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*US Army Information Systems Engineering Command
Fort Huachuca, AZ 85613-5300*

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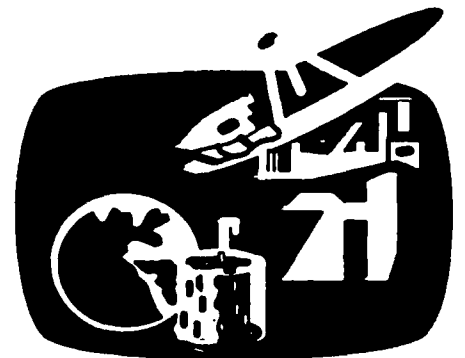
ANNUAL HISTORICAL REPORTS

(ASQBG-B-89-017)

January, 1989

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**U.S. ARMY INSTITUTE FOR RESEARCH IN
MANAGEMENT INFORMATION,
COMMUNICATIONS, AND COMPUTER SCIENCES
ANNUAL HISTORICAL REVIEW**

(RCS CHIS-6 [R3])

FISCAL YEAR 1988

1 October 1987 - 30 September 1988

Prepared by

LTC James T. Blake

Deputy Director

17 January 1989

EXECUTIVE SUMMARY

This year has been very productive for AIRMICS. Several research projects have been completed and a number of new and exciting research initiatives have begun. For example, on the topic of projects completed, we developed an Ada Reuse Guidebook to help Ada practitioners understand and apply reuse principles in the design of future systems, and we published a Guide for Decision Support System Development which has already found use in the development of the Defense System Management College's Project Management Support System. New initiatives include the development of a pilot project to study the use of low-cost, reliable, video teleconferencing technology, and our participation in the DOD Small Business Innovation Research Program.

AIRMICS has a broad research mission. It covers the entire Information Mission Area (IMA). To manage this mission, we have partitioned our program into eight research areas--Distributed Systems, Software Engineering, Communications and Networks, Very Large Data Bases, Decision Support, Information Security, Management of Information, and Supercomputers. While our resources do not permit us to embark on major projects in all of the research areas, we still maintain some level of effort in each of these through cooperative efforts with other government agencies or through participation in university-based research centers.

This is the second year that we have evaluated corporate Independent Research and Development (IR&D) for ISC. We have evaluated 1660 projects from 44 companies. This effort has led to the identification of 186 IMA/ISC-related projects and reports on 25 of these projects were sent to DCSPLANS for dissemination to interested agencies in ISC. Development and eventual commercialization of these projects will provide positive benefits to ISC.

Also during FY 1988, we were assigned the additional mission of providing technology transfer support to ISC and its associated Program Executive Officers (PEOs). This year we established the resource and management structure needed to accomplish this mission, and next fiscal year, we expect ISC to provide us with the personnel resources to execute this mission.

An authorization for six over-hire positions allowed us to staff the previously vacant Communication & Networks Systems Division. We also participated in the DA Intern Program, the ROTC Cooperative Program, and supplemented our professional staff with top-notch researchers from leading universities through the Intergovernmental Personnel Act Program.

AIRMICS' portion of the FY 1988 RDTE appropriations was approximately two million dollars. But, including funds from other activities, we actually executed a program of nearly five million dollars. Our research program included joint efforts with the Office of the Assistant Secretary of the Army for Manpower and Reserve Affairs (ASA(MRA)); Defense Communications Agency; National Aeronautics and Space Administration; Forces Command; the Software Technology for Adaptable, Reliable Systems (STARS) Program Office; Rome Air Development Center; and the Army Research Office.



John R. Mitchell
Director, AIRMICS

PREFACE

This Annual Historical Review (AHR), prepared in accordance with the provisions of AR 870-5, Military History: Responsibilities, Policies, and Procedures, covers the major activities of the U.S. Army Institute for Research in Management Information, Communications, and Computer Sciences (AIRMICS) for Fiscal Year 1988.

