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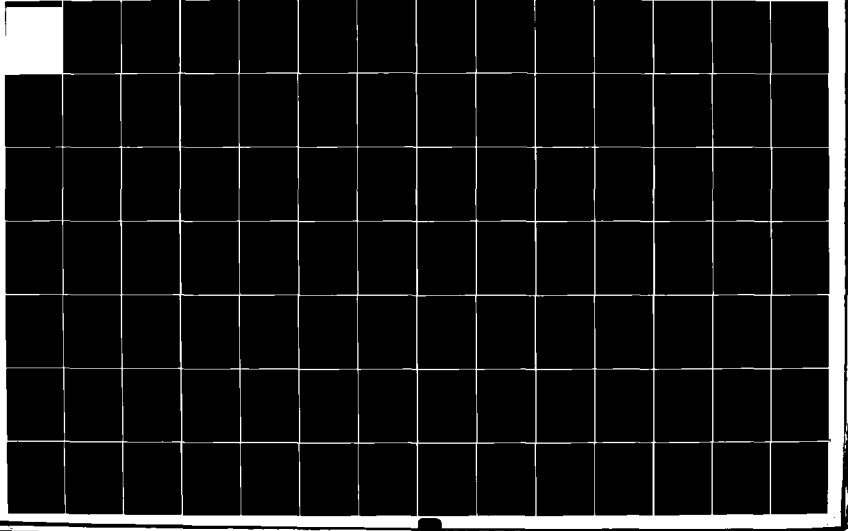

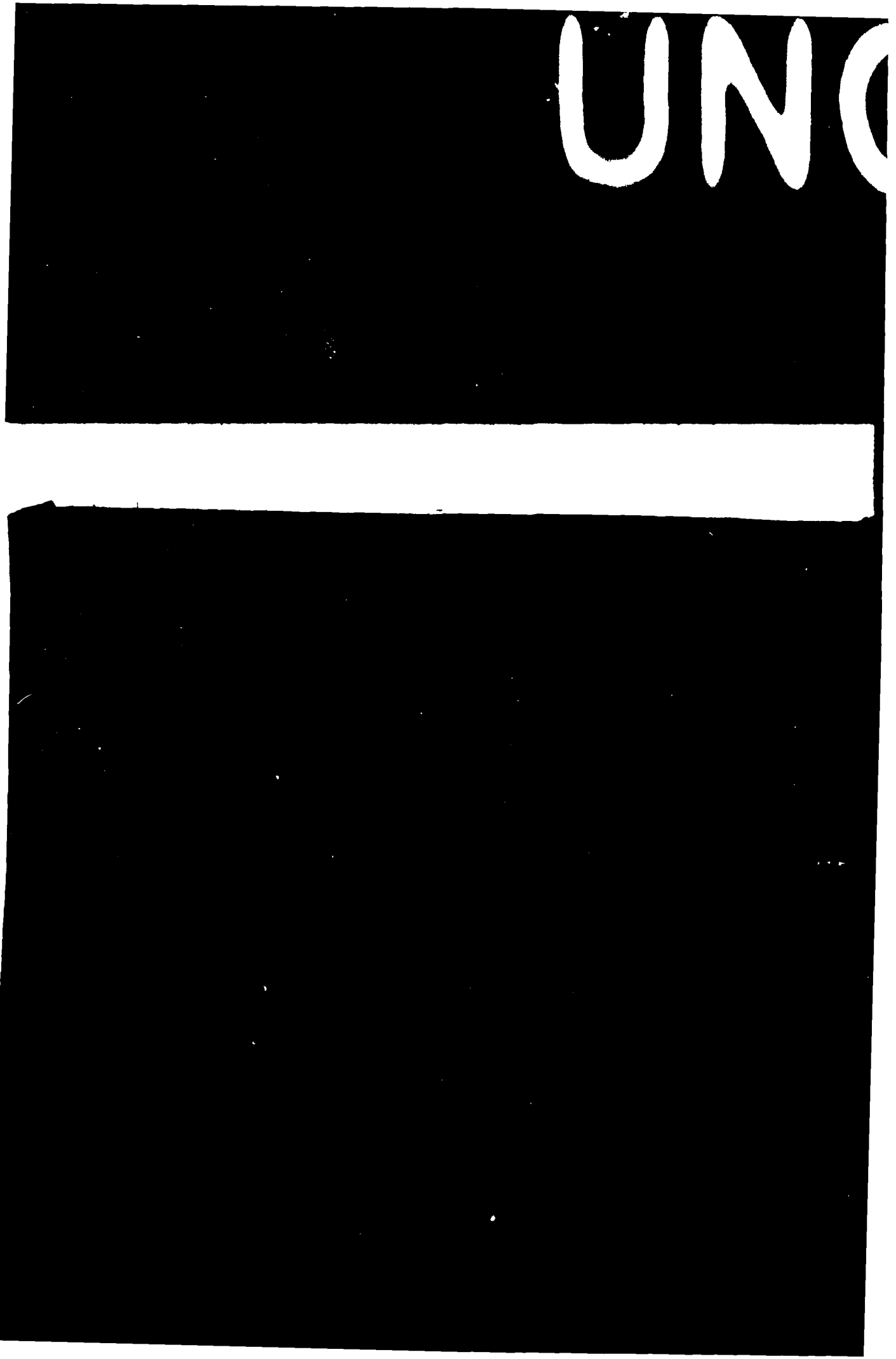
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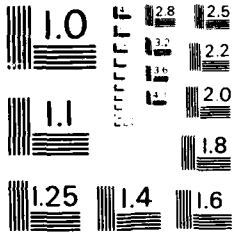
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Department of the Army
Assistant Secretary of the Army
Research, Development, & Acquisition
Washington, D.C. 20310

(12)

ARMY SCIENCE BOARD
1982 SUMMER STUDY

REPORT OF PANEL
ON
SCIENCE & ENGINEERING PERSONNEL

NOVEMBER 1982

2-2552A
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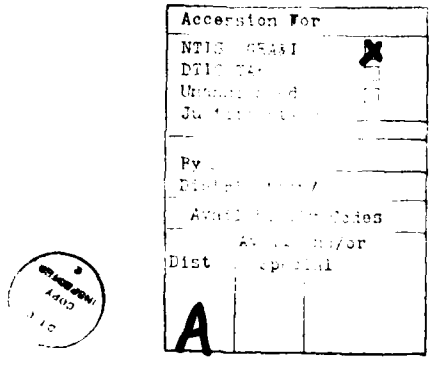
This report is a product of the Army Science Board. The Board is an independent, objective advisory group to the Secretary of the Army and the Army Chief of Staff. Statements, opinions, recommendations, and/or conclusions contained in this report are those of the 1982 Summer Study Group on Science and Engineering Personnel and do not necessarily represent the official position of the U. S. Army or the Department of Defense.



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study examines the acquisition and retention of scientific and engineering personnel for the U.S. Army. The study focus is on the future--a future of ever-more-complex technology, with ever-greater requirements for highly trained technical personnel. The review outlines findings and recommendations in the areas of Army military RD&A management and materiel maintenance (officers and enlisted personnel); Army civilian S&E resources (in-house work force); university and industry resources; and national technological literacy (public appreciation of technology).

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FOREWORD

This document constitutes the final report of the Army Science Board 1982 Summer Study on Science and Engineering Personnel.

The several recommendations are intended to improve the Army's capability to acquire and retain the well-qualified personnel needed to meet the requirements of the Army's high-technology future.

TASKING LETTER

The Army Science Board (ASB) 1982 "Summer Study" on Science and Engineering Personnel was planned in late 1981, in accordance with the tasking letter outlined on pp. 2 and 4.

As indicated, the letter provided relevant background -- and then-current impressions -- with respect to anticipated national and Army-wide shortages of engineers, technicians, and scientists; and called for an examination of acquisition and retention problems and potential solutions, specifically for the Army.

TASKING LETTER — ASB SUMMER STUDY ON S&E PERSONNEL

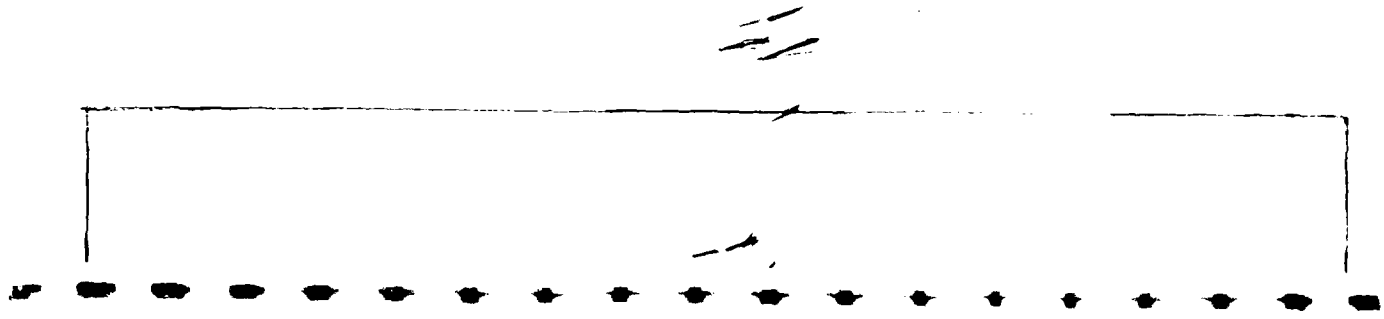
LETTER FROM MS. AMORETTA M. HOEBER, PDASA (RDA), TO DR. R. A. MONTGOMERY, ASB CHAIRMAN, 28 OCT 1981

- I ASK THAT YOU CONDUCT . . . A SUMMER STUDY
  - APPOINT 10 - 15 ARMY SCIENCE BOARD MEMBERS
  - EXAMINE THE ACQUISITION AND RETENTION OF ARMY SCIENTIFIC AND ENGINEERING (S&E) PERSONNEL
- INDICATIONS OF A GROWING NATIONAL SHORTAGE OF ENGINEERS, TECHNICIANS, SCIENTISTS
- FOR ARMY CIVILIANS, THE SITUATION IS EXACERBATED BY
  - GRADE LEVEL CEILINGS
  - NON-COMPETITIVE SALARIES
  - ERODING FACILITIES AND EQUIPMENT
  - LIMITED PROFESSIONAL ADVANCEMENT OPTIONS
- SHORTAGES OF UNIFORMED S&E PERSONNEL CONTRIBUTE TO
  - DECREASED READINESS
  - LESS KNOWLEDGEABLE PROGRAM AND TECHNICAL MANAGEMENT
  - INCREASED RELIANCE ON CONTRACTOR / CONSULTANT ADVICE

TASKING LETTER (cont'd)

As noted, the intent was to take full advantage of previous studies, and to concentrate on initiatives that could be taken by the Army – – whether achievable within the Army or requiring action by higher authority.

The initial organizational meetings were held in late January 1982; numerous visits, briefings, interviews and discussion meetings were scheduled, culminating in the "final writing session" at the Woods Hole Study Center of the National Academy of Sciences, Woods Hole, Massachusetts, 16–25 August 1982. Some of the material included in this final report was prepared subsequently.



TASKING LETTER — ASB SUMMER STUDY ON S&E PERSONNEL (CONT'D)

- THE S&E SUMMER STUDY SHOULD
  - EXAMINE CURRENT AND PROJECTED SHORTAGES
  - BUILD ON PRIOR STUDIES
  - FIND INITIATIVES ACHIEVABLE WITHIN THE ARMY
  - IF NECESSARY, IDENTIFY INITIATIVES FOR RECOMMENDATION TO HIGHER AUTHORITY
  - COORDINATE WITH AGENCIES OUTSIDE DOD
- I ENVISION
  - GROUP / SUBGROUP MEETINGS OVER FIRST HALF OF 1982
  - TWO-WEEK FINAL WRITING SESSION

2-2554
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PARTICIPANTS

The participants in the ASB Summer Study represented a highly-placed group with broad experience in industry, academia, and government. In terms of composite experience, the members included: from industry, two past presidents and three active vice-presidents; from universities, one dean of engineering and four full professors; and from government, two who had served at the Assistant Secretary/Assistant Administrator level, one retired general officer, and three former DOD civilians.

Exceptionally competent support was provided by the listed Army Staff Assistants.

ASB SUMMER STUDY -- S&E PERSONNEL

PARTICIPANTS

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LTC JOSEPH M. GESKER	ODCSPER
MR. DANIEL M. SHEIL	ODCSPER

2-2385B
OCT 82

SUBGROUP ORGANIZATION

To improve the efficiency of the Summer Study, subgroups were formed in the areas identified below; activities were carried out separately or jointly as appropriate.

