

ARMY E3 PROGRAM: A PROCESS FOCUSED ON TEAMING

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Abstract

This paper highlights the history of the Army electromagnetic environmental effects (E3) program, including the management approaches that were used to execute the program. Weaknesses in this process resulted in very serious system deficiencies that have been difficult and expensive to correct. The paper reviews the Department of the Army (DA) policy changes that have been implemented to improve the E3 program. Key changes include the establishment of E3 Review Boards (E3RBs) as advisory teams designed to support acquisition managers' awareness of the electromagnetic environment in which systems must survive. The teams' main functions are to define the environment, establish impact, and propose solutions for management decision. The paper highlights the power of the Total Quality Management (TQM)-based working group process with specific case studies worked by E3 boards and examines benefits that the program has achieved while operating in a world of diminishing resources. The paper concludes with a status summary and a look at the future of the E3 program.

1. Army E3 Focused on Teaming

DA E3 policy was refocused by the Army Acquisition Executive (AAE) in Policy Memorandum 91-3 of 22 January 1991. This memorandum provided new policy guidance on the E3 program, stating the program's goal to identify and quantify system limitations when operating in its expected electromagnetic environment (EME). The AAE memorandum identified the major players as project managers and other program sponsors, user representatives, and technical matrix organizations supporting programs. The new Army policy mandated use of E3RBs to team all the program acquisition disciplines in advisory groups designed to support E3

decisions made by program managers regarding complex EMEs such as illustrated in Figure 1.

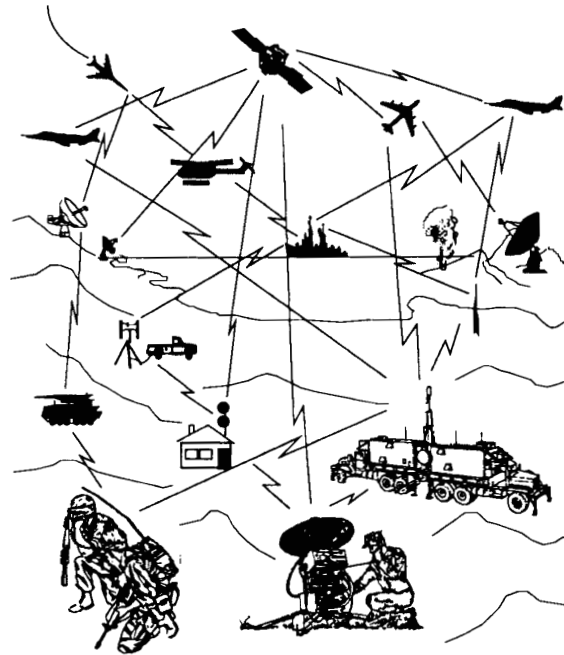


Figure 1. Complex Electromagnetic Environment

2. History

The E3 program dates back to the early days of electronic systems on the battlefield. As early as the 1930s and 1940s, interference from friendly as well as hostile forces was of great importance to tactical communications.

During this period, the exploration of higher frequency bands was evolving. By the early 1940s, use of a portion of the UHF spectrum (200 to 600

MHz) was well established. World War II was accompanied by additional expansion into the microwave bands above 1 GHz. In parallel with this trend, continued improvement in technology resulted in increased power from radio-frequency (RF) sources and higher sensitivity of receiver systems.

During the pre-World War II Louisiana Exercise, vehicular interference was so intense that communications were disrupted. Then-Colonel Dwight D. Eisenhower was in charge of these maneuvers. He insisted that something be done to reduce this interference. Much of the work to resolve this problem was completed at Fort Monmouth. This work included early large-scale computer simulation of interference under PROJECT MONMOUTH.

In July 1960, concerns arising from the PROJECT MONMOUTH studies of the increasing impact of radio-frequency interference (RFI) on military operations prompted the Department of Defense (DoD) to initiate a program to ensure electromagnetic compatibility (EMC) during the conceptual, design, acquisition, and operational life-cycle phases of all military communications-electronics (C-E) equipment, subsystems, and systems. The program provided for the establishment of a center to analyze the EMC aspects of developing C-E systems and a database for support of analysis efforts. DoD Directive 3222.3 assigned responsibility for EMC standards and specifications to the Secretary of the Navy, for EMC measurement techniques and instrumentation to the Secretary of the Army, and for EMC analysis capabilities and use of the EMC database to the Secretary of the Air Force. The Air Force was, therefore, designated the administrative agency for the joint DoD Electromagnetic Compatibility Analysis Center (ECAC).

More recently, commencing with the Vietnam conflict, the sophistication and sensitivity of electronic battlefield systems to both friendly and hostile sources of interference became even more significant. Jamming and propagation problems became major factors in the determination of communications systems performance, and cosite interference became a major source of interference.

During the 1980s, battlefield automation and system complexity became significant E3 factors on the global battlefield. Further, system sensitivity to outside disturbances has multiplied tenfold with the introduction

of integrated circuit technology and improved solid state amplification in the GHz bands.

