Force XXI unit by being:

- Supportive to the commander by providing:

    - Allow him the freedom to move about the battlefield at will while linked through communications to his staff and subordinates.

    - An effective staff that can:

        - Gather, analyze, provide and store information

        - Develop plans and orders

        - Communicate

        - Coordinate and monitor execution

- Deployable: The C2 system must match the force projection capabilities of tomorrows Army and fit abroad strategic airlift while continuing to operate.

- Versatile: Tailorable, able to integrate GO and NGO staff. Flexible enough to accommodate joint and combined integration in any environment.

- Survivable: Able to provide a small, mobile target to limit enemy opportunity to attack it with lethal or nonlethal means.

- Agile: Able to plan, decide and act faster than the enemy.

- Mobile: Able to keep pace with modern weapon systems in any terrain.

Characteristics of a Battle Command Support System (BCSS)

Figure V-3

detected due to their visual, electronic, and thermal signatures.[72] It is impractical to harden all our CP vehicles; we must therefore reduce their size and signature and have the ability to displace them often.

Agile. Current command posts do not provide a suitable work environment for high technology, automated equipment. CPs have just recently incorporated computers in capacities other than those of a word processor. While Warrior is an initiative to help the commander see the battlefield from the military intelligence/G2 perspective, the lack of a VTC capability, intercoms between vans, shared data base information, and reliance on current ops for situational awareness reduces the staff agility to the same methods used in 1945.

Mobile.

Current CP vehicles do not share the same mobility as that of the forces they support.[73] Our main and rear CPs are not completely mobile and require transportation assets not organic to the division headquarters company to move them.[74]

Support to the Commander

Staffs gather, analyze, provide and share information; develop and recommend plans; coordinate and supervise execution; and communicate in much the same fashion now as they have for over the past forty years. C2 has reached a peak performance level that will not significantly improve without the insertion of a new enabler. The division commander, on the other hand, is tied to his command posts for information. Moving forward in his

M113, today's division commander is hampered by range limitations of his current communications systems and reliant on the TAC and Main CP to keep him abreast of the situation throughout his battle space. The commander's vehicle lacks the same mobility and protection as is M1/M2 fleet and lacks the robustness of communications and personnel necessary to properly "see the battlefield."

Current C2 systems are not capable of meeting twentieth century demands. Command, control, and communications to date have not kept pace with weapons development over the past decade and a half. Fielding the C2V with outdated communications equipment and an organization hardly different from one our grandfathers served in is like a new paint job over a rusted-out car.

The current C2 sysem is too outdated and a worn to make the journey into the twenty-first century. The army takes five years to develop an idea and fifteen years to change a system. Therefore, now is the time to start moving the army toward the future. Today's operations are shaping those of tomorrow. The patterns in the conduct of future operations are sufficiently clear to set in motion changes in a command and control system. The opportunity for change is here.

Vd. How We Change

"Modernization no longer is about systems, it is about capabilities."[75] The ability to orchestrate force capabilities to achieve decisive results is the key to success.[76]

The "digital revolution"[77] must now make its way into army command and control. "We are redesigning this force to move the Army into the 21st Century."[78] Rather than simply ask, "How can we execute command and control faster, better, or with fewer people?", we should ask "Why do specific tasks at all?" We must decide what functions are no longer required, and which ones can be separated from the CPs. We must clarify tasks to shorten communications paths, improve situational awareness, and enhance decisionmaking? The current division of three command posts and a command group organized along functional lines, rather than perhaps a battlefield framework, must be reconsidered.

Reengineering mean starting over. In their book Reengineering the Corporation, Michael Hammer and James Champy demonstrate how existing corporations can reinvent themselves through reengineering.[79] Reengineering is to the information revolution what the specialization of labor was to the industrial revolution. The army must embrace and apply the principles of reengineering or run the risk of being "eclipsed" by the greater successes of armies that do.[80]

"Reengineering cannot be carried out in small cautious steps. It is an all-or-nothing proposition that produces dramatically impressive results."[81] Traditionally, change has been by tinkering with what already exists and making incremental changes over the years, leaving the basic structure intact. If we are to be truly enabled by new technologies, then we must ask ourselves "given current and near term technological advances and

the new battle command doctrine, what would we want our C2 system to look like if we design if from scratch?" Reengineering means questioning not only what we do but how we do it, a review of our procedures as well as our tasks. Figure V-4 outlines a number of possibilities we should consider as we reengineer our command and control system for Force XXI.

The Chief of Staff and other senior army leaders have made a compelling argument for change. It has been a forceful message that has linked our future success, in a time of limited resources, to the ability to learn, anticipate, and adapt.[82] The digitization of the army is a goal for which we can shoot. However, little has been said or done with regard to reengineering our command and control system to support the digitized forces we envision fielding for the 21st century.

VI. The Battle Command Support System for Force XXI

VIa. A Modular C2 System

Using a modular concept, commanders can leverage split-based operations and enhance the capabilities of intelligence, fire support, logistics and planning. The split-based enhancements outlined in Appendix G support the BCSS model. The modular concept provides commanders a BCSS 'toolbox' rather than the rigid system which we employ today. The basic tools or modules optimize the CP configuration for a mission and a command style. The use of modules enhances the commanders ability to organize the C2 system in many ways: from the current arrangements of TAC, main, rear CP's with a command group; through recently

- As few people as possible should be involved in the performance of a process.
- Several jobs may be combined into one.
- The steps in the process should be performed in a natural order.
- Processes have multiple versions
- Work should be performed where it makes the most sense.
- Checks and controls should be reduced favor of command functions.
- Reconciliation can be minimized.
- A tactical officer can provide a single POC for a given portion of the battlefield.
- Size of CP's can be reduced through electronic collocation, such as VTC, wireless intercoms and infrared data transmitters.

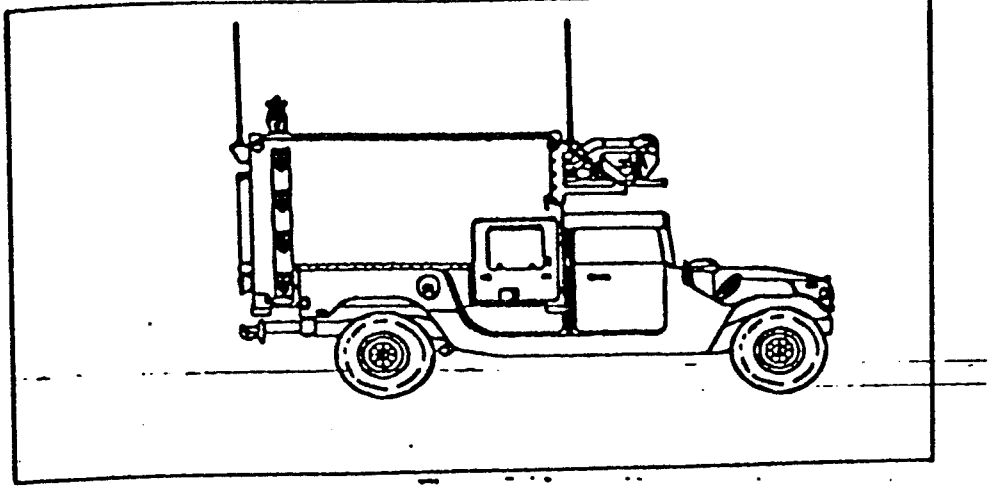
Possibilities for Reengineering the Command and Control System
Figure V-4

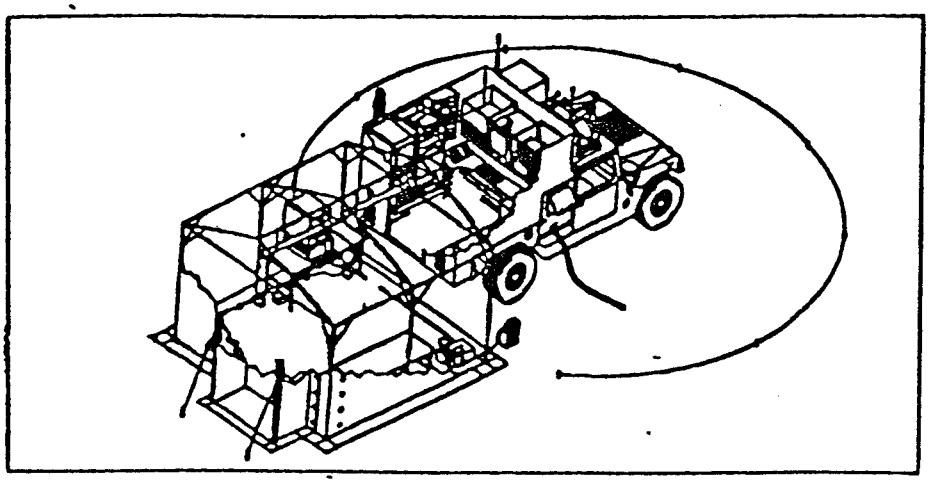
proposed alternatives using only forward and rearward CP's; to variants of a single CP.[83] It also allows the commander to select tailored staff arrangements from a single battle support team[84] to a rotating planning and operations team concept.[85]

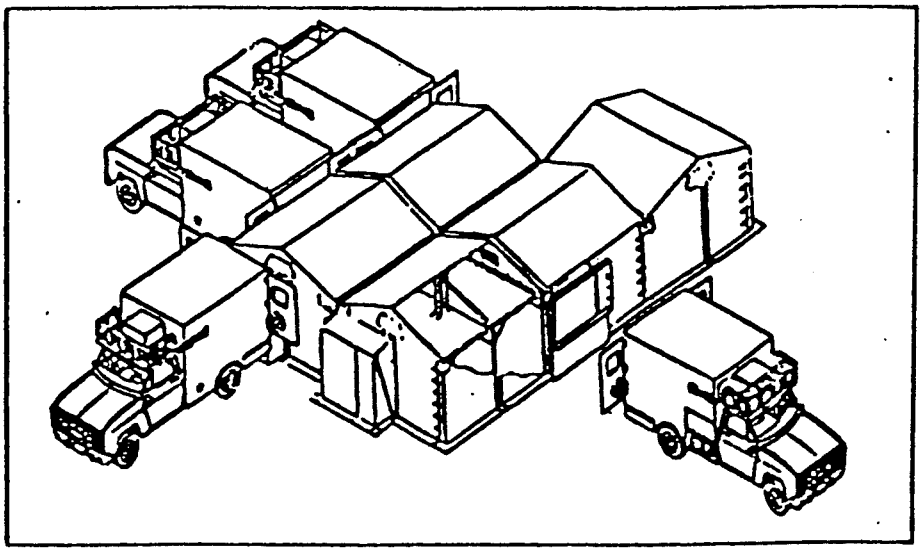
In addition to establishing CPs that meet his needs, commanders have the capability to "kick out" a specialized CP and battle support team for a specific purpose such as a passage of lines, river crossing, humanitarian missions or split based operations. Commanders will be able to adapt their C2 system to the contexts and environments of their ongoing situations without degrading the overall C2 system performance.

VIb. Implementation

To implement the concept of modular CPs, there are three basic components of the organization from which commanders can add or subtract capabilities as the mission requires. These consist of a battle command vehicle for the commander; a set of armored command and control vehicles (C2V) for use forward; and a set of high mobility multiwheeled vehicles (HMMWVs) with C2 shelters [86] in place of the current 5-ton expando-vans. Each "module" would be configured with manpower and equipment sets that are separable, functionally independent and deployable in packages. This modular system will enhance both CP deployability and battlefield mobility.[87] The three basic components are all compatible with the Standard Integrated Command Post System (SICPS) concept which provides a covered work area that can be linked together (Figure VI-1).