On an over-all basis, fourteen site visits were conducted -- ten to government laboratories, two to industrial organizations, and two to educational institutions. Additional briefings were scheduled by the subgroups, with every effort made to minimize interference with ongoing activities.

In addition to this summary report, records of meetings and supporting memoranda are available.

ASB SUMMER STUDY -- S&E PERSONNEL
SUBGROUP ORGANIZATION

MR. M. L. LOHR, CHAIRMAN

MR. A. R. EATON, VICE-CHAIRMAN

- ARMY CIVILIAN PHYSICAL, LIFE, & SOCIAL SCIENTISTS

  DR. W. K. TALLEY, CHAIRMAN
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- ARMY UNIFORMED SCIENTISTS, ENGINEERS, & ASSOCIATED TECHNICAL SPECIALISTS

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  DR. P. P. SIDWELL
  DR. J. STERNBERG

- COORDINATION / INTEGRATION / REPORTING

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  MG L. L. STAHL, (AUS-RET)
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- ARMY STAFF ASSISTANTS

  MR. J. F. BORDEN
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  LTC J. M. GESKER
  MR. D. M. SHEIL
  MR. J. E. SPATES, POINT OF CONTACT

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PLENARY SESSIONS

In addition to the subgroup visits and meetings, plenary sessions were held to listen to results of prior or concurrent studies, as well as observations by leaders of the Army community. Particular attention was devoted to the following reports:

1. "Defense Manpower Data Center (DMDC) Studies", 22 February 1982, *Memorandum* to Distribution from Jerry L. Calhoun, Deputy Assistant Secretary of Defense (Civilian Personnel Policy), forwarding information gathered by Rick McGonigal of Human Resources Research Organization;

2. "USDRE Independent Review of DOD Laboratories", 22 March 1982, prepared by Dr. Robert J. Hermann for Under Secretary for Defense Research and Engineering;

3. "Study of Scientists and Engineers in DCD Laboratories", draft report 17 June 1982, The DOD Laboratory Management Task Force Personnel and Manpower Working Group, Herbert Rabin, Chairman;

4. "Report of the Defense Science Board Task Force on University Responsiveness to National Security Requirements", January 1982, Dr. Ivan Bennett, Chairman;

5. "Research and Development for Military Strength: Concerns and Recommendations", April 1982, The Center for Strategic and International Studies, Georgetown University, The Panel on Science and Technology, Frederick Seitz, Chairman.

Particular reference should be made to the comments of General John W. Vessey, Jr., then the Vice Chief of Staff of the Army. He stressed the potentially severe management and manpower problems relating to the development, maintenance, and operation of complex systems -- and urged the Summer Study participants to be bold and dynamic in considering recommendations for much-needed action.

ASB SUMMER STUDY -- S&E PERSONNEL
PRINCIPAL INTERFACES

PLENARY SESSIONS (FOUR 2-DAY MEETINGS / 30 MAJOR BRIEFINGS)

- COMMENTS BY GENERAL VESSEY, VCSA (STUDY SPONSOR)
- PERSPECTIVES FROM CONGRESSIONAL, INDUSTRIAL, EDUCATIONAL, PROFESSIONAL SOCIETY, AND NON-DEFENSE GOVERNMENT REPRESENTATIVES
- PRESENTATIONS OF FINDINGS OF RELATED DEFENSE STUDIES BY THE AIR FORCE, DOD LABORATORY MANAGEMENT TASK FORCE, DEFENSE SCIENCE BOARD, JOINT LOGISTICS COMMANDERS, USDRE INDEPENDENT REVIEW OF LABORATORIES – INCLUDING PRIOR AND ONGOING ARMY SCIENCE BOARD WORK
- OBSERVATIONS FROM MANY ELEMENTS WITHIN THE ARMY MILITARY AND CIVILIAN COMMUNITIES (E.G., GENERAL OFFICERS AT OSD AND DARCOM, LABORATORY DIRECTORS, MAJOR COMMAND STAFFS, NON-LABORATORY PERSONNEL, AND THE DA STAFF
- EXECUTIVE SESSION PROGRESS REPORTS

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SUMMARY PERSPECTIVE

As indicated, the perspective of this report is optimistic and positive. Assuming that the identified problems are attacked, and that effective action is taken, the Army should be able to meet its needs for scientific and engineering personnel and -- while acting in its own self-interest -- should be able to make significant, recognizable contributions toward the solution of the over-all national problem.

SUMMARY PERSPECTIVE

- WHILE MANY STUDIES / REFERENCES INDICATE
  - A DEVELOPING NATIONAL SHORTAGE OF S&E's
  - THAT THE U.S. IS LOSING THE "TECHNOLOGY" RACE
  - THAT WE HAVE CURRICULUM PROBLEMS IN PRIMARY / SECONDARY MATH AND SCIENCE
  - THAT THERE ARE INSTRUCTION / FACULTY LIMITATIONS IN UNIVERSITIES
- WE NOTE THAT
  - THE ARMY S&E QUANTITATIVE REQUIREMENTS ARE NOT A LARGE FACTOR IN THE NATIONAL SHORTAGE
  - POTENTIAL PROBLEMS RELATE TO QUALITY – NOT QUANTITY
  - POTENTIAL SOLUTIONS ARE AVAILABLE – – BUT REQUIRE FORTHRIGHT ARMY ACTIONS AND SOME OUTSIDE ASSISTANCE
  - THE ARMY CAN CONTRIBUTE TO SOLVING SOME PARTS OF THE NATIONAL PROBLEM

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REPORT OUTLINE

The remainder of this report is divided into the sections listed below.

It is important to note that the focus of the ASB Summer Study is on the future -- a future of ever-more-complex technology, with ever-greater requirements for highly trained technical personnel.

REPORT OUTLINE

- ARMY MILITARY RD&A MANAGEMENT AND MATERIEL MAINTENANCE -- OFFICERS AND ENLISTED PERSONNEL
- ARMY CIVILIAN S&E RESOURCES – IN-HOUSE WORK FORCE
- UNIVERSITY AND INDUSTRY RESOURCES
- NATIONAL "TECHNOLOGY LITERACY" – PUBLIC APPRECIATION OF TECHNOLOGY

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ASB SUMMER STUDY -- S&E PERSONNEL

ARMY MILITARY

RD&A MANAGEMENT AND MATERIEL MAINTENANCE

2-2561
SEP 82

RD&A MANAGEMENT

The Army needs for S&E trained officers represents a small fraction of the total Army officer strength -- less than 10%. Of this small percentage, we will address two of the five identified needs. These two, in our view, represent the highest leverage.

We have listed development of requirements separately from RD&A because we wish tc highlight its importance in the materiel acquisition process. Requirements represent a marriage of operational need and technology. Critical, irrevocable trade-offs take place between technology capabilities and the need specification as it evolves and is finalized. The developer must understand the need; likewise, the operational representatives must appreciate the relevant technologies and potential development difficulties and risks. It is this all-important give-and-take which produces realistic costs, doable schedules, and an end item specification of worth and temporal durability.

By giving our study the indicated focus on RD&A management, we do not want to leave the impression that we believe technically-qualified officers are not needed elsewhere. On the contrary, since the Army will be fighting with weapons and systems of increasing sophistication, we feel that S&E education and experience will be very generally required to understand, manage, work with, and employ these new capabilities to maximum advantage.

ARMY MILITARY RD&A MANAGEMENT AND MATERIEL MAINTENANCE

RD&A MANAGEMENT (INCLUDING REQUIREMENTS DEFINITION)

- ARMY NEEDS OFFICERS WITH S&E EDUCATION AND EXPERIENCE TO
  - MAN UNITS (E.G., COMMUNICATIONS-ELECTRONICS, AIR DEFENSE ARTILLERY, TOPOGRAPHICS)
  - MANAGE EQUIPMENT MAINTENANCE
  - *– SHARE IN REQUIREMENTS, CONCEPT, AND DOCTRINE DEVELOPMENT
  - *– DIRECT RD&A
  - TEACH TECHNICAL SUBJECTS
- FOCUS OF OUR STUDY IS ON * ABOVE, INCLUDING WEAPON SYSTEMS, COMBAT SUPPORT, AND COMBAT SERVICE SUPPORT –

  THESE AREAS REPRESENT LARGE EXPENDITURES WITH CRITICAL IMPACT ON FUTURE MILITARY EFFECTIVENESS

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THE ISSUE

Hardly a week goes by without our being reminded by the press that another weapon system is in some sort of difficulty. Missed schedules and cost escalation are the most commonly reported horror stories. Unfortunately, we also see instances in which the system fails to function as promised during the development phase.

There are many factors that have contributed to the troublesome record on the development and acquisition of new combat and combat support systems for the Army. Some of these factors, such as congressional and OSD involvement, are outside the Army's scope. Others, within the Army's cognizance, have to do with management procedures and practices. But, in our opinion, a fundamental factor that needs increased emphasis is the technical background – – education and experience – – of the officers who make crucial management judgments and decisions where very complex and difficult technical issues are involved.

THE ISSUE

- THE DOD's RD&A EFFORTS HAVE BEEN TROUBLED BY
  - EXCESSIVE DELAYS AND COSTS
  - POOR INITIAL AND CHANGING REQUIREMENTS
  - INCOMPLETE TECHNICAL RISK ASSESSMENT
  - INADEQUATE SOLDIER / MACHINE INTERFACE CONSIDERATIONS
  - QUESTIONABLE EQUIPMENT RELIABILITY / AVAILABILITY / MAINTAINABILITY
  - MARGINAL VALUE OF END ITEMS
  - SPOTTY IN-HOUSE TECHNOLOGY OUTPUT
- THE ARMY HAS EXPERIENCED ITS SHARE OF THESE PROBLEMS
  MANAGEMENT DECISIONS HAVE BEEN A MATERIAL CONTRIBUTOR TO THESE PROBLEMS
- WE BELIEVE THAT ADDITIONAL S&E EDUCATION AND EXPERIENCE WILL LEAD TO SIGNIFICANT IMPROVEMENT IN THE KEY MANAGEMENT DECISIONS INVOLVED

EFFECTIVE MANAGEMENT OF RD&A

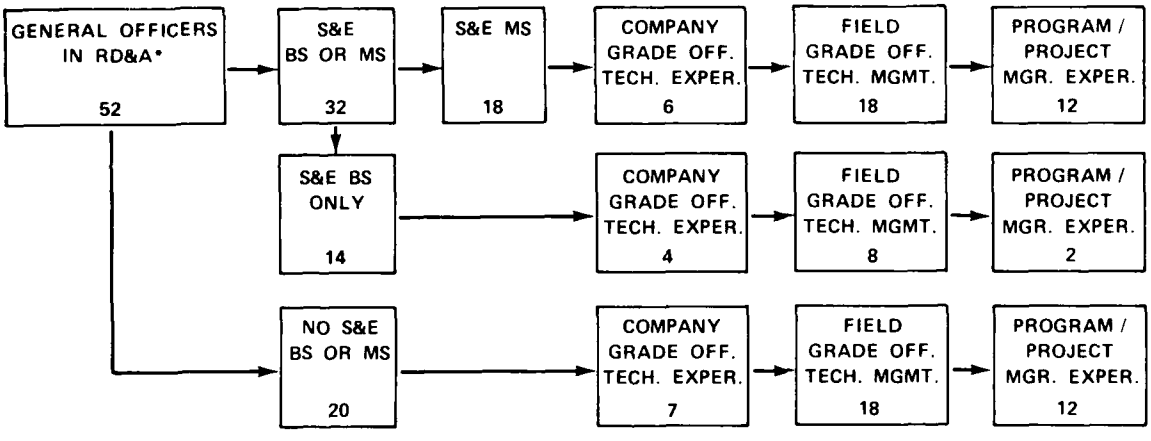
The Army develops officers with leadership and management skills who can move into new and unfamiliar military assignments, assess what needs to be done, and do it. It is a misconception to believe that such skills are sufficient for the management and direction of research, system development, and acquisition, as well as the highly complex and technical process of developing affordable, achievable, and militarily useful operational requirements.

Operational experience is essential to understand the combat and military environment at different levels in the force structure. This operational experience must be complemented by technical education and technical experience to develop the instincts required for making good management decisions in the RD&A area. The manager must know what questions to ask, which areas are weak and should be probed, and how to get at the facts to resolve controversial issues. Decisions will have to be made that hinge on sound appreciation of the present and future state of technology and a quantitative understanding of operational issues that clarify precisely what is needed from the key technologies.

Top-level Army management emphasis is already being given to the selection of officers for the RD&A area. In our opinion, however, the Army does not currently have available a sufficiently large group of qualified officers to choose from -- i.e., officers with the requisite technical education and technical experience. The chart shows that, at this time, a significant percentage (approximately 40%) of the general officers in RD&A do not have S&E education; and that a very large percentage (approximately 70%) have not had technical experience at the company grade level. For the future, we feel that far greater emphasis on technical background is required.

