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ON TARGET - THE DIGITAL TOPOGRAPHIC REVOLUTION

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The "Digital Topographic Revolution" has had organizational as well as technical impacts on the way your Army operates.

ABSTRACT

The Field Support Office (FSO) was established by the U.S. Army Topographic Engineering Center (TEC) (formerly the U.S. Army Engineer Topographic Laboratories) in May 1990. Its mission is to develop programs and coordinate TEC activities related to the direct support of Army topographic engineer units and other field organizations and activities requiring topographic support. This action was directly related to recent efforts by Army topographic engineers and terrain analysts to automate their production techniques and capabilities -- a trend, otherwise known as the "Digital Topographic Revolution." During 31 July to 2 August 1990, the FSO hosted a technical exchange meeting with key personnel from worldwide topographic engineer field units in attendance. When word arrived on 2 August that Iraq had attacked Kuwait, the key players on the Army "topo team" were already assembled and able to begin development of a plan to provide topographic support to any U.S. involvement in the Middle East. This paper highlights the efforts of TEC, its FSO personnel, and the Army's topographic engineer and terrain analysts in support of Operations Desert Shield and Operation Desert Storm.

INTRODUCTION

Traditionally, all terrain analysis production is performed manually using thematic overlays called Tactical Terrain Analysis Data Bases (TTADBs) or Planning Terrain Analysis Data Bases (PTADBs). These data bases were a series of overlays, registered to a map sheet, depicting the following subject themes; Surface Configuration (Slope), Surface Materials (Soils), Vegetation, Surface Drainage (Hydrology), Transportation and Obstacles.

While the Defense Mapping Agency (DMA) creates an excellent series of terrain data bases with the necessary information to support tactical decisionmaking, the extraction, analysis and synthesis of these data bases can be a time-consuming and repetitive task. Many of these tasks can now be performed easily using personal computers (PCs) and the government-owned software suites called TerraBase and the Condensed Army Mobility Model Software (CAMMS). The software uses transformed DMA digital terrain data, such as Digital Terrain Elevation Data (DTED) and Interim Terrain Data (ITD). ITD is a digital version of TTADBs. A combination of all of these relatively recent developments have led to the "Digital Topographic Revolution."

THE FIELD SUPPORT OFFICE

The "Digital Topographic Revolution" at the tactical level was in its infancy until three years ago. Numerous initiatives within the Army force structure placed systems in the hands of topographers at all levels of the Army. These initiatives included the development of the U.S. Army Europe Digital Topographic

Enhancement Program (DTEP), the U.S. Forces Command Automated Intelligence Support System (FAISS), and TEC's Digital Topographic Support System - Prototype (DTSS-P).

All of these systems required some transformation of DMA digital terrain data, but more importantly, they required some type of direct assistance from TEC. Prior to the existence of the FSO, support for these systems came from various elements within TEC. It was recognized that an element within TEC to provide direct support to the topographers within the Army structure would be a valuable asset. This element became the Field Support Office. From a functional point of view, the responsibilities of the FSO are to analyze requirements, establish programs and coordinate TEC activities related to the direct support of Army topographic units, terrain detachments and those other field organizations or activities with requirements for topographic support. The FSO also maintains and provides administrative control of fielded terrain analysis software.

The FSO was organized under the concept of having the basic resources elements available to solve technical challenges as they arise. The FSO chief can, if needed, request assistance from each of the various TEC elements. (See Figure 1.)

One of first initiatives of the FSO was to sponsor a technical exchange meeting (TEM) consisting of operations officers from all of the major topographic units. The purposes of the TEM were to:

a. Exchange information on production techniques in Army field topographic units.

b. Review and evaluate on-going topographic research and development programs.

c. Identify issues related to current automation efforts in topographic units.

d. Promote technical interoperability and standardization.