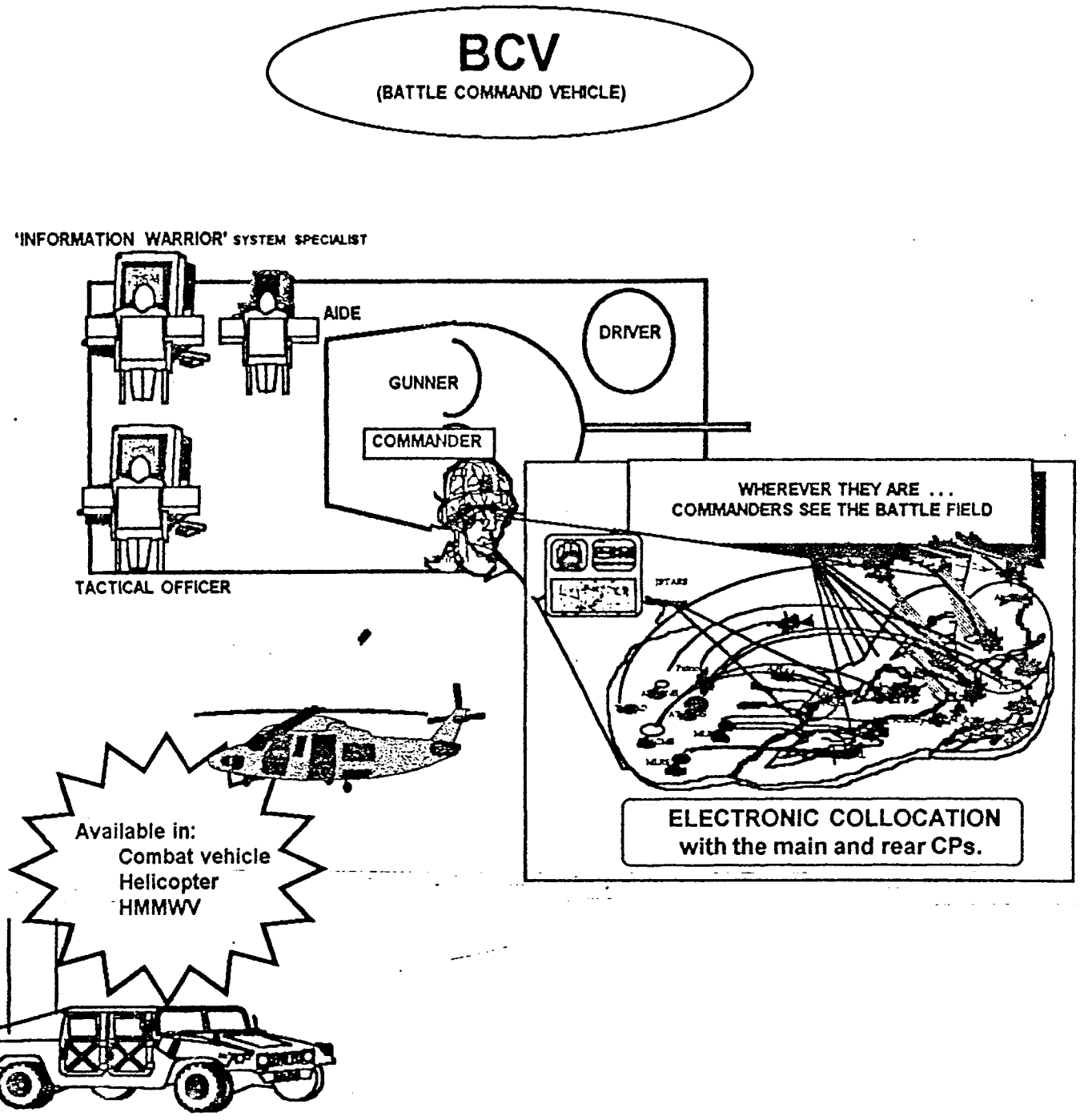


CP Vehicle with Standard Integrated Command Post Shelter (SICPS)

Figure VI-1

The commander, in his battle command vehicle (BCV), would have the same capability to "see the battlefield" in terms of the relevant common picture from anywhere on the battlefield. The BCV concept is not one but three vehicles that the commander can use at his choosing. The commander would have at his disposal a HMMWV, helicopter, and a combat vehicle all configured to accommodate his battle support team (BST). Figure VI-2 provides a concept for the combat variation of the BCV and BST. The commander's BST would consist of the driver or pilot for each vehicle (a copilot would be available in the helicopter and a gunner in his combat vehicle), the aide de camp, a ***tactical officer***, *and an* ***information warrior***. The most important characteristics of the commanders BST are its capability to communicate, access information, remain mobile and protect the commander.[88]

The tactical officer functions much like a bridge officer on a naval ship. He is viewed as a branch immaterial officer and the position is a rating that can be achieved through a specific qualification dealing with the competencies of the information system as well as the officer's tactical competence. A pool of tactical officers would be maintained, probably under the G3 to use in all command posts. The implication is that a tactical officer generally has a higher situational awareness of the battlefield than do other staff officers. The tactical officer would support the commander by keeping abreast of the current situation, conducting short-notice planning, and keeping the



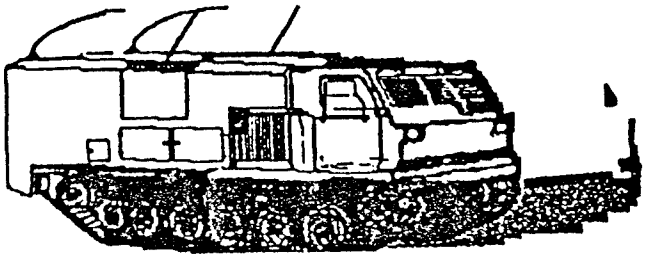
Battle Command Vehicle (BCV)

Figure VI-2

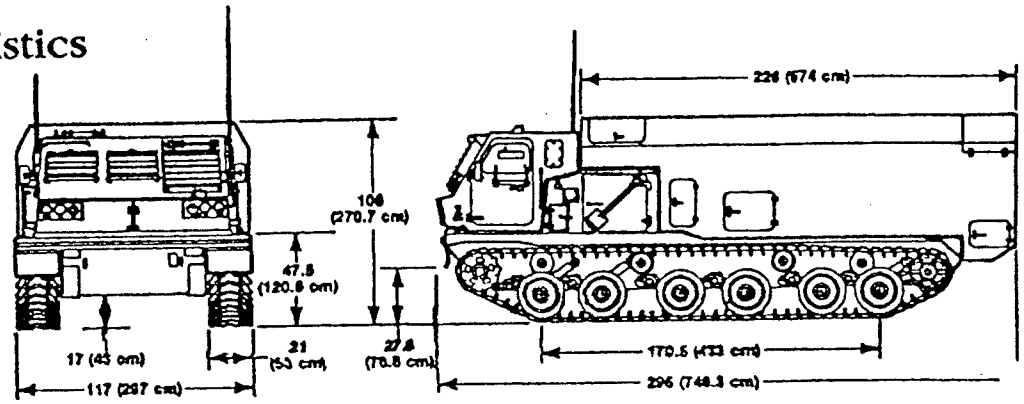
staff informed of the commander's decisions. The information warrior[89] manipulates the digital command, control and communications (C3) system to provide the commander with information he requests. One of his key functions is to keep the commander from having to focus on the technology, thereby allowing the commander to keep his eyes on the battlefield, not the keyboard. In any of the BCVs, the aide would assist with communications while the tactical officer would keep abreast of operations, and the information warrior would operate the commander's C4 system.

The combat variant BCV, depicted to look like a modified Bradley fighting vehicle in this example, must provide the commander the mobility and survivability to go forward. The commonality of the vehicle signature will add to its survivability. Four modular workstations would be available in each BCV--one each for the commander, the aide, the tactical officer and the information warrior. Additional BCVs could be added to increase the size of the command group, or a C2V, capable of carrying eight to nine officers could be used. The command group and the BCV provide the commander access into the division C2 system. They allows him to see the battlefield and hear the information needed to make decisions.

The second component of the modular command post concept is a set of C2Vs (Figure VI-3). These vehicles can be used by the commander as a TAC CP when employing three echelons of CPs, as a forward (FWD) CP when employing a two-echelon CP configuration;

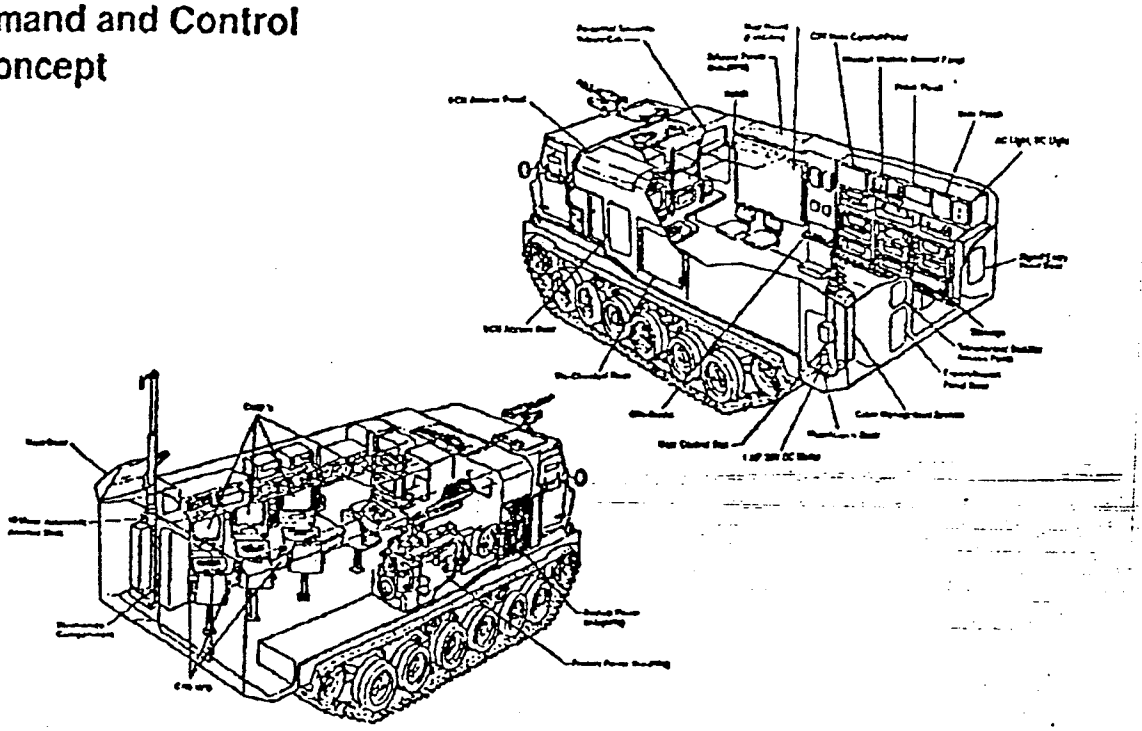


XM4 Characteristics



Dimensions in inches (centimeters)