WE BELIEVE THAT

- EFFECTIVE MANAGEMENT OF RD&A PROGRAMS IS BEST ACCOMPLISHED BY INDIVIDUALS WITH A SOLID GRASP OF THE SUBSTANCE OF TECHNICAL AND OPERATIONAL ISSUES.
- MANY ARMY RD&A MANAGERS DO NOT HAVE, IN OUR VIEW, THE BACKGROUND IN TECHNICAL EDUCATION AND TECHNICAL EXPERIENCE REQUIRED FOR THE ARMY'S HIGH-TECHNOLOGY FUTURE.



*INCLUDES 8 CURRENT PROGRAM / PROJECT MANAGERS AND 2 OFFICERS WITH S&E MS WITHOUT S&E BS.

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FINDINGS / OBSERVATIONS / PERCEPTIONS

Command positions within the area of combat arms are perceived as the best pathway to achievement, success, and development of a competitive edge for promotion. The "proper" sequence of windows/gates to be passed through within prescribed time limits acts against RD&A assignments being positive elements in successful career progression.

The Army fails to use its annual input of approximately 400 S&E graduates in technical positions. Only after eight years of service are these resources assigned to S&E billets; but after eight years, technology in their fields has passed them by. The lack of a progressive RD&A career path prohibits the on-going development and retention of technical expertise in establishing requirements, performing research, doing design work, or following through on procurement processes.

The lack of RD&A as an S&E accession specialty results in improper utilization of S&E talent and rapid personal technical obsolescence. A cohesive rationale, and a systematic approach, are needed to determine recruitment and assignment requirements for the broad spectrum of scientific and engineering disciplines appropriate for the Army. Graduate education requirements as certified by the Army Education Requirements Board (AERB) could then become an integrated element in this approach. As a result, an Army career could be made more attractive to the high-quality individuals needed in the RD&A area.

OFFICER FINDINGS

- CAREER PLAN
  - COMBAT ARMS PERCEIVED AS PREFERRED CHOICE FOR ADVANCEMENT
  - TRADITIONALLY PREFERRED ASSIGNMENTS FOR CAREER PROGRESSION HAVE NOT BEEN IN RD&A

- TECHNICAL EXPERIENCE
  - VERY FEW S&E GRADUATES ARE GIVEN TECHNICAL ASSIGNMENTS DURING FIRST 8 YEARS
  - NO ORDERLY PROGRESSION IN RD&A ASSIGNMENTS

OFFICER PROFESSIONAL DEVELOPMENT FOR RD&A

The present career plan for officers is designed to develop combat leaders rather than RD&A managers. The RD&A area is not represented by accession specialties. Under these circumstances, it is very difficult to attract high-quality individuals who have a strong technical interest as well as a desire to make a career in the Army. Those individuals with a strong technical interest will not have an opportunity to follow that interest for many years. Their undergraduate training will be largely wasted because it isn't used. The RD&A area is definitely a second choice for many officers. Given the above pattern, it is not surprising that many officers in RD&A management find themselves forced to make crucial decisions without an adequate background for those decisions.

We recommend that a new career plan be established for the RD&A area, starting at the end of the second year, so that officers in RD&A (perhaps 9% of the Army total) are competing with each other and not with the entire officer population. The usual career path places heavy emphasis on command assignments. We strongly believe that an RD&A officer must have operational assignments, but the attainment of the operational knowledge essential for RD&A does not depend on having command assignments. An RD&A officer should not be at a competitive promotion disadvantage without command assignments.

To an even greater extent than at present, the ROTC scholarship program could be used to attract promising RD&A officers with S&E degrees who could serve to make the Army competitive even if a national S&E shortage develops. As pointed out in the Hermann report (Ref. 2, p. 9), graduates with an S&E B.S. degree must sacrifice $4,000–$10,000 per year to enter government service rather than industry; ROTC scholarships would provide compensation.

This new career plan should provide the RD&A officer with a mix of operational and training assignments, with graduate training that is a logical follow-on of undergraduate training, and with equal opportunity for general officer selection.

OFFICER RECOMMENDATIONS

A MAJOR CHANGE IN OFFICER PROFESSIONAL DEVELOPMENT FOR RD&A IS NECESSARY

- ESTABLISH A COMPETITIVE CATEGORY (OR ITS EQUIVALENT) FOR RD&A STARTING AT TWO YEARS OF SERVICE TO
  - DEVELOP SENIOR OFFICERS WITH THE MIX OF TECHNICAL AND OPERATIONAL EXPERIENCE REQUIRED FOR EFFECTIVE MANAGEMENT OF :
    - OPERATIONAL REQUIREMENTS DEVELOPMENT
    - RESEARCH
    - HARDWARE / SOFTWARE DEVELOPMENT
    - ACQUISITION
  - ATTRACT, DEVELOP AND RETAIN HIGH QUALITY INDIVIDUALS WITH S&E EDUCATION AND INTERESTS
  - ENSURE EQUAL OPPORTUNITY TO BECOME A GENERAL OFFICER (I.E., TECHNICAL MANAGEMENT EQUIVALENT TO " COMMAND ")

NOTIONAL OFFICER CAREER PROGRESSION

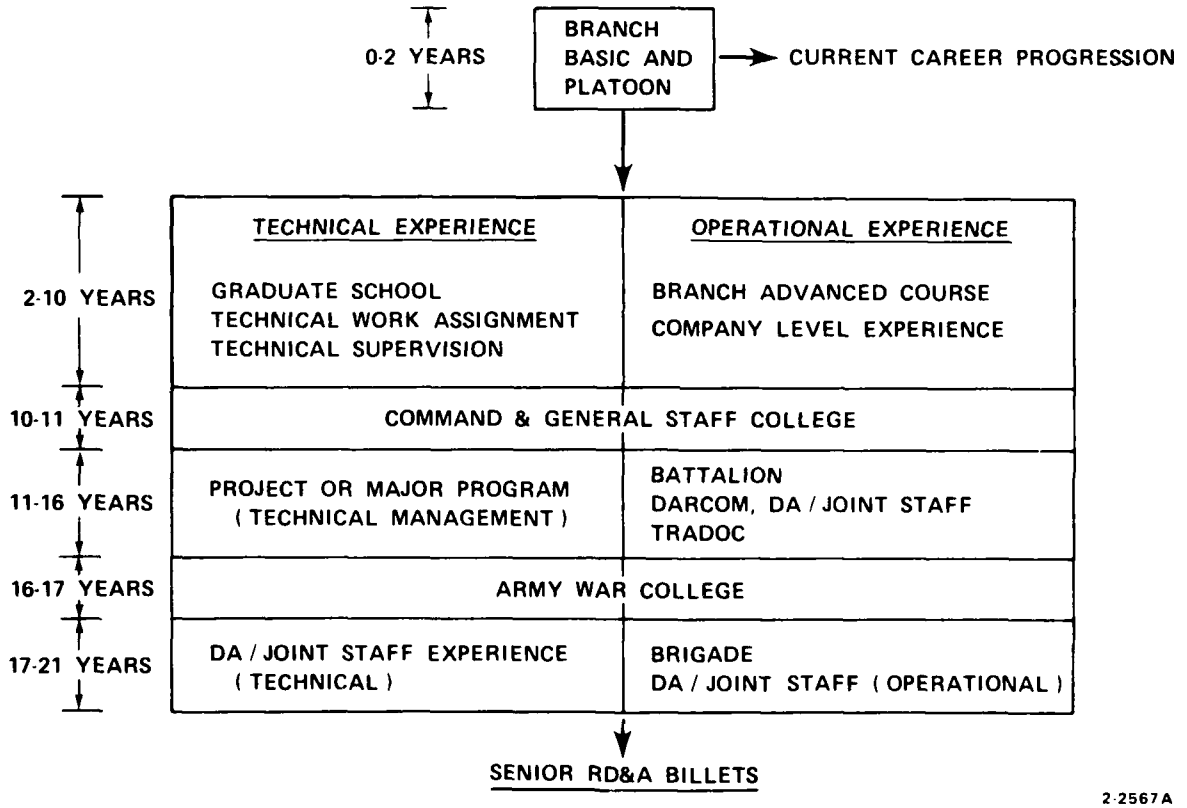
With this approach, the first two years of commissioned service for the S&E graduate are in combat arms. With the branch basic course and platoon experience completed at the end of two years, a career decision point is reached. An officer may opt to follow today's conventional route or go the path of an RD&A career.

The career is designed to provide for ever-increasing levels of experience and managerial responsibilities -- both technical and operational. At the end of 21 years, about one-half of the time has been served in line units and one-half in technical assignments. The ratio of service in technical vs operational assignments is meant to be flexible, 50 / 50 is simply a target for planning purposes.

Based on a limited investigation by the Panel on S&E Personnel, it appears that the authority exists within the Army to make the changes required to establish the recommended RD&A career plan for officers, including -- if deemed necessary -- a new competitive category.

For all approaches to development of improved career plans for RD&A officers, it is critical to assure that suitable opportunity is provided for promotion to general officer -- opportunity equal to that in other areas of the Army.

NOTIONAL CAREER FOR S&E GRADUATES



2-2567A
DEC 82

NEAR TERM RECOMMENDATIONS

We have suggested a notional career that would, in our opinion, develop the essential mix of technical and operational experience. The Army should examine in more depth the detailed structure of a suitable new RD&A career plan. Pending the completion of that study, and formal implementation of a new career plan, there are a number of actions indicated on the chart that could be taken now -- actions that would, in our opinion, represent steps in the right direction with the potential for early results.

RECOMMENDED NEAR-TERM ACTIONS FOR DEVELOPMENT OF A NEW RD&A CAREER PLAN

- ESTABLISH AN APPROPRIATE GROUP TO DETERMINE A PREFERRED APPROACH FOR THE IMPLEMENTATION OF A NEW RD&A CAREER PLAN -- CONSIDERING A NEW COMPETITIVE CATEGORY IF DEEMED NECESSARY

- " FENCE " AN ADDITIONAL NUMBER OF ROTC SCHOLARSHIPS TO S&E FIELDS BEGINNING IN 1983-1984 SCHOOL YEAR -- PERHAPS 70-80% OF ALL ROTC SCHOLARSHIPS
  - THIS ACTION WILL HELP TO COMPENSATE FOR THE HIGHER PAY AVAILABLE TO S&E GRADUATES IN CIVILIAN FIELDS

- IMMEDIATELY SCREEN OFFICERS NOW COMPLETING 2-3 YEARS SERVICE TO SELECT ATTENDEES FOR GRADUATE SCHOOL -- TO START THE "NOTIONAL CAREER"

- IMMEDIATELY IDENTIFY TECHNICAL EXPERIENCE BILLETS FOR THE 2-10 YEAR PERIOD IN THE ARMY'S RD&A ACTIVITIES -- FOR ASSIGNMENT TO QUALIFIED OFFICERS

- LIMIT FURTHER ENTRIES INTO THE RD&A AREA TO THOSE OFFICERS WITH AT LEAST A B.S. IN S&E

- ASSURE EQUAL OPPORTUNITY FOR PROMOTION -- TO ALL GRADES -- FOR THOSE OFFICERS IN THE RD&A AREA

2-3472A
DEC 82

MATERIEL MAINTENANCE

Of the three needs for enlisted technicians, the highest leverage relates to the maintenance and repair of equipment. Thus we will concentrate solely on this maintenance need.

It is increasingly difficult for the Army to keep highly skilled technicians in military occupational specialties (MOSs) that have high civilian demand for those skills. The Army currently relies upon re-enlistment bonuses as the extraordinary inducement to retain required technician talent. Re-enlistments are up across the Army, but not in critical-speciality, high-skill-level MOSs.

Force modernization underway is creating an ever-increasing maintenance and repair load on an already stretched maintenance capability. New equipment is easier to operate but often more difficult to repair. The recent TRADOC "Soldier-Machine Interface Requirements Complexity Study" of 30 new systems (completed in May 1982) found increased training required for system maintenance, higher aptitudes required for such system repairs, and greater technical proficiency needed by NCOs and officers. High-technology-based systems may, indeed, be potential force multipliers -- but of little actual value if their operational availability is low because of complicated fault diagnosis, isolation, and repair procedures, or because appropriately-trained technicians are not available.

It should be emphasized that new systems do not necessarily have to be more difficult to maintain; increased attention to designing for easier maintenance is important to improving the Soldier-Machine interface. Even with the best-designed equipment, however, it will be essential for the Army to retain qualified technicians.

