Controlling the MOD's Air Defence Command Information System

By Robin Lovelock

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The majority of ADCIS facilities are provided via the plasma IDT man-machine interface

The British Army will have more effective command and control of its air defence systems as a result of ADCIS

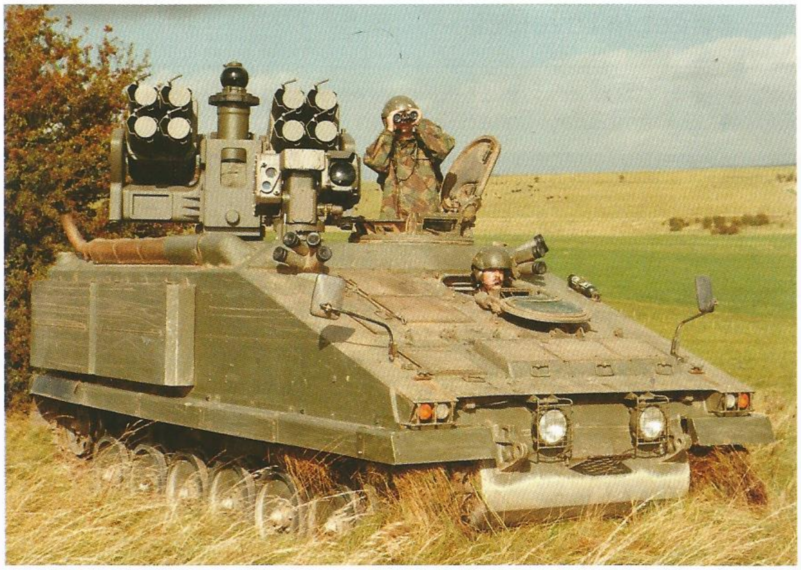
The Air Defence Command Information System (ADCIS) is a £100 million project programme. EASAMS, the prime contractor for ADCIS, has a fixed-price contract from the United Kingdom (UK) Ministry of Defence (MOD) to supply the complete turnkey command and control system.

ADCIS is described as breaking the mould of defence contracting in the UK as a result of its award to EASAMS, a non-manufacturing systems/software house. EASAMS contracted to supply hardware and software from companies that include Raytheon, Control Data Corp. (CDC), Cossor, Siemens/Plessey, Huntings (HCTL), Marconi, Digital Equipment Corp. (DEC) and Logica. EASAMS' key role is in the areas of project management, design and software implementation. Award of the contract followed three years of competitive engineering study by two competing consortia, both led by systems houses, one of which was EASAMS.

ADCIS will provide the British Army with more effective command and control of Army air defence weapons including Rapier, Javelin and high velocity missiles. Its main function is to insure that Allied aircraft are safely routed through Army air defences. A network of computers located at corps, division and fire control centres (FCCs) are linked by packet-switched communications and digital combat net radio (CNR) to the man-on-the-ground.

military VAX computers coupled to CDC military Winchester disk backing stores. These air defence cells have local plasma interactive display terminals (IDTs) and printers. All of these VAX-equipped cells are linked by the Ptarmigan packet-switched digital communications system.

The VAX computer architecture was a key element in EASAMS' bid for the ADCIS contract. DEC has sold some 140,000 VAX computers



Army air defence weapons platforms communicate with ADCIS via data entry devices that receive and display weapon control orders. Photo courtesy of the Ministry of Defence

ADCIS equipment is to be delivered installed within the vehicles that comprise the air defence cells at the various army command levels. At corps, this would be a truck-mounted container, and at divisions and FCCs, typically would be a Saxon armoured vehicle. Weapons platforms are supplied with an intelligent data entry device (DED) that communicates with its FCC via CNR. The DED and radio equipment are mounted in the tracked Rapier, the high-velocity missile armoured vehicle, or landrover for towed Rapier and handheld Javelin weapons. The DED can also be located in the trench.

The ADCIS computer and display installations will be built to withstand the normal rigours of a modern land battle including survival of mechanical vibration and shock (such as a tracked vehicle racing over rocky terrain), and temperature extremes from tropical to arctic conditions.

Corps, divisions and FCCs are equipped with Raytheon 860

worldwide into both the military and commercial sectors. There is, therefore, considerable familiarity in the software industry with DEC software, such as the VMS operating system, which is important when one needs to rapidly build up an experienced software team. There is also a wide choice of well proven products, both software and hardware, capable of exploiting and interfacing with VAX equipment.

The Raytheon 860 processor is a military twin of the DEC commercial 6210 machine, based upon microprocessor chips designed by DEC. The 860 is a 32-bit machine with spare slots to provide the capability of expansion to include an additional two central processing units and 32 MBytes of random access memory.