C2V Command and Control Vehicle Concept



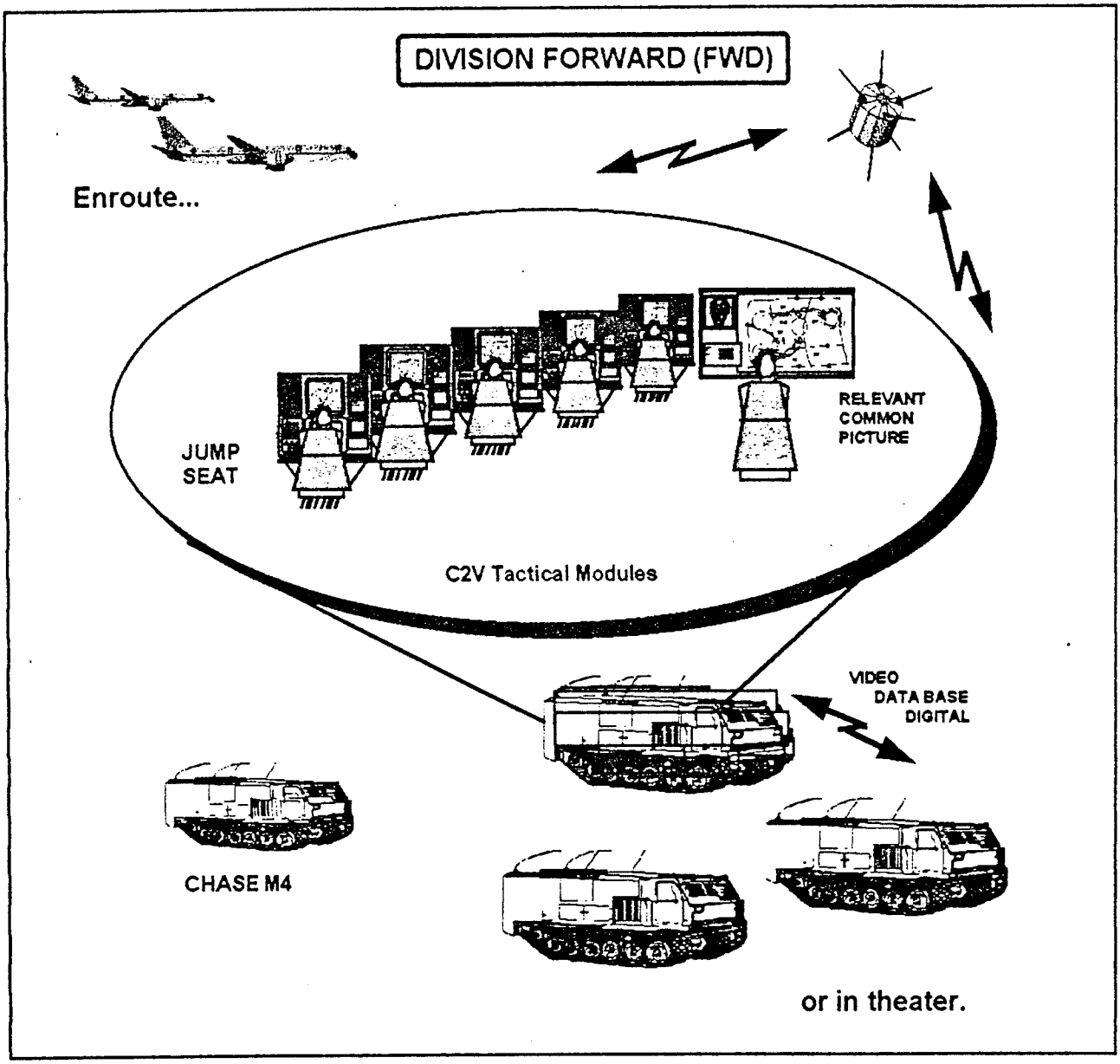
Command and Control Vehicle (C2V)

Figure VI-3

as the only CP when only one is called for; or as an assault CP. The organization and functions of this command post differ from that of the current TAC. The FWD CP (a term we will use here to refer to the armored C2Vs regardless of their designation TAC, FWD, ASLT, etc) would consist of three C2Vs and be responsible for the execution of the close and deep fights under the supervision of the Assistant Chief of Staff, G3.

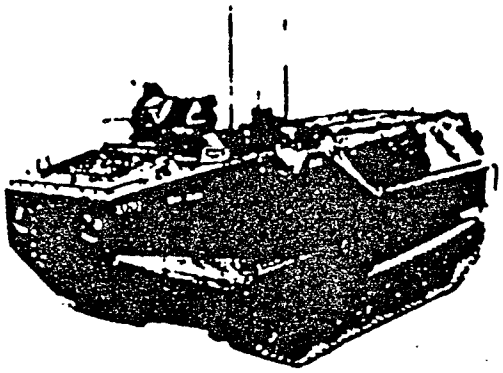
In this CP, weapon systems and units are monitored and orchestrated to achieve the commander's intent. The organization of the FWD CP (Figure VI-4) is austere. Here tactical officers monitor the conduct of battle, keep the commander and deputy commanders informed and conduct quick planning and intervention. These are the executers rather than planners and they are organized more along battlefield framework lines than those of the battlefield operating systems.[90] There is little duplication of effort in this staff and those who will operate from other CPs. The FWD CP must be able to operate on the move and have a 24-hour capability. The C2V will make maximum use of information and computer technology to reduce the individual workload and improve situational awareness.

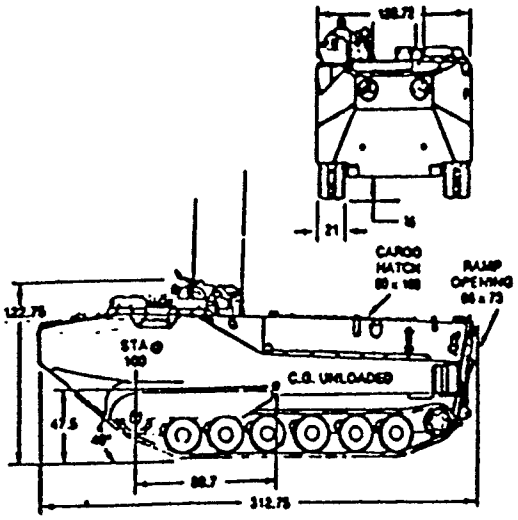
In practice, the FWD CP organizes and operates somewhat like the U.S. Marine Corps assault amphibious command and control vehicle, the AAVC7[91] (Figure VI-5). The AAVC7, with work stations for 10 personnel, allows the commander and primary staff to operate on the move from one carrier while the executive officer and the "Bravo" command group operate from another. A



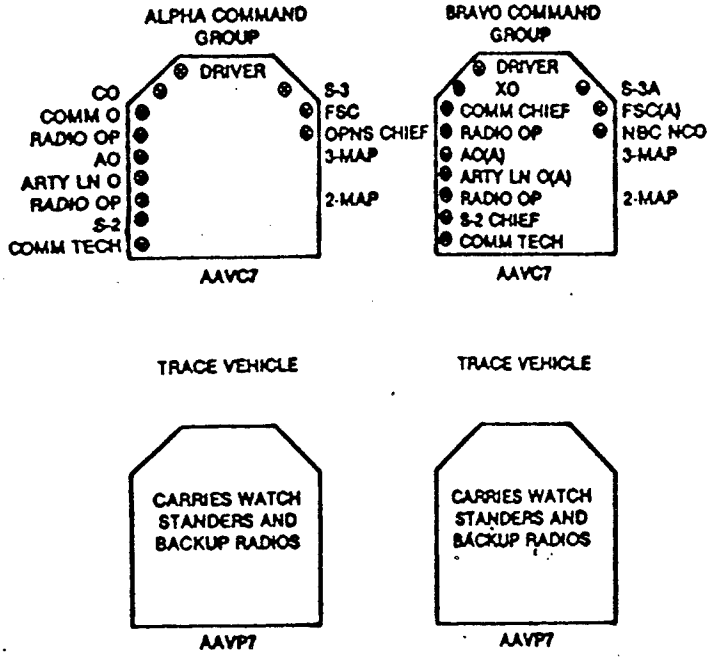
BCSS FORWARD CP CONCEPT

Figure VI-4





AAVC7 Interior.



(a) Staff and communication personnel	
(b) Armament station:	
Operation	
Armament:	
Machinegun	7.62mm, M60D
Weight	23.16 pounds
Rate of fire	550 rounds per minute
Muzzle velocity	28 feet per second
Range (maximum)	3,200 meters

USMC AAVC7

Figure VI-5

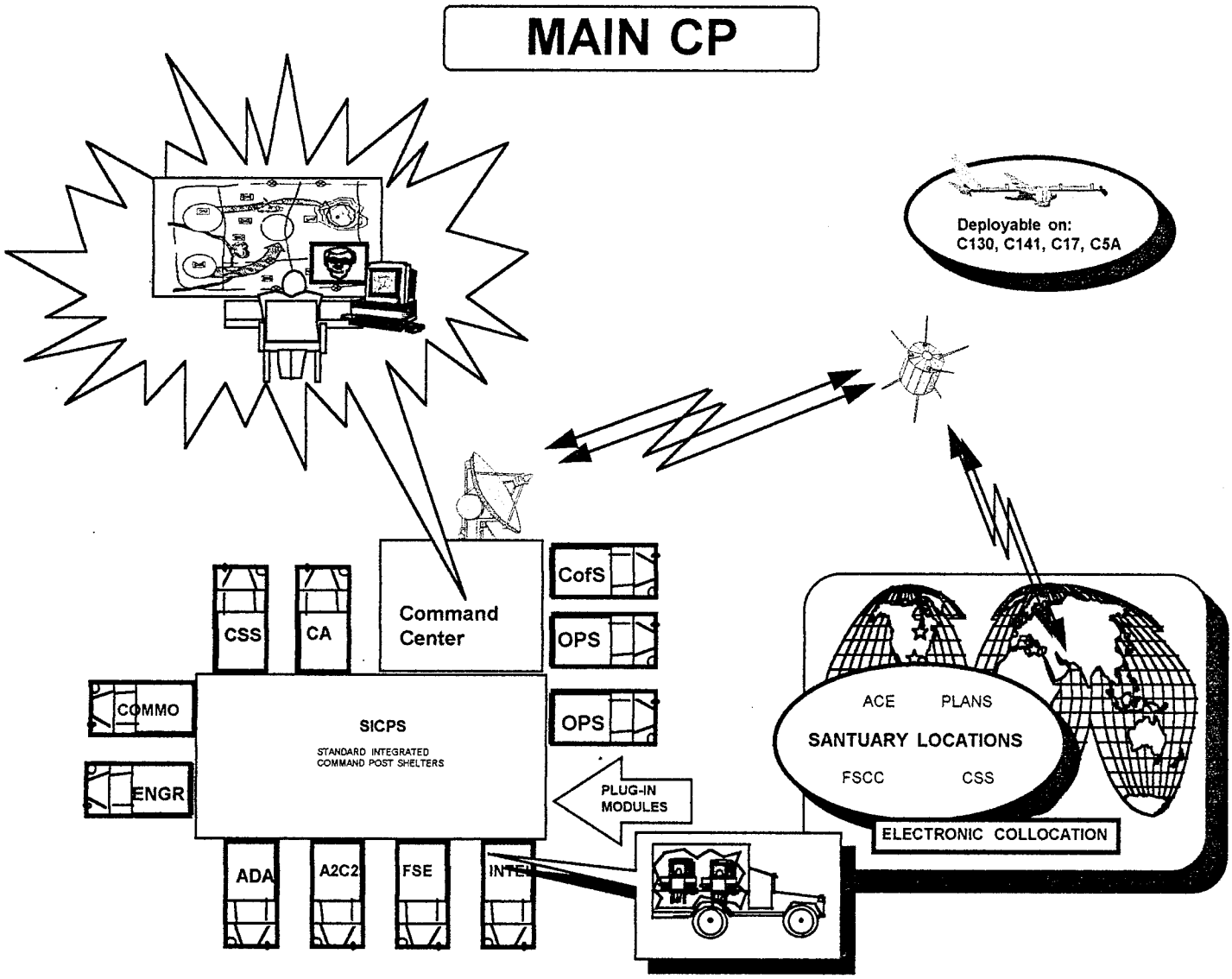
trace vehicle carries additional equipment and security troops for each command group.

In the FWD CP example, an organization for mid- to high-intensity conflict may provide for a deep and close battle team, consisting of three officers each, focusing on their battlefield area and acting as the interface between commander and the remainder of the staff. Other officers monitor the status of the rear battle area airspace (A2C2), fire support assets, CSS status and communications. Together they synchronize, modify and support the close and deep fights. The G2 and G3 (positioned in the FWD CP in this example) would operate from a command console with a large flat screen (1 to 1.5 meters) that allows them to see multiple views of the battlefield simultaneously. The information warrior in each C2V assists the G2 and G3 in accessing information and prevents them from becoming fixated on the system rather than the information.

A wireless high capacity network links each C2V within a range up to 10 kilometers, reducing the need to locate vehicles side by side. A fiber optic backbone will allow for voice, data, and video connectivity between halted CP modules. Electronic collocation through video teleconferencing (VTC) will provide the FWD CP battle support team the ability to receive intelligence, operational instructions, and plans, and to coordinate execution with other staff members further to the rear as well as subordinate units on the front.