ARMY MILITARY RD&A MANAGEMENT AND MATERIEL MAINTENANCE

MATERIEL MAINTENANCE

- ARMY NEEDS ENLISTED TECHNICIANS TO
  - MAN UNITS
  - *- MAINTAIN EQUIPMENT
  - TRAIN
- FOCUS IS ON * ABOVE

MAINTENANCE PROBLEMS ARE BECOMING MORE DIFFICULT WITH THE INTRODUCTION OF NEW, MORE COMPLEX SYSTEMS

2-2569
SEP 82

THE TECHNICIAN PROBLEM

The Army has not yet developed a credible system for measuring hands-on soldier proficiency in maintenance and repair. The Skill Qualification Tests (SQTs) were intended to fulfill this function, but the initial effort has proved unsatisfactory and there is still no agreement on what tests should be used and what the tests mean.

Some performance data on diagnostics have raised questions about the existing enlisted skill levels -- or about current procedures. A review of data on European M60 units showed that 40% of the items diagnosed as faulty and sent back to the support unit for repair were found to be in good condition. The data for comparable German units were only a few percent.

Whatever the current situation, the introduction of the new generation of more complex systems can be expected to require increased skill performance. The reliability goal for many of the new systems is comparable to or better than the reliability of the systems they replace. However, the new systems are much more complex and can fail in many more ways. Thus, even with the same mean time between failure (MTBF), the problem of diagnostics is much more difficult and in many cases, the repair job is also more difficult.

THE TECHNICIAN PROBLEM

- THE PROFICIENCY OF THE CURRENT TECHNICIAN FORCE IS UNCERTAIN. THERE HAS BEEN CONSIDERABLE CONTROVERSY ABOUT HOW TO RELIABLY MEASURE MAINTENANCE SKILL LEVELS

- THE RECENT TRADOC SOLDIER-MACHINE INTERFACE REQUIREMENTS COMPLEXITY STUDY (COMPLETED MAY 1982) FOUND THAT MAINTENANCE AND REPAIR TRAINING REQUIREMENTS ARE BEING INCREASED BY THE INTRODUCTION OF THE NEW GENERATION OF ADVANCED SYSTEMS (SKILL REQUIREMENTS FOR EFFECTIVE FAULT DIAGNOSIS ARE OF PARTICULAR CONCERN)

TECHNICIAN FINDINGS

Today the enlisted technician is advanced in pay and grade solely on his demonstrated and estimated leadership potential. Demonstrated skill capability is not recognized by an increase in pay. As a result, cost effective maintenance is often not realized. Even worse, we sometimes convert a skilled technician into an ineffective leader in a misguided push to reward technical excellence.

The force structure requirement for an MOS should provide for an orderly, upward flow of an enlisted career. Abrupt increases in numbers required as skill levels go higher creates mismatches as attempts are made to promote too rapidly or move from one MOS to another.

Over-all, the Army establishes the relative numbers of enlisted soldiers in different grades in the form of a pyramid with, as would be expected, larger numbers of enlisted soldiers in the lower grades. However, in each MOS the distribution of enlisted ranks required for that MOS is specified by the field units. The stated requirements for several maintenance MOSs are shown in the viewgraph. It is apparent that an orderly progression from lower to higher rank is not readily achieved. In practice, a large number of lateral transfers between specific MOSs are required to fill vacancies and to allow for the promotion of individuals. This creates turbulence, aggravates training requirements, leads to the loss of many enlisted technicians, and is not consistent with the existence of a skilled technician force at any one time. There is a mismatch between the enlisted technicians on hand and those required for many of the enlisted grades in many of the MOSs.

Furthermore, since the policy for promotion of enlisted technicians is based on leadership potential and not on demonstrated proficiency as a technician, many enlisted soldiers are promoted to supervisory grades without becoming proficient in the maintenance tasks performed by technicians they supervise.

As a consequence, the technician does not receive rewards for becoming a better technician and, in effect, has no place to go. Without an incentive to stay, many leave the service. Thus, over-all maintenance proficiency is adversely affected and a heavy load is placed on recruiting and on training new recruits.

TECHNICIAN FINDINGS

- PROMOTION BASED PRIMARILY ON LEADERSHIP POTENTIAL, RATHER THAN TECHNICAL PROFICIENCY
  - SUPERVISORS MAY NOT BE TECHNICALLY PROFICIENT
  - TECHNICIAN HAS NO PLACE "TO GO"
  - HEAVY SKILL-LEVEL-ONE RECRUITING AND TRAINING LOAD
- THE COMPLEXITY OF EQUIPMENT AND MAINTENANCE REQUIREMENTS DRIVES THE NEED FOR SKILL LEVELS AND SPECIALTIES, E.G.:

	AN / TSQ-73 OP / REP	AERIAL SURVL SEN REP	PERSHING ELCT MAT SP
E-7	39	--	17
E-6	94	24	86
E-5	73	9	85
E-4	34	13	49
E-3	34	38	49

- FORCE STRUCTURE REQUIREMENTS SUCH AS ABOVE ARE NOT CONSISTENT WITH AN ORDERLY MOS CAREER PROGRESSION. NEITHER IS THE ENLISTED PERSONNEL MANAGEMENT SYSTEMS (EPMS) STRUCTURED TO PROVIDE THIS PROGRESSION
- THE ARMY-WIDE SUMMATION OF FORCE STRUCTURE DISTRIBUTIONS IS INCONSISTENT WITH EPMS
- THE ARMY SEEKS TO OVERCOME THIS INCONSISTENCY BY TOO-RAPID PROMOTION AND / OR LATERAL TRANSFERS WITHIN A CAREER MANAGEMENT FIELD

2-2571A
DEC 82

ESTABLISHMENT OF SKILL COMPETENCY PAY LEVELS

More pay for more output has long been recognized as simply good management. Increased pay for increased output recognizes the equity involved and further provides assignment flexibility. In fact, some authorized positions could easily be double-slotted – – filled by a leader or technician. This could help smooth out the imbalance in authorized totals by grade in MOS careers – – imbalance in the sense that, for a given pay level, the required grade total should be less than for the pay level immediately below it. Last but not least, training loads may be decreased if more good leaders and good technicians are retained by the Army.

TECHNICIAN RECOMMENDATIONS

A MAJOR CHANGE SHOULD BE MADE IN THE BASIS ON WHICH ENLISTED TECHNICIANS ARE PAID

- ESTABLISH ADDITIONAL TECHNICIAN SKILL PAY LEVELS BASED SOLELY ON DEMONSTRATED TECHNICAL PROFICIENCY TO
  - UPGRADE MAINTENANCE SKILL LEVEL

    RETAINING AND DEVELOPING MORE SKILLED TECHNICIANS WILL PREMIT GREATER FLEXIBILITY IN DESCRIBING FORCE STRUCTURE NEEDS. THIS WILL FACILITATE THE DEVELOPMENT OF A MORE ORDERLY MOS CAREER PROGRESSION
  - REDUCE INITIAL ACQUISITION AND TRAINING REQUIREMENTS

    IMPLEMENTATION OF THIS RECOMMENDATION WILL SAVE MONEY BY EASING THE ENTRY-LEVEL TRAINING LOAD AND POPULATING THE FORCE WITH AN INCREASED NUMBER OF MORE PRODUCTIVE MAINTENANCE AND REPAIR TECHNICIANS

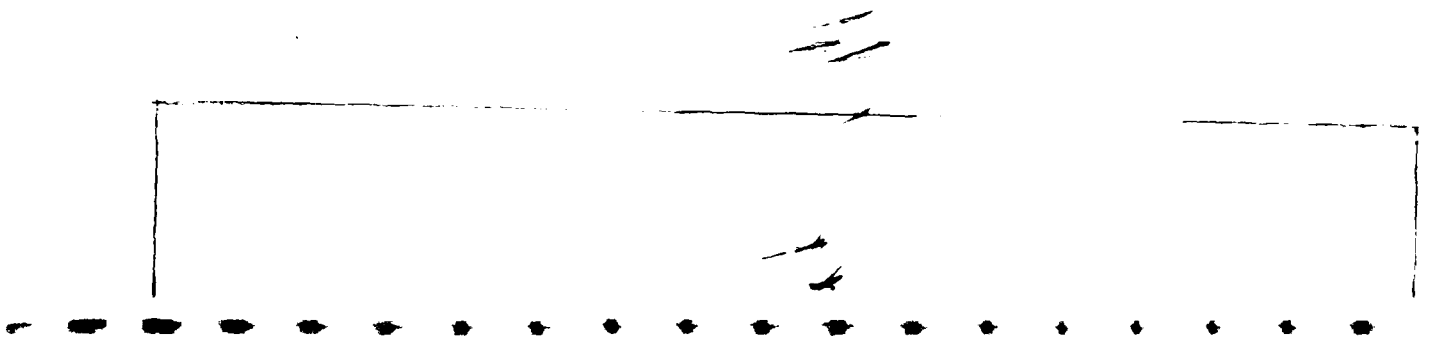
RECOMMENDATION

It is recognized that further study will be necessary to develop detailed implementation plans for the ideas presented here. It is therefore recommended that the Secretary of the Army establish an appropriate group to consider this issue.

RECOMMENDATION
RELATIVE TO ARMY MATERIEL MAINTENANCE

- THAT THE SECRETARY OF THE ARMY AUTHORIZE DEVELOPMENT OF AN IMPLEMENTATION PLAN TO ESTABLISH SKILL COMPETENCY PAY LEVELS IN EXISTING PAY GRADES

2-3086
NOV 82



ASB SUMMER STUDY -- S&E PERSONNEL

ARMY CIVILIAN S&E RESOURCES

2-2573
SEP 82

ARMY CIVILIAN S&E PERSONNEL

Attention is constantly drawn to a purported national shortage of engineers. Whether or not the shortage does exist -- and despite occasional regional mismatches of supply and demand in some fields -- the problems of the Army in recruiting and retaining quality scientists and engineers (S&Es) are only secondarily related to these shortages. This is true primarily because the Army employs only about 1.2% of these people; the Army skill mix lags the current national distribution (and thus the Army does not compete for the newest, smallest components of the pool); and the Army does not usually attempt to compete against industry for the very top new S&Es.

The charts (on the page below) show an exaggerated indication of the Army S&Es presence in the national S&E workforce; if the vertical bars representing Army personnel were drawn to scale, they would be undetectable.

It should be noted that while the total workforce is a shade under 2.5 million, the potential workforce is over 5 million. More than half of those trained to at least the bachelor level in science or engineering are otherwise employed and are not counted in the S&E workforce. Were a true shortage to develop, accompanied by rapid escalation in compensation relative to inflation and competing careers, some now in or about to enter these alternative careers might augment the active S&E pool.

ARMY CIVILIAN S&E PERSONNEL
DISTRIBUTION BY ORGANIZATION & ACTIVITY

- THE ARMY EMPLOYS 8,000 CIVILIAN SCIENTISTS AND 21,600 ENGINEERS

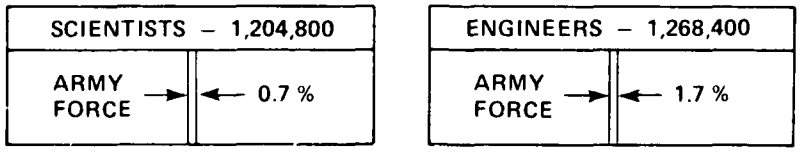
THEY ARE DISTRIBUTED BY ORGANIZATION:

DARCOM	CORPS OF ENGINEERS	OTHER
14,000	11,000	4,600

THEIR ACTIVITIES:

R&D	T&E	CONST	MGMT	OTHER
9,700	7,000	3,800	5,400	3,700

AND, IN COMPARISON TO THE TOTAL U.S. S&E WORK FORCE OF 2,473,200:



SOURCES: NSB SCIENCE INDICATORS 1980 TABLE 5-36
ARMY EMPLOYED S&Es – US ARMY CIVILIAN PERSONNEL INFO SYSTEM

2 2574
SEP 82

ARMY CIVILIAN S&E RESOURCES

While exceptions can be found -- particularly for upper level S&E vacancies left from the massive retirements and resignations in 1979 -- neither available aggregate statistics nor interviews with DA R&D managers support a conclusion that the Army is unable to attract and retain adequate numbers of S&Es. This is particularly true at the "working level" -- GS-7 to GS-13. Since October 1980, the size of the DA S&E workforce has grown by approximately 7%, from 27,500 to 29,600. The Army S&E voluntary loss rate, which in the five-year period '76 through '81 ranged from 1-1/2% to 2-1/2%, compares favorably with the Department of Defense as a whole and with comparable industry statistics.

The fact that there does not appear to be a quantitative problem should not lead to a false sense of security, since there is no objective basis for concluding that the quality is adequate to meet DA requirements. The fact that some 150-200 S&Es voluntarily leave the DA workforce at the GS-12 level annually may not be disturbing in itself. If, however, these losses comprise the higher quality from the journeyman level, as many managers seem to believe, the numbers become alarming.