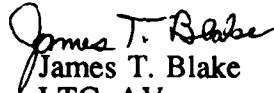

James T. Blake
LTC, AV

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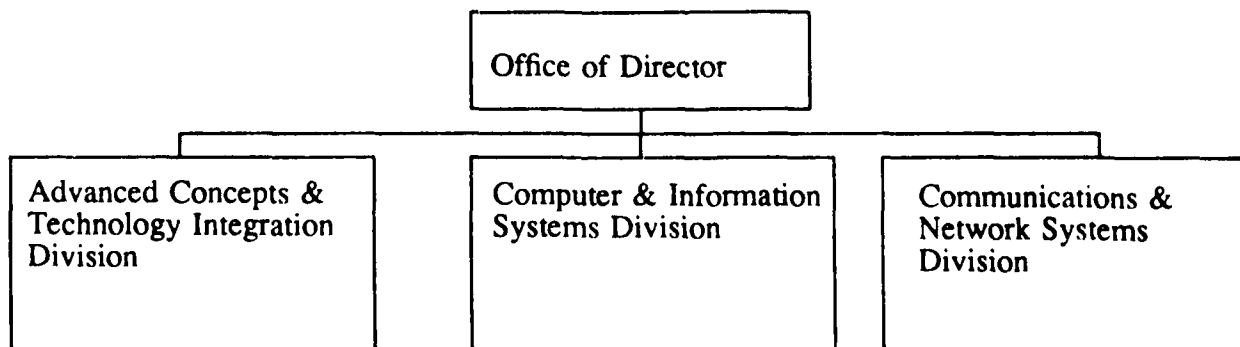
Chapter I
INTRODUCTION

A. *Mission Statement.* Conduct and sponsor applied research in the areas of telecommunications, automation, visual information, records management, and printing and publications systems which address USAISC mission needs.

B. *Key Personnel.*

TITLE/INCUMBENT	INCUMBENCY
DIRECTOR, AIRMICS	
Mr. John R. Mitchell, GM-15	12 May 1985 - Present
DEPUTY DIRECTOR	
LTC Larry L. Henly	21 April 1986 - 15 Jun 1988
LTC James T. Blake	16 June 1988 - Present
RESOURCE MANAGER	
Mrs. Randa Sharman, GS-11	5 May 1986 - Present
CHIEF, ADVANCED CONCEPTS & TECHNOLOGY INTEGRATION DIVISION	
Mr. James Gantt, GM-14	1 October 1985 - Present
CHIEF, COMPUTER & INFORMATION SYSTEMS DIVISION	
Mr. Glenn Racine, GM-14	4 August 1987 - Present
CHIEF, COMMUNICATIONS & NETWORK SYSTEMS DIVISION	
Dr. C. Ronald Green, GM-14	4 August 1987 - Present

C. *Organizational Chart.*



D. Strength Figures.

		OFF	WO	ENL	CIV	INTERN	OH	TOTAL
BEG FY 1988								
	AUTH	6	0	0	15	3	0	24
	REQ	6	0	0	26	0	0	32
	ASG	4	0	0	12	2	0	18
END FY 1988								
	AUTH	6	0	0	15	3	0	24
	REQ	6	0	0	26	0	0	32
	ASG	5	0	0	13	1	0	19

E. *Dollar Resources.* In addition to the normal appropriation of RDTE funds, AIRMICS received additional funds from various government agencies to conduct joint research and development (R&D) projects. DA funding was also provided for two DA Interns, one ROTC Cooperative Program student, and one full time person to support the Historically and Predominantly Black Colleges and Universities (HPBCU) Research Program. Our funding for FY 1988 can be summarized as follows (amounts are in thousands of dollars):

RDTE		
	PE62783A (Project DY10)	2140
	Funds from other government agencies:	
	Department of the Army for	
	HPBCU	376
	Office of the Secretary of the Army	
	(Artificial Intelligence Center)	150
	Information Systems Command	500
	Software Technology for Adaptable, Reliable	
	Systems (STARS) Program Office	250
	Forces Command	433
	Army Materiel Command	536
	Defense Communication Agency	80
	Defense Systems Management College	30
	Laboratory Command	40
	PEO Strategic Information Systems	23
	Program Manager Acquisition Information	
	Management	247