The third component of the modular command post system is the main CP or rearward CP (Figure VI-6). In this CP, the base organization consists of modules from the chief of staff, the five coordinating staff elements and required special staff. To down-size the main CP, the majority of CP members are located further to the rear, by electronic collocation with the warfighters in the CPs. Others might simply be eliminated as a result of the increased technology.[92] Using HMMWVs exclusively in the main CP reduces the lift requirements as well as the size and signature of the CP.

By relocating the Analysis and Control Element (ACE); fire support coordination center (FSCC); combat service support (CSS), deception and plans cells from the main CP and placing them in a sanctuary location or even home station, the CP reduces in size by three-fifths. The main CP would then consist of decision makers who could monitor their functional area, battlefield operating systems (BOS), or area of the battlefield, close, deep or rear, and make recommendations to the commander through the chief of staff. Plans could be developed, intelligence analyzed, fires planned and logistical status's collected further to the rear and information feed to the main CP and the commander in the form of an electronic relevant common picture to which everyone on the staff would have access. Operations orders could be briefed by VTC and taped for playback by members of the staff not available for the initial brief.



BCSS MAIN or REARWARD CP CONCEPT

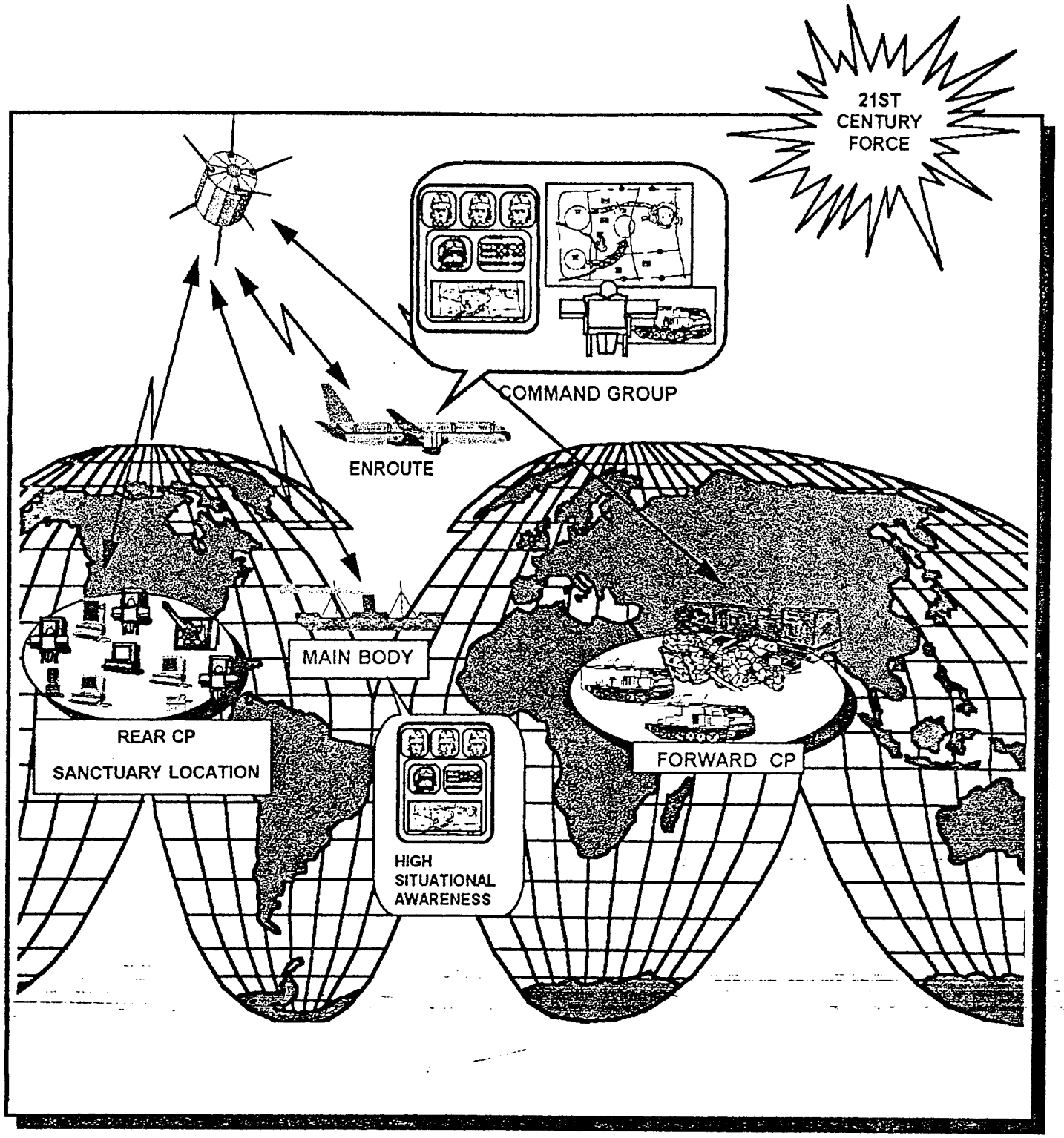
FIGURE VI-6

VIc. Characteristics of the BCSS Deployability.

Reducing the size of the main CP through electronics collocation and smaller vehicles makes early deployability of the CP, or any portion of it, a reality. The modular system allows the commander to tailor his BCSS to his deployment timetable and availability of aircraft. Enroute to the contingency area by airlift, the assault CP, in this case the C2Vs, could receive information, intelligence and plans from the main command post in HMMWVs set up at a port or airfield. A rearward CP element at home station could provide a critical link to technicians, logistics, and national assets for the execution of the mission. A single forward CP of HMMWVs may be sufficient in an OOTW situation for forward control of an operation while the main CP operates from the unit's home station (Figure VI-7).

Versatilty. Battle staffs and command posts must be capable of performing a variety of missions in unfamiliar conditions and environments. Commanders face threats that may not be consistent with our past experiences.[93] The BCSS will change if called upon for operations other than war (OOTW). The staff and CP composition to respond to Hurricane Andrew relief would differ from that for a potential peacekeeping mission or for a peace enforcement mission.

Command posts must have the capability to rapidly accept and effectively use staff augmentation when the operational environment requires staff expertise not organic to the unit. Division and corps commanders must have at their disposal staff



Example Deployment by Echelon

Figure VI-7

and CP modules from which they can build a CP configuration that is not only optimum for the mission but for their command style.[94]

Using modules, the commander can task organize his CPs and staff just as they have done with maneuver units for years. The modular approach provides flexibility during deployment, giving the commander the capability to rapidly project command, control, communications, computers and intelligence (C4I) assets into the area of operations. The CP could also accommodate interagency and NGO representatives.

Survivability. Long distance communications, electronic collocation and reduced signature support survivability. The smaller CP's are easier to secure and harder for the enemy to find either physically or electronically. Digitized information further enhances survivability as it is generally more secure than voice.

Agility. Battle staffs can quickly assess a situation using the relevant common picture and can recommend a COA to the commander, allowing him to make decisions more quickly than his adversary can react. LTG Funk, in his article "The Army's Digital Revolution," reminds us that "agility...is a prerequisite for seizing and holding the initiative....Greater quickness permits the rapid concentration of friendly strength against enemy vulnerabilities." The ability of leaders to know friendly and enemy force locations at a glance has taken the guess work out of maneuvering. Further, the ability to digitally burst operations

overlays to subordinates speeds troop-leading procedures, enhancing the ability to exercise battle command on the move. This capability enables the commander to maintain a greater operational tempo with improved accuracy anywhere on the battlefield where they can mass their effects on the enemy.[95]

Mobility. The BCSS must be capable of quick movement within the theater. The huge infrastructure built around our main and rear CPs today is unacceptable for the FORCE XXI Army. A division forward command post (FWD) must position itself where it best supports the commander in his efforts to fight the close and deep battle. This CP must be small, mobile, and capable of mobile operations.

The main CP (using HMMWVs) possess a similar capability to operate on the move as the C2Vs. Voice interface and early versions of artificial intelligence could greatly improve this operate-on-the-move capability. The reduced size of each command post and the selection of more mobile vehicles allows them to keep pace with the tempo of modern battle over all types of terrain.

The BCV, by providing electronic collocation and a common picture, offers a solution to mobility and survivability problems. The commander must not only be mobile but have some level of protection to allow him the capability to be forward on the battlefield, lead from the front, and still maintain his view of the battlefield.

Supportive to the commander

All of the technology must, however, allow the commander the freedom to command. Commanders must not be tied to any CP or specific type of vehicle. As we perfect the ability to construct the relevant common picture, the best place for the commander to "see the battlefield" may be from the large screen monitor in his own CP. Any modification to the CP structure, staff organization, and location must not lose sight of the mission--to provide the commander the information he needs to make an informed decision wherever he is on the battlefield.

Digitization using faster computers presents even greater volumes of information to be managed. The fear of information overload is a concern as we visualize unit locations, status reports, logistics, intelligence, orders, and graphics being transmitted around the battlefield. To prevent such an overload, a protocol must be developed that will allow the commander and his staff to *pull* required information from a data base that is constantly being updated. A *push* system of a few critical information bites will undoubtedly also be needed and can be designed to alert commanders and staffs, warning of designated events or status changes. This *push/pull* system prevents the commander and staff from having to read every message transmitted and allows them to focus on the battle.[96] One example of the *push/pull* system may be in status reporting. For example, every four hours the brigades may provide a report indicating activities, status of combat systems, etc. This information is

updated in the data base and is available for any commander or staff officer to *pull* out as needed. In the *push* system architecture, if a unit's combat power reaches a predesignated level, e.g. 80 percent or less, a note would immediately be transmitted to those established in the protocol.

VII. Conclusion

Sharing information within the CPs is the cornerstone of reengineering the battle staff and CPs. The ability to maintain a seamless communications network allows us to reduce the physical size of the CPs by relocating the larger cells common in CPs today. Using digitization, the BCSS will support the commander by assisting in the performance of routine functions and by making computers easier to use. The introduction of artificial intelligence will assist planners by providing force ratios, wargame results, and simple analyses of missions and courses of action and many other time consuming tasks. This same system could one day provide the BST member the options available to an enemy or friendly force, could automatically generate resupply reports when a unit's logistical status reaches a prescribed level, and could plan airspace coordination measures for a given course of action.

Making the interface between man and computer easier will be the greatest accomplishment, since the limiting factor in the future will be the human requirement to input and receive data from a computer system. Current large keyboards and fixed screens may be replaced by voice interface and heads-up display

(HUD) visors. The light pen, VTC, and E-mail technology will assist the BST in its support to the commander and again allow us to reduce the size of our current large staffs.

As our ability to acquire, analyze and share information, with the force becomes a reality, our challenge will be to break the old paradigms. Tactical unit commanders must let go of their large staffs and robust command posts and find the dollars in these years of fiscal constraints required to move the army into the 21st Century. Battle command truly is a revolution, and must include reengineering the way we command and control our battles on a digitized battlefield as well as the tactics we employ in the fight. If the army is to operate successfully in such a high tech environment, it must begin to refine the process now.

The battle command support system for Force XXI must be a modular, fully integrated, people, computer, and communications system on which the commander can rely for correct and timely information, anywhere in the world. The BCSS must support the commander's requirements for information and be deployable, versatile, survivable, agile, and mobile, just as are the forces of Force XXI. Electronic collocation will replace physical collocation. More capable command and control vehicles (C2V) will replace M577s forward, and HMMWVs can replace expando vans and 5 tons. Staffs will be smaller but more situationally aware. Everyone in the CP will focus on their area of battle, much as do the crew of a ship's bridge or combat information center (CIC).

The United States stands at the crossroads of the Third Wave society. Now is the time to move forward. History helps us imagine how warfighters in the early twentieth century must have felt at the development of mechanization and wireless communications. Men of vision tore down the barriers to change and charged ahead into the future. The goal, as General Sullivan is fond of saying, is to get it "*about right.*" As the army moves into this new era, the possibilities for a Force XXI battle commander support system are only beginning to be conceived. We must focus on command and leverage the technology to enable control. We must reengineer the tactical command and control system so that it makes sense for the highly technological environment of the 21st Century.