There is a distinct lack of objective quality indicators. Anecdotal comments can be found to support any claim for current new hire quality, ranging from "quality has never been better" to "none of them are competent." Similarly, quality assessments of existing S&Es are subjective and diverse. Unless the Army commits itself to making objective quality assessments of its staff, which can be monitored for trends, it will, of course, never be in any better position to confidently assess the quality of its S&Es.

The bold new concepts of Air/Land Battle 2000 will require the Army to develop and acquire greatly increased technological capabilities -- quantitatively and qualitatively -- in areas where there is forecast to be a long-term shortage of S&Es.

Complicating the personnel picture, it is estimated that the costs to completion of presently planned Army acquisition programs require a 6% per year real dollar increase in the Army Acquisition Budget. We anticipate strong pressures to reduce personnel costs during this time, a time when the Army must effect major upgrades in its technical capabilities. This could present the Army with the problem of hiring or retraining substantial numbers of S&Es with expertise that is nationally scarce, while possibly reducing the total number of its civilian S&Es.

ARMY CIVILIAN S&E RESOURCES

FINDINGS

- ARMY IS SMALL SUBSET OF NATIONAL S&E LABOR FORCE
- QUANTITY VS QUALITY
  - NO UNUSUAL PROBLEMS WITH UNFILLED VACANCIES OR TURNOVER RATES FOR S&Es IN ARMY ORGANIZATIONS INVESTIGATED
  - NO SYSTEMATIC COLLECTION OF PERSONNEL QUALITY DATA EXISTS; QUALITY DATA ARE ANECDOTAL; NO CONSISTENT TRENDS
  - HIGH GRADE CEILING CREATES QUALITY LEAKAGE AT GS-12
- COSTS TO BUY OUT PLANNED SYSTEMS REQUIRE 6 % / YR REAL DOLLAR INCREASES IN ARMY PROCUREMENT BUDGET
  - WILL CREATE PRESSURE TO REDUCE S&E PERSONNEL COSTS
- ARMY PLANS FOR FUTURE CAPABILITIES (SUCH AS AIR / LAND BATTLE 2000) DEPEND INCREASINGLY ON " BRILLIANT WEAPONS ", INTRICATE C^3 AND ROBOTIC OR HYBRID SYSTEMS
  - WILL CREATE PRESSURE TO INCREASE TECHNICAL QUALITY OF S&Es, AND CHANGE THE SKILL MIX

CONCLUSIONS

- PROBLEM IS QUALITY – NOT QUANTITY
- ARMY BUDGET LIMITATIONS AND A NATIONAL SHORTFALL OF S&Es WILL CREATE PRESSURE TO REDUCE QUALITY

2-2632C
DEC 82

ARMY CIVILIAN S&E RESOURCES (Cont'd)

In the event of a real shortage, and certainly with respect to hiring quality S&Es, the Army is at a competitive disadvantage with the private sector: the Army is unable to pay for expenses incurred in an employment interview, the Army takes a considerable amount of time to make a job offer; and Army starting salaries are lower. While engineers may be hired directly, scientists' names must appear on an OPM register before they can even be considered for employment. This is particularly unfortunate in the case of computer scientists for whom the national shortage is as serious as it is for engineers.

People working for the Army are further frustrated. The current performance appraisal system does not realistically assess the quality of the work of scientists and engineers: high quality performers are not appropriately rewarded. The situation is exacerbated by the difficulty in documenting and implementing the separation of a marginal performer from the S&E workforce, a process which typically takes years and exposes supervisors to the risk of civil suit action. Additional problems result from the lack of a viable non-management career path beyond the GS 12 level. Too frequently the GS-12 scientist or engineer must enter the management track and become a supervisor in order to advance to GS-13. Such an action may erode both technical and management quality. The Army will be deprived of a highly trained S&E with full time scientific or engineering responsibilities and the GS-13 supervisory slot will be filled by an individual who may not be appropriately trained or bent for his/her job responsibilities. Finally, the high grade ceiling lowers morale of junior scientists and engineers. These must frequently choose between leaving the Army at the GS-12 level or switching to management in order to take advantage of artificially restricted promotional opportunities.

ARMY CIVILIAN S&E RESOURCES (CONT'D)

FINDINGS (CONT'D)

- THE PERSONNEL SYSTEM, ADEQUATE FOR THE VAST MAJORITY OF GOVERNMENT EMPLOYEES, ERODES THE QUALITY OF S&E's
  - OPM REGISTERS DENY DIRECT HIRE AUTHORITY FOR SCIENTISTS
  - NO VIABLE NON-MANAGEMENT CAREER PATH
  - MARGINAL PERFORMERS SEPARABLE ONLY WITH GREAT DIFFICULTY
  - HIGH GRADE CEILINGS, SALARY COMPACTION DISCOURAGING

2-3082A
DEC 82

ARMY CIVILIAN S&E RESOURCES (Cont'd)

In the organizations that were visited, Army S&Es were frustrated by the steady increase of the amount of time spent on administrative chores. As these activities infringe upon the time of S&Es that could be spent on scientific matters, the results are an underutilization of the expertise of S&Es and damage to their morale.

There was no visible evidence that those "Carlucci Initiatives" that were aimed at problems such as these were being felt at the levels visited. Also, the recommendations made by the ASB *ad hoc* subgroup, chaired by Dr. Yaru, on "Improving the Acquisition Process" aimed at improving efficiency, should significantly improve the utilization of S&Es and improve morale when they finally "trickle down" to the working levels. The three recommendations relevant to Army S&Es are those concerned with

- Decentralization (Carlucci Decision No. 1)
- Reduced Administrative Costs and Time for Procurement (Carlucci Decision No. 2)
- Reduction and Simplification of Army Directives (Carlucci Decision No. 14).

While one can argue the appropriate size of the Army in-house effort, if it exists at all, it must be first rate. First rate research and development requires the best available equipment. At the present time, we feel that most Army R&D equipment is modern and is of acceptable quality, but subject to rapid obsolescence. Computers represent a special instance of such research equipment.

Army management does not emphasize long-term, structured professional development for Army S&Es. The tendency is to support short-term training, or retraining as necessary, to meet current needs. Most long-term training and career development is initiated by individuals and is supported restrictively. Few Army S&Es receive substantial career renewal, e.g., sabbaticals. Indeed, since the USDR&E 19 July 1982 directive, defense contractors can use DOD money to allow their employees to earn degrees; Army employees cannot.

ARMY CIVILIAN S&E RESOURCES (CONT'D)

FINDINGS (CONT'D)

- MANAGEMENT PRACTICES ERODE THE PRODUCTIVITY OF ARMY S&Es
  - WHEN "CARLUCCI INITIATIVES" TRICKLE DOWN – PERHAPS FEWER BUREAUCRATIC FRUSTRATIONS
  - ARMY LAB EQUIPMENT OFTEN NOT COMPARABLE IN QUALITY TO BEST PRIVATE AND OTHER GOVERNMENT LABS, AND THREATENED BY INCREASINGLY RAPID OBSOLESCENCE
  - MANAGEMENT EMPHASIZES SHORT-TERM, STOP-GAP TRAINING OF ARMY S&Es TO MEET PERSONNEL SHORTAGES RATHER THAN LONG-TERM PLANNED PROFESSIONAL DEVELOPMENT

ARMY CIVILIAN S&E RESOURCES (Cont'd)

Because the Army is a part of the Federal Government, Army S&Es share in the highly negative public image that most Federal Government employees are "incompetent bureaucrats" rather than quality professionals. Furthermore, since less faculty research is sponsored by the Army than by any other major government source, university students are less often exposed to the nature of Army technical problems than to those of the other services or to the research priorities of the National Science Foundation, etc. This campus image of Army civilian R&D is unflattering at best, and certainly does not include interesting S&E problems and opportunities.

Ethnic minority and women S&Es are an underutilized resource of the nation. They comprise a talent pool that could be disproportionately attracted to an organization that had a clear commitment to assisting them in achieving their career goals. To do so, it would be necessary to accommodate special needs, such as those of some women for occasional periods of part-time work, temporary leaves of absence, etc., without penalty to their over-all career progress.

ARMY CIVILIAN S&E RESOURCES (CONT'D)

FINDINGS (CONT'D)

- THE PUBLIC AND CAMPUS PERCEPTION OF FEDERAL / ARMY EMPLOYMENT IS NEGATIVE
  - " EMPLOYEES ARE MORE BUREAUCRATS THAN PROFESSIONALS "
  - ARMY R&D NOT VISIBLE AS A QUALITY TECHNICAL ENDEAVOR
- THE ARMY, WITH NO MORE THAN A TYPICAL COMPLEMENT OF WOMEN AND MINORITY S&Es, DOES NOT PROVIDE EXCEPTIONAL ROLE MODELS

CONCLUSION

- THE IMAGE OF ARMY R&D REDUCES ITS S&E RECRUITING POOL

2-2578A
DEC 82

RECOMMENDATIONS
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

Each of the indicated *recommendations is* discussed in detail on the following pages.

RECOMMENDATIONS
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

(1) EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION TO ESTABLISH A PERFORMANCE-BASED PERSONNEL SYSTEM

(2) DEVELOP AND IMPLEMENT ADVANCED DEGREE PROGRAMS – VIA DARCOM AND OTHER RELEVANT ORGANIZATIONS

(3) DEVELOP QUALITY ASSESSMENT PROCEDURES FOR ARMY R&D ORGANIZATIONS

(4) REQUEST OPM UPDATE S&E RECRUITMENT PRACTICES

(5) INITIATE AND EXPAND S&E PRODUCTIVITY IMPROVEMENT PROGRAMS

(6) MOUNT A NATIONAL PUBLICITY CAMPAIGN TO PROMOTE WORKING AS CIVILIAN S&Es FOR THE ARMY

2-2579A
SEP 82

NAVY PERSONNEL PROJECT

Under authority of the Civil Service Reform Act of 1978 (CSRA) – Title VI, the Navy department initiated a five-year demonstration project in August 1980 to address key problem areas under the existing personnel system – – problems the ASB has again identified as acutely affecting Army R&D managers' ability to maintain and improve the quality of their S&Es. Key problem areas addressed are: (1) Using an individual's performance as a basis for assignment, promotion (demotion), and – – if necessary – – termination. (2) Linking pay to performance. (3) The job classification system. (4) Reduction-in-Force (RIF) procedures.

Because the "pay bands" were confused with "merit pay" or "incentive pay" selection procedures, too many people (98.8% of the workforce) were deemed eligible for incentive pay. For this reason, and others, the ASB has addressed not the NOSC/NWC experiment but rather draft legislation now being considered.

While results of the experiment to date have been encouraging, they also have suggested the need for further innovations and improvement. Furthermore, legislative changes are necessary to provide a nonexperimental statutory basis for the improvements to the Personnel system – – specifically as amendments to Title V, United States Code, Chapters 55 and 56. DOD has designated the Department of the Navy as its representative for this legislative initiative. A "Demonstration Working Group" chaired by George P. Steinhauer was formed to review and revise draft legislation during the summer and early fall of 1982.

NAVY PERSONNEL PROJECT

- CIVIL SERVICE REFORM ACT AUTHORIZES DEMONSTRATION PROJECTS DESIGNED TO IMPROVE THE PERFORMANCE OF FEDERAL EMPLOYEES (MAX : 12 GOVERNMENT WIDE / 5000 PEOPLE EACH / 5 YEARS)

- IN 1981 NAVAL OCEAN SYSTEMS CENTER (NOSC) / SAN DIEGO, CA AND NAVAL WEAPONS CENTER (NWC) / CHINA LAKE, CA INITIATED A PROGRAM FOR S&Es WHICH :
  - ROLLED GS 5-15s INTO FOUR POSITION CLASSIFICATION LEVELS
  - SET BROAD PAY BANDS WITHIN THESE CLASSIFICATIONS
  - DEVELOPED SIMPLIFIED CLASSIFICATION AND PERFORMANCE STANDARDS
  - LINKED PAY TO PERFORMANCE THROUGH FORMAL OBJECTIVES
  - PROVIDED FLEXIBILITY FOR DOWNWARD CLASSIFICATION
  - MADE PERFORMANCE A MAJOR FACTOR IN REDUCTION-IN-FORCE SITUATIONS
  - PROVIDED FOR TRANSITION TO / FROM THE REGULAR CIVIL SERVICE

- FOLLOW-ON PLANNED TO INCLUDE NON-PROFESSIONAL SPECIALISTS, ADMINISTRATIVE, AND CLERICAL / SECRETARIAL CATEGORIES

- PROGRESS REPORT : IT'S A WINNER !