	SUBTOTAL	4805
OMA		
	P39	
	HPBCU	29
	ROTC Cooperative Program	7
	P87	
	INTERN Program	48

	TOTAL	4889

Chapter II

SIGNIFICANT ACTIVITIES

A. Independent Research and Development (IR&D)

AIRMICS has responsibility for the USAISC IR&D program, and this is our first complete year for carrying out the mission. During FY 1988, AIRMICS completed evaluation of approximately 1606 projects from 44 companies. Of these, 186 (11.6%) were ISC/LMIA related, and reports on 25 of these projects were forwarded to DCSPANS for dissemination to interested agencies in ISC. Interested ISC agencies have the opportunity to participate in on-site reviews of these companies' IR&D programs. This aspect of the program is particularly important since it provides ISC a window into non-governmental research that can potentially benefit the IMA. AIRMICS devotes a significant amount of effort in screening corporate IR&D for ISC so as to identify those projects that have the potential for exploitation and high payoff. We encourage ISC activities to attend on-site reviews so that the command can capitalize on this effort. IMA-related research is being performed in software engineering, communications, and distributed systems.

B. Conferences and Coordination

AIRMICS participated in and co-sponsored several conferences and workshops. The Empirical Foundations of Information and Software Sciences Symposium on "From Data to Models" was co-sponsored with Georgia Tech, and the Sixth Annual Conference on Ada Technology was co-sponsored with CECOM. In addition, AIRMICS continued its active relationship with four of academia's leading research centers.

As a member of the Software Engineering Research Center (SERC), co-located at Purdue and the University of Florida, we participated in several advisory board meetings. One product from our relationship with SERC was a value-added report we issued on a maintenance survey SERC performed during the year.

AIRMICS is also an affiliate of the Software Engineering Institute (SEI) at Carnegie Mellon. This year we laid the ground work for putting together a plan to implement SEI's assessment program within ISEC. The assessment program is a formalized process to evaluate an organization's software engineering capabilities and needs and should be of benefit to ISEC in determining where we stand in terms of capability to address current and future software development and maintenance support.

As a member of the Center for Communications and Signal Processing (CCSP), an NSF recognized "Center of Excellence" located at North Carolina State University, AIRMICS actively participated in the Center's semi-annual program reviews and assisted in the transfer of the technological enhancements obtained from these research results. This center has been conducting basic and applied research in three main areas: Algorithms and Architecture, Multi-dimensional Signal Processing, and Communications and Networking. The Center's objective is to develop models, techniques, and prototypes to be used for further development and design in Communications and Signal Processing. AIRMICS participates in this research center to leverage its limited research funds with other industrial sponsors and to sensitize the center to Army research requirements. In order to familiarize intra-government personnel with the Center's activities and to transfer new technologies to other government agencies, AIRMICS hosted a special CCSP program review with other government

representatives from ISEC, ARO, and CECOM. The developed programs and technologies at the Center will be useful for ISC and the Army in the development and design of future network systems.

As a member of the Center for Innovation Management Studies (CIMS), located at Lehigh University, we participated in several advisory board meetings. AIRMICS also served as the pilot data collection site for a research project on research communications. This project is designed to develop guidelines for R&D organizations, such as AIRMICS, on how to improve the successful transfer of research information into and out of the organization. This effort could improve the transfer of AIRMICS' research results into ISC and the IMA community.

Conference participation is valuable in apprising the research community of Army needs and problems in hopes they will direct future efforts to solving them. Additionally, participation in the research centers enables us to serve as a focal point for transferring pertinent SEI, SERC, and CCSP results into the ISC/ISEC community.