ENDNOTES

1. Martin Van Creveld, Command in War. (Cambridge, MA, and London, England: Harvard University Press, 1985), p. 268.

2. Alvin and Heidi Toffler, War and Anti-War (Boston: Little, Brown and Company, 1993), p. 10 and p. 71. The Tofflers argue that "waves" of warfare follow "waves" of civilization. They call the information age we live in today a knowledge civilization, the Third Wave of civilization. The First Wave is agrarian civilization, and the Second Wave is industrial civilization. They suggest that each wave of civilization has a characateristic type of warfare: First Wave has face-to-face combat with agrarian age weapons; Second Wave has mass destruction from mass armies with mass-produced equipment. The Tofflers state that modern warfare, Third Wave Warfare, is characterized by knowledge power.

3. Paul E. Funk, LTG, "*The Army Digital Revolution*," Army Magazine, February 1994, p. 33.

4. AUSA, Digitization and the Modern Battlefield, AUSA Background Brief, June 1993.

5. AUSA, Force XXI Battle Commander, Defense Report from the Institute of Land Warfare, Arlington, VA: May 1994.

6. General Sullivan address to the School of Advanced Military Studies, Ft. Leavenworth, KS: October 1994.

7. Paul E. Funk, LTG, III Corps Commander, address to School of Advanced Military Studies, Ft. Leavenworth, KS: 13 October 1994.

8. Battle Command Concept paper, Battle Command Battle Lab, Ft. Leavenworth, KS, December 1993.

9. Michael Hammer and James Champy, Reengineering the Corporation, (New York: Harper Collins, 1993), p. 44.

10. Robert M. Epstein," The Theory and Practice of Modern War," Unfinished Paper. CGSC, Ft. Leavenworth, KS.

11. Van Creveld, Command in War, p. 61-62.

12. Hittle, James Donald, The Military Staff, Its History and Development, (Harrisburg, PA: Stackpole, 1975), p. 189-195.

13. Ibid., p. 214-215.

14. Van Creveld, Command in War, p. 193.

15. U.S. Army, Field Service Regulation 100-5 Operations. Washington, DC: HQ Department of the Army, May 1941, p. 31.

16. Van Creveld, Command in War, p. 193.

17. A.J. Bacevich, The Pentomic Era, (Washington, DC, NDU Press, 1986), pp. 67-70.

18. Van Creveld, Command in War, p. 236.

19. Ibid., p. 235.

20. Ibid., p. 239. [This figure being divided about equally between those whose sole MOS this was and those who carried it out as an addition duty.]

21. Ibid., p. 71.

22. BCTP Lessons Learned, and interviews with LTC Robert Kennedy, Former BCTP Observer Controller (OC), Ft. Leavenworth, KS, August 1994.

23. RAND, Understanding Commander's Information Needs, (Santa Monica, June 1989), p. 90.

24. Bolger, "Command or Control," p. 73.

25. Van Creveld, Command in War, p. 265.

26. He attributes this growth to a number of factors: (a) the increased demand made on command systems by present-day warfare; (b) technological developments that have multiplied the means at the disposal of the command systems; (c) changes in the nature of the command process, resulting from the interaction of factors (a) and (b); (d) the appearance of new weapons systems that, when coupled with structural changes inside command systems themselves, have increased the vulnerability of command systems; and (e) the rise in cost, caused by factors (a) through (d).

27. Carl Von Clausewitz, On War, Ed and Trans by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1984), p. 100-112.

28. Antoine Henri de Jomini, The Art of War, trans. Capt. G.H. Mendell and Lieut. W.P. Craighill, (Connecticut: Greenwood Press, 1862), p. 165.

29. FM 100-5, May 1986, p. 22.

30. Sullivan, Dubik, War in the Information Age.

31. AFSC Pub 1, The Joint Staff Officers Guide 1993, (Washington, DC, 1993), p. 3-2.

32. U.S. Army, FM 101-5, Staff Organizations and Operations, (Washington, DC: HQ Department of the Army, August 1993), pp. 3-83.

33. U.S. Army, FM 71-100, Division Operations, Initial Draft, (Washington, DC: HQ Department of the Army, 15 July 1994), pp. 3-9.

34. FM 101-5, pp. 5-10.

35. U.S. Marine Corps, FMFM 3, Command and Control, (Washington, DC: HQ Department of the Navy, 1993), p. 26; USMC Information requirements are: Timely, accurate, complete, objective, useable and relevant. The USMC model for a command and control system outlines five components which are necessary for success: 1) C2 facilities, 2) decision support information, 3) information exchange, 4) surveillance, and 5) control of C2 support forces. The difference here between the two services is that Army doctrine omits surveillance from C2 functions and places it in the Intelligence Battlefield Operating System (BOS). Yet it is this component that allows the commander to "sense" his battle space. As the commander's 'eyes', it is the origin of much of the information he requires.'

Confusion increases the need for information, which can in turn increase uncertainty. Therefore USMC doctrine emphasizes that its information flow must be positioned properly by anticipating what information will be needed; it must be mobile in that vertical and horizontal flow must be commensurate with the tempo of operations; it must be accessible to allow commanders and staffs to 'pull' random information a needed, and it finally must be fused in a logical blend to provide an accurate, concise and complete summary.

36. General Gordon Sullivan as quoted by Robert K. Ackerman, "Bytes Tranforms Army, Turn Service Roles Upside Down," Signal, May 1994.

37. AUSA: Digitization and the Modern Battlefield.

38. Van Creveld, p. 193.

39. Ibid, p. 8.

40. Philip R. Tilly, "A Recommendation for the Heavy Division Command Group," Master of Military Arts and Science Thesis, United States Command and General Staff College, Ft. Leavenworth, KS., 1994.

41. Ibid., p. 72.

42. Y. Rabin, "After the Great Maneuvers," Marrachot, August 1960, p. 6-9. U.S. Army, Commanders Table of Organization and Equipment Handbook, Number 87004L-CTH, Headquarters and Headquarters Company, Heavy Division, Washington, DC: HQ Department of the Army, 15 May 1990, p. 10. Mobility of the command post vehicles will increase in importance for the Force XXI Army. Israeli Prime Minister Yitsak Rabin, as deputy chief of staff of the Israel Defense Force (IDF) in 1960 noted, "Commanders [of armored forces] must be able to gather intelligence, process it, prepare orders, and issue them while on the move." Experience has demonstrated that our command posts must have the best vehicles with high speed and cross country capability over any terrain and in any weather. They should be much the same in signature as other vehicles in unit. This is particularly important for the commander's vehicle as it moves among forward positions on the battlefield. If these two requirements are observed, both mobility and survivability will be enhanced.

43. Battle Command Concept Paper, and Commanders Table of Organization and Equipment Handbook.

44. TRADOC Pam 525-5; Fort Monroe, VA: Army Training and Doctrine Command, August 1994, p. 31.

45. Army modernization efforts are built around five major thrusts: win the information war; protect the force; dominate maneuvers; project and sustain combat power; and execute precision strike, will enable rapid battlefield decisionmaking based on real-time, shared, situational awareness.

46. Ackerman, "Bytes Tranforms Army."

47. Army Command and Control Master Plan 1990, US Army Combined Arms Combat Development Activity, Ft Leavenworth, KS, 31 Jul 1990, p. 12.

48. FM 100-5, pp. 2-14.

49. BG Lon E. Maggart, and COL Gregory Fontenot, "Breaching Operations: Impliations for Battle Command and Battle Space," Military Review, February 1994, p. 19.

50. FM 100-5, pp. 2-15.

51. TRADOC Pam 525-5, p. 1-5.

52. Army Command and Control Master Plan 1990.

53. TRADOC Pam 525-5, p. 1-5.

54. Van Creveld, Command in War, p. 191.

55. Ibid.

56. Ibid.

57. Battle Command Concept Paper.

58. Jack Burkett, "Command and Control: The Key to Winning," Military Review, Volume 70, No. 7, July 1990: p. 60-68.

59. Ibid.

60. The C2V is currently scheduled to be fielded with only four terminal typework stations and two spare seats inside the command module. According to the C2V Operational Requirements Document and the Operations Concept (10 May 1993 final draft) and C2v heavy variant TTP for heavy battalion, brigade, division and corps command posts, March 18, 1994. It is about a one for one exchange for CP M577s. Interior set-up and crew recommendations similar to that of the M577s it replaces. In effect we have fielded a faster, more mobile M577 rather than seizing the opportunity to rethink the use of the C2V in future environments. FMFM 9-2 Amphibious Vehicles, HQ US Marine Corps, Washington DC 1981 with revisions Sep 91, p. 2-20-25. In comparison the USMC AAVC7 has work stations for 9 staff members and an entire command group.

61. FMFM 3, p. 6. It later goes on to say that "increasing the speed of the decision cycle creates tempo."

62. John H. Tilelli, Jr, LTG, USA, "Force Projection Essential to Army Doctrine," Military Review, Ft. Leavenworth, KS, January 1994.

63. TRADOC Pam 525-5; p. 4-6.

64. Army Command and Control Master Plan, p. 5-6.

65. Dean R. Anderson, COL, "Modernizing Army Command and Control," Military Review, Volume 70, No. 70 (July 1990): 2-10.

66. TRADOC Pam 525-5; p. 2-1 - 2-11.

67. TRADOC Pam 525-5; p. 3-4.

68. Fredrick R. Strain, "The New Joint Warfare Future," Joint Forces Quarterly, Natural Defense University, Ft. McNair, Autumn 1993.

69. A battleboard is a set of maps and charts with current situation information posted manually from reports received by the TOC. In the near term this function can be performed by computers consisting primarily of databases that are automatically updated at a specified time or distance. And last the chain of command, like a telescope, must be able of extension and contraction as needed. The commander needs the freedom to command from anywhere on the battlefield, spending time in his CPs, with subordinate units in the plans cell, as he desires. Current communications capabilities provide him this freedom while emerging near term technology will greatly enhance this capability.

70. Tilly, "A Recommendation for the Heavy Division Command Group," p. 72.

71. Franklin Childress, PAO National Training Center during Digitized Rotation, interview with author August 1994, Ft. Leavenworth, KS.

72. Kenneth A. McDevitt, "Why Standardize Command Posts?" Military Review, Volume 70, No. 7, July 1990, p. 54.

73. Operational Requirements Document for Mobile Command and Control (C2) Capability for Heavy Forces, Command and Control Vehicle (C2V), BCBL, Ft. Leavenworth, KS, 1993, p.1.

74. Commanders TOE Handbook, p. 10.

75. Battle Command Concept Paper, Commanders Table of Organization and Equipment Handbook, p. 10.

76. Ackerman, "Bytes Tranforms Army, p. 21.

77. Funk, *The Army Digital Revolution*, p. 33.

78. Ackerman, "Bytes Tranforms Army, p. 22.

79. Hammer and Champy, Reengineering the Corporation, p. 44.

80. Ibid., p. 2.

81. Ibid., p. 5.

82. Eliot A. Cohen and John Gooch, Military Misfortunes: The Anatomy of Failure in War, (New York: The Free Press, 1990), p. 26. Cohen and Gooch assert that there are three basic kinds of failure: failure to learn, failure to anticipate and failure to adapt. Each has its own characteristics and consequences. By separating failures out and identifying their essential features, we can provide ourselves with a simple topology with which distinguish one military failure from another.

83. Ibid.

84. Ibid, p. 22.

85. Concept for a Knowledge-based Commander With a Process-Oriented Staff, EER Systems Corporation for the BCBL, March 1994.

86. The fiberglass fire support shelter similar to that of the M997 HUMMV provides an excellent C2 shelter and was used extensively in the 9th ID (MTZ) for command posts during the concept development for a motorized unit. These shelters are compatible will SICPS and provide workspace for up to 3 personnel in the shelter.