"THE DIGITAL TOPOGRAPHIC REVOLUTION"

AND

OPERATION DESERT SHIELD/DESERT STORM

The Army force structure authorizes topographic assets at theater, corps and division levels. At theater and corps level, these units provide topographic survey, cartographic, reproduction and terrain analysis support to their support headquarters. Terrain analysis support is provided at the division level. Additional support to the division is provided as needed. The topographic units deployed (See Figure 2) in support of Operations Desert Shield/Desert Storm were as follows:

a. 30th Engineer Battalion (Topographic) (Army) from Fort Bragg, N.C.

b. 100th Engineer Company (Cartographic) (Army) from Fort Bragg, N.C.

c. 175th Engineer Company (Cartographic) (Corps) from Fort Bragg, N.C.

d. Company A, 649th Engineer Battalion (Topographic) (Army) from Schwetzingen, Germany.

e. An eight person detachment in direct support of each of the

seven deployed divisions.

In the early stages of Operations Desert Shield/Desert Storm, the only digital terrain data available over the geographic area was DMA DTED. As topographic units began deploying, each requested their own set. Since the units did not have a specific geographic requirement, each unit received 77 DTED cells. Each DMA DTED cell covers one degree of longitude by one degree of latitude. Cells were downloaded and transformed from the DMA distribution media, nine-track tape, to 5.25-inch data diskettes. The majority of this data was generated during a three-week, twenty-four hour operation distributing in excess of 12,600 disks.

The FSO is the configuration manager for a government-owned and maintained PC-based software suite called TerraBase. This software provides the capability to manipulate DTED and perform functions such as line-of-sight, contour mapping, slope map generation and visual area plots. Additionally, the software would allow the operators to generate their own digital TTADBs, enabling them to generate cross-country movement and speed predictions products. Modifications to TerraBase allowed the exploitation of several topographic community initiatives. These initiatives were:

a. DMA released compact disc-read only memory (CD-ROMs) containing DTED. The first CD-ROM was of the Desert Shield/ Desert Storm geographic area. The modification of TerraBase allowed an analyst to download DTED as needed.

b. The integration of a low-level multispectral image processor named MS IMAGER had been created by the Department of Geography and Environmental Engineering, U.S. Military Academy, at West Point, N.Y. This program allowed an analyst to perform multispectral imagery manipulation and processing.

c. The integration of a climatic data base named Battlefield Environmental Effects System (BEES) was created by the Geographic Sciences Laboratory at TEC. This program allowed an analyst to extract climatic information from a data base of the Desert Shield/Desert Storm geographic area.

d. The integration of a program called Moving Map, displayed 24-bit Arc-Digitized Raster Graphic Data (ADRG) from DMA. The program also was developed at the Military Academy, and allowed an analyst to view a portion of the ADRG map and treat it as an image file.

e. The integration of library files for the importation of DMA ITD/Planning ITD (PITD) data.

Concurrent with the above activities, the FSO assisted by other elements within TEC, digitized the Surface Configuration, Surface Materials and Vegetation Overlay from several PTADBs in an effort to provide some type of interim data prior to the arrival of ITD and PITD from DMA. These files were then imported into TerraBase and distributed to units as they deployed in support of the operation.

Shortly after the release of DTED on CD-ROM, DMA released the first cells of ITD (scale 1:50,000) and PITD (scale 1:250,000). These cells were the digital equivalent of the PTADB/TTADB. With their introduction, performing significant terrain analysis tasks on a computer was feasible. The major hurdle was the transformation of this data from the DMA format (Standard Linear Format, SLF) to a format acceptable for the software/systems deployed in the Kuwait Theater of Operations (KTO). These topographic systems included the DTSS-P, the FAISS with Terrabase and other PCs using TerraBase software.

The procedures to transform and process this data used the geographic information system, PC ARC INFO. The FSO, along with the help of several programmers from TEC, created numerous small macro languages and computers programs to perform these PC ARC INFO functions. After receiving nine-track tapes containing ITD/PITD from DMA, the FSO team downloaded, processed and imported this data into TerraBase. An interim step of this process was the generation of a format which could be imported and used by the DTSS-P. As these new data bases were generated, they were shipped on 3.5-inch or 5.25-inch diskettes to the topographers deployed in the KTO. (See Figure 3.)

