STUDY PROJECT

COMMUNICATIONS, THE FORGOTTEN ELEMENT OF C^3 A STUDY OF WARGAMING, MODELING, AND SIMULATIONS

BY

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AN INDIVIDUAL STUDY PROJECT

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ABSTRACT

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The question is: Can commanders at all levels, up to and including the NCA, better plan for and predict outcomes of potential conflict given realistic constraints with respect to communications assets and services? Communications for strategic and tactical operations can no longer continue to be assumed. We have, for many years in the past, not exercised our senior commanders into making decisions based on availability of communications resources and services. While technology has improved exponentially compared to our ability to use all available communications services, 'we' continue to demand and expect more. Communications and information have become a valuable resource, however finite, both in industry as well as in the military. In addition, advances in technology together with inherent changing architectures, make consideration of system fragility and availability a key element in the decision-making process.

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Communications, the Forgotten Element of C^3I: A Study of WarGaming, Modeling, and Simulations

INTRODUCTION

Unless communications is included as an integral element of wargaming, modeling, and simulations, decisions by our most senior civilian and military leaders will be flawed. Our country, our government, and especially the Department of Defense have become increasingly dependant on near real-time communications and its myriad applications, yet at the same time, less and less knowledgeable of their capabilities and limitations. Advances in communications technologies and methods together with inherent changing architectures make consideration of system fragilities and availability of services key elements in the decision making process. Command and control as well as availability of intelligence are not possible without communications of some kind. Today and in the future, having some understanding of communications sophistication and fragility are of paramount importance. The only way for operational commanders to gain this knowledge is through realistic exercises and accurate simulation.

THE STUDY

This paper focuses on communications as a key element of command and control gaming, modeling, and simulations.

Communications, within the context of Command, Control, Communications, and Intelligence (C^3I) is the key factor or element that links all the other elements to form a cohesive system. Communications has been assumed to be available, and its cost has been valued at zero in gaming, modeling, and simulations at all levels of command.

At issue is the value of communications and its effect on senior leadership decision-making. If leaders are exposed to realistic communications constraints and limitations during war games, simulations, exercises, and models, these constraints would lead to decisions based on courses of action that otherwise would not have been considered.

This paper examines the issue, explores available literature on the subject, and provides a synopsis of comments from both industry and military leaders. The intent of this paper is to convince the reader that communications must be included as an important and realistic element of the total war gaming effort rather than assumed as being always available and having no cost.

METHODS, ASSUMPTIONS AND LIMITATIONS

The study involved an extensive review of available literature (to include the most current in professional periodicals) and interviews with civilian and military modeling and gaming experts.

Visits were made to service modeling and gaming facilities. Meetings and symposia on this subject were attended, and a survey was conducted of recent senior combat commanders attending the U.S. Army War College Class of 1991 (Appendix 1).

Central to the issue was a thorough review of descriptive catalogues of available models, games, and simulations. This, together with personal accounts from military officials, and visits to service facilities provided valuable insight of present efforts and future plans with respect to integration of communications into the total command and control gaming and modeling concept.

Interviews and research in support of this paper were conducted from sources available from all the military services, the joint staff, and the Department of Defense. While most of the arguments presented focus specifically on the Army and some of its systems, parallel comparisons can be made of similar problems in the Navy, Air Force and Marine Corps.

Some important service facilities were not visited because of a limitation on travel funds.

THE ISSUE

While some specific models simulate communications problems, situations, and topography, they do so for unique applications and

generally apply only to the communicator. Senior service commanders seldom if ever, incorporate communications into their overall wargaming effort. When they do, decision-making, and the use of alternative courses of action are not affected. This is the case from the highest levels of joint and unified commands down to platoon and squad level. Although communications problems on contact (in combat) must be resolved immediately by on-the-ground (in-the-air or surface) commanders, at higher levels, where strategic and tactical communications merge, problems can be anticipated and simulated prior to actual conflict. Alternative courses of action can be measured and weighed given constraints, particular situations, or geography.

Within each service, efforts to replicate communications constraints are done in isolation from the total combat effort. Little consideration is given to interoperability among the services or with allies or to include communications as a critical element that affects decision-making. In the Army for example, the "Network Assessment Model" (NAS)[1] developed by Teledyne-Brown Engineering for the Signal School at Fort Gordon, gives Signal Corps officers and soldiers the capability to plan and assess communications lines given terrain and the mission of the combat unit they support. This very effective tool enables signal officers to more accurately develop, plan, and execute communications support for combat units. But this assessment model is not an integral part of any larger combat simulation, model, or

war game. Army Warrior Preparation Centers, Combat Simulation Sites, and actual command post and field training exercises do not include operations or simulations that realistically portray shortfalls and problems in this very important and critical area.