The CDC Rough Rider ABS-106-2 backing store provides 90 MBytes of military-specification dual Winchester disk storage, to complement the 860 processors. This equipment minimises risk of failure and insures that there will be

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adequate computing power for the future.

CNR permits the FCC and a number of weapons platforms to share a radio frequency and exchange data. Packetised high-level protocols permit CNR to meet the stringent end-to-end performance requirements of ADCIS. Information such as alerting messages or weapons control orders must be relayed to hundreds of sites within a few seconds.

In a typical deployment of ADCIS, there will be many tens of VAX-equipped cells and several hundred DED-equipped weapons platforms. A corps might include four divisions, each commanding ten FCCs, with each, in turn, controlling 20 weapons platforms.

A corps, division or FCC normally has a step-up - an identically equipped twin headquarters able to leapfrog and exchange roles with the main cell. This Army requirement of switching command between units (so that one can be operating while the other moves to a new location) is a significant feature of ADCIS.

ADCIS automates Army air defence procedures, including the automatic processing of friendly mission flight plans into weapon control orders. As an illustration of how ADCIS will provide safe passage for friendly aircraft, consider the following situation:

A forward brigade requires immediate evacuation of casualties by helicopter that will require flying through a heavily defended area. The helicopter mission is tasked, and the mission route is entered into the ADCIS by the brigade's air defence liaison officer. The ADCIS automatically distributes the message containing those route details to the FCCs which control the weapons covering that route. Then the FCCs automatically calculate the restrictions to be put on each weapon, based upon other restrictions in force and the weapons platform's location and coverage, and sends these weapon control orders over CNR.

The DED located at the weapons platform receives the new order and automatically displays it at the time it applies to that particular weapon. The result is that weapons are restricted when necessary to provide a safe passage for the friendly mission, while their ability to engage hostile aircraft is maximised.

Although automation of weapon control orders is an important function of ADCIS, the system also provides a much wider range of facilities such as:

- airspace control and air defence functions,
- logistics and deployment functions,
- general-purpose functions, and
- system management functions.

Computer assistance permits automation to provide rapid and secure distribution between cells, which better facilitates the entering, retrieving and interpreting of the information.

Examples of automation are:

- switching of geographic information such as boundaries or routes for entry or display between map graphics, grid, latitude/longitude, and GEO-REF co-ordinate forms; and
- automatic addressing of messages based upon their type or operator command such as "all sites within a particular command's boundary."

The majority of ADCIS facilities are provided via the plasma IDT man-machine interface (MMI). This Marconi display terminal can display messages and battlemap graphics on its plasma panel. It has a Qwerty keyboard and function keys for entry and retrieval of information. An internal processor supplies local intelligence to provide improved performance and stand-alone capability when remote from the host VAX computers.

Terrain models are used to assist prediction of the combat effectiveness of ADCIS

ADCIS enables Allied aircraft to be safely routed through Army air defence weapons. Photo courtesy of the UK Ministry of Defence

EASAMS and MOD worked together early in the project programme to agree to a detailed and precise MMI specification. MMI prototyping and system simulation were used to permit Army operational staff to use ADCIS facilities within a realistic battle scenario. This permitted validation of the MMI specification to ensure that an operationally useful and user-friendly system would result.

During the first year project system design phase, EASAMS invested considerable effort into computer modelling and simulation work. Computer simulation was used to test the design of the system, particularly the ability of the software and communications to meet end-to-end timeliness requirements. Computer programs simulated the detailed flow of information packets within computers and through the communications links. Other computer models were used to investigate the loading of men in the system (e.g., the time available for them to make decisions and enter information at a keyboard).

Terrain models are used to assist prediction of the combat effectiveness of ADCIS. These attempt to quantify the Army air defence system's overall capability to shoot down enemy aircraft while not endangering its own air missions.

ADCIS software is written in Ada to program the military VAXes, plasma IDTs and DED computers. EASAMS has a large computer bureau at its ADCIS project sited in Camberley, UK. The core of the bureau consists of a DEC cluster of VAX 8530 and VAX 6310 machines, 7.5 GBytes of on-line disc storage networked to over 50 VAXstation 3100/30s and 80 other terminals. The bureau provides an integrated support environment for a wide range of activities including specification writing, system modelling, MMI prototyping and Ada software production.

New techniques have been applied successfully to the project, including formal methods for analysis and design, and the use of a fourth generation relational database language to maintain design information. This design database has been used to support rapid prototyping of MMI and system functionality, specification document production, and automated production of the operational Ada software.

The concept has been to build a C^3 system factory, able not only to produce systems on time and within budget, but to meet the user's real requirement as well.