MAINTAINING THE INFORMATION FLOW: SIGNAL CORPS MANPOWER AND PERSONNEL REQUIREMENTS FOR THE BATTLEFIELD

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Abstract

Army transformation depends heavily upon superior Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) to provide a force multiplier. C4ISR requirements also bring electronic systems and technologies to the battlefield in quantities never before used by the Army. In order to function and serve the soldiers, these systems require support personnel predominantly from the unit's Signal Company. To determine if identified signal manpower levels would adequately support a C4ISR function for the new Stryker Brigade Combat Team (SBCT), an assessment of signal support was conducted. The assessment methodologies were (1) a comparison of the Stryker signal personnel with signal personnel of current units, (2) a comparison of electronic equipment per repairer levels in the SBCT and current units, (3) an analysis of the C4ISR maintenance backlog during an operational exercise, and (4) an analysis of signal personnel questionnaires. Results indicated that the signal personnel assigned to the SBCT may not be sufficient. Manpower for some of the Military Occupational Specialties (MOSs) needs to be increased, specifically the information systems personnel (MOS 74B) and various electronics repair personnel. If the C4ISR is not sufficiently maintained, it will degrade and not provide the expected force multiplier needed by the warfighter.

INTRODUCTION

Army transformation depends heavily on superior Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) to

provide a large force multiplier to the battlefield. To accomplish this, timely, accurate information must be provided to unit commanders on a consistent basis. The C4ISR provides the function of collecting information and passing that information up and down echelons as well as within the Unit of Action (UA). This flow of information, essential for the mission and greater survival, flows primarily through communications networks and computing systems and depends directly on accurate and continuous operation of these networks. The C4ISR requirements for the already digitized forces, such as the Fourth Infantry Division (4^{th} ID) and the Stryker Brigade Combat Team (SBCT), the latter just now being deployed, and the Future Combat System, the objective force, bring electronic systems and technologies to the battlefield in quantities never before used by the Army.

In order to function and serve the soldiers, these systems require very capable support personnel, usually from the unit's Signal Company and associated signal personnel, to perform complex activities, such as maintaining the information systems and networks, operating and maintaining the signal communication systems, establishing and maintaining communications security, operating and maintaining the audio-visual communications systems, and repairing the communications-electronics equipment. In any UA, the staffing and personnel mix must be appropriate to the task of supporting the C4ISR.

Determining the optimal manpower and personnel for Army's new SBCT signal support presents a unique challenge in that the SBCT is designed to be "light" enough to easily deploy and maneuver but "lethal" and effective enough to be useful. Therefore, the SBCT should ideally have a large "tooth-to-tail" ratio but still have the capability to quickly and thoroughly maintain its critical equipment, in particular, its C4ISR equipment. For that reason, as part of the overall assessment of the C4ISR, the U.S. Army Test and Evaluation Command's Army Evaluation Center requested that the U.S. Army Research Laboratory's Human Research and Engineering Directorate conduct an analysis of the Stryker Brigade signal support to determine if the assigned signal manpower and personnel levels would properly support the C4ISR architecture and functions.

Level	Systems	Connectivity
Upper TI	MCS AFATDS ASAS CSSCS	LAN NTDR
BSN EPLRS NCS SMART-T Radio Retrans Spitfire SOTM HF Radio		
Lower TI	Inter/Intra communications Systems FBCB2 Sensors	SINCGARS EPLRS Radios

Table 1. The SBCT belongs to a two level C4ISR network of computers and communications referred to as the Upper TI and the Lower TI.

METHODS

The Army's C4ISR system is a network of communications systems, computer systems, sensor systems, and surveillance systems designed to provide needed battlefield information more quickly to the leadership at each echelon. (Mazzucchi, 2003). The architecture includes satellite and airborne communication networks, as well as more traditional radio networks (Klynsma and Scott, 2001). For discussion purposes, within the SBCT, the C4ISR can be considered as consisting of an upper tactical internet (TI) and a lower TI, as depicted in Table 1. The upper TI consists of portions of the Army Tactical Command and Control Systems (ATCCS): the Maneuver Control System (MCS), the Advanced Field Artillery Tactical Data System (AFATDS), the All-Source Analysis System (ASAS), and the Combat Service Support Control System (CSSCS). Much of the connectivity within the upper TI is through the local area network (LAN) and the Near Term Digital Radios (NTDR). In the lower TI, the systems include the inter and intra communications systems, Force XXI Battle Command Brigade and Below (FBCB2) and a number of sensing systems all the way down to the individual fighting platform. These are connected through various radios, including the Enhanced Position Location Reporting System (EPLRS) and the Single Channel Ground and Air Radio System (SINCGARS). A variety of signal communications systems interconnect and tie all these systems together. Some of these systems are the Brigade Subscriber Node (BSN), the EPLRS Net Control Station (NCS), a Satellite Communications (SATCOM) system at the tactical level such as the Secure Mobile Anti-Jam Reliable Tactical Terminal (SMART-T), and the radio retransmission (Radio Retrans) systems. Other voice-carrying long distance systems include the High Frequency (HF) radio and the Spitfire Satellite On The Move (SOTM) system.

The C4ISR support and maintenance activities are conducted by the signal personnel assigned to the Stryker Brigade. Signal personnel manpower strengths and personnel types were evaluated by an analysis of the Table of Organization and Equipment (TOE) structure and the data collected about the performance of the signal personnel in the Stryker Brigade. Since the signal personnel perform a variety of functions in support of the C4ISR, it was necessary to evaluate several areas of their activities as well as the manpower and personnel strengths. In terms of performance, initialization of the C4ISR, maintenance of the hardware, and maintenance of the networks were evaluated.

For the purpose of this evaluation, the signal personnel were separated into six categories: signal officers and non-commissioned officers (NCOs); information systems and networking personnel that maintain computing systems and networks; signal communications systems operators and maintainers for the systems such as the BSN, EPLRS NCS, tactical satellite systems, etc.; communications security (COMSEC) personnel; audio and visual communications systems personnel; and communications/electronics repair personnel. Table 2 shows these categories and the Military Occupational Specialties (MOSs) related to each.