87. Modular Command Post Concept: p. 3-1.

88. FM 100-5, Operations p. 1-1 to 1-5 discusses how commanders, particularly those previously focused at the tactical level of war, may find themselves operating on more than one level of war simultaneously. This blending of levels of war will place different demands on the future BCSS. It may require additional echelons of command posts, split based operations, direct communications with the National Command Authority (NCA), as well as joint and allied forces.

89. It is commonly used to refer to someone technically proficient in information management systems as well as having a general understanding of the tactical operation. The information warrior, this concept is viewed as a technician, a master at manipulating the C2 systems information capabilities. If the commander needs to see a specific part of the battlefield on his digital display the information warrior accesses it for him. Change overlays, show the status of the aviation regiment, get video from the division cavalry squadron, access information on an adjacent unit or act as a scribe for the commander, are all the responsibility of the information warrior. Like the tactical officer the information warrior is viewed as branch immaterial and specialized technical training is required. In this concept

a warrant officer or senior non-commissioned officers could fill this position after appropriate training and certification.

90. The Forward CP (FWD) in this concept consists of three C2V's with five work stations consoles and 2 jump seats (current plan provides for only four work stations and 2 junp seats). A chase M4 could be configured to carry a second shift of operators while four M998T, squad carrier type HMMWV's carry security, maintenance and support personnel. MP's in M1097 HMMWV's could be attached for additional security. Organization of the Fwd CP consists of BST members focused on the close, deep and rear battles while fire support and aviation officers keep the commander updated of his ability to influence the battle with these resources.

91. FMFM 3, p. C-2.

92. RAND, Understanding Commander's Information Needs.

93. Heavy Division Assessment Battle Command Assessment, p. 4-4.

94. Ibid., p. A-24-A-26.

95. Funk, *The Army Digital Revolution*, p. 33.

96. Battle Command Concept paper.

APPENDIX A

Glossary of Terms

ABCS	Army Battle Command System
Army Battle Command System	Migration of all fielded and developmental Army C2 systems into one fully integrated and interoperable system with seamless connectivity from the NCA to the foxhole.
ASMP	Army Strategic Mobility Program
Automation	The use of computer equipment to automate existing manual procedures. This is not digitization.
Battle command	The art of decision making, leading, and motivating soldiers and their organizations into action to accomplish missions: includes visualizing current state and future state, then formulating concepts of operations to get from one to another at least cost; also includes assigning missions, prioritizing and allocating resources, selecting the critical time and place to act, and knowing how and when to make adjustments during the fight.
Battle dynamics	Five major interrelated dynamics that define significant areas of change from current operations to Force XXI Operations; dynamics are battle command, battlespace, depth, and simultaneous attack, early entry, and combat service support.

Battlespace	Components of this space are determined by the maximum capabilities of friendly and enemy forces to acquire and dominate each other by fires and maneuver and in the electromagnetic spectrum.
Blueprint of the Battlefield	(TRADOC Pam 11-9, 10 May 91) - a comprehensive, hierarchical listing of Army functions performed in support of the battlefield and their definitions; collectively includes three blueprints--one for each level of war: strategic, operational, and tactical.
Broadcast intelligence	Capability to rapidly "pull down" or broadcast accurate/real-time intelligence (all levels, even national level) to the lowest possible tactical level, precluding the layered procedural intelligence flow of information.
Close operations	These are offensive or defensive operations where forces are in immediate contact with the enemy. Close operations are often referred to as the close fight.
C2	Command and control
C3W	Command and control warfare
C3I	Command, control, communications, and intelligence
C4I	Command, control, communications, computers and intelligence
Combat service support	The essential logistics functions, activities, and tasks necessary to sustain all elements of an operating force in an area of operations.
Combined operation	An operation conducted by forces of two or more allied nations together to accomplish a single mission.

Command	Is the authority that a commander in the military service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the authority and responsibility for effectively using available resources and for planning and the employment of, organizing, directing, coordinating, and controlling military forces for the accomplishment of assigned missions. Joint Pub 1-02.
Control	Is the authority that may be less than full command exercised by a commander over part of the activities of subordinate or other organizations. Joint Pub 1-02.
Command and control	This is the exercise of command that is the process through which the activities of military forces are directed, coordinated, and controlled to accomplish the mission. This process encompasses the personnel, equipment, communications, facilities, and procedures necessary to gather and analyze information, to plan for what is to be done, and to supervise the execution of operations. The process for exercising authority and direction by the commander over his forces within the division area of operations.
Command and control warfare	The integrated use of operations security, military deception, psychological operations, electronic warfare, and physical destruction mutually supported by intelligence to deny information to, to influence, or to degrade adversary C2 capabilities while

protecting friendly C2 capabilities against such actions; C2W applies across the full range of military operations and all levels of war.

Command group

A small party that accompanies the commander when he departs the command post to be present at a critical action. The party is organized and equipped to suit the commander, and normally provides local security and other personal assistance for the commander as he requires. The division commander and those members of his staff whom he designates to be with him, normally a G3 officer, Fire Support Element (FSE) representative, and the Air Liaison Officer (ALO), as a minimum. The command group is not a permanent organization. The purpose of the command group is to make and communicate decisions and to provide leadership, direction, guidance, and supervision. The command group consists of the commander and whoever he designates to accompany him. The command group can locate anywhere on the battlefield, whether at a command post or on the move. Moving or stationary, regardless of location, the command group must be able to communicate with both subordinates and staff members and transmit decisions from any point on the battlefield. This is formed wherever the commander is--in a CP, a subordinate unit's CP, or in an alternate location. Commanders at higher echelons may choose to form a command operations element, typically resourced from personnel in the Tactical Command Post (TAC CP) or Main Command Post (MAIN CP). This element must be highly mobile so it can provide the commander

with a limited operations cell capability with the ability to move to the point of decision in support of the commander.

Command Post

A unit's or subunit's headquarters where the commander and the staff perform their activities. In combat, a unit's or subunit's headquarters is often divided into echelons; the echelon in which the unit or subunit commander is located or from where he operates is called a command post. It provides the commander and his staff a grouping of facilities for planning, directing, coordinating, and controlling forces and operations.

Command Post Effectiveness Factors

These factors include speed, simplicity, design, standardization, continuous operations, qualified personnel, communications, information, and automation.

Command Post Survivability Factors

These factors include mobility, austerity, dispersion, redundancy, signature, cover and concealment, deception, and operational security (OPSEC).

Communications

This is the means through which commanders exercise immediate, personal (positive) control over their units. It is the vital link between command (the vision of an operation) and the outcome of control (battlefield activities which subordinates conduct). Within this vital linkage, computers and communications greatly enhance the capability of tactical headquarters to quickly collect, store, analyze, and transmit large amounts of information.

Commander's Critical Information Requirements	These are characterized as: situationally dependent, specified by the commander, generally time sensitive, applicable only to the commander who specifies them, normally published in an Operations Order (OPORD) or Operations Plans (OPLAN), normally transmitted over predetermined channels, and a link between the current and future operations.
Core processes	The essential functions an organization must perform to accomplish its primary task.
Cybernetics	The science of communication and control theory that is concerned especially with the comparative study of automatic control systems (as the nervous system and brain and mechanical-electrical communication systems.)
Deep Operations	These are operations designed in depth to secure advantages in later engagements, protect the current close fight, and defeat the enemy more rapidly by denying freedom of action and disrupting or destroying the coherence and tempo of its operations.
Depth and simultaneous attack	The simultaneous application of combat power against an enemy throughout the depth and breadth of the battlefield; objective goes beyond defeating the enemy; objective is to accelerate enemy defeat.
Digitization	Digitization is the process of integrating information systems across the battlefield using the power of the computer microprocessor and digital electronics. Coupled with

	satellite communications, digitization redefines the depth and breadth of the battlefield. The principal advantage of digitization redefines the depth and breadth of the battlefield. The principal advantage of digitization is increased speed and range of data transmissions of near real-time information.
Doctrine	Fundamental principles by which military forces guide their actions in support of national objectives; doctrine is authoritative but requires judgment in application.
Early entry operations	Operations involving the initial deploying forces; they occur whenever the missions require the projection of U.S. forces from CONUS or elsewhere.
EMP	electromagnetic pulse
Electronic warfare	Military actions that include: electronic attack--the use of either electromagnetic or directed energy to degrade, neutralize, or destroy an enemy's combat capability; electronic protection--those actions taken to protect personnel, facilities, and equipment from friendly or enemy employment of electronic warfare; electronic warfare support--those actions tasked by an operational commander to search for, intercept, identify, and locate sources of radiated electromagnetic energy for the purpose of immediate threat recognition.
Force XXI	Force XXI is the Army's institutional response to the redesign of the Army for the information age. The Army is in the process of digitizing the battlefield, building in the

	information-age requirements of speed and precision. It is upgrading intelligence, maneuver, fire support, sustainment, and command and control platforms with advanced technologies that can gather, sort, share and distribute information. The goal: a lethal, digitized land force with the operational versatility to respond to a wide range of crises and opposing forces with equally deadly capabilities.
Force projection	The movement of military forces from CONUS or a theater in response to requirements of war or operations other than war; force-projection operations extend from mobilization and deployment of forces, to redeployment to CONUS or home theater, to subsequent demobilization.
Full-dimensional operations	The application of all capabilities available to an Army commander to accomplish his mission decisively and at the least cost across the full range of possible operations.
Hierarchical	Arranged in the standard military organization of units; characterized by a vertical hierarchy of information flow and decision making.
Information Age	The future time period when social, cultural, and economic patterns will reflect the decentralized, nonhierarchical flow of information; contrast this to more centralized, hierarchical social, cultural, and economic patterns that reflect the Industrial Age's mechanization of production systems.

Information operations	Continuous combined arms operations that enable, enhance, and protect the commander's decision cycle and execution while influencing an opponent's; operations are accomplished through effective intelligence, command and control, and command and control warfare operations, supported by all available friendly information systems; battle command information operations are conducted across the full range of military operations
Information warfare	Actions taken to preserve the integrity of one's own information system from exploitation, to corrupt or destroy an adversary's information system, and in the process, to achieve an information advantage in the application of force.
Interagency	In this context, military operations conducted in conjunction with nonmilitary organizations; agencies of the U.S. Government, NGOs, and/or PVOs (also multiagency).
Modularity	A force design methodology that establishes a means to provide interchangeable, expandable, and tailorable force elements.
Multinational operations	A collective term to describe military actions conducted by forces of two or more nations typically organized within the structure of a coalition or alliance.
NGO	Nongovernment organization
Niche capability	Capability of a force to acquire selected, modern, sophisticated

	technology that could dominate the battlefield or battlespace, for example, directed energy weapon or sophisticated air defense system.
Noncombat operations	Military operations other than war
Nongovernment organization	Professional associations, foundations, multinational businesses, or other groups with an interest in improving the quality of life of people.
Nonhierarchical	Arranged in a nonstandard military organization of units; characterized by a horizontal flow of information and decision making.
OOTW	Operations other than war
Operations other than war	Military activities during peacetime and conflict that do not necessarily involve armed clashes between two organized forces.
Paradigm	The word "paradigm" has been a loosely used term as of late. The concept of paradigms and paradigm shifts can help us better understand the nature of unexpected changes. Understanding what causes them gives a better chance of anticipating the shifts. A paradigm is defined as "the way we perceive the world; water to the fish. The paradigm explains the world to use and helps us predict its behavior." Paradigms should give us the advantage of being able to create a valid set of expectations about what will probably occur in the world based on a shared set of assumptions. "When we are in the middle of the paradigm it is hard to imagine any other paradigm." Joel Barker in his book Future Edge explains paradigms in great detail and offers two reasons for paradigms to

	change: (1) We develop some technology or tool that will allow us to solve a problem in a different way or (2) We get smarter and learned to "play the game" better.
Precision-guided missile/ munitions	A munition capable of locating, identifying, and maneuvering to engage a point target with an accuracy sufficient to yield a high probability of destruction.
Protocol	A standard procedure for regulating data transmission between headquarters.
PVO	Private voluntary organization
RSTA	Reconnaissance, surveillance, target acquisition
Situational awareness	Ability to have accurate and real-time information of friendly, enemy, neutral, and noncombatant locations; a common, relevant picture of the battlefield scaled to specific level of interest and special needs
Spectrum supremacy	Control over the required portions of the electromagnetic spectrum to enable the conduct of Force XXI Operations.
Spectrum of threats	Arrayed potential threats across a spectrum from simple to complex in scope, doctrine, organization, training, materiel, leadership, and soldiers.
Strap-on technologies	Available technologies used to upgrade/enhance existing weapon systems.
Survivability Factors	The concept of survivability includes all aspects of protecting a fences fighting potential. There

	are nine factors: mobility, austerity, dispersion, redundancy, location, signature, deception, operational security. (for additional details see FM 101-5, pg. 5-2 - 5-5.)
Tailorability	Capability to determine the right mix and sequencing of units with sufficient combat power to accomplish the mission and sustain the force, based on METT-T, analysis, and other criteria such as available lift, pre-positioned assets and host nation support.
TBM	Theater ballistic missile
VTC	Video Teleconference

APPENDIX B

Assumptions

No concept paper about the future can begin without establishing some basic parameters. These assumptions are necessary to build the theoretical construct of Force XXI and its capabilities. These assumptions were developed during the research and analysis of concepts addressed.