The National Simulation Center at Fort Leavenworth, Kansas recently published a concept paper for the Army's 'Family of Simulations'.[2] This paper is a comprehensive plan to incorporate "each echelon (company through Corps) with command and control training simulation that closely replicates the lethality and stress of the battlefield". This family of simulations includes JANUS[3], Panther 1.0[4], Brigade Battalion Simulation[5], Corps Battle Simulation[6], Tactical Simulator[7], Combat Service Support Training Simulation System[8], and Panther 2.0[9]. Figure 1 shows all these models interweaved at different levels or echelons of command. Not one of the models that make up the 'Family of Simulations', however, takes into account communications. Communications within each element has not been designed or written into the software. The links that keep command and control functioning in real time is totally ignored. In essence, communications are assumed to be in place, totally reliable, invulnerable to actions of the enemy or the environment, and operated at peak efficiency.

Army officials at Ft. Leavenworth further indicate that there are no plans to incorporate Signal modules in any future models, simulations, or wargames. The Signal officer assigned to the

Center has no role in the 'gaming' itself. He is only responsible for ensuring that communications links between modeling/wargaming sites are in place and reliable. Reliable communications in the game themselves are assumed throughout the plan. Absence of communications linkage in command and control play, as is the case at Ft. Leavenworth, defeats the purpose of: "closely replicating the lethality and stress of the battlefield".

While Army simulation efforts are used here to focus on the need for integral communications modules within most levels of design and execution, the Navy and Air Force have similar shortcomings. The Navy has not incorporated communications play into their exercises, wargames or simulations[10]. Like most Army operations, signal availability and communications services are assumed. Pilots in all of the services relate that they have so many communications channels that many times they turn all their radios off except for the one required for the operation at hand. Naval surface operations rely to heavily on UHF satellite links without considering other forms of transmission. Submariners, on the other hand, unavailable for long periods of time, rely principally on established operational procedures to ensure contact (or lack thereof) with their operational commanders. Now that TACAMO[11], for example, has made the transition from 24-hour day operations to "interim ground alert[12]", procedures must be established that will ensure communications are available when needed. These procedures must be modeled and gamed to establish