Four types of analyses were used to evaluate various aspects of the manpower and personnel support for the C4ISR of the Stryker Brigade: (1) a comparison of the Stryker signal personnel and manpower with two other units, (2) a comparison of electronic equipment per repairer in the Stryker Brigade and the other units, (3) an analysis of the

TYPES OF SIGNAL PERSONNEL	MOSs Represented	ANALYSES			
		MTOE signal personnel	Electronic equipment/ repairer	C4ISR backlog	Signal soldier questionnaire
Officers and NCOs	25A, 53A, 250, 251, 00Z, 31W 31Z, 33W, 35W, 74Z	P			
Information Systems and Networking	74B	S		P	S
Signal Communications Systems	31C, 31F, 31L, 31R, 31S, 31U	S		P	P
Plans and Communications Security	74C	P			
Audio/Visual Communications Systems	74C			P	
Communication/ Electronic Equipment Repairer	35E, 35F, 35J, 31F, 31P	S	P	P	

P = Primary Data Analysis S = Secondary Data Analysis

Table 2. Types of analyses conducted on SBCT signal personnel by category of personnel and the MOSs for each category.

C4ISR maintenance backlog during an operational exercise, and (4) an analysis of signal personnel answers to questionnaires about their duties. Table 2 indicates which analyses were the primary and the secondary analyses for each category of C4ISR support personnel. This evaluation did not look at manpower and personnel levels for operations of the signal equipment.

RESULTS OF ANALYSES

Comparison of the Stryker Signal Personnel with Those of Current Units

To estimate the required signal personnel strengths of the Stryker Brigade, the assigned strengths in the SBCT TOE was compared to the TOE strengths of other previous Army units (DOA, 2000; FORSCOM, 1999; FORSCOM, 2001). Because the Stryker Brigade has a new brigade combat team structure, it does not directly correspond to any current unit. Therefore, it was necessary to compare it to Army units with somewhat similar structures, while recognizing that such a comparison has inherent limits. A second problem arose in that the Stryker is a digitized brigade and even similar brigades and divisions would not have the same signal personnel requirements as a digitized unit. For these reasons, it was decided to attempt comparisons with one unit that was similar in size and structure and also with the Army's first digitized division (FDD), regardless of size. The first unit selected was a small heavy division (HD) which was comparable in size and included all of the same type of organizations and combat vehicles with communications equipment, and with a similar, though limited, command,

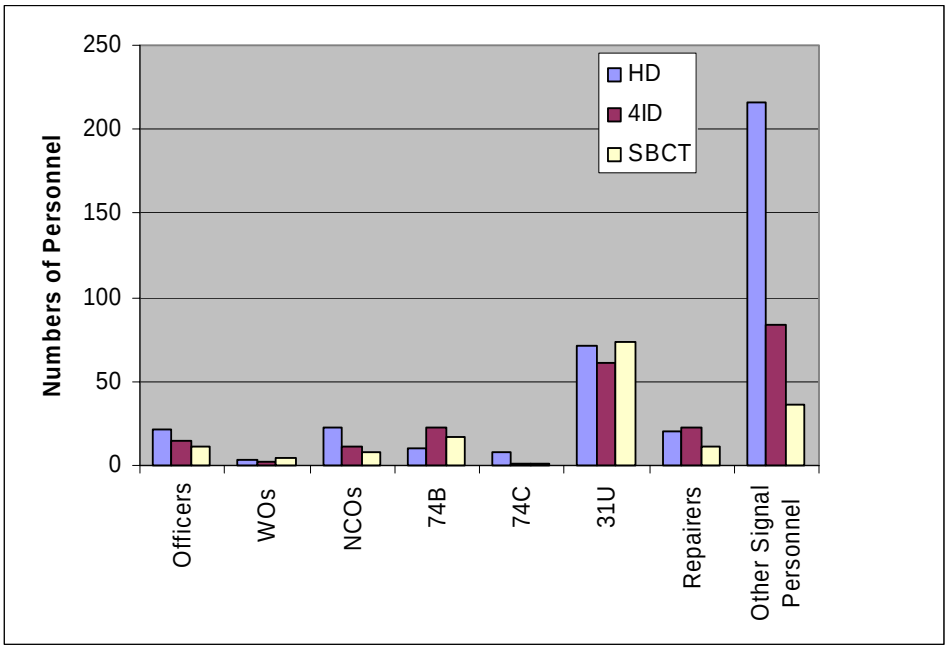

Figure 1. Signal Company personnel by categories or MOS for the HD, the 4th ID and the SBCT. (The numbers of personnel are normalized for the numbers of personnel in the SBCT.)

control, communications (C3) structure as the Stryker Brigade. The Army's FDD, the 4th ID, also selected for this analysis, has a similar C4ISR structure, but it is three times greater in size than the Stryker Brigade.

To make comparisons of the signal personnel levels for the three organizations, the signal personnel of the HD and the 4th ID were normalized to the total personnel strength of the SBCT, i.e., the proportions of signal personnel in the HD and the 4th ID were calculated on the basis of an organization the size of the SBCT. Since signal personnel serve in a support capacity to the rest of the organization, the number of personnel served by each signal corps individual was calculated for each organization, creating the ratio of supported personnel to each type of signal personnel. Then those ratios were divided into the overall number of personnel of the SBCT, producing a predicted signal personnel for the SBCT. The signal personnel were grouped by specific categories of interest. Comparisons of the sizes of the actual SBCT signal manpower with the normalized manpower levels of the HD and 4th ID are in Figure 1.