C. Ada Research

AIRMICS initiated efforts to improve the Ada practitioner's understanding of Ada reusability and to prepare for implementation and use of a reusable object library in all phases of the software development life cycle. This year we developed a Reuse Guidebook aimed at helping the command with reuse issues. This is the first draft of such a document, and as a result, we received a number of positive comments aimed at improving the guide. Next fiscal year we will incorporate the comments from the field and issue the guidebook to appropriate activities within the Army. We are very optimistic about the progress we are making in this area since the potential for implementation of reuse concepts could significantly reduce software development costs (as much as a 40 per cent). To supplement our professional staff, Dr. Jim Hooper, University of Alabama at Huntsville, was hired under the Laboratory Research Cooperative Program to assist us in our software engineering research projects in reusability and Ada. He is currently evaluating all reuse efforts being performed in both the military and civilian sectors of the economy. We will use the information provided by this study to evaluate our progress in the reuse area and to focus our future efforts.

D. Database Research

AIRMICS began an effort to perform research and development into the concept and design of an encyclopedia built along the lines of the Army Information Model that will accommodate changes in the model, represent security requirements of the model, and provide a browsing and query capability. The encyclopedia provides the means to organize, manage, and access Army metadata (information which describes data), which is essential to achieve synchronization of data values as well as interoperability and integration among Army information systems. This was the first year of the three year effort and we have already begun developing a prototype system that will be functional in April 1989.

E. Technology Insertion

In the software engineering area, AIRMICS has developed an approach to define a software engineering environment complete with a life cycle model and policies, procedures, training, methodologies, and tools to address each life cycle phase. The intent is to establish a software process group with representatives from ISSC and the ISEC

headquarters elements. This group would act as a change agent and provide a forum for sharing information. We are hopeful that we will get the necessary support from the command to make this group a viable tool for enhancing these software life cycle activities.

F. Information Centers (ICs)

In late 1985, Information Centers were formed within the DOIM activities across the Army. The mission of these ICs is to serve as the Army point-of-contact for all Information Mission Area (IMA)-related problems. The IC research conducted by AIRMICS served to facilitate the formation of these centers through the publication of the "IC Planning and Implementation Guide." The purpose of this guide is to provide assistance to DOIM shops responsible for implementing ICs in the Army. Working closely with ISC-DCSPLANS, we have continued our research with the purpose of assisting these centers in the transition from automation support to support for the entire IMA. In FY 1988 we began developing a guidebook for use Armywide by DOIMs and IC managers. While the "IMA Integration Guide" will not be published until February 1989, we have received a number of positive comments on the usefulness of this guide from command elements. The next step toward moving the Army forward in the area of IMA integration within the Army is the development of tools which can automate the handling of routine requests for assistance from the ICs. An expert system that performs a "Help Desk" function for the ICs would be invaluable in this area. We have proposed the development of a prototype for such a tool, and are now searching for funding to continue this research.

G. Decision Support Systems (DSS)

We have enjoyed considerable success with our DSS research this fiscal year. AIRMICS published the "Guide for DSS Development," and we have received positive feedback DOD wide on the effectiveness of this guide. For example, The Defense Systems Management College is using the guide in conjunction with their Project Management Support System. Using a tutorial style, the guide provides a methodology for systematic development of a DSS. The guide uses one large example, which is incrementally developed, and a number of smaller examples to reinforce important concepts. The approach was tested by building a prototype DSS in Ada on a microcomputer and then revising the methodology based on this experience. One result from this research demonstrated the portability of Ada code. The initial development work was done on the UNIX operating system, and the recompilation on MS-DOS was painless. Another significant finding from our research was the paucity of tools. Further research in the DSS area should be devoted to the development of such tools. The basic idea is to develop a DSS designer's toolbox. Included in this toolbox would be such items as an input/output generator, interactive interface tools, modeling and control tools, and data handling tools. Unfortunately, no funding is available to tackle this research. The development of this DSS guide was sponsored by Product Manager, Combat Service Support Control System, however, the concepts are applicable to any Army developer of DSS for microcomputers.