The army is in a state of revolution. Force XXI, as outlined by General Sullivan and other senior leaders, is a response to the demands of the information age envisioned in the 21st century.

Change will be the only stable part of our future. Technology will change a thousand fold the next 20-30 years.[1]

Organizations of battalions, brigades, divisions and corps will evolve over time to a size and composition that will provide versatility needed to succeed on a variety of information age battlefields.[2]

Operations will be joint and or combined.[3]

Tailored force packages may require only part of a unit to deploy and execute missions.[4]

Courage, selflessness, comradeship and leadership are not diminished by changing technology, organizations or concepts. The potential of the microprocessor has not been fully developed and the envisioned C2 tools such as secure wireless communications, decision support aids, relevant common picture, electronic collocation are only partially available today.[5]

Army budgets will continue to decline in real terms. Research, development and procurement of new systems will compete for limited dollars.[6]

1. Gordon R. Sullivan, General, America's Army and Modernization, Military Review, July 1993, p. 59.

2. U.S. Army, FM 100-5, Operations, Washington, DC: HQ Department of the Army, May 1993, p. 2-2.

3. U.S. Army, FM 100-5, Operations, Washington, DC: HQ Department of the Army, May 1993, p. 1-5.

4. Gordon R. Sullivan, General and Colonel James M. Dubik, War in the Information Age, Military Review, April 1982, p. 58.

5. Army Budget, Fiscal Year 1995: An Analysis, Association of the United States Army, Institute of Land Warfare, May 1994.

6. Michael Hammer and James Champy, Reengineering the Corporation, New York: Harper Collins, 1993, p. 44.

Appendix C

Army Command and Control Master Plan Guidance

- Joint and combined cooperation are essential to ensure success on the battlefield.

- The increased likelihood of regional conflicts requires the Army to be able to conduct operations across the full spectrum of warfare, with emphasis on lower levels of conflict and special operations.

- There is a need for both heavy and light forces that can operate at varying levels of conflict in any theater.

- Current and evolving space systems will add a further dimension to the land battle.

- Technological advances will continue to increase weapons lethality and to extend the distances over which battles must be fought.

- The same C2 systems that support combat operations must also support Army forces committed to nation building programs in underdeveloped regions lacking communications infrastructures and the host nation support upon which we have become so dependent.

- Commanders and staffs will need C2 systems that can cope with the flood of tactical, operational, and strategic information flowing into command posts from advanced sensors, other C2 systems, and intelligence sources. The future Army C2 system must reduce soldier workloads and enhance human performance.

- New technological advances in electronics, communications, and artificial intelligence will continue at an exponential pace, and will provide opportunities for exploitation in the areas of reconnaissance, surveillance, and target acquisition systems; robotics and space programs; and decision support systems.

Appendix D

Elements of a Command and Control System

An effective command and control system is first and foremost an arrangement and orchestration of personnel, procedures, facilities, equipment and information management systems (MIS) to move and process information to facilitate the commanders decision and execution process.

a. Personnel: includes the commander, his staff to include any augmentees from attached or supporting units or organizations. These may include fire support, aviation, joint or combined liaisons, intergovernment agency or nongovernmental agency personnel. Van Creveld and FM 101-5 appear to agree that an effective staff should: secure and provide information, data and advice; prepare orders and plans; transmit orders, plans, and directives to the command; and should supervise and monitor to ensure reliable execution.

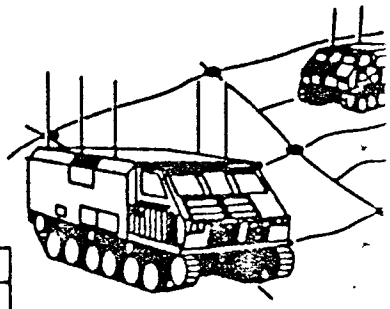
b. Procedures: includes the various way the unit conducts itself to include, doctrine, techniques, tactics, SOPs and regulations. Central to the procedures used is the military decisionmaking process.

c. Facilities: these are the nerve centers of the units and consist of groups of personnel and equipment organized to perform a specific mission. These facilities support the processing, collection and dissemination of information at each echelon of command.

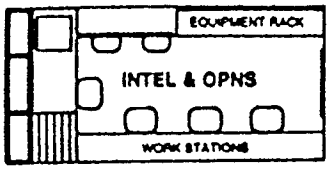
d. Equipment: which includes items provided in the Table of Organization and Equipment (TOE) or Table of Distribution and Allowances (TDA) and other means such as, vehicles, radios, computers, maps, acetate and copy machines.

e. Management information systems infers a conceptual exchange system by which the organization can collect, process, display, disseminate and protect its information. This includes communications paths, data storage and distribution systems.

APPENDIX E

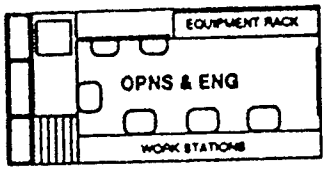


1 DNVT TA-1038/U
1 LAUE (POSNAV)
1 LCU (OPNS)
1 RDO SET AN/VRC-90
1 RDO SET TAC SATCOM AN/VSC-7
1 TCU-V2 (INTEL)



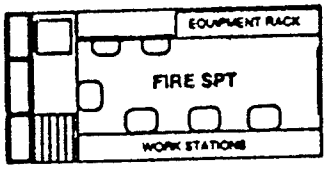
DUTY POSITION	RANK	MOS	QTY	SHIFT	REMARKS
DEPUTY G2	O4	34D	1	A/B	HHC, DIV
ASSISTANT G3	O3	11A	1	A	HHC, DIV
CHEMICAL OFFICER (SOF LNO)	O3	74B	1	A/B	DIV CHEM CO (SOCI)
INTEL SERGEANT	E7	96B	1	A/B	HHC, DIV (TC)
SENIOR CI AGENT	E7	97B	1	B	HHC, DIV
INTEL ANALYST	E6	96B	1	A	HHC, DIV
C2V DRIVER	E4	19K	1	A/B	HHC, DIV

3 DNVT TA-1038/U
1 EPUU AN/VSQ-XXX(V)3
1 FAX AN/UXC-7
1 LAUE (POSNAV)
1 MSRT AN/VRC-87
1 RDO SET AN/VRC-92
1 RDO SET AN/GRC-193A
1 RDO SET TAC SATCOM AN/VSC-7
2 TCU-V2 (OPNS & ENGR)

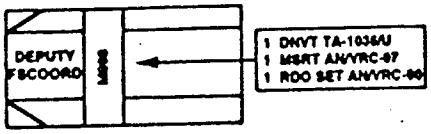


DUTY POSITION	RANK	MOS	QTY	SHIFT	REMARKS
(COMMANDER)	O6	00B	1		HHC, DIV
ADC-M	O7	00B	1		HHC, DIV
DEPUTY G3	O4	12A	1	A/B	HHC, DIV
TAC INTEL OFFICER	O3	35D	1	B	HHC, DIV
ENGR STAFF OFF	O3	21B	1	A	HHC, EN BDE
MASTER GUNNER	E8	18Z	1	A/B	HHC, DIV (TC)
ASST OPNS SGT	E7	19K	1	B	HHC, DIV
ENG STAFF NCO	E7	12B	1	B	HHC, EN BDE
C2V DRIVER	E4	19K	1	A/B	HHC, DIV

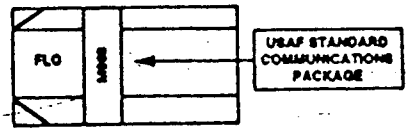
3 DNVT TA-1043A/U
1 EPUU AN/VSQ-XXX(V)3
1 FAX AN/UXC-7
1 LAUE (POSNAV)
1 LSD
1 RDO SET AN/VRC-90
2 RDO SET AN/VRC-92
1 RDO SET TAC SATCOM AN/VSC-7
2 TCU-V2 (FSCT)
1 VFMED AN/GSC-21



DUTY POSITION	RANK	MOS	QTY	SHIFT	REMARKS
DEP FSCOORD	O6	13A	1		HHB, DIVARTY
ASST FSCOORD	O4	13A	2	A&B	HHB, DIVARTY
ASSISTANT G3 AIR	O3	15B	1	A	HHC, DIV
AVIATION LNO	O3	15B	1	A/B	HHC, AVN BDE
(FLO)			1	A/B	(USAF)
(ANGLICO)			1	A/B	(USN)
OPNS SERGEANT ADA	E7	16S	1	B	HHC, DIV
FIRE SPT SERGEANT	E6	13F	1	A&B	HHB, DIVARTY (TC)
C2V DRIVER	E4	13F	1	A/B	HHB, DIVARTY