With the above calculations to estimate total signal manpower requirements for the SBCT based on the HD, the Stryker Brigade appears to require an additional 194 signal personnel over the 173 assigned throughout the brigade. These would predominantly be within the Signal Company, as opposed to being spread throughout the brigade. A further breakdown in Figure 1 by MOS groupings identifies the MOSs that have been significantly reduced in the SBCT TOE. Four observations can be made from these comparisons: (1) the officers and NCOs assigned to support the C4ISR administrative activities are substantially reduced for the Stryker Brigade; (2) the C4ISR support in the Other Signal Personnel group is also significantly reduced over predicted levels; (3) the COMSEC personnel, MOS 74C, are reduced for both the 4th ID and the Stryker Brigade from the HD levels; and (4) the number of communications-electronic

repair personnel is substantially reduced.

Officers and NCOs. As can be seen from Figure 1, the signal officers and NCOs appear to be under staffed in the SBCT (and somewhat less so in the FDD). These represent MOSs identified as officers and NCOs in Table 1. Four officer/NCO MOSs (25C, 00Z, 31Z, and 74Z) are not assigned to the Stryker Brigade but are included in either or both the HD and the 4th ID. The explanation for this reduction is that a Signal Company needs fewer officers and NCOs since it is smaller and less complex than a signal battalion, which is the size and complexity necessary to support an entire division. (In fact, the 4th ID requires two signal battalions to support it.) This reduction in personnel appears appropriate for a company serving the Stryker Brigade and therefore, the Signal Company's officer/NCO manpower appears to be at a reasonable strength.

Signal Communications Systems Personnel. The personnel analysis depicted in Figure 1 also shows extremely significant reductions for MOSs collated in the Other Signal Personnel category. The specific MOSs that have been reduced in the SBCT, are MOS 31F, the network switching systems operator-maintainer, MOS 31L, the cable systems installer-maintainer, and MOS 31R, the multi-channel transmission systems operator-maintainer. These MOSs comprise the primary loss in the Stryker Brigade signal personnel. This loss of personnel may be accounted for by the reduced use of switching systems and wire communications systems and the transition to radio, digital, and over-the-air communications systems, but this reduction may be too extreme. The quantity of communications equipment is not reduced, only the type of systems has changed possibly creating the need for a different type of signal maintainer.

Plans and COMSEC Personnel. The decreased use of wire systems in the SBCT implies an increased need for the use of COMSEC in over-the-air transmissions. The Stryker Signal Company retains only one MOS 74C. Although this is the same prediction as for the (normalized) 4th ID, predictions from the HD indicate a need for eight MOS 74Cs to support the COMSEC of the Stryker Brigade. The 4th ID, however has a total of eight MOS 74Cs and although the eight may be overworked at times, they would have the opportunity to rotate their shifts. It seems likely that the single MOS 74C of the Stryker Brigade will readily be overworked trying to support the COMSEC of the digitized brigade.

Communications and Electronic Equipment Repairers. The TOE for the SBCT identifies 11 communications and electronic equipment repair personnel divided between the Signal Company and the Brigade Support Battalion (BSB). As can be seen from Figure 1, the these repair personnel are reduced to fewer than half the repair personnel that is predicted, based on the HD and the 4th ID which is 20 and 23 repairers, respectively.

Comparison of Electronic Equipment per Repairer in the SBCT and Current Units

As was seen in the above analysis, the Stryker Brigade has substantially fewer communications electronics repair personnel per capita (i.e., per supported soldier) as the HD and 4th ID. In addition to that disparity, the quantities of communications and electronic equipment required for operations have increased significantly in the Stryker Brigade. When compared to the HD, the SBCT has 2.25 times as much C4ISR equipment per soldier. Figure 2 displays the overall ratios of signal equipment per repair person for the SBCT, HD and FDD. As can be seen from Figure 2, on average, the Stryker

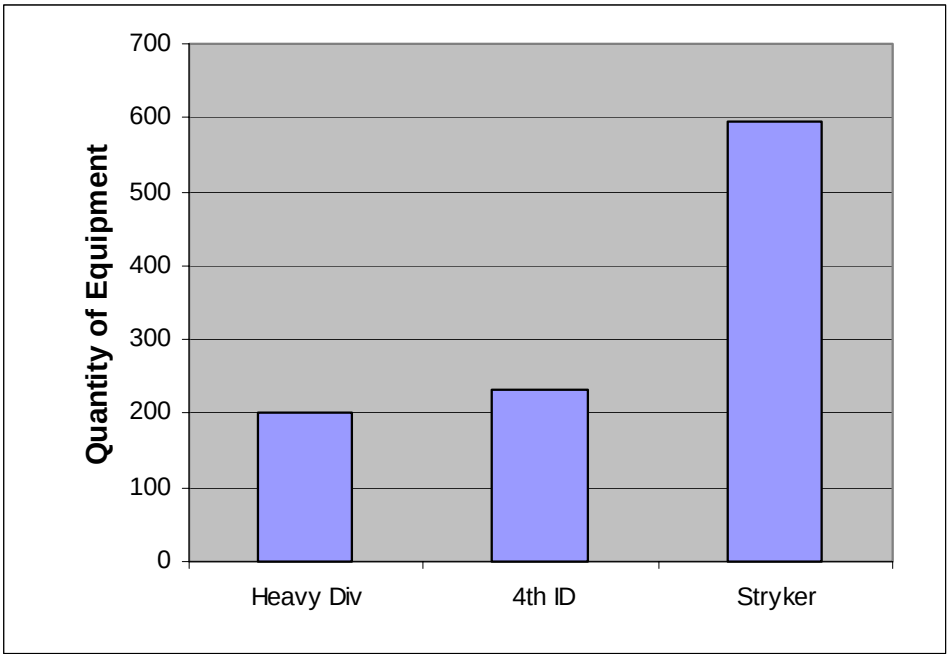

Figure 2. Quantity of C4ISR equipment per repairer for the HD, the 4th ID, and the SBCT.

electronics repair personnel are each responsible for almost three times as much equipment as the repairers in the HD and about 2.6 times as much as in the FDD. This large disparity in the equipment-per-repairer ratio indicates that the SBCT may need an increase in electronic repair personnel.