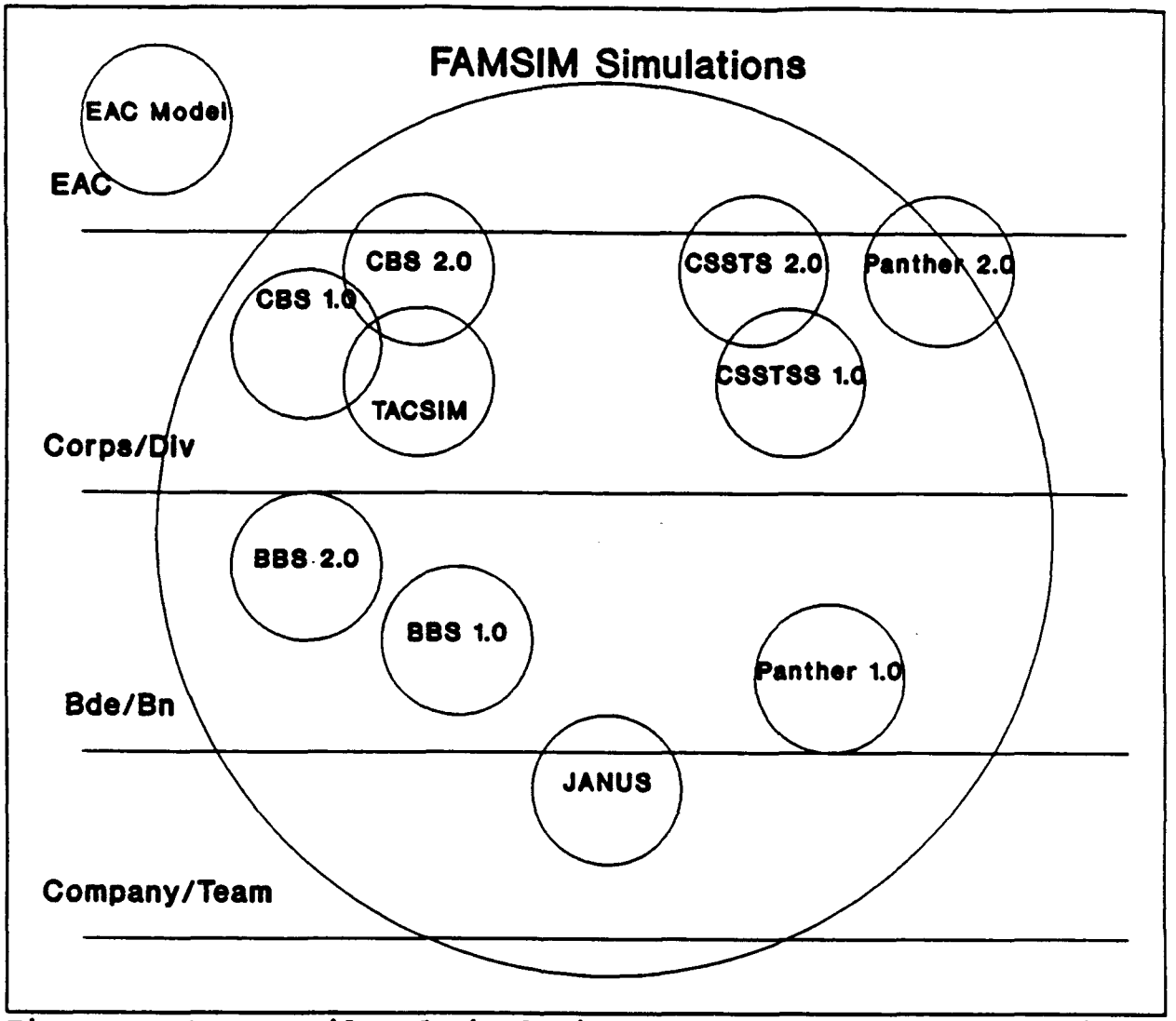

Figure 1: Army Family of Simulations. (Extract) Source: National Simulation Center, Ft. Leavenworth, KS

norms and operational soundness.

At the service level, redundancy of means has created a sense of complacency that is likely to prove dangerous in the future as use of computers and data exchange become more prevalent. Unavailability and/or reduction of communications and resulting loss of information exchange can severely affect senior commanders'

options. This real-life constraint is never played or simulated. In models or games commanders' options involve factors that have to do with forces, equipments, geography, and intelligence; never communications. Yet when communications fail or its capabilities are reduced, intelligence for the commander and orders from him will change. For instance, if the link between computers fails to deliver intelligence about the enemy's order of battle, or a critical Air Mission Order, the commander must recognize the loss of this data and react accordingly. Commanders must react if information arrives on time, but garbled or unclear. This phenomena is more likely to appear as packet switching becomes more widespread. Procedures must be established beforehand in anticipation of these problems. Unless these problems are practiced problems will not be detected, solutions sought and the required procedures will never be established.

For example, Army air defense operators do not turn on radars until just before missiles are fired. Air defenders rely principally on the air picture provided by remote sensors and transmitted on tactical UHF/VHF and land lines. If these UHF/VHF systems go out of service; the mission must be canceled, or preparations made for autonomous operations. Alternatively, they can prepare to operate in a constrained fashion using AM radios instead. In cases such as this, gaming would have trained the commander to anticipate what course of action to take if communications fail.

Joint and Unified commanders have a unique challenge and dilemma with respect to the exercise of command and control. In peace and in times of war when major headquarters do not move very often, the Defense Communications Agency provides strategic communications and services. When the battlefield begins to shift, and theaters of operation redesignate their boundaries, these headquarters encounter a series of new problems that are usually labeled "interoperability problems". In simple terms, this means that two radios, or two telephones, or two computers, or two service entities cannot speak to one another. This use of "interoperabilty" is frequently an excuse for not having anticipated problems. Such lack of anticipation arises from not having modeled, simulated, or war gamed a particular situation. In specific cases the term is used to avoid criticism for not having proper procedures available.