Hardening these systems to the EME has been difficult and expensive. The advent of non-developmental items (NDIs) and their compressed acquisition approaches during the mid-1980s added a level of uncertainty to adequately defining the EME in which a system must perform. Program officers and their staffs were focused on fielding new products quickly at reduced cost. Some NDI technology provided only the level of EME protection inherent in existing product design. Hardware acquired through the NDI process was selected based on existing capabilities with little regard to the impact that other battlefield systems might have on performance. Emerging problems with complexity and battlefield automation were generally not considered. The current geopolitical situation that potentially places former Red emitters on the same side of the battlefield as the friendly Blues was certainly not considered by acquisition staffs prior to 1991.

3. A New Way of Doing Business

The new policy implemented in 1991 is designed to focus on these weaknesses through the use of integrated teams of Army acquisition staff composed of project managers, their technical matrix staff, and the combat developers. These teams are the E3RBs. They are designed to act as advisory bodies to support project decisions that are driven by the electromagnetic environments in which the system must survive. Key responsibilities of the boards are defining the environment, determining its impact on the system, and designing and taking corrective action to reduce system vulnerability. Solutions may take the form of design changes, operational workarounds, or avoidance when all else has been ruled impractical or impossible.

4. CECOM Program

The U.S. Army Communications-Electronics Command (CECOM) implementation of the E3 program has been focused on matrix support to Level I project managers in the Program Executive Offices (PEOs) for Communications Systems (COMM), Command and Control Systems, and Intelligence and Electronic Warfare (IEW). Within the CECOM Research, Development and Engineering Center (RDEC), a focal

point for all E3 issues was identified. This focal point is the Command, Control and Communications (C3) Engineering Division (C3ED) within the C3 Systems Directorate (C3SD). The responsibility for chairing the E3RBs was assigned to the lead technical activity supporting the project managers for the Level 1 systems to be covered. Senior-level technical staff from the RDEC directorates were assigned to boards supporting the eleven major programs to be covered by December 1991. These boards are listed in Table 1.

Table 1. CECOME3 Boards

Board Chairman	Organization (see List of Acronyms)	PM/PEO
C3SD	EPLRS JTIDS	COMM COMM
C3SD	GPS	COMM
C3SD	MSE	COMM
C3SD	SINCGARS	COMM
C3SD	AFATDS ASAS CSSCS FAADC2I MCS	CCS CCS CCS CCS CCS
EW/RSTA	JSTARS	IEW

Each of these boards has been operated as an advisory group to the program manager. The boards use the tools of TQM to develop the environment in which the system must survive, work the system vulnerabilities, and develop action plans for their respective PMs. This process flow is depicted in Figure 2. Generally, all of the boards have had regular meetings and have at least published an initial report on significant results. Some of the interesting efforts to date include:

- Predicting levels of vulnerability.
 - Informing users of operational workarounds.
- Supporting 461/462 Standards tailored for NDI acquisitions.
- Determining impacts on collocated systems.

- Integrating platforms.
- Focusing on the impact of battlefield automation.

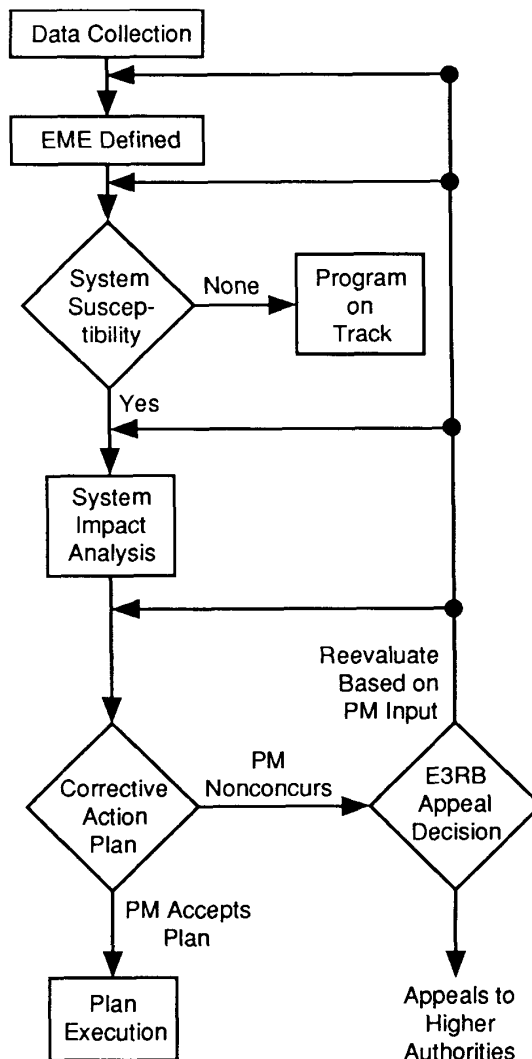


Figure 2. E3RB Process

As a result of the TEAMING and sharing of knowledge/skills among the key players, several program weaknesses were uncovered. All of these issues have been shared through a CECOM working group chaired by the CECOM command representative.

The CECOM boards address issues that include:

- In-band communication engineering analysis.
- Battlefield automation.
- Propagation impact.
- EMI budgeting.

5. Army Materiel Command Working Group

An Army Materiel Command (AMC) working group shares ideas among Army commodity managers. Issues concerning AMC and DA have been presented at the AMC-based Army E3 Board.

In some cases, these issues were solved by the individual boards; in others, issues have been elevated to the AMC group to be worked by representatives of all of the major subordinate commands. Major issues at the AMC level include:

- Environment determination and maintenance.
- Maintenance of E3 awareness for all career disciplines.
- Funding.
- Process for lightning/nuclear.

6. E3 Future

The future of the E3 program remains bright. Even with the significant budgetary constraints all DoD staff are facing, this program has the visibility to survive. More important, the thrust of using the E3RB approach has achieved measurable results. Effort for the major systems will continue with the focus on emerging battlefield scenarios, platform integration, and battlefield automated systems.

During the first year of the process, several new PM-managed boards have been chartered in the space and intelligence/electronic warfare worlds. This expansion will continue.

A CECOM Level II/III program for smaller systems and components started in 1992. This process

is tailored to the large number of systems and components that CECOM provides to the rest of the Army. These E3RBs are designed to be commodity oriented. The first Level II/III E3RB is supporting CECOM's aviation-related products. The overall process for Level II/III systems has been developed by a process action team made up of representatives from the directorates that are part of the process. It is the same process used on major system programs but is focused more on platform integration. Major team players include the project office, users, and technical staff.

To summarize, the Army has had an E3 program for many years. AAE Memorandum 91-3 initiated a recent DA refocus. CECOM implemented the program for major systems during 1991 and is currently implementing the program for all its systems during 1992. The key to continued success will be measurable results that save Army dollars. To date the program track record is excellent.

List of Acronyms in Table 1

AFATDS	Advanced Field Artillery Tactical Data System
ASAS	All Source Analysis System
C3SD	Command, Control and Communications Systems Directorate
CCS	Command and Control Systems
COMM	Communications Systems
CSSCS	Combat Service/Support Control System
EW/RSTA	Electronic Warfare/Reconnaissance, Surveillance, Target Acquisition
EPLRS	Enhanced Position Location Reporting System
FAADC2I	Forward Area Air Defense Command, Control, and Intelligence
GPS	Global Positioning System
IEW	Intelligence and Electronic Warfare
JSTARS	Joint Surveillance, Target Acquisition and Reconnaissance System
JTIDS	Joint Tactical Information Distribution System
MCS	Maneuver Control System
MSE	Mobile Subscriber Equipment
PEO	Program Executive Office(r)
PM	Project Manager
SINCGARS	Single Channel Ground and Airborne Radio System

Biographies

Kenneth H. Brockel is Chief of the Command, Control and Communications Engineering Division (C3ED), CECOM RDEC. Mr. Brockel received his BSEE from the University of Toledo (Ohio) in 1967. He began his career in industry, at the Frequency Engineering Laboratories in Farmingdale, NJ, where he was responsible for the system and microwave-circuit design for such products as microwave synthesizers and low phase-noise measurement instruments. Mr. Brockel headed a group responsible for expanding these efforts to Government programs, including Army and Navy ground- and space-based applications for microwave synthesis. In Government service since 1975, he has worked in the areas of tactical radio and communications and has contributed to several DA-sponsored studies to improve the performance of major Army communications systems. Since 1983, Mr. Brockel has held branch or division leadership roles, managing staffs supporting such systems as MSE, GPS, and SINCGARS. An expert in the reliability area, he has taken a lead role in developing TQM-based programs to improve Army communications system reliability. Mr. Brockel is currently making major contributions in the areas of propagation reliability, communications system modeling and simulation, and electromagnetic environmental effects (E3).

Paul A. Major is Chief of the Frequency Engineering Branch in C3SD, CECOM RDEC. Mr. Major received a BEE from Gannon University in 1963 and an MSEE from Monmouth College (NJ) in 1972. He joined CECOM in 1963 and was involved in the field of EMC analysis as well as EMI standards efforts. Chief of the Frequency Engineering Branch since 1983, Mr. Major has been directing development of tactical frequency management software, the frequency allocation process, EMI standards compliance, and Army E3 efforts.

John F. Van Savage (M'65-SM'77) is an electronics engineer in C3SD, CECOM RDEC. He received a BS in physics from Fairleigh Dickinson University in 1956. Mr. Van Savage is a member of the IEEE Engineering Management Board of Governors (BOG) and acts as its Standards Liaison. Locally, he chairs the Aerospace and Electronics System/Engineering Society, a joint chapter of the New Jersey Coast Section of the IEEE. Mr. Van Savage has participated in many Regional and Sectional IEEE committees such as Awards Admission and Advancement, Tellers Committee, and others. He was Chapter Chairman of the North Jersey Section for 1987. He is the recipient of many IEEE awards and in 1985 received the IEEE Centennial Medal.