Analysis of the C4ISR Maintenance Backlog

The operation of the C4ISR depends on the consistent functioning of the C4ISR equipment and networks. Repairs that are not made degrade the overall system. It is the responsibility of the Signal Company and the signal personnel throughout the Stryker Brigade to keep the C4ISR system operational. Any inability of the repair personnel to keep pace with the C4ISR system repairs would be an indicator of the need for additional personnel to maintain the C4ISR. An analysis of C4ISR trouble reports (TRs) from the first 10 days of an operational exercise (OE) was conducted, and the daily totals of the unresolved problems were calculated. Further analyses identified the unit where backlogs occurred and the sub-systems that were most likely to be problematic. For this analysis, a "*backlog*" is defined as the number of TRs remaining more than 24 hours.

For the 10 days evaluated, there were 89 C4ISR system-related TRs. As can be seen in Figure 3, some TRs took as many as 6 days to resolve (close). Fourteen TRs were never closed (see Figure 4). Figure 5 shows the daily backlog of unresolved TRs during the first 10 days of the OE. As can be seen, by day 4, a large number of TRs, exceeding 20 unresolved TRs, developed. This was reduced somewhat by day 7 and seemed to stabilize for the last 3 days. However, even for those last days, the total maintenance actions to be resolved exceeded 15.

Less than half of the TRs (44%) were resolved within 24 hours. The remainder

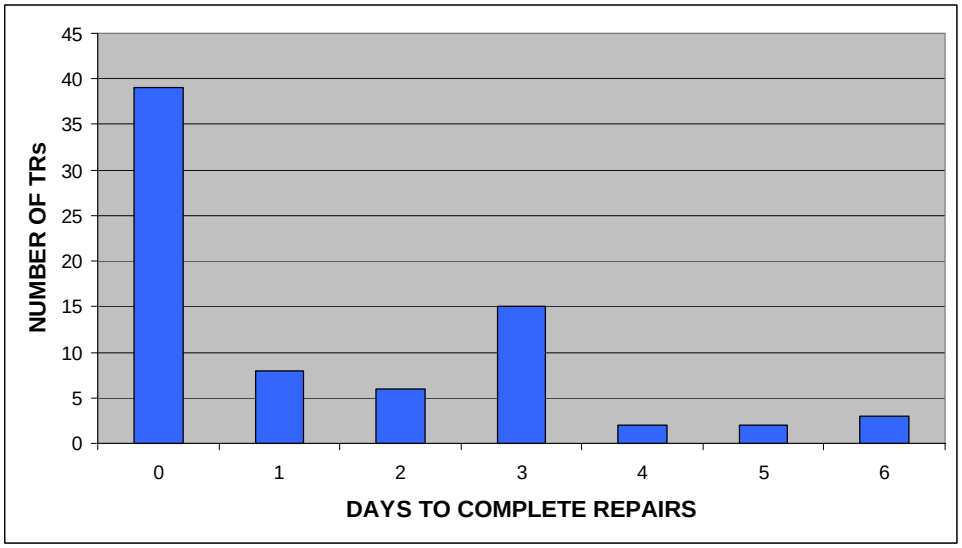

Figure 3. Time in days to resolve C4ISR TRs during the first 10 days of the Stryker OE.

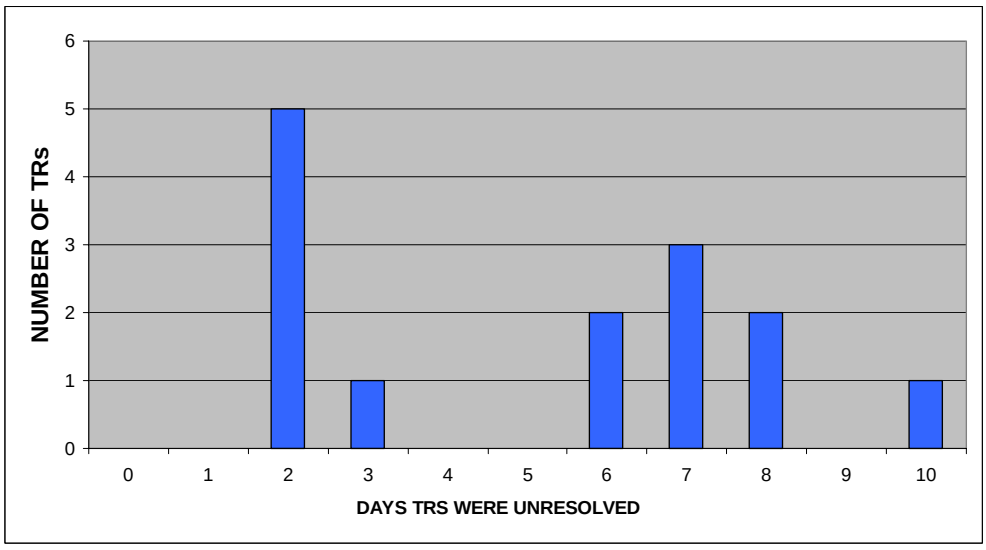

Figure 4. Time in days that C4ISR TRs that never closed remained open during the first 10 days of the Stryker OE.