H. Executive Information Systems (EIS)

During FY 1987 and FY 1988, AIRMICS supported Product Manager, Acquisition Information Management (AIM) in the development of an EIS which will link the Army Acquisition Executive (AAE) to the Program Executive Officers (PEOs), and the PEOs to their Program Managers (PMs). The purpose of this research is to improve

the effectiveness of oversight and decision making by the AAE. This research has been divided into three phases. In the first phase, a proof of principle prototype, called the Army Acquisition Management System (AAMS), was developed. This prototype implemented capabilities for: (a) data collection, (b) chart definition via either templates or a graphical programming language, and (c) selective display of charts and explanatory texts. The objectives of the second phase, which was started in September 1988, are: (a) evaluate the improvements brought about by the AAMS through before and after measurements, (b) demonstrate a common data architecture, (c) refine the requirements of the initial prototype, validate and refine the AAMS, (d) develop a training plan, and (e) design and develop import software for data collection. The objectives of the third phase, which will end in FY 1990, are: (a) develop a multi-tier relational database architecture and prototype, (b) develop a user interface into the main DBMS used by the PEOs and PMs, and (c) institutionalize the AAMS with the PEO community. The results of this research can be used by all Army PMs and the principles demonstrated will have applicability in many other Army management environments.

I. Pilot Video Teleconferencing (VTC) Network

In November 1987, the Assistant Secretary of the Army for Research, Development, and Acquisition, ASA(RDA), and the Assistant Secretary of the Army for Manpower and Reserve Affairs, ASA(MRA), approved and funded the development of a pilot VTC network to link Army locations with Historically Black Colleges and Universities (HBCUs). In May 1988, we started the project with Atlanta University. The project will explore the uses, costs, and benefits of low-cost, full-motion, 2-way, non-secure VTC as applied to Army problems. It will also apply VTC technology to improve campus relations and increase the ability of HBCUs to support the Information Mission Area by training students and conducting research. The project called for the installation of three VTC units, and two were installed, at Ft. Huachuca and Atlanta University, this fiscal year. The installation of the VTC unit at Ft. Belvoir was delayed until FY 1989. This IMA-related research has generated a great deal of interest in video teleconferencing throughout DOD because we have shown that low-cost VTC technology is a viable alternative or supplement to the Army's current, high-cost approach of providing VTC.

J. Information Architecture Reference Model (IARM)

Over the past several years, AIRMICS has conducted research into the development of a global information systems architecture model. This model will satisfy the top layer of the Army Information Architecture--the Geographic/Technical Architecture. In May 1988, the research culminated in the publication of a white paper entitled, "Information Architecture Reference Model, IARM". The goal of the research and model is to provide a framework for future information systems research and a common reference model for systems developers. The framework allows for the integration of new and evolutionary technology, both hardware and software, while providing a consistent interface to the user. The model described in the May 1988 white paper was presented to DISC4, ISC and ISEC. The white paper is being reviewed for use within DISC4, ISC-DCSPLANS and ISEC-SID. The model is being used by Purdue University to demonstrate how distributed systems can be mapped to the reference model. The model has also been reviewed by an ISEC support contractor as a method for determining required information services. In FY 1989, we plan to refine the model. This effort will concentrate on the further definition of the services and interconnections.

K. Design of Adaptable Distributed System

In the development of tools and prototypes for the design and development of distributed systems, AIRMICS and NASA, Langley Research Center, with technical support from Purdue University, have been conducting a study on an adaptable system called the Robust, Adaptability, and Integrity in Distributed Data Base (RAID) System. The system will be used to deal with heterogeneous databases, diverse applications, reliability, performance, and emerging architectures. Its development and implementation are expected to be complete by the summer of 1990. A mini-version of the RAID (Mini-RAID) has been installed in the AIRMICS computer laboratory for on-site evaluation, demonstration, and determination of needed enhancements. When the development of RAID is completed, it will be used as a tool for designing distributed systems with the capabilities of incorporating new systems, without extensive reconfiguration of existing systems, at Army posts.

L. SBIR

AIRMICS is participating for the first time in the Department of Defense (DOD) Small Business Innovation Research (SBIR) Program. The DOD SBIR program strives to stimulate technological innovation in the private sector, strengthening the role of small businesses in meeting DOD research and development needs, fostering and encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DOD-supported research or research and development results in areas selected by the DOD components. In FY 1988, AIRMICS had two topics selected for inclusion in the FY 1989 Program. The two selected topics are: "Distributed System Simulation Performance Improvements Through New Algorithmic Modeling and Hardware Architectures" and "Decision Making in a Geographically Distributed Environment." We are optimistic that some innovative proposals will be received on these topics and that we will be able to capitalize on this effort in FY 1989.