While the U.S. accomplished its goals in Grenada, a number of "interoperability problems" were identified. These were not only equipment interoperability problems, but in the main, the U.S. Atlantic Fleet and the XVIII Airborne Corps services were not prepared to operate jointly. From a communications perspective,[Note1] interoperability need not have been a problem if

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[1] **Note:** If one uses a brand "A" radio to communicate with a brand "B" radio, there are no problems so long as both radios are on the same frequency. But when communications security (COMSEC) equipment is added, or data transmissions are attempted, a new set of circumstances arise. Users must, of course, be on the same COMSEC keylist, must have each others call signs, and must know what frequencies are being used and for what purpose. In the case

these situations had been anticipated and modeled in activities in which these forces or their leadership had to participate.

In contrast, during Operation Just Cause in Panama, communications interoperability was a success. General Maxwell Thurman testified before the Senate Armed Services Committee that his ability to command and control his forces was mainly due to a well established communications plan[13]. He showed an actual copy of his communications operating instructions and bragged about its simplicity compared to what had been in place for the Grenada invasion. The implication was clear that General Thurman had the time to carefully plan his operation and had applied the lessons learned during Grenada. The Grenada and Panama invasions are examples of how the time element is a factor in such assessments: in one case the planners had two days, in the second six months.

The recent Gulf expedition and war should give all the services and their leaders experience with communications in real scenarios. Things went very well mostly because there was plenty of time to prepare and the war didn't last very long. There was time to saturate the theater with communications and services ordinarily not available. Panama and the Gulf enjoyed this luxury. Expecting that these conditions always must or will exist will

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of data, given that communications are now secure, data-transmission protocols or 'handshakes' must be the same to be successful. Procedures for both sender and receiver must be understood and must be standard. [1]

prove to be unwise.

Even though successful during Operations Desert Shield/Storm, communications problems among U.S. units and with Allies Forces were not exercised in large scale war games prior to deployment[14]. Communications successes were due in large part to the robustness of the Saudi Arabian communications infrastructure, the ample time allowed for deployment and infusion of equipment from worldwide assets, the lack of Soviet threat, and most importantly, the fact that the Iraqis did not have the means or take the opportunity to interfere with Coalition communications.

The Army's tactical communications were not successful at the beginning of the Gulf conflict. In the midst of worldwide fielding the new Mobile Subscriber Equipment (MSE)[15], interoperability problems with units still using the older equipment had not been anticipated. Communications among units with different systems and with different capabilities (analog vis. digital) became a problem. Air defense communications were brittle and had little or no redundancy[16]. Air defense operations (to include Patriot and Hawk) would have been severely hindered had firing batteries and/or engagement control stations been forced to move. Eventually, these problems and others were solved by contractors brought to the scene and by providing interfaces with hardware rather than software or common protocols.

All the services had unique problems in addition to difficulties communicating with allied elements. The majority of failures were due not to bad equipment, but due to a lack of procedures. Successes were the result of individual ingenuity when faced, under stress, with critical missions.

The U.S. military should learn from Saddam Hussein's defeat. The Iraqis were unable to command and control their forces because the Coalition made Iraq's communications centers the highest priority targets during first stage of the air war and during special forces operations. By reducing the leadership's ability to communicate, the Iraqis were denied critical intelligence on troop positions and displacements and any ability they may have had to regroup or reconstitute their forces to meet new threats was eliminated. Saddam Hussein and his top leaders had not foreseen or practiced command of forces. The Iraqis presumed their communications would work adequately throughout. None of the U.S. services will be ignoring the implications of these lessons if they continue to avoid factoring communications into command and control exercise and simulations.

Having demonstrated how effectively communications systems can be eliminated or reduced, the U.S. should appreciate that any potential adversary will have as its highest priority the destruction and elimination of communications facilities. Recognition of this weakness makes it imperative that military and

civilian operators practice designing such constraints. This can only be done by communications modules that can be included as an important element in large scale war gaming efforts.

MODELS

A review of models, simulations, and wargames, as well as interviews with designers of future software clearly shows that communications are not included in wargaming efforts in any way that influences senior commanders' information or decisions. Where played, communications is usually presented in terms of percentage of degradation. How this degradation affects the outcome of a game, or how it influences a model is never clear. What is clear is that when lack of communications begins to affect the difficulty of the game or the time required to play it, game controllers usually reset parameters to remove this difficulty. Because of this, the game then teaches that the cost of communications is zero and that its reliability is infinite.