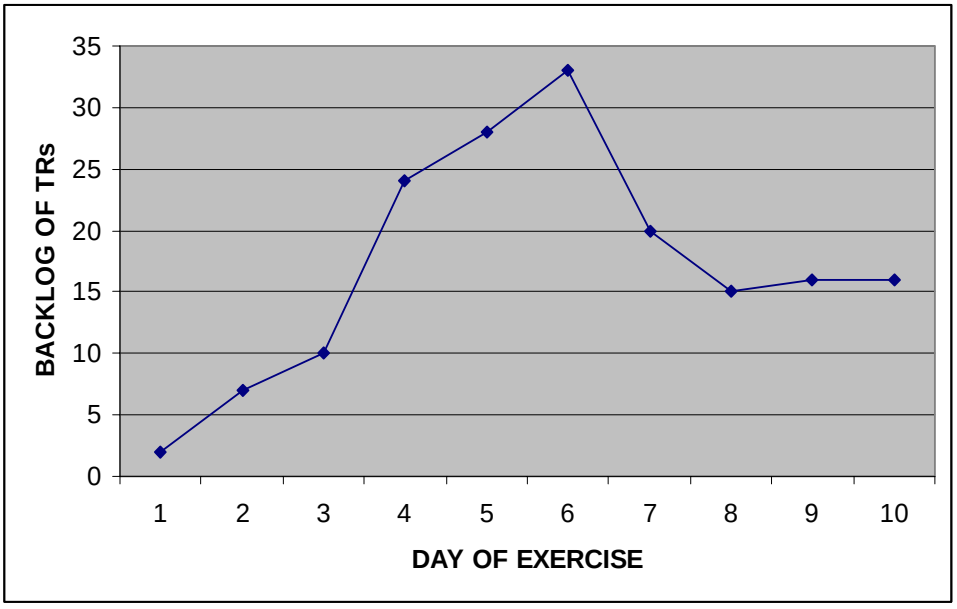

Figure 5. Daily backlog of TRs (unresolved in 24 hours) during the first 10 days of an OE by a SBCT.

composed a backlog of system repairs needing to be completed. To determine the type of additional support required, an analysis was done by brigade organizational unit of the backlog of TRs. Figure 6 shows the number of TRs exceeding 24 hours by organizational

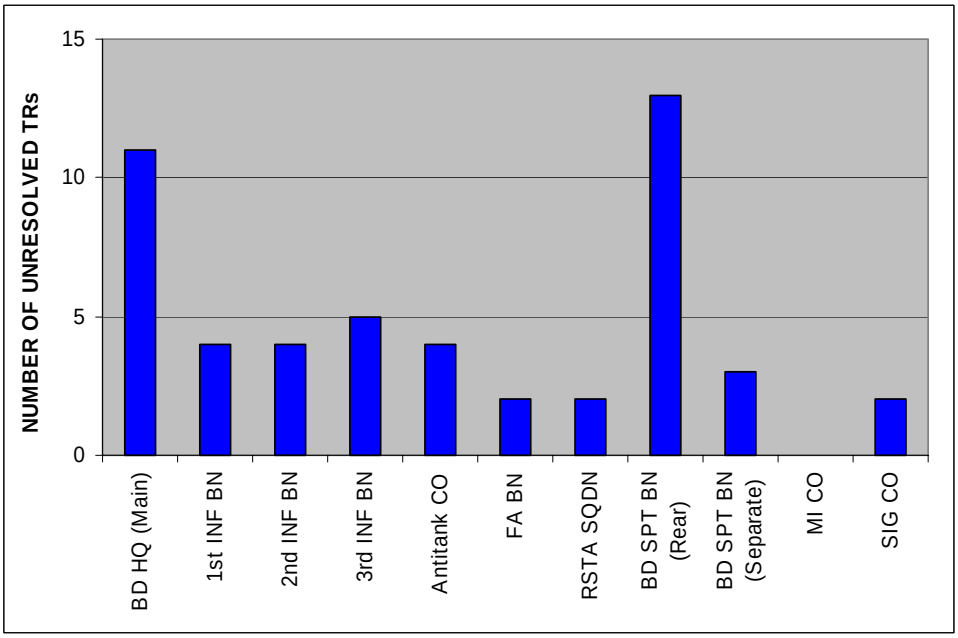

Figure 6. Number of TRs not resolved within 24 hours at various SBCT units. (The units shown are Brigade Headquarters [Main], the 1st, 2nd, and 3rd Infantry Battalions, the Antitank Company, the Field Artillery Battalion, the Reconnaissance Surveillance Target Acquisition Squadron, the Brigade Support Battalion [Rear], the Brigade Support Battalion [Separate]. the Military Intelligence Company, and the Signal Company.

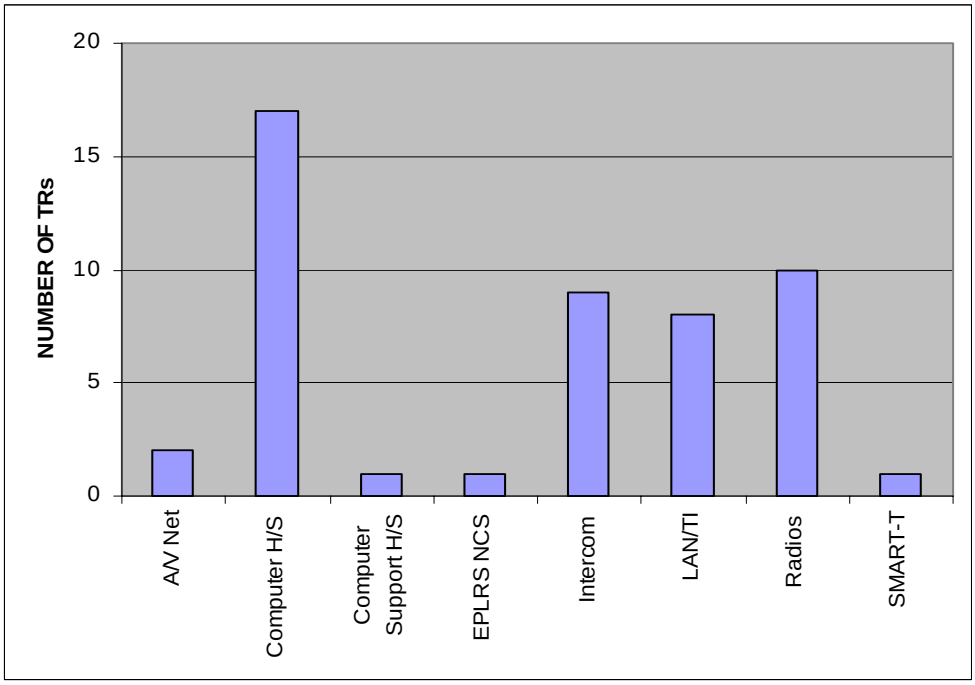

Figure 7. Number of TRs not resolved within 24 hours, by types of equipment. (Categories include audio/visual network, computers hardware/software, computer support hardware/software, such as printers, EPLRS Net Control Station equipment, intercom systems, the LAN and the TI, radios of all types, and the SMART-T satellite system.)

unit. As can be seen, there is a backlog of TRs across the organizational units, but the largest numbers of those TRs occurred at Brigade Headquarters in the Brigade Main Tactical Operations Center (TOC) and in the Brigade Support Battalion at brigade rear. This would suggest that there were not enough signal support personnel to keep pace with the required system repairs in those units.