2-2618
SEP 82

RECOMMENDATION (1)

The CSRA (1978) experiment is the basis for proposed legislation to create a performance-based personnel system. The experiment should not be adopted without change, however.

Army participation with the working group is strongly recommended to ensure that draft legislation (as of June 1982) is expanded and modified to contain components that the ASB believes are absolutely essential in order to solve the problems of the personnel management system relative to S&E personnel. Specific changes and additions recommended by the ASB relate to (1) replacing the "performance grades" of the Navy experimental system with performance percentile rankings, (2) mandated removal of consistently low-ranked performers, (3) guaranteed immunity from personal liability when civil suits result from management personnel actions, (4) automatic indexing of compensation schedules to regional norms, (5) removing the "pay cap", and (6) adjusting salaries on the basis of comparing total compensation (including perquisites) of regional competitors for S&Es.

With the recommended additions, the ASB believes that the proposed legislation would represent a sound adaptation of the successful present-day S&E personnel management practices of the private sector, rather than simply translating the Navy experiment -- including any flaws -- into law.

RECOMMENDATION (1)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION TO ESTABLISH A PERFORMANCE-BASED PERSONNEL SYSTEM BUILT ON RESULTS OF NAVY "EXPERIMENT"
  - GIVE MANAGERS REAL AUTHORITY TO USE PERFORMANCE AS A BASIS FOR ASSIGNMENT, PROMOTION, DOWNGRADING AND TERMINATION
  - IMPROVE COMPENSATION SYSTEM
  - REVISE JOB CLASSIFICATION SYSTEM TO CREATE S&E CAREER PATH
  - REVISE RIF PROCEDURES TO PROTECT QUALITY
- TAKE ADVANTAGE OF PRESENT OPPORTUNITY TO INFLUENCE "DEMONSTRATION PROJECT WORKING GROUP"

2-2580A
SEP 82

RECOMMENDATION (1) (Cont'd)

Annual percentile ranking of S&E personnel would identify both excellent and submarginal performers, and should be a required administrative procedure. This ranking is done in the private sector. Implementation has been invariably difficult, but the benefits of such ranking systems far outweigh the problems of its creation. That it has not succeeded with other governmental groups (e.g., Officer Performance Reviews) should not be justification for avoiding it for Army civilian S&Es.

By necessity, the lowest percentiles will always be populated. While being ranked in the lowest percentiles occasionally does not preclude being of at least potential value, the ASB does believe that being consistently ranked in the lowest percentiles would be a strong indication of being of low value. Legislatively permitted removal of such low value personnel is recommended by the ASB. The Department of the Army should support legislative action, such as HR24, which would establish in law the principle of immunity from civil suit for government officials who take actions within the scope of their management responsibilities.

RECOMMENDATION (1) CONT'D
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION . . .
  - GIVE R&D MANAGERS REAL AUTHORITY TO USE PERFORMANCE AS BASIS FOR ASSIGNMENT, PROMOTION, DOWNGRADING AND TERMINATION
    - MATCH INDIVIDUAL COMPETENCE TO JOB REQUIREMENTS
    - STREAMLINE ADMINISTRATIVE PROCESS
    - *REQUIRE ANNUAL PERCENTILE RANKING OF S&Es TO IDENTIFY KEY PERSONNEL AND MARGINAL PERFORMERS
    - *PERMIT REMOVAL OF CONSISTENTLY SUB-MARGINAL PERFORMERS
    - *GUARANTEE IMMUNITY FROM PERSONAL LIABILITY WHEN CIVIL-SUITS RESULT FROM MANAGEMENT ACTIONS

* NOT PRESENTLY INCLUDED IN PROPOSED LEGISLATION

2-2581B
DEC 82

RECOMMENDATION (1) (Cont'd)

The Draft Legislative Proposal from the Demonstration Project Working Group includes the linkage of pay changes to performance ratings. Within job classification pay bands employees should receive salary increases based only on contributions and higher performance. The sole determining factor should be the employee's performance appraisal, regardless of time spent within the pay band. Employees whose performance is judged marginal or adequate may receive no or limited pay increases. Combined with cost-of-living increases for the pay bands, an employee's salary may then fall below the lower limit of his/her job classification pay band. The Legislative Proposal provides for the automatic migration of such an employee to the next lower pay band. This action is not to be considered an adverse action requiring rights of appeal and other aspects of due process.

To retain the present workforce of Army scientists and engineers and to be better able to recruit S&Es in all geographic locations, the Army should include in the Legislative Proposal career compensation benefits that are commensurate with the regional professional norms of industry, academic, and not-for-profit organizations. Such regional norms are standard industrial practice.

Most such career compensated packages include more than salaries and fringe benefits. They also contain benefits such as support to attend professional meetings, incentive awards and bonus pay, sabbaticals and other less tangible rewards. The Army should incorporate some of these benefits, as they compare with the professional norms of industry and not-for-profits in the nearby areas, in addition to funding one-shot merit awards and removing the government pay cap. Furthermore, compensation plans/packages should be automatically revised annually by qualified individuals, in order that the Army remain regionally competitive. This implies that the Army must have the authority to make these revisions free from congressional approval.

RECOMMENDATION (1) CONT'D
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION . . .
  - IMPROVE COMPENSATION SYSTEM
    - LINK PAY CHANGES TO PERFORMANCE RATINGS
    - "ZERO RAISES AND DOWNWARD MIGRATION" NO LONGER TO BE CONSIDERED "ADVERSE ACTION"
    - FUND ONE-SHOT MERIT AWARDS LIBERALLY
    - *– EVALUATE TOTAL COMPENSATION – NOT JUST SALARY
    - *– MAKE CAREER COMPENSATION COMPARABLE TO REGIONAL PROFESSIONAL NORMS
    - *– REMOVE PAY CAP

* NOT PRESENTLY INCLUDED IN PROPOSED LEGISLATION

2-2582A
SEP 82

RECOMMENDATION (1) (Cont'd)

The semiautomatic increases in pay reduce initiative among S&Es. Performance/pay measures, broader pay ranges, and the opportunity to rise as a working S&E (rather than becoming a manager) have been cited as desired changes to the ASB by both junior and senior Army research and development personnel.

The High Grade Ceiling has produced roughly the same distribution of populations in the GS-12 and GS-13 grades as existed when managers were held to total numbers and average grade levels. Legislation to permit Army adoption of such management control measures should be sought.

RECOMMENDATION (1) CONT'D
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION . . .
  - REVISE JOB CLASSIFICATION SYSTEM TO CREATE S&E CAREER PATH
    - USE FEWER BUT BROADER GRADES
    - BASE GRADE CHANGES ON PERFORMANCE
    - DEVELOP REALISTIC DUAL-LADDER NON-SUPERVISORY CAREER OPTION
    - REMOVE HIGH GRADE CEILINGS

2-2623-1
NOV 82

RECOMMENDATION (1) (Cont'd)

RIF procedures should be revised to protect the ability of the organization to perform its functions for the benefit of the public. To this end, the primary concern in a RIF should be maintenance of the quality of the retained S&E workforce. By grouping by performance, managers can establish RIF ladders so that seniority protects only within a competence group. Thus, if a RIF required a 7% reduction, all of the bottom 5 percentile group might go and the least senior one-eighth of the next 20 percentile group (using a five group, 5/20/50/20/5, ranking).

New blood is critical to the viability of a research organization. To provide sufficient protection, all quality new hires should go into RIF-shielded, three-year trainee programs.

RECOMMENDATION (1) CONT'D
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- EXPAND AND VIGOROUSLY SUPPORT PROPOSED LEGISLATION . . .
  - REVISE RIF PROCEDURES TO PROTECT QUALITY
    - COMBINE PERFORMANCE RATING GROUPS INTO RETENTION GROUPS
    - RECOGNIZE SENIORITY AND VETERANS PREFERENCE, AS SUBORDINATE TO PERFORMANCE WITHIN RETENTION GROUPS
    - PROTECT QUALITY NEW HIRES FROM RIF

2-2625-1
NOV 82

RECOMMENDATION (2)

Army scientists and engineers are frequently local experts in their areas of technical competence. Army installations -- particularly the laboratories -- may have research equipment unavailable to local colleges and universities. We urge DARCOM (and other relevant organizations) to extend present programs with colleges and begin new ones aimed at utilizatic n of Army personnel (as formal instructors and research advisors) and Army facilities (as research tools) to produce M.S. and perhaps Ph.D. graduates. As those elements that contribute to successful programs emerge, other parts of the Army should adopt/adapt them for their own programs.

Models for these programs already exist. There are 1200 evening school students at The Johns Hopkins University who are taught at the Applied Physics Laboratory by instructors who are usually APL employees exceptionally qualified in their areas. The curricula lead to M.S. degrees; about 20% of the students are APL employees.

At the Lawrence Livermore National Laboratory over 100 graduate students are working for M.S. and Ph.D. degrees in the Department of Applied Science (D.A.S.). D.A.S. is a department in the College of Engineering of the University of California, Davis -- Davis and Livermore are 70 air-miles apart! Students not only have access to some $150 million of research equipment but also receive all their formal course-work at Livermore.

RECOMMENDATION (2)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- DEVELOP AND IMPLEMENT ADVANCED DEGREE PROGRAMS – VIA DARCOM AND OTHER RELEVANT ORGANIZATIONS
  - SUCH PROGRAMS SHOULD BE PRODUCED IN COLLABORATION WITH MAJOR, LOCAL UNIVERSITIES, IF POSSIBLE
  - LAB PERSONNEL SHOULD BE AMONG TEACHING FACULTY
  - LAB EMPLOYEES SHOULD BE AMONG THE STUDENTS
  - OTHER PARTS OF THE ARMY SHOULD ADAPT SUCCESSFUL PORTIONS OF THESE PROGRAMS THAT ARE SUITED TO THEIR NEEDS

2-2583A
SEP 82

RECOMMENDATION (3)

Models are available that could be adapted for use in assessing the quality of the Army S&E staff and the laboratory environments in which they work. For example, carrying over the procedures used for the accreditation of undergraduate engineering programs and/or graduate academic program reviews, assessment of staff and laboratories by appropriately selected teams of peers outside the individual laboratory (or other R&D group) could be conducted periodically by considering:

A. Quality of S&E Personnel
   1. Individual backgrounds (C.V., publications, patents, sponsored research if applicable);
   2. Value of research or project work to the laboratory's mission;
   3. Attendance at technical meetings;
   4. Relationships with junior staff;
   5. Qualifications to supervise summer employees, graduate students, cooperative education students, junior staff;
   6. Assessment by the laboratory administration;
   7. Morale and esprit de corps.

B. Effectiveness of lab unit in carrying out its mission;

C. Effectiveness of lab unit in selecting and monitoring contractors;

D. Quality of the laboratory equipment;

E. Computer support of the lab unit and degree of staff usage;

F. Support of the S&E staff by the administration of the unit;

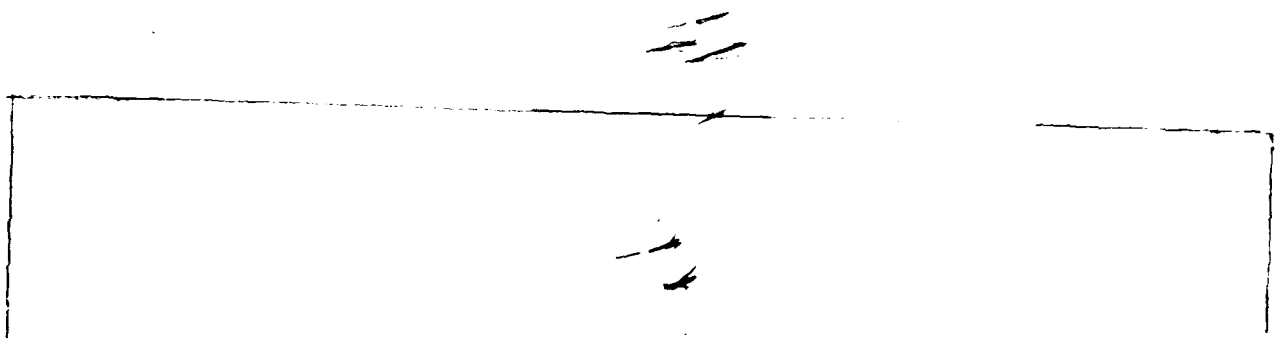
G. Rank within the laboratory structure as seen by: other Army Laboratory managers, ODCSRDA, DARCOM, TRADOC.