The Joint Analysis Directorate of the Joint Chiefs of Staff catalogs over 700 simulations, war games, exercises, and models in general use throughout the U.S. Department of Defense, as well as in Australia, Canada, England, and Germany[17]. A detailed review of this large document shows no evidence that communications is played any manner. No purpose would be served here to detail every game and model in this catalog except to note that comparisons with

other catalogs available within the Department of Defense reveal the same condition exists in other services[18] [19].

The U.S. Army Communications-Electronics Command (CECOM), together with the MITRE Corporation, is attempting to address the issue of " the Army integrated C3I system through engineering analysis of architectural requirements[20]." From a service standpoint, this is a start towards integrated modeling because one of their stated goals is to "focus on quantifying C^3I contributions to the combat effectiveness of the Army's future battlefield environment". Although this effort includes most of the Army communications community, and there seems to be some involvement with the newly created Defense Simulation and Modeling Office, there is no evidence of participation by the combat development communities of the war fighting branches.

Scientists, researchers, and software designers conclude that the military and industry have been remiss in this area. Communications has been addressed before, but only in an abstract sense and not well defined. Comprehensive modeling was too difficult or not worth the effort. Commonly, there has been concern about how to 'score' communications failures or lack of services, and what values or weights to assign to a communications module and its elements. All those interviewed agreed that communications and new emerging technologies make it imperative

that situational and operational wargaming include dynamic and influential C^3 systems as a whole, not as separate parts. The nearest effort found to that addressed in this paper was work being done by Booz-Allen & Hamilton[21].

Booz-Allen is studying the effect of communications dead time (how long it takes from sender to receiver) on decision-making. The study contrasts the effect of the time dimension on orders given by leaders during the Civil War as compared to the time dimension of orders issued by leaders during intervening wars through the present. The study seeks to examine how technological innovations improve the ability and the rapidity of communications, commanders' orders, and how these influence the outcome of the battlefield in what different ways and at what speed.

Time can be translated into technology of communications. Terrain and procedures were the only keys to successful transmission before 1860. A message took longer to reach front line commanders when carried by messenger on horseback than did a message transmitted by smoke or by semaphores from a mountaintop.

With the advent of the telegraph, communications took a new meaning. Today, in a world of almost instant communications and continual feedback with the promise of even more technological advances, time and reliability can make the difference between success and failure.

A historical review of conflicts and wars since ancient times clearly reflects an increase in battle area dispersion[22] (Figure 2). The two essential facets affecting this dispersion are command and control capability, and mobility of forces. Commanders traditionally have not allowed subordinate units to disperse farther than they can be controlled. Mobility assets such as trucks, aircraft and etc. also determine how far units are away from their leaders. Dispersion has a direct relationship to communications technology. While quantities of mobility assets can certainly disperse the battlefield, units must still remain under effective command and control. This range is dependant on command and control means (communications). Compare the degree of command and control President Truman exercised over General McArthur to that exercised by President Bush over General Schwarzkopf. There was certainly more control by President Bush given the communications capabilities, feedback, and instant press reports of today even though the distance was about the same. Truman, in contrast, did not have the communications available today, and could not exercise the degree of control he would have liked. Responsiveness of available communications means and the inherent time delay of that era were not conducive to effective and instant command and control.

Operational successes and failures can depend on time and reliable communications. Communications technologies have, over the years, dispersed the battlefield farther and farther away from leaders and commanders. Yet models, games and simulations that are

Trends in Dispersion for Ground Armies
(Typical Army of 100,00 Soldiers)

	Battle Area (Dispersion in Sq Km)
Ancient Armies	1.0
Napoleonic Era	20.1
Am. Civil War	25.8
World War I	248
World War II	2,750
'73 October War	3,500
Europe '85	5,000
Persian Gulf '90	5,500 (est.)

Figure 2: Trends in Dispersion for Ground Armies. Source: Extract from chart by Charles F. Hawkins, Data Memory Systems, Inc., April 1991.

supposed to replicate the realities of war do not exercise this vital linkage. Commanders at all levels are using inadequate tools and making decisions with a false sense of reality when they fail to consider how communications (or lack thereof) will affect courses of action for the eventual execution of any concept, operational, or war plan.

NEEDS

Interviews with senior military leaders and visits with gaming and modeling experts (both civilian and military), together with a recent survey of the U.S. Army War College class of 1991[23] showed concern about communications, and a need for a more realistic way of exercising command and control capabilities and limitations.