A further analysis was conducted to determine the types of signal personnel that might be required to support the C4ISR. Identifying the number of C4ISR sub-system repairs remaining open would indicate the type of additional signal personnel needed to maintain the system. The sub-systems taking more than 24 hours to repair are categorized and plotted in Figure 7. As can be seen, C4ISR computing systems, including hardware or software problems, comprise the largest portion of the C4ISR backlog. The other three major contributors were the LAN and the TI support, the intercoms, and radios. The LAN and TI support TRs, and most, if not all, of the intercom problems were a result of software connectivity issues.

These data imply a requirement for additional signal personnel to maintain the upper TI of the C4ISR system, specifically information systems specialists, LAN and TI specialists, MOS 74B. These personnel should primarily supplement those residing at Brigade Main and at the Brigade Support Battalion, S6 Section. These additional personnel would help to reduce the backlog of TRs that result in the operational degradation of the C4ISR. Also from these data, it appears that Radio Equipment Repairmen, MOS 35E, located in the Brigade Support Battalion, could help reduce the

backlog of radio repairs.

Analysis of Signal Personnel Answers to Questionnaires

Questionnaires were given at the end of the OE to Signal Company personnel to obtain an estimate of perceived job difficulty for C4ISR support of system setup and maintenance. A sample of 34 Signal Company participants answered questionnaires, which represents 39% of the Signal Company at full strength. The rank of the soldiers ranged from E3 through 1st Lieutenant and included personnel from the Signal Company Command Section, the BSN Section, the Computer Network Defense Team, the Electronics Maintenance Section, the EPLRS Section, the Network Management Section, the Retransmission Team, the Tactical Satellite Section, and the Trojan Spirit Section. All Signal Company sections were represented.

The soldiers were asked how difficult it was for them to setup, initialize, and perform COMSEC on the systems for which they were responsible. Although COMSEC is generally part of the initialization process, the COMSEC tasks may be perceived as more or less difficult than the other portions of initialization, so they were asked about COMSEC separately. As can be seen from Figure 8, most of the systems the soldiers had to initialize were generally rated as being easy to setup, initialize, and perform COMSEC on. The one exception to the ease of setup was the retransmission equipment. The Retransmission Team explained that setup was difficult because of the number and type of antennas that they needed to erect.

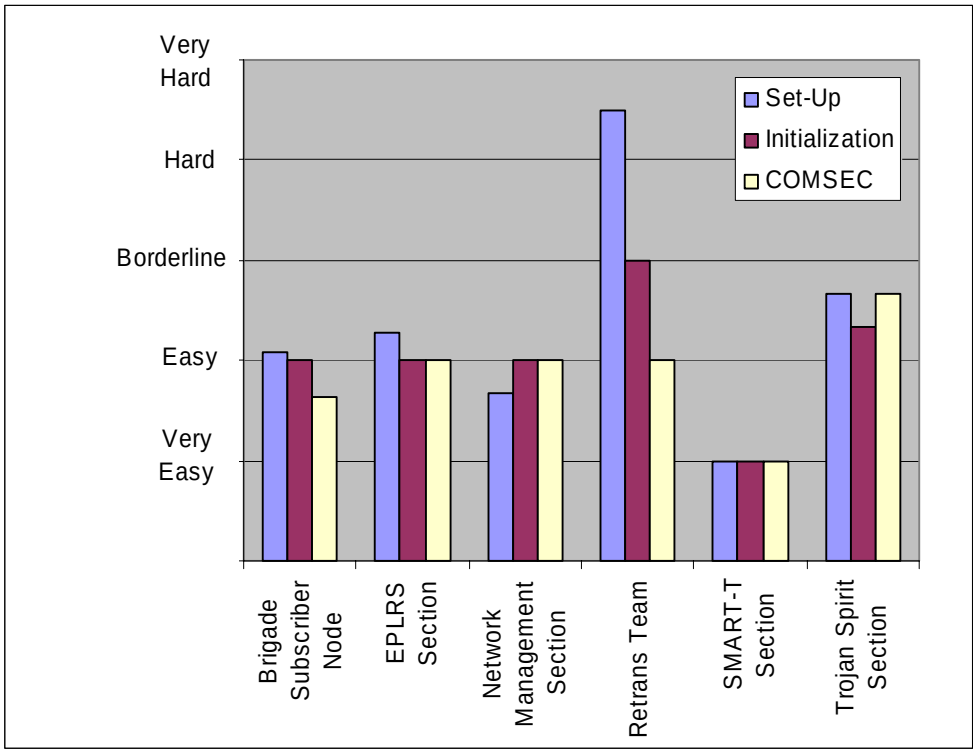

Figure 8. Mean responses on difficulty for setup, initialization, and COMSEC preparation by the different signal personnel sections.