(Cont'd on page 71)

RECOMMENDATION (3)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- DEVELOP QUALITY ASSESSMENT PROCEDURES FOR ARMY R&D ORGANIZATIONS IMMEDIATELY, AND UPDATE AT 3 YEAR INTERVALS TO TRACK TRENDS
  - PROVIDE ROUTINE, CREDIBLE ASSESSMENT OF THE "HEALTH" AND CAPABILITY TO ACCOMPLISH MISSION, AS IS DONE IN PRIVATE SECTOR
  - PROVIDE GREATER VISIBILITY OF CAPABILITY TO ARMY MANAGEMENT
  - COULD YIELD RECOGNITION OF IN-HOUSE EFFORTS BY NATIONAL EXPERTS IF EXTERNAL PEERS INCLUDED

2-2584A
SEP 82



RECOMMENDATION (3) (Cont'd)

Members of the quality assessment teams could be selected from among such groups as: other Army Laboratory (technical) directors; staff from ARO, ODCSRDA, DARCOM, TRADOC; academia; professional peers in government laboratories outside the Army, etc. Most would typically be recognized leaders in the field(s) of the laboratory and would have the confidence of the staff under review. Their input would provide the Army with a mechanism for evaluating the laboratories themselves, and hence with a method for indexing the mean performance of a laboratory (or R&D unit) to that of the entire Army system.

The ASB recommends that the amount of the merit pool available to each individual laboratory be established in terms of its relative quality within the Army system as determined by the assessment team. It would still be expected that each laboratory director would rank-order his or her own S&E staff, perhaps in accordance with items A-1 through A-7 above, in order to distribute the merit rewards available. It is further anticipated that appropriate corrective actions would be taken in the face of declines in quality.

It is recommended that individual S&E staff reviews be performed annually and that records be kept to immediately identify trends. Outside team assessments should be conducted on a regular, but less frequent basis, and on a time scale to be established by the Department of the Army. We suggest an interval of three years.

In this manner, the Army would establish a Quality Assurance Program for its S&E personnel.

RECOMMENDATION (3)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- DEVELOP QUALITY ASSESSMENT PROCEDURES FOR ARMY R&D ORGANIZATIONS IMMEDIATELY, AND UPDATE AT 3 YEAR INTERVALS TO TRACK TRENDS
  - PROVIDE ROUTINE, CREDIBLE ASSESSMENT OF THE "HEALTH" AND CAPABILITY TO ACCOMPLISH MISSION, AS IS DONE IN PRIVATE SECTOR
  - PROVIDE GREATER VISIBILITY OF CAPABILITY TO ARMY MANAGEMENT
  - COULD YIELD RECOGNITION OF IN-HOUSE EFFORTS BY NATIONAL EXPERTS IF EXTERNAL PEERS INCLUDED

2-2584A
SEP 82

RECOMMENDATION (4)

As noted in the Findings (cf. p. 47), the Army currently faces special hiring problems for scientists; scientists must be listed on an OPM register before they can be considered for employment. This time-consuming process has been eliminated for engineers; it is equally important to eliminate it for the categories of scientists who are in great demand (e.g., computer scientists).

Clearly the Army would be more competitive in hiring top-notch people if it could pay for expenses involved in employment interviews; this issue should be attacked.

Relative to reimbursement for educational costs leading to a degree, reference should be made to a July 19, 1982 letter from the USDRE which addresses the decline in numbers of engineering graduate students and research-oriented faculty, and the related shortage of advanced-degree talent available in defense work. The letter encourages DOD contractors to provide graduate level educational opportunities for their engineers with costs covered by the Department of Defense. To do this the letter notes that DAR 15-205.44(g) provides for educational cost recovery for courses or degrees. Under the Government Employees Training Act, the S&Es employed by the Army are specifically denied support to pursue a degree; instead reimbursement of educational costs for Army S&Es is limited to costs only of courses which can be directly related to job requirements. The ASB recommends that OPM seek legislative authority to eliminate this difference and allow reimbursement of government S&Es for costs of degrees.

RECOMMENDATION (4)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- REQUEST OPM UPDATE S&E RECRUITMENT PRACTICES
  - FIX OR BYPASS OPM REGISTER SYSTEM FOR NEEDED SCIENTISTS
  - EXTEND DIRECT HIRE AUTHORITY FOR ENGINEERS *TO SCIENTISTS (E.G., COMPUTER SCIENTISTS)*
  - REIMBURSE JOB INTERVIEW EXPENSES
  - REIMBURSE COSTS LEADING TO DEGREE RATHER THAN FOR INDIVIDUAL COURSES

2-2585
SEP 82

RECOMMENDATION (5)

The ASB summer study subgroup on S&E Personnel endorses the recommendations of the Yaru ASB *ad hoc* subgroup report and urges the Army to implement them as rapidly as possible, in order to improve acquisition, utilization, and retention of Army civilian S&Es.

Efforts must be made to keep official channels of communication open at all levels. "Quality of Professional Life" committees, which include junior researchers, have been quite successful in improving communication between top management and all levels of the organization. Such mechanisms, of which a "Quality of Professional Life" committee is only one, should be instituted in all installations employing S&Es.

The objective of all training of S&Es must be not only to provide the appropriate personnel for near-term missions but also to invest in the personnel required for implementation of the Long Range Research Plan. Continuing Education programs must be expanded to include long-term career development, e.g., the earning of advanced degrees. Career renewal and training which yields a shift in career emphasis must be readily available if the Army is to make maximum use of its S&Es in fulfilling projected long-term personnel needs and prevent obsolescence of its S&E talent. Rotation of researchers into the user community is an aid to complete understanding of the research necessary to accomplish mission objectives.

The general principle of laboratory automation and the introduction of modern technology to labs must be supported to compensate for the decline of technical support and, thus, to prevent the underutilization of S&Es. If automation is not possible, additional personnel must be acquired to provide support services which are responsive to the needs of S&Es. The Army must exercise care to protect, renew, and, upgrade its equipment assets for continued R&D productivity and full utilization and retention of S&Es.

When computers were first introduced, they were very expensive, required a large number of staff, and had little software transportability between machines. Hence, special controls and procedures on purchase of computers were imposed. Today the special restrictions are no longer needed and serve only to slow the appropriate introduction of computer techniques into Army labs. Lack of such equipment, especially in lab automation, contributes to the underutilization of S&Es.

RECOMMENDATION (5)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- INITIATE AND EXPAND S&E PRODUCTIVITY IMPROVEMENT PROGRAMS AT ALL ARMY INSTALLATIONS
  - REDUCE BUREAUCRATIC BURDENS (CARLUCCI / YARU)
  - INSURE CLEAR AND CONSISTENT COMMUNICATIONS AT ALL LEVELS
  - MAKE ABUNDANT USE OF FORMAL EDUCATION AND FIELD EXPERIENCE TO IMPROVE QUALITY, AND PREVENT OBSOLESCENCE OF S&Es
    - SYSTEMATIC, LONG-TERM PROFESSIONAL EDUCATION OF ARMY S&Es SHOULD BE KEYED TO ARMY LONG-RANGE PLAN
  - PROVIDE MORE COMPUTER-AIDED-DESIGN AND LAB AUTOMATION
  - INCREASE CLERICAL AND PARAPROFESSIONAL SUPPORT
  - SUPPORT RENEWAL AND REPLACEMENT OF EQUIPMENT / FACILITIES
  - REMOVE COMPUTERS FROM SPECIAL PROCUREMENT STATUS

2-2586
SEP 82

RECOMMENDATION (6)

To attract more civilian scientists and engineers to work for the Army and to dispel the very negative public image of the federal government employee, the Secretary of the Army should verify that key elements of job satisfaction exist within the Army system, enhancing these where necessary and then initiate a national public relations campaign to extol the benefits of working for the Army. This campaign should emphasize that the Army scientist or engineer works at the forefront of technology with high quality peers on challenging and responsible assignments as a part of the national defense team. The campaign should highlight the educational opportunities offered by the government. These positive elements are those now frequently mentioned by Army S&Es and such a publicity campaign will demonstrate that the government worker is more than a bureaucrat but, first and foremost, a professional.

If this campaign is directed toward the pool of women and minority scientists and engineers, stressing real and highly visible career advancements achieved by and available to them as Army civilian S&Es, a disproportionate percentage of this S&E talent pool can be expected to view the Army as a top rank desirable employer.

RECOMMENDATION (6)
RELATIVE TO ARMY CIVILIAN S&E RESOURCES

- MOUNT A NATIONAL PUBLICITY CAMPAIGN TO PROMOTE WORKING AS CIVILIAN S&Es FOR THE ARMY

  SEC ARMY COULD IMPROVE THE KEY JOB ELEMENTS THAT MAKE CIVILIAN S&E CAREERS ATTRACTIVE. AFTER ASSURING HIMSELF THAT SUCH ELEMENTS ARE UNIFORMLY AVAILABLE, HE SHOULD CONSIDER A NATIONAL PUBLIC RELATIONS CAMPAIGN TO PROMOTE THE BENEFITS OF WORKING AS A CIVILIAN S&E FOR THE ARMY.

  FREQUENTLY MENTIONED ELEMENTS INCLUDE :

  - WORK ON FOREFRONT OF TECHNOLOGY
  - CHALLENGING AND RESPONSIBLE ASSIGNMENTS
  - HIGH QUALITY PEERS
  - HIGHLY VISIBLE CAREER OPPORTUNITY FOR WOMEN AND MINORITIES
  - PART OF NATIONAL DEFENSE TEAM
  - EDUCATIONAL OPPORTUNITIES

- CAMPAIGN SHOULD INCLUDE TARGETING OF WOMEN AND MINORITY S&E's

ASB SUMMER STUDY -- S&E PERSONNEL

UNIVERSITY AND INDUSTRY RESOURCES

2-2588
SEP 82

CRISIS IN ENGINEERING EDUCATION

No one has been able to establish an "ideal" student/faculty ratio; nor has anyone been able to ascertain the maximum ratio beyond which the quality of education declines.

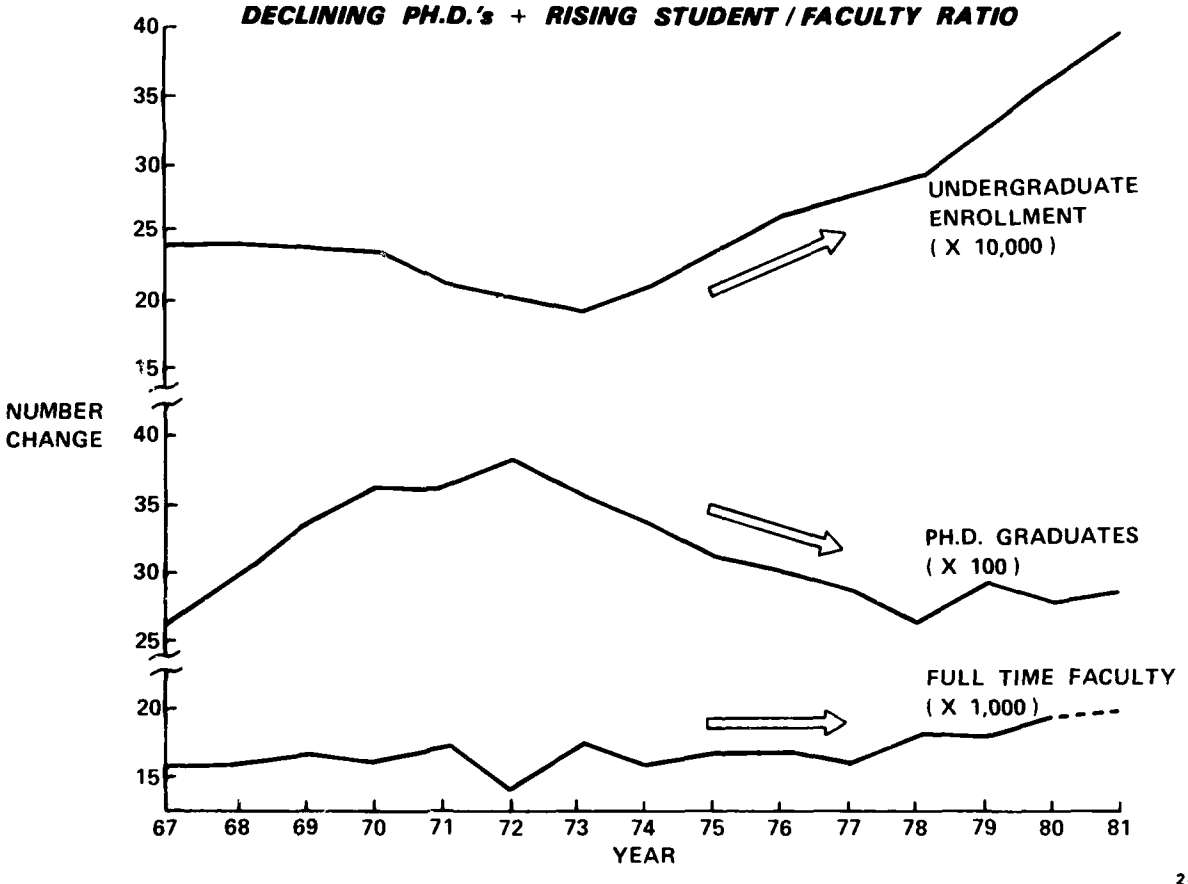
However, based on authoritative statistics of the past 15 years it is clear that neither the number of faculty nor the number of new Ph.D.s (the pool from which faculty is drawn) are growing as fast as is undergraduate engineering enrollment.