M. Visiting Scholars Program

AIRMICS participated in the Visiting Scholars Program. The program provides a method for professors in various disciplines to spend their sabbaticals, or part of their sabbaticals, at AIRMICS pursuing research on a topic of common interest. This year, from January to May 1988, Dr. Dharma Agrawal of North Carolina State University, an internationally recognized researcher in distributed systems, worked with AIRMICS addressing some of the issues involved in distributed systems modeling. The results of his research are available in a report titled "Generic Distributed System Model." The work done by Dr. Agrawal will enable ISC to develop and maintain an Army-oriented distributed systems program which will support the introduction of distributed systems into the networks supported by ISC.

N. Voice/Data Integrator (VDI)

AIRMICS, in a joint effort with the Rome Air Development Center (RADC), has completed the design specifications for a smart multiplexer which will enable data from a Defense Data Network (DDN) packet switch and a Defense Switched Network (DSN) circuit switch to be routed over both AUTOVON and DDN trunks. An emulator to be used for demonstration of the concepts involved will be delivered in January 1989. A follow-on project to build ten prototype VDIs will be let by RADC in the third quarter of 1989. The follow-on contract will be completed in 22 months. The incorporation

of VDI prototypes into typical, though perhaps simulated, Army environments will enable ISC to explore and compare various methods for increasing the efficiency of its networks.

O. Integrated Services Digital Networks (ISDN)

AIRMICS conducted the first VTC on ISDN within the Army. The video teleconference was held between three sites, each transmitting serially nationwide. Each of six presentations reviewed different aspects of the ISDN technology. From the Georgia Institute of Technology, an introduction to what ISDN is and what it is not, along with a presentation on its availability, was given. From the University of Maryland, ISDN migration plans within DGD, and the current Army digital/analog switching status were presented. From the University of Arizona, ISDN was discussed from the user's perspective by the Arizona State Transportation Department, and from the provider's perspective by the Mountain Bell Operating Company. The results of this effort, and other R&D initiatives, focused many of the management and technical ISDN issues that the Information Systems Command (ISC) is currently grappling with. AIRMICS will continue to provide insight into the ISDN technology to ISC through its activities in applications research, integration, and interoperability of ISDN with current and future Department of Defense networks. In FY 1989, AIRMICS plans to develop an applications research test bed for ISDN applications. Currently, we need additional funding for the project and are looking for a sponsor.

P. Defense Communications Agency (DCA) Research, Development, Testing, and Evaluation (RDTE) Working Groups

During the past few years the Department of the Army budget line for the Defense Communications System (DCS) RDTE was zero. The Defense Communications Engineering Center (DCEC), through DCA, established eight RDTE Working Groups. AIRMICS aggressively increased interaction with these working groups to help identify the Army's areas of interest within the DCA plan. This led to improved Information Systems Command (ISC) engineer contact at the DCA Working Group level where DCS requirements of mutual interest and concern were formalized. With the identification of mutual RDTE interests that directly assist ISC and the Army in accomplishing their mission, AIRMICS will develop the plan to seek support from DA. Through increased emphasis on R&D, ISC is assured that the future DCS will support Army requirements. These requirements will be formalized in a requirements document and staffed through ISC to DA for validation and funding in FY 1989.

Q. Technology Transition Strategies

AIRMICS is conducting research in technology transition strategies. This research is currently targeted at developing ways to insert new technology into the office/knowledge-worker environment. With existing resource constraints, both personnel and fiscal, we must find ways to integrate new technologies into the office environment without replacing current systems or creating numerous "patches" to make the systems functional. The integration or insertion of new technology will make the office or knowledge worker more productive by making available a greater number of usable tools. AIRMICS is using its current office automation environment as a testbed to verify the costs and benefits that can be achieved from this research effort.