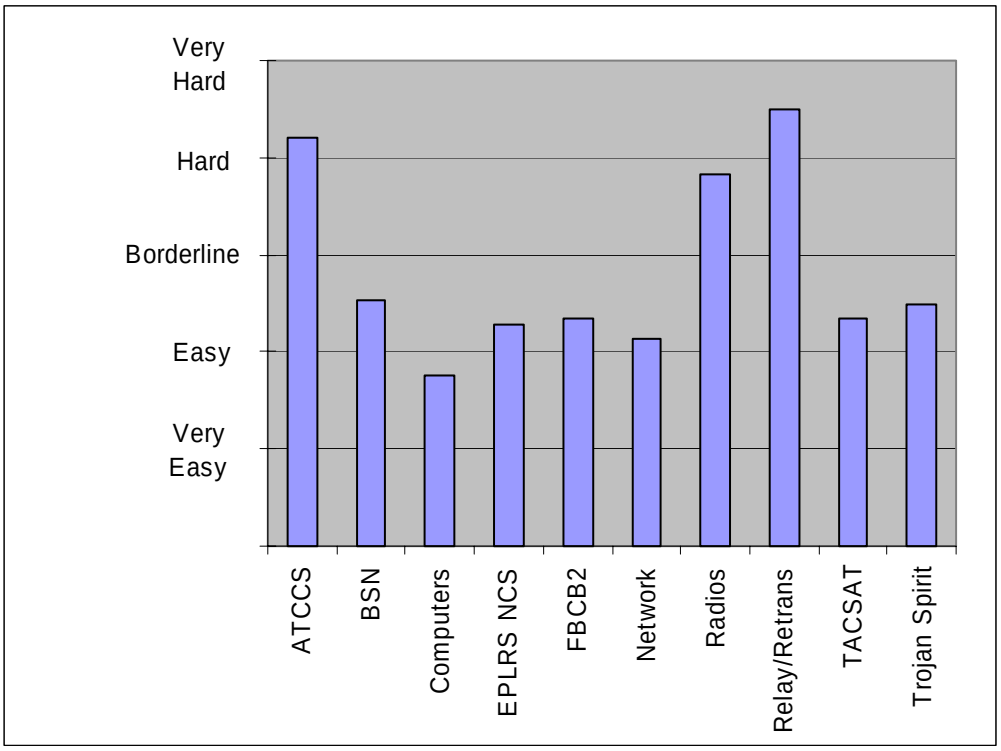

Figure 9. Mean responses to difficulty of maintenance activities by types of equipment. (Equipment shown are the ATCCS computers, BSN, computers other than ATCCS, EPLRS NCS, FBCB2, networks, radios, the relay/retransmission system, the tactical satellite system, and the Trojan Spirit.)

Twenty-nine percent of the signal personnel queried responded that they had helped to setup and initialize equipment outside their area of responsibility. They initialized systems in the various command posts and at the company level. In one case, a soldier mentioned that one of the Retransmission Teams was short an operator, and for this reason, he assisted in the retransmission initialization.

The soldiers were asked how difficult it was for them to maintain the systems for which they were responsible. Figure 9 shows the average responses for the different systems. As with setup and maintenance, the systems were generally rated as being easy to maintain. The exceptions were ATCCS, which includes the MCS, ASAS, CSSCS, and AFATDS; the radios; and the retransmission system. The radios specifically mentioned were the NTDRs for which there were a number of failures during the exercise.

Eighteen percent of the soldiers responded that they were required to perform maintenance on systems other than those for which they are responsible. One soldier mentioned that this was a problem because they were not adequately trained even on some of the systems they were responsible for.

Figure 10 shows the average number of incidents of perceived maintenance actions per signal soldier responding to the questionnaire. Maintenance performed on computing systems, (specifically mentioned were the ATCCS systems), are perceived as being more frequent than on other systems.

The soldiers' responses to the questionnaires indicate that the tasks they perform,

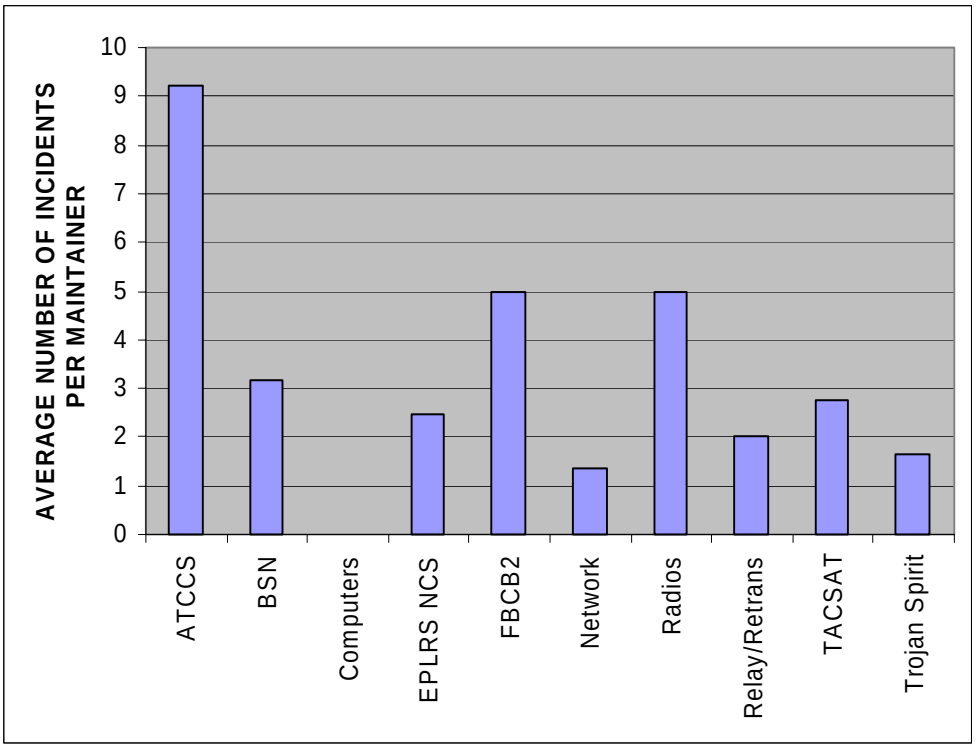

Figure 10. Mean number of perceived maintenance actions for signal personnel by area of responsibility. (Equipment shown are the ATCCS computers, BSN, computers other than ATCCS, EPLRS NCS, FBCB2, networks, radios, the relay/retransmission system, the tactical satellite system, and the Trojan Spirit.)

that is, setup, initialization, and maintenance of the C4ISR system, are generally not difficult. Maintenance tasks were rated as slightly more difficult than the other tasks, but some of that difficulty is a function of inadequate training on the systems as indicated by comments on the questionnaire. In relation to that finding, the soldiers were asked if they thought that they needed more training on their systems. Ninety-four percent said that additional training would make their job easier. In general, they indicated that all systems could be better trained, but in particular, the soldiers said that additional training would be especially beneficial for networks with commercial off-the-shelf subsystems such as routers.