In particular, the over-all student/faculty ratio in U.S. engineering schools has increased by nearly 50% since 1974 and is continuing to increase. Furthermore, the number of new engineering Ph.D.s has been declining since 1972; most of this decline is due to declining numbers of U.S. citizens earning Ph.D.s. As a result the outlook for the next decade is a further reduction in engineers qualified to fill faculty positions with the likely outcome being further increases in the student/faculty ratio. It is certain that if these trends continue, the quality of undergraduate education for engineers will -- at some point -- deteriorate to an unacceptable level.

The Deans of the 287 accredited U.S. engineering schools formally recorded their concern about this decline in the quality of engineering education during the June 1982 ASEE national convention. They have recommended temporary reduction of undergraduate enrollment and substantial new incentives to increase Ph.D. enrollments as a strategy to reverse these destructive trends and, thereby, ensure adequate engineering manpower of acceptable quality by the end of the century.

In the meantime, the ASB urges the Army to implement its recommendations regarding quality assessment and improvement of civilian S&Es to minimize the risk of further quality declines within the Army due to shortfalls in the U.S. engineering schools.

CRISIS IN ENGINEERING EDUCATION =
DECLINING PH.D.'s + RISING STUDENT / FACULTY RATIO



DATA SOURCES : AMERICAN SOCIETY FOR ENGINEERING EDUCATION
ENGINEERING MANPOWER COMMISSION

2-2589
SEP 82

FINDINGS

In addition to sharply increasing student/faculty ratios, U.S. engineering schools are suffering from a serious shortage of support budgets (travel, maintenance, technicians, etc.) and laboratory teaching equipment. Industry experts estimate $500M-$1B/year for ten years is needed to restore U.S. engineering schools' ability to provide high quality engineering education.

Traditional patterns of Army funded research do not include unrestricted exploratory research desired by University faculty. Consequently, very little of the Army R&D effort is visible to faculty, or students on University campuses. This lack of direct visibility is further exacerbated by the Army's failure to place its qualified employees in major university teaching positions as adjunct faculty or as resident graduate students on long term educational leaves of absence.

FINDINGS
RELATIVE TO UNIVERSITY AND INDUSTRY RESOURCES

- ENGINEERING SCHOOLS SUSPECT QUALITY OF THEIR EDUCATION DECLINING -- NEED ASSISTANCE
- ARMY'S NEED FOR "DIRECTED" RESEARCH MAKES IT LOW CHOICE AS FACULTY PATRON
- ARMY'S R&D EFFORT NOT VISIBLE ON CAMPUS
  - FAILS TO PLACE ITS QUALIFIED EMPLOYEES IN UNIVERSITY TEACHING / RESIDENT PROGRAMS
- SYSTEM ACQUISITION PROCESS TENDS TO FORCE INDUSTRY TO MAKE INEFFICIENT USE OF S&Es

FINDINGS (Cont'd)

Multiple contractor competitions may result in largely wasted effort by many of the best S&Es of the losers. This may amount to the loss of tens to thousands of valuable man-years. The waste is particularly evident when: all contractors are technically qualified; the Army specifies the design point details; and the competition seeks only to establish the lowest credible cost estimate. Here, the low bid may result from minimum factory costs, yet the most creative and competent S&Es of the losing contractor(s) waste their time producing separate designs, all of which meet Army specs.

The procurement system used by most DOD agencies attempts to minimize risk by running all phases of a new program largely in series, and frequently based on inadequate specs. This approach not only takes very much longer than necessary but usually gets equipment into the field so late that, not only is the time of contractor S&Es wasted in making design changes to eliminate field problems, but also to overcome degrees of obsolescence resulting from stretched-out program schedules.

Many Army design points involve complete system integration aimed at minimizing initial acquisition cost. They make no provision, provide no budget, and give no competitive credit for designs having minimum times and costs for system upgrades to overcome obsolescence. This ca. result in the use of numerous contractor S&E man-years for major redesigns, or completely new programs to correct a system for obsolescense of some of its key elements, despite the fact that other elements may not be obsolete for many years.

In the drive for minimum acquisition costs, Army requirements frequently omit the specification of extra efforts to make the systems easy to operate and maintain. As a result, additional contractor S&Es with training, interface equipment, and modification programs are required to make the system adequately operable and supportable in the field.

The use of computers for various types of engineering and scientific work can substantially reduce the total S&E hours required for a program, particularly during large program buildups requiring numerous new hires. However, many companies, particularly at the second and third tier subcontract level cannot afford the cost for the training software and software management as normal capital expenditures required by computer intensive systems. Accordingly, they expect to hire additional S&Es to meet their contract commitments. Of course, those larger companies who have been able to afford computerized engineering enjoy major competitive advantages.

FINDINGS (CONT'D)
RELATIVE TO UNIVERSITY & INDUSTRY RESOURCES

- ACQUISITION METHODS FOR NEW DESIGNS CREATE EXCESSIVE NEEDS FOR S&Es TO COMPETE FOR PROGRAMS AND CORRECT FIELD DEFICIENCIES
- SYSTEM DEFINITIONS NEGLECT COST AND TIME FOR SUBSEQUENT ANTI-OBSOLESCENCE PROGRAMS WITH ADDITIONAL S&E REQUIREMENTS
- SYSTEMS ARE SELDOM "USER-FRIENDLY" AND REQUIRE SKILLED S&Es FOR TRAINING, OPERATIONAL READINESS TESTING, MAINTENANCE AND REPAIR
- MANY COMPANIES CANNOT AFFORD THE INITIAL INSTALLATION COSTS OF COMPUTER SYSTEMS FOR DESIGN, ANALYSIS, SIMULATION, TEST AND DATA MANAGEMENT WHICH COULD REPLACE S&Es. THOSE ALREADY INSTALLED GIVE COMPETITIVE ADVANTAGE

RECOMMENDATIONS
RELATIVE TO UNIVERSITY AND INDUSTRY RESOURCES

Each of the indicated recommendations is discussed in detail on the following pages.

RECOMMENDATIONS
RELATIVE TO UNIVERSITY & INDUSTRY RESOURCES

(1) REDUCE S&E MANPOWER REQUIREMENTS BY IMPROVING THE SYSTEMS ACQUISITION PROCESS

(2) STRENGTHEN TIES AMONG ARMY, DEFENSE CONTRACTORS, AND UNIVERSITIES

(3) SUPPORT – VIA ARO – ADDITIONAL UNIVERSITY CENTERS OF EXPERTISE IN SELECTED TECHNICAL AREAS CRITICAL TO ARMY

2-2591A
SEP 82

RECOMMENDATION (1)

Army acquisition procedures which may presently exacerbate contractor needs for S&Es can be largely corrected by expediting implementation of those Carlucci Initiatives and Yaru ASB Committee recommendations related to over-all procurement efficiency. In particular, more clearly defined selection criteria, including identification of disqualifiers (such as overload, lack of credible capacity, lack of credible ability to build-up, etc.) could discourage potential losers from entering competitions, thereby, probably reducing the number of companies that waste S&E efforts by 40% to 60%.

The new DARCOM planning system should result in much better resource allocation, program prioritization, program integration, and assurance that Army technical activities are focused on the operational requirements, doctrine, tactics, and missions of Air/Land Battle 2000. This should minimize unproductive, improperly phased, and obsolescent efforts, with consequent reductions in demand for S&Es to meet Army needs. The planning system can also properly be expanded to include formal methods for anticipating shortages of S&Es in time to nullify their effects.

The Carlucci Initiative on Pre-Planned Product Improvement (P^3I) can minimize the requirement for S&Es involved in unnecessary redesigns or programs to replace obsolete elements. System designs frequently have twice the potential life of some of their subsystems, which, in turn, have twice the potential life of some of their components. Recognition of these facts in the RFP and provision of both budget and evaluation criteria that recognize the value of P^3I can have multiple program payoffs.

However, P^3I requires standardization of such characteristics as system architecture, protocol, and programming languages, which tend to resist rapid obsolescence.

Army program emphasis on "user friendly" characteristics can have major payoffs in operability and support of fielded equipment. Success will reduce the number of S&Es required to modify a system and to provide special interface and/or test equipment after the system has been found unsatisfactory in the field. Equipments can be made "user friendly" by properly specified operability and service characteristics. These will involve such items as built-in-test equipment, the employment of "user friendly" software; "hands off" field and factory test equipment; and the application of human factor technology to all operations and interfaces of equipments with operator and support personnel.

Demands for S&Es can be reduced by strongly encouraging the use of computers for analysis, simulation, design, testing, and data management. Although such use of computers is usually considered primarily a cost and time saver with attractive payback times, some contractors cannot afford the initial cost or operational disruption they entail without special contract considerations.

RECOMMENDATION (1)
RELATIVE TO UNIVERSITY & INDUSTRY RESOURCES

- REDUCE S&E MANPOWER REQUIREMENTS BY IMPROVING THE SYSTEMS ACQUISITION PROCESS
  - EXPEDITE IMPLEMENTATION OF THE CARLUCCI INITIATIVES AND YARU COMMITTEE RECOMMENDATIONS AFFECTING ACQUISITION EFFICIENCY
  - EXPEDITE IMPLEMENTATION OF ARMY PLANNING INITIATIVES FOR BETTER OPERATIONAL-TECHNOLOGICAL SYNERGY IN PROGRAM DEFINITION AND PRIORITIES
  - EXPEDITE IMPLEMENTATION OF PREPLANNED PRODUCT IMPROVEMENT (P^3I) TO MINIMIZE S&E NEEDS FOR FUTURE ANTI-OBSOLESCENCE PROGRAMS
  - EMPHASIZE UTILIZATION OF BITE, USER FRIENDLY SOFTWARE AND HUMAN FACTOR TECHNOLOGY IN INTERFACES OF EQUIPMENT WITH OPERATOR AND SUPPORT PERSONNEL
  - DEVELOP PROGRAM INCENTIVES (OTHER THAN ULTIMATE COST SAVINGS) TO PROVIDE FINANCIAL SUPPORT FOR INITIAL COMPUTER INSTALLATIONS TO REDUCE NEEDS FOR S&E BUILDUPS

2-2627A
SEP 82

RECOMMENDATION (2)

Defense contractors have utilized the approximately 50% tax-write-off to tender support to universities. This support has strengthened the sources of our nation's supply of S&E personnel. A stronger incentive for such support is now needed, especially in those areas of technology vital to national security.

The simple expedient of allowing 100% recovery of university related expenditures by contractors on defense contracts would achieve the desired results. Examples of such expenditures could be fellowships, purchase of equipment, refurbishing or building facilities for key technologies, unrestricted funds to aid faculty recruitment and retention, participation in nontask specific activities such as industrial liaison, VLSI, and CAD university/industry consortia, and employee education expenses currently disallowed. Each contractor should be allowed to structure his own program guided by his enlightened self-interest and should have the freedom to select universities of his own choice. The amount of expenditures can be controlled by establishing a ceiling, applied uniformly, as a per*centage of the contractor's DOD sales.*

Allowability of such expenses can be established under Defense Acquisition Regulation 15-205.44(g). Partial steps have already been taken in this direction through a directive by the Under Secretary of Defense (R&E) directed to the Secretaries of the Army; Navy; Air Force; and Director, Defense Logistics Agency to allow recovery of certain expenses.

Use is now made of faculty as technical consultants. This practice should be encouraged and extended even to offering faculty members part-time employment. The benefits of doing so include not only use of their skills, but also an access to the academic community. If faculty members are a part of the total Army RD&A activity -- from Pentagon planning to field execution -- a more complete and more attractive picture of Army research will eventually replace the current, unflattering perception held on campuses.

Scholarships tenable at specific schools in fields of interest to the Army should be given, and recipients should pledge to work in Army Research facilities during summers and following graduation.

Both efforts -- involvement of faculty and the support of students -- should be well publicized.

RECOMMENDATION (2)
RELATIVE TO UNIVERSITY & INDUSTRY RESOURCES

- STRENGTHEN TIES AMONG ARMY, DEFENSE CONTRACTORS, AND UNIVERSITIES
  - UNDER SECRETARY OF DEFENSE (R