1 DNVT TA-1038/U
1 MSRT AN/VRC-87
1 RDO SET AN/VRC-90

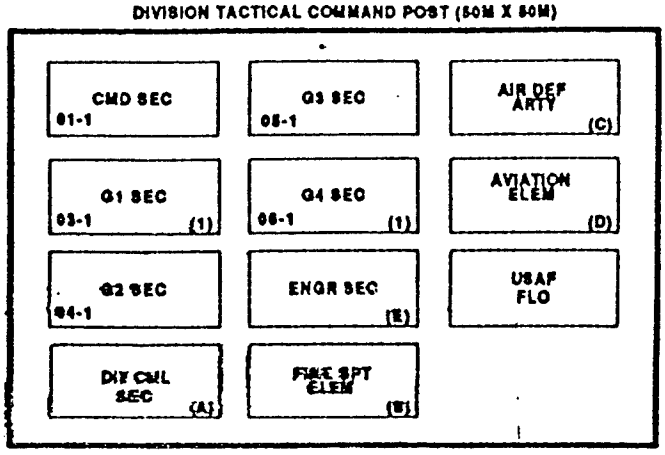


USAF STANDARD COMMUNICATIONS PACKAGE

Proposed Staffing of C2V-Equipped Division TAC CP

SOURCE: Operational Requirements document for C2V, p. 8

APPENDIX F



Source: TOE Handbook 87004L-CTH. p.78

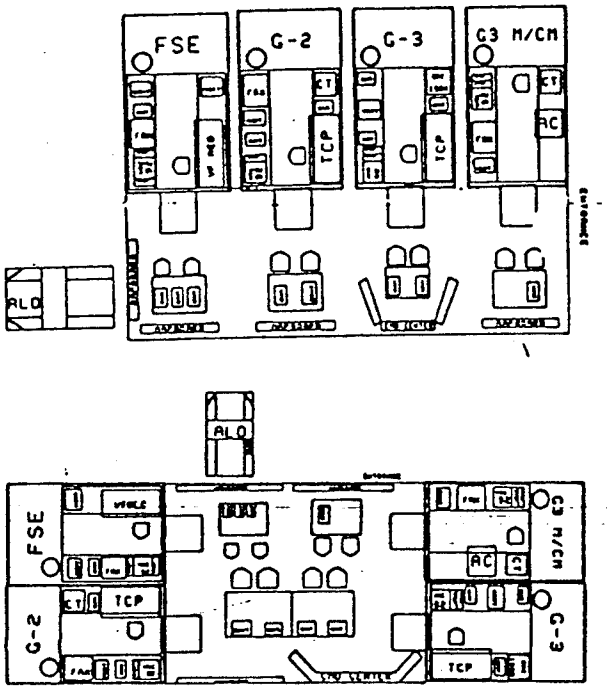


Figure 2-4. TAC CP deployment, side-by-side and back-to back

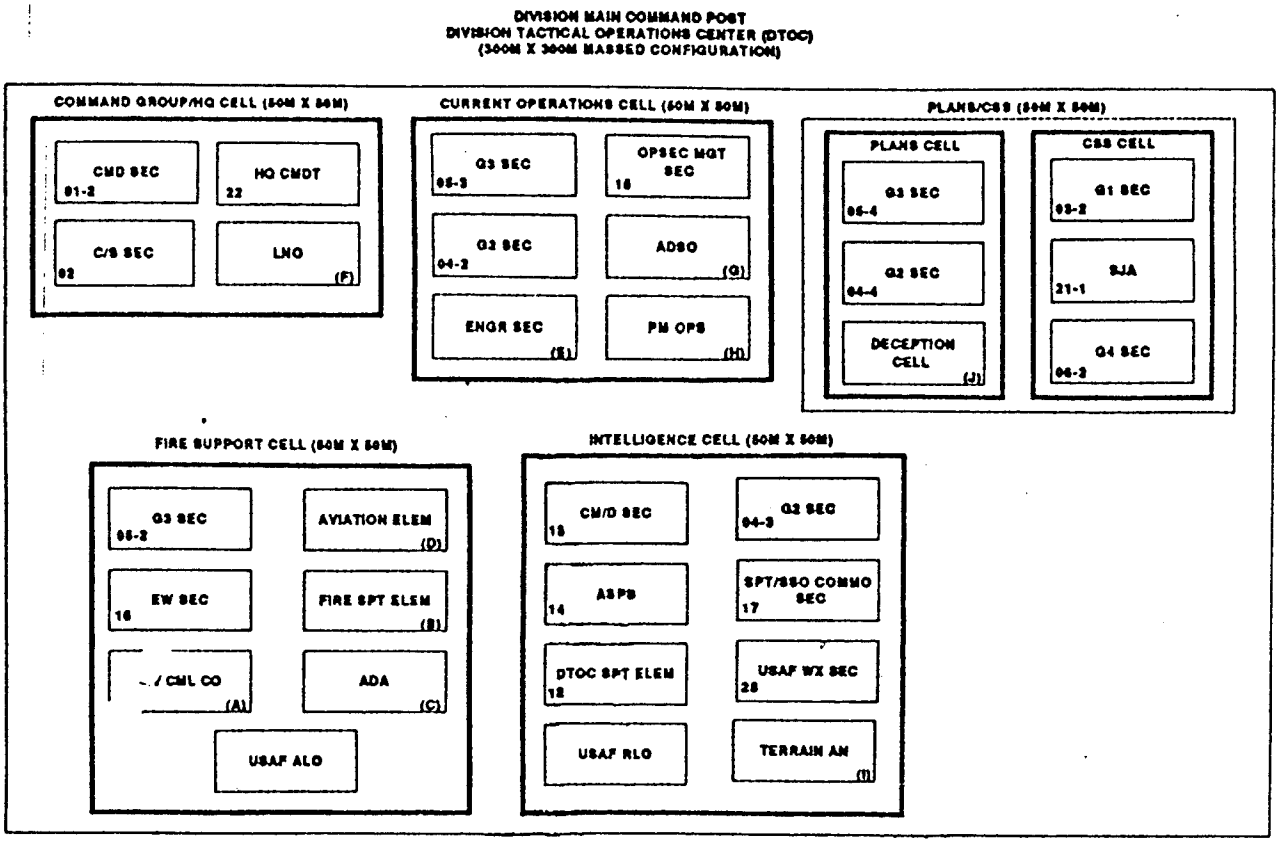
Source: FM 71-100-1, p. 2-16

Current TAC CP Organization

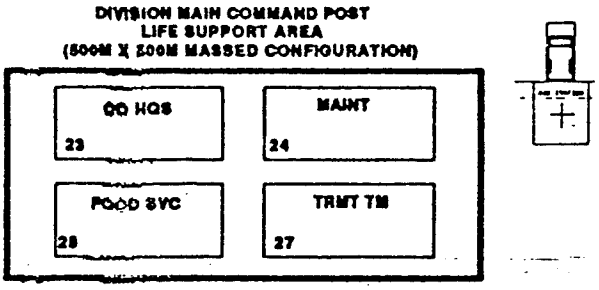
TAC CP

- Control close operations
- Monitor execution of deep and rear plans
- Assess the current tactical situation
- Assess the status and capabilities of friendly forces
- Monitor CS and CSS status to the close operations

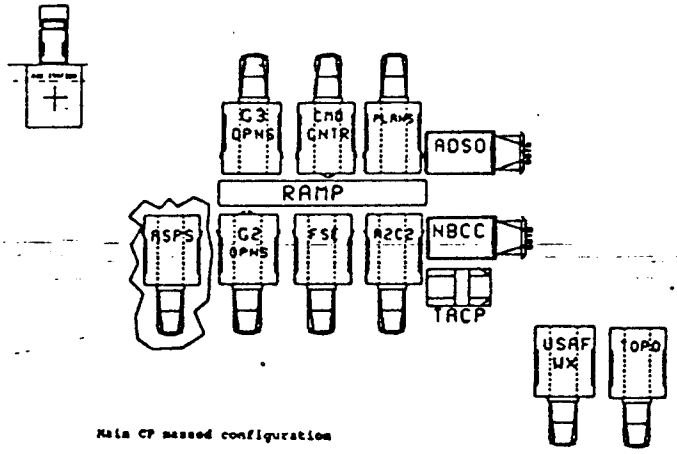
Current TAC CP Responsibilities



Source: TOE Handbook 87004L-CTH. p.81



Source: TOE Handbook 87004L-CTH. p.80



Main CP massed configuration

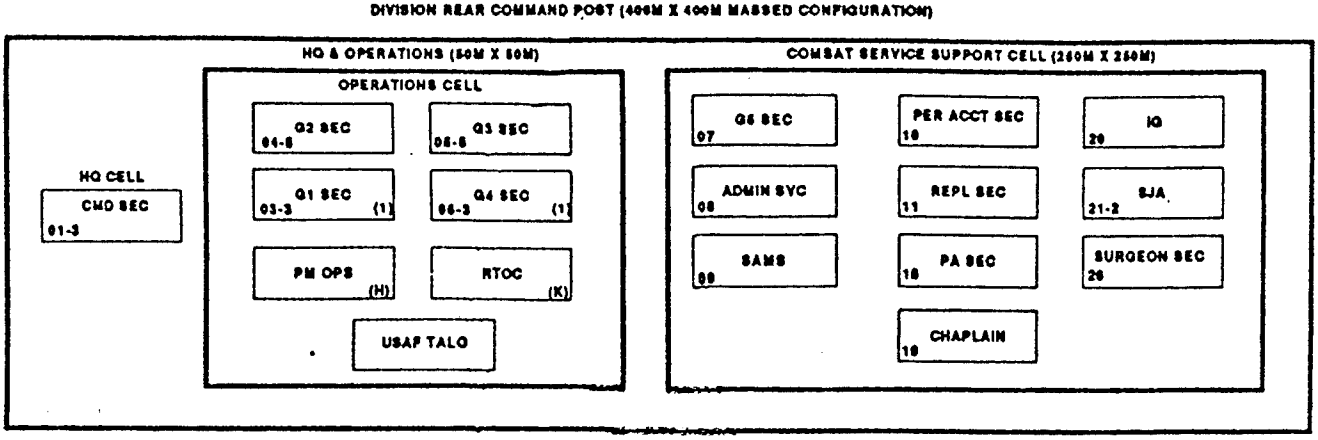
Source: FM 71-100-1, p. 2-34

Current Main CP Organization

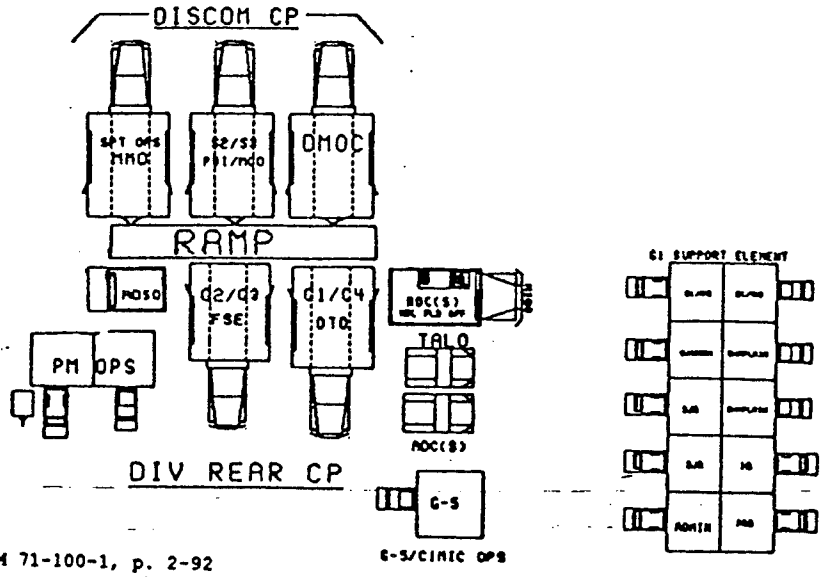
Main

- Analyze situation information to anticipate future requirements.
- Provide and accept liaison support.
- To synchronize current close, deep and rear operations
- To issue and modify orders
- To plan and control deep operations
- To allocate resources to current operations
- To plan future operations and tactical movement
- To monitor situation of higher, lower, adjacent and support units.
- To request, collect, analyze and disseminate intelligence information from all sources.
- To maintain current and anticipated enemy situation
- Control lethal and non-lethal deep fires
- Ensure adequate fire support to the current close, deep and rear operations.
- To monitor CSS situation information and project CSS capacity 24-72 hours into the future.

Current Main CP Responsibilities



Source: TOE Handbook 87004L-CTH. p.79



Source: FM 71-100-1, p. 2-92

Current Rear CP Organization

F-5

Rear CP

- To collect, analyze and provide CSS situation
- To coordinate and control CSS functions
- To recommend the positioning of CSS units in the rear area to best support division operations
- Designate MSRs and alternate MSRs
- To plan for the assumption of main CP functions
- To coordinate tactical air lift
- To plan and conduct rear security operations
- To plan and control terrain management of division rear area, in coordination with the G3
- To prepare plans for reconstitution
- Monitor close and deep operations
- Integrate available host-nation forces

Current Rear CP Responsibilities

APPENDIX G

An expanded variety of missions and unfamiliar operating environments are not the only factors making a change in command post organization for combat necessary. Long-distance deployments to the area of operations will precede an operation. At the same time, constrained strategic lift will require phasing of all but the smallest deploying force. As a consequence, during a deployment, the commander's C2 infrastructure must be able to:

- Reduce the number of personnel and amount of equipment that initially must deploy to provide C2 for an operation--war or OOTW
- Enhance a commander's ability to tailor C2 structures to meet specific situations, as those situations develop, by providing increased options for CP organization
- Enhance a commander's ability to conduct enroute operations as well as provide adequate C2 at significant deployment operating nodes (e.g., aerial and sea ports) by providing increased ability to form independently operating but electronically tethered C2 cells
- Enhance a commander's ability to conduct early entry operations and the initial phases of decisive operations by providing increased information handling capabilities without concurrent, large staff physical signature
- Enhance the mobility and survivability of the C2 infrastructure by reducing its physical signature and making it lighter
- Preserve a commander's ability to provide adequate C2 for the parts of their force that remain at home station.