DISCUSSION

For this evaluation, the variety of analyses were conducted so that all signal personnel could be evaluated. The various analyses also provide corroborating evidence to answer the question of whether the signal personnel in the SBCT would be sufficient to support the brigade's C4ISR function. The strongest evidence to answer that question comes from the backlog analysis which evaluates the timeliness of the support performance of the signal personnel. The analysis of the unresolved TRs from the OE shows an excessive number (greater than 10) of unresolved TRs for 7 of the 10 days analyzed (see Figure 5). The unresolved TRs peak at day 6 and seems to stabilize in days

8 through 10, but it is alarming that it stabilizes at a level exceeding 15 unresolved TRs per day. Additionally, observers at the OE reported that when repair personnel arrived on site for a logged repair, they were often asked to perform other maintenance by the system operators. This could indicate that there were more breakdowns of C4ISR systems than are reported in this analysis. Some of these problems may be mitigated by an operator migrating to a substitute system, but such actions could not continue indefinitely without degrading operator performance and the efficiency of the primary C4ISR customers, i.e., the commanders and their staffs.

Of the types of systems that were not repaired within 24 hours (see Figure 7), the computers and related systems, i.e., computer hardware and software, computer support equipment, and computer networks comprised the bulk of the backlog followed by TOC intercoms and radios. This finding is supported by the perceptions of the soldiers (see Figure 10). The computers and related systems, including the TOC intercoms, are maintained by the Information Systems Operator-Analyst, MOS 74B, and this backlog indicates a serious lack of these personnel. The TR analysis indicating a substantial backlog of radio repairs was corroborated by the soldiers' answers to the questions about the difficulty of repairing radios. This leads to the conclusion that the equipment repair manpower, in particular the radio repairer, MOS 35E, needs to be increased. Also the ratios of equipment quantity to the number of repairers support the conclusion that there is a shortage of repair personnel in the Stryker Brigade.

The comparative analysis of the SBCT TOEs with the MTOEs of the HD and the 4th ID (see Figure 1) identifies a drastic reduction in some signal personnel, specifically MOSs 31F (the Network Switching Systems Operator-Maintainer), 31L (the Cable Systems Installer-Maintainer), and the 31R (the Multi-channel Transmission Systems Operator-Maintainer). This is probably because of the shift from analog switching systems to digital networks, LANs, wide area networks (WANs), and the TI, which is controlled by computing systems. Such a shift is expected with the digitized Army, along with an accompanying shift in the duties of the signal personnel from wire system repairers-maintainers to information-systems operator-analysts. This analysis indicates that such a shift has occurred in the SBCT, but it also indicates that too few of these new signal personnel are in place.

The TOE analysis predicts an estimated eight COMSEC personnel for the Stryker Brigade-sized organization while the actual Stryker MTOE only identifies a single COMSEC custodian for the brigade. There was no corroborating evidence from other analyses since the COMSEC custodian was not one of the questionnaire respondents and there was no backlog of maintenance activities that indicated a COMSEC problem. On the other hand, the COMSEC custodian performs many of his duties in preparation for the brigade's deployment, and unless the action is protracted, the custodian's job is complete before the first day of the exercise. Problems resulting from a shortage of COMSEC personnel are not likely to appear before two weeks or maybe a month into a war. However, a requirement for additional COMSEC personnel seems consistent with the increased use of secure over-the-air communications, networks and loading key and mission data into systems, such as the FBCB2 and the ATCCS.

One additional observation was obtained outside of this evaluation but is pertinent to the need for signal personnel for the SBCT. A comment from a Combat Repair Team (CRT) member during the Stryker Initial Operational Test (IOT) stated that the CRT

required signal repair personnel (MOS 31U) with the team to repair communications systems on the damaged vehicles. The CRT is a maintenance team from the Brigade Support Battalion that repairs damaged vehicles in the field. Although the staffing of the CRT in the SBCT consists of the same types of personnel as in the HD and the 4th ID, the SBCT's involvement in a more nonlinear, open battlefield makes the CRTs more vulnerable to enemy fire and thus requires combat escorts for CRTs to move to disabled combat vehicles. If C4ISR repairs are required on a disabled vehicle, a lack of signal personnel on the CRT would prevent a timely repair of the C4ISR systems and result in an impaired system. This could impact the working of the lower TI, which passes blue position information to higher echelons via the FBCB2, and could have a negative impact on inter-vehicular C2 message traffic.

This evaluation of the signal personnel was directed at answering the issue of whether the Stryker will have sufficient manpower quantities and the appropriate personnel skills and training to support the C4ISR proper functioning at an adequate level. The conclusion is that the signal personnel assigned to the Stryker Brigade may not be sufficient. Although this evaluation did not try to estimate the number and types of personnel that would be required, it determined that the manpower for some of the MOSs needs to be increased, specifically the Information Systems Operator-Analysts (MOS 74B) and these are predominantly located at the Brigade Headquarters (Main) and the Brigade Support Battalion. Manpower levels for various electronics repair personnel should be increased, and consideration should be given to include assigning repair personnel in the CRT. Also, the quantity of COMSEC personnel (MOS 74C) required for brigade operations should be revaluated. If the C4ISR support personnel are not able to keep pace with the maintenance of the overall C4ISR system, then C4ISR will not provide the force multiplier needed by the warfighter.

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