Senior military leaders (past and present) agree that they gave little thought to communications during exercises and other types of simulated conflicts. Communications were expected to be in place and perform reliably. When asked if their strategic, operational, or tactical decisions would be different if they had realized certain types of communications or services might be interrupted or unavailable, every officer interviewed replied that they would be. When discussing recent wars and problems associated with command and control, all agreed that the majority of problems could have been resolved if some form of exercise would have included communications. One Gulf war example regularly cited was the problem with the Navy's ability to receive by computer the daily air tasking order. The data link or between the two was not wide enough to receive this large document in time for air operations. Instead of using the data communications, the order had to be flown to the aircraft carriers every day. Practice, in this case, would have identified this problem. The required hardware and software to quickly handle large amounts of data would

have been made available. The field expedient solution of daily flights to distribute the air tasking order might not have been viable if the enemy posed a greater threat than he did.

Officials at service gaming and modeling facilities were all aware that the absence of realistic communications play at their sites took away from the reality of what was being practiced. With one exception[24], there is no present or future effort to integrate communications into the training process.

The War College survey was well received and provided valuable information. Ninety-eight percent of the respondents indicated that communications was "crucial to their units' mission". Those that did not were commanders of special forces/operations units that operate under almost total radio silence and follow rigid pre-established procedures.

There was ambivalence on the part of the respondents when asked if communications was played in command post exercises and computer or board games. Some had, but the majority had not. Likewise when asked if communications reconstitution had been exercised as part of war contingencies, the responses revealed that it (reconstitution) had not been exercised. When asked if "degraded communications made any difference or affected their unit's mission" almost all (92 percent) indicated that it did. The majority replied that if they could command the same unit again,

they would place more "emphasis on communications".

Sixteen commanders wrote unsolicited comments on the bottom of the questionnaires. These comments all related to their personal experiences as commanders and their relationship with their Signal officers. These comments uniformly reflected that in spite of a general lack of interest (at higher headquarters) to practice with degraded communications, they (the commanders) took it upon themselves to exercise their units in such maneuvers. They did so by pre-arranging procedures given certain circumstances or actually changing to alternate communications to accomplish a mission perhaps in a less than perfect manner.

Officers and former commanders interviewed during the last nine months were all very concerned that more emphasis was not placed on communications. All indicated that while they realized its importance, in the 'heat of the battle' their main concern was to proceed with the mission. During actual exercises and gaming, communications was never a problem, and therefore commanders did not think about it very much. Only during after-action hot-washes did they realize that certain missions would not have been accomplished had there been degradation of services or restriction in the means of communications. The survey's general consensus

confirmed that communications does not get much play in exercises, games, or simulations. Many times in field exercises, communications units were deployed well ahead of the combat units in order to ensure critical links were in place and reliable before the exercise began.

All of the other services and their respective combat arms face the same problems. Communications are seen as applicable to individual systems and needs, and not as part of the whole combined mission. Naval officers training for duty in the E-2C Hawkeye surveillance aircraft receive extensive hands-on experience on the actual equipment they will use[25]. Simulators emulate radar images, radio transmissions, and aircraft environmental conditions (size, temperature, light, and etc..). Officer trainees experience every situation that is replicable in a real E-2C prior to actually deploying for duty - except for communications failures. Officers in training and instructors who were interviewed did not seem concerned about this element not being included as part of their training. When queried they agreed that inclusion of communications play into their training would certainly enhance their ability to deal with real life situations. These officers were not aware of any efforts to revise their training or refit the simulators to add this type of feature[26].

FUTURE APPROACH TO COMBAT MODELING

Software writers and computer model designers have wrestled with the problem of including communications modules into their total effort. The difficulty stems from the fact that communications, along with services that are available, are complex and therefore not easily suited for the formulation of scoring systems.

Unlike tanks, artillery, airplanes, trucks, and types of terrain, there has been no serious attempt to quantify communications, its components, and its inherent problems. Equipment numbers, losses, and gains can be quantified by logical algorithms that take into account range, effective power, and other capabilities. The possible combination of elements and factors that come into play when establishing a single radio link are not conducive to the most elegant quantification. Expanded to account for encryption and data transmission, the problem is compounded exponentially. Add message traffic service (hard copy or facsimile), voice, point-to-point circuitry, and any special handling of sensitive information, and the problem becomes more challenging. A communications system that is composed of many networks, from the simplest at squad level to a most complex at the joint or national level, has so many variables and factors associated with it that serious attempts to quantify any have not been undertaken. Until this basic research is completed,

communications play in modular form in simulations, models, and war games will not be available.

Like many other tough problems, this one too can be solved. There is no physical phenomena which bars solution. Patience and an understanding of how integrated communications work with combat operations and not in isolation are key. There was general agreement among experts (both civil and military) that the communications and modeling communities must work closely with those who are going to use the system: Army, Naval, Air Force and Marine combat leaders. No purpose will be served if models are developed that could not meet the training and mission requirements of our war fighters.

Given that the time dimension of information requirements for each echelon are known, that types of equipment and capabilities are known, and that reliability rates and mean-time-between-failures (MTBF) are known, models can begin to be designed using probabilities rather than discreet numbers or values.

Any approach or effort to design a communications system module for inclusion in larger scale war gaming, simulation, or modeling must consider time as the principal element affecting the decision-maker and those he commands and controls. The need for information and the rapidity with which it is needed affect decisions in a different way at different echelons. Needs for

information (tactical/operational) must have values that reflect what is required in real-time, near real-time, and non real-time. These elements when tied to types of equipment, their reliability, and type of service required can be expressed in terms of probabilities.

Probabilities of communications success (or failure) can be factored into the overall probability of success of a particular mission or plan. For example, movement of tanks without communications during the day is difficult. The same movement at night it is almost impossible. If the mission is to move tanks from point A to point B, probability factors for day and for night operations will be different. All actions leading to the execution of a mission has many elements, to include communications. Each one of these elements can be expressed in terms its own probability. The product of all these, which now includes communications, will result in the overall mission probability of success.

The example above, while simple, illustrates the complexity of factoring communications in the overall gaming process. Consideration must be given to time delay or urgency of the requirement, type of equipments and reliability rates, the level or echelon of command, and the type of mission.

SUMMARY AND CONCLUSIONS

Communications makes command, control, and intelligence processing possible. Still, however, serious efforts have not been made to realistically practice operating under a constrained communications environment.

The tank movement example above shows that absence of communications affects the outcome of a mission in the day and at night in different ways. War games, models, and simulations must be designed so that operations under restrictive communications are quantified in a manner that realistically exercises the decision maker. The impact of less than perfect communications in gaming must force participants to seek alternative means to command and control forces. Commanders and leaders must realistically train and practice in order that potential problems may be anticipated, weaknesses identified, and procedures established prior to actual conflict.

No purpose is served when signal units establish communications in the field prior to the arrival of combat elements. The realism of war, the time constraints involved, and the problems inherent with tactical movements is lost. Just the same, no purpose is served when leaders war game or simulate crisis, wars, and conflicts under the assumption that communications are totally in place, reliable, and capable of

handling any volume of voice and data traffic.

Military leaders at all levels must demand realism when practicing command and control. They must demand that communications be included as an important and integral element of all war games, models, and simulations.

Endnotes

1. Teledyne-Brown Engineering developed the Network Assessment Model (NAS) under a U.S. Army contract. 1988

2. "The Family of Simulations (FAMSIM) Concept Paper, Draft, National Simulation Center, Ft. Leavenworth, KS, 30 November 1990.

3. JANUS models maneuver, fires, air defense, artillery, aviation, and aviation support.

4. Panther is a low intensity conflict (LIC) computer assisted simulation that models direct and indirect fires, Army aviation, engineers, intelligence, logistics, civil affairs, and psychological operations. Any type of unit up to brigade-level.

5. Brigade Battalion Simulation (BBS) supports combat maneuver commanders and battalion as well as brigade staffs. BBS models direct and indirect fires, movement, mobility/counter-mobility, air defense, Army aviation and close air support, chemical and nuclear effects, combat service support, and airborne/airmobile operations.

6. Corps Battle Simulation (CBS) trains commanders and staff officers at the joint, corps, and division levels. CBS models ground movement and combat, Army aviation and tactical air support, air defense artillery, field artillery, engineers, logistics, and chemical and nuclear effects.

7. Tactical Simulator (TACSIM) replicates theater, corps, and division level intelligence collection assets. TACSIM links with CBS.

8. CSSTSS will be fielded in 1994 and will train theater, corps, and division support commanders and staff. Subsystems of the model are supply, maintenance, ammunition, transportation, medical, fuel, and forward reception/onward movement.

9. Panther 2.0 focuses on LIC at division through country-team level. This models simulates interaction between host nation counterinsurgency structure and the U.S. agencies involved.

10. Moore, Molly, "War Exposed Rivalries, Weaknesses in Military", The Washington Post, 10 June 1991, page 1.

11. TAke Charge And Move Out (TACAMO). Naval airborne communications platforms used for 24-hour communications with submarines and surface ships.

12. " Nonstop Air Link to Nuclear Subs Cut", The Washington Post, 26 May 1991, p A36.

13. Testimony by General Thurman before the Senate Armed Services Committee, March 1990.

14. Moore, Molly, "War Exposed Rivalries, Weaknesses in Military", The Washington Post, 10 June 1991, page 1.

15. The Mobile Subscriber Equipment (MSE), is being built and fielded, under contract with GTE. MSE will eventually replace all Army tactical communications equipment both the active and reserve components.

16. Conversation with military and civilian contractor personnel who participated in Desert Shield/Storm. March 1991.

17. Joint Analysis Organization of the Joint Chiefs of Staff, Catalog of Wargaming and Military Simulation Models, 11th Edition, March 1990.

18. Department of Defense, U.S. Army Logistics Management College, Ft. Lee, Virginia, January 1991. "Catalog of Logistics Models"

19. Joint Services Working Group of the Joint Directors of Laboratories Subpanel on Decision Aiding, "Command and Control Decision Aids Information System", by: Command and Control Microcomputer Users Group (C^2 MUG), Ft. Leavenworth, Kansas 24 July 1990.

20. Modeling and Analysis Division, Architectural Engineering Division, U.S. Army Communications-Electronics Command (CECOM), Implementation Plan, - undated (1991)

21. Herman, Mark L., Booz-Allen, and Hamilton, December 1990.

22. Hawkins, Charles F., Trench Warfare in the Persian Gulf, Data Memory Systems, Inc., April 1991.

23. Survey conducted by the author in December 1990. A total of 126 respondents included former recent commanders of Army combat units from the following branches: Infantry, Armor, Field Artillery, Air Defense Artillery, Aviation, and Engineers.

24. See Endnote # 19.

25. Visit to E-2C simulation facility, Miramar Air Station, California, January 1991.

26. Ibid.

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"Army C3 Support Units Fall Behind Pace of Battle", Defense News, 15 April 1991, p37.

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MSP Survey

The Missing Factor in C3I Wargaming, Simulations and Modeling: Communications !

(Dec 90 - 1/2)

Please respond to the questions according to the following scale:

1 Strongly Agree/Fully Agree/2 Somewhat Agree/3 Disagree/4 Strongly Disagree/5

Circle the correct response

1. Communications was crucial to my unit's mission. 1 2 3 4 5

2. I participated in Communications planning. 1 2 3 4 5

3. Availability of Comms determined the tactical employment of my unit. 1 2 3 4 5

4. My S3 was deeply involved in Comms planning. 1 2 3 4 5

5. I was never worried about Comms; I knew it would always be there. 1 2 3 4 5

6. My staff was fully aware of Comms availability and services available. 1 2 3 4 5

7. My Signal officer **always** was involved in the planning and execution of tactical operations. 1 2 3 4 5

8. In my experience, communications was **never** played in Command Post Exercises (CPX). 1 2 3 4 5

9. In my experience, communications was **never** a factor during computer or board gaming. N/A 1 2 3 4 5

10. Employment and deployment of my unit was dependant on availability of comms. 1 2 3 4 5

11. Degraded comms did not make any difference or affect my unit's mission(s). 1 2 3 4 5

12. Communications with my higher headquarters was not important. 1 2 3 4 5

13. My unit trained to operate and accomplish its mission with degraded comms and comm services. 1 2 3 4 5

14. My S4 and my SigO planned and coordinated comms reconstitution in our war plans/contingencies. 1 2 3 4 5

15. My S4 and my SigO planned and coordinated alternate means of transportation for comms assets; ie: sling-loading to remote mountain tops. 1 2 3 4 5

16. I supported and enforced declared states of "minimize" (communications-wise). 1 2 3 4 5

17. My Signal officer's recommendations with respect to availability of comms made a difference in my decisions regarding tactical employment of my unit. 1 2 3 4 5

18. My basic branch is: _____

19. My highest level of command was: _____

20. I am (Active Duty)/(Reserve)/(NG) _____

21. If I could do it again, I would place _____emphasis on communications planning, and execution.

*LESS
*THE SAME
*MORE