Parallel to the above actions, DMA began releasing Landsat Thematic Mapper Data coverage over the entire geographic area. This data had been geo-rectified, resampled to 25-meter resolution and recorded into one degree by one degree cells. With the introduction of the FAISS to deployed topographers, the FSO began the downloading and tranforming this data to a format compatible

with the MS Imager program in the TerraBase suite. The distribution media for this data was the digital audio tape (DAT).

Concurrent with all of the above activities, the 30th Engineer Battalion (Topographic) (Army) was preparing for deployment to the KTO. The 30th was the highest level of topographic support within the theater and would be the technical controlling element for all topographic matters within the Army structure. The FSO was in daily telephone contact with the 30th prior to and after their deployment, assisting in the resolution of technical challenges as they arose.

Prior to their deployment, the 30th Engineer Battalion had acquired one of each of the systems mentioned earlier plus two additional Sun-based Earth Resources Data Analysis Systems (ERDAS). Engineers from TEC, in coordination within the FSO, procured or orchestrated the acquisition of these systems. In conjunction with these systems, some of the technical problems solved were:

a. The development of a Local Area Network to allow the transfer of files between three operating environments -- the Sun Operating System, VAX VMS and DOS.

b. The acquisition of Global Positioning System receivers with technical support from TEC.

c. Various technical problems associated with each of the systems.

d. Distribution problems associated with all transformed digital

data from the FSO.

e. Fielding of a new reproduction system called Quick Response Multicolored Printer - Prototype (QRMP-P).

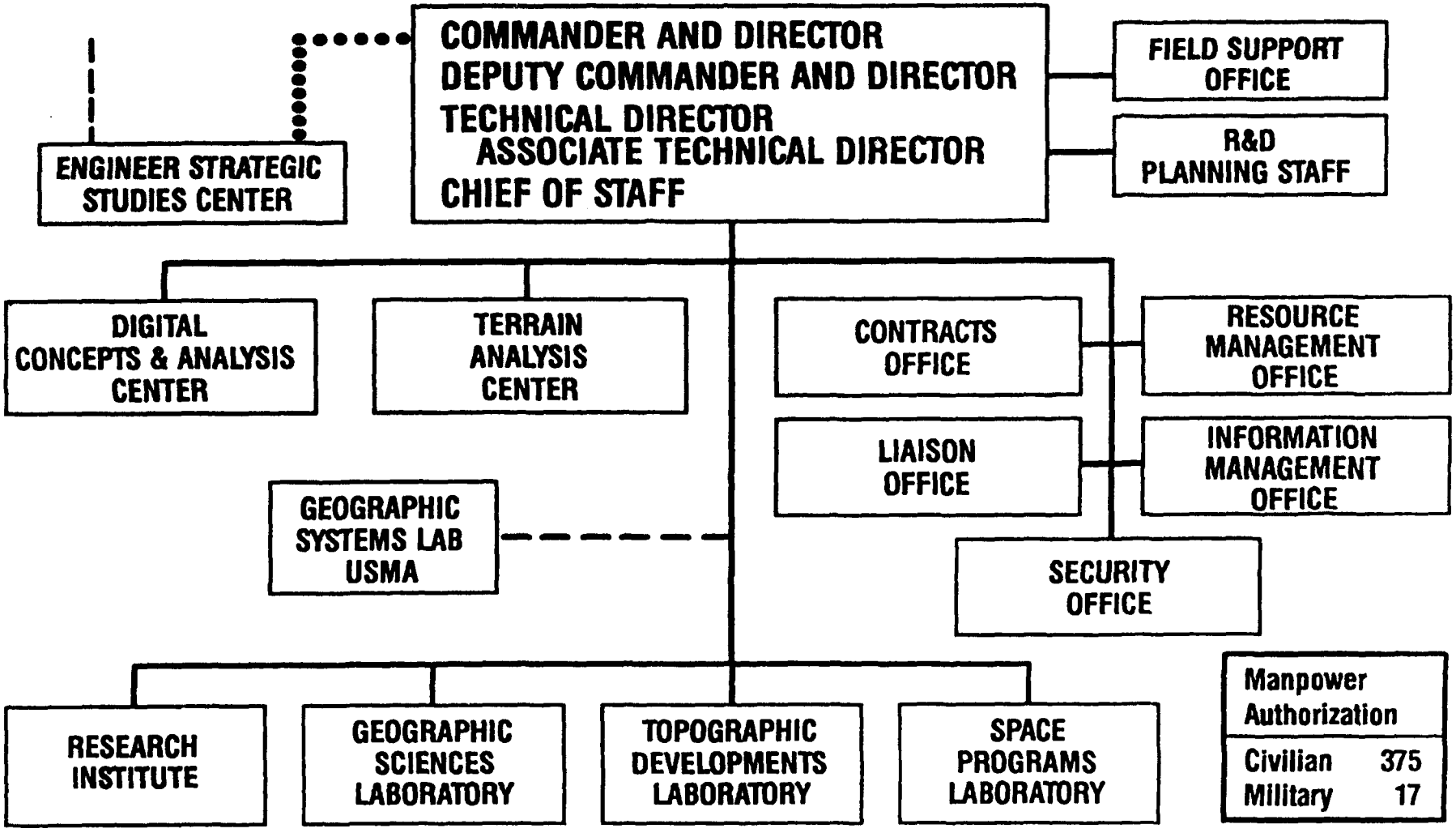
f. Assisting the FAISS program manager in operational testing, training and deployment to each topographic unit.

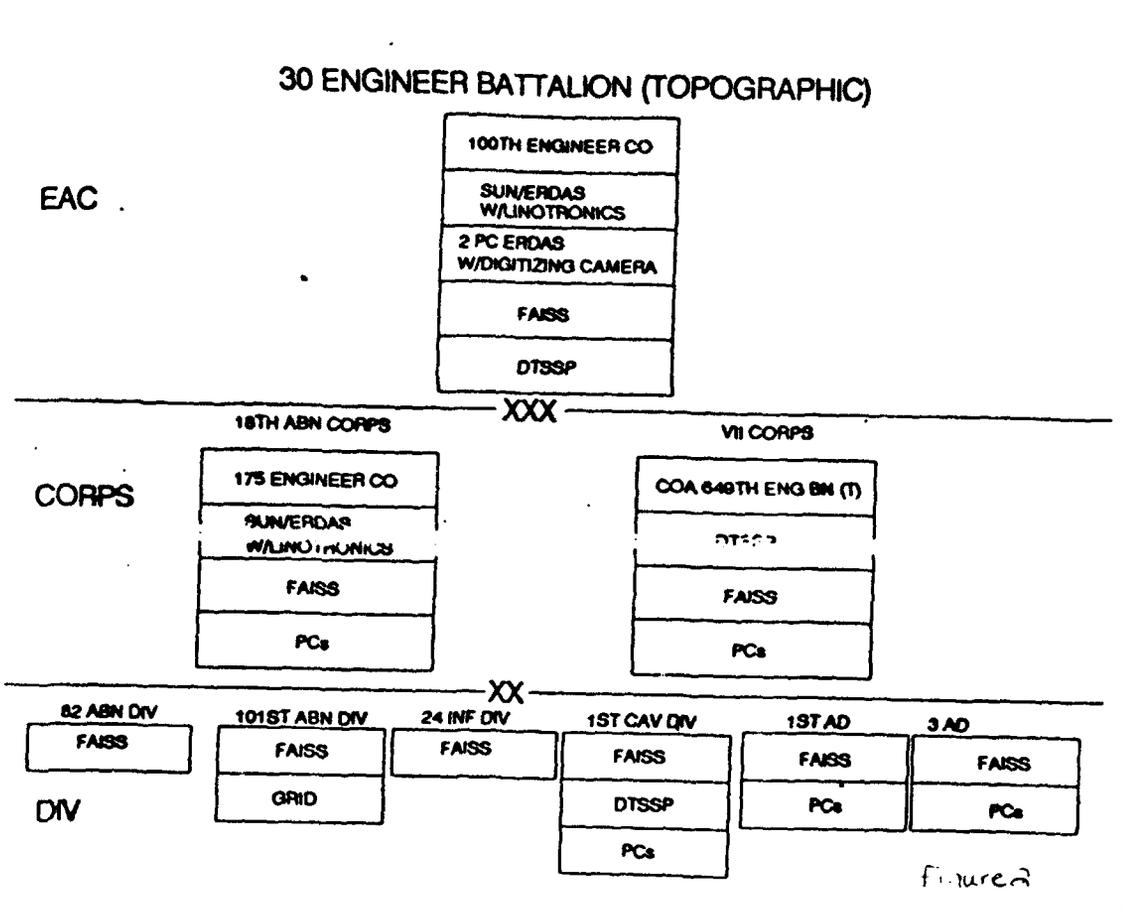
g. Providing technical assistance in the integration of multi-system, multi-environment architecture. (See Figure 4.)

CONCLUSION

The FSO will continue to ease the topographers transition during the "Digital Topographic Revolution." The productivity of the topographic soldier has expanded dynamically, offering increased support both quanitatively and qualitatively. The presentation of tactical decision aids from the digital environment can decidedly affect the war planning and execution processes.

U.S. ARMY
TOPOGRAPHIC ENGINEERING CENTER




30 ENGINEER BATTALION (TOPOGRAPHIC)
EAC
100TH ENGINEER CO
SUN/ERDAS W/LINOTRONICS
2 PC ERDAS W/DIGITIZING CAMERA
FAISS
DTSSP
XXX
CORPS
18TH ABN CORPS
175 ENGINEER CO
SUN/ERDAS W/LINOTRONICS
FAISS
PCs
VII CORPS
COA 649TH ENG BN (T)
FAISS
PCs
XX
DIV
82 ABN DIV
FAISS
101ST ABN DIV
FAISS
GRID
24 INF DIV
FAISS
1ST CAV DIV
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DTSSP
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3 AD
FAISS
PCs

figure 2

ITD/PITD TRANSFORMATION

9-Track

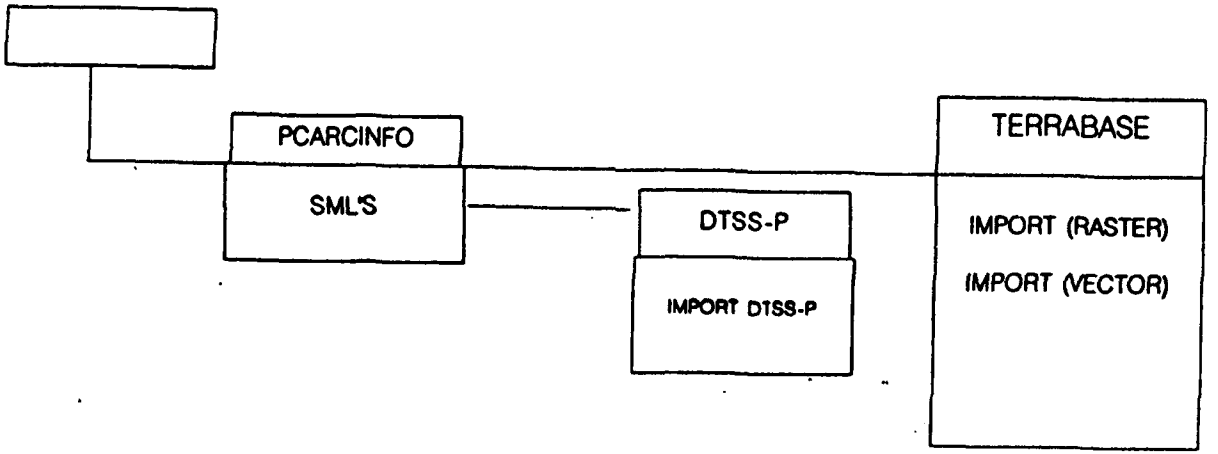

Fig 3

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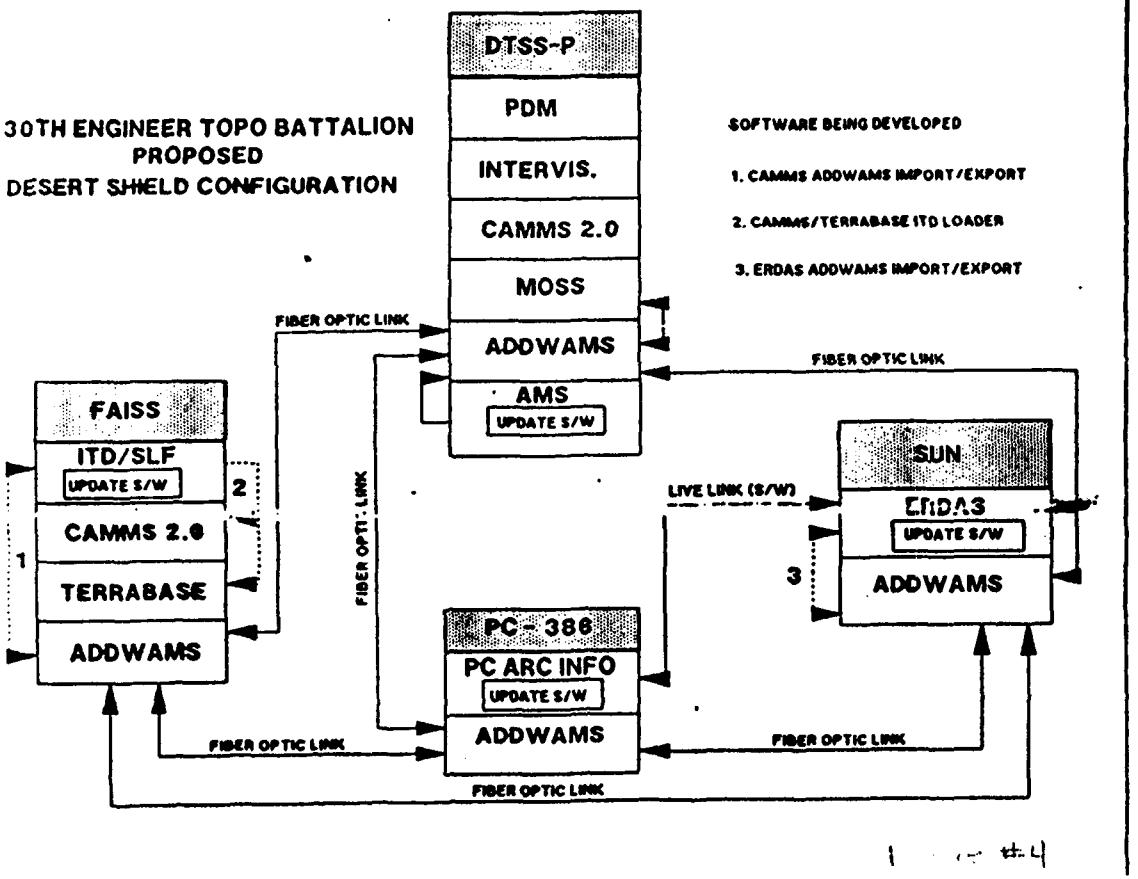
30TH ENGINEER TOPO BATTALION
PROPOSED
DESERT SHIELD CONFIGURATION



SOFTWARE BEING DEVELOPED

1. CAMMS ADDWAMS IMPORT/EXPORT
2. CAMMS/TERRABASE ITD LOADER
3. ERDAS ADDWAMS IMPORT/EXPORT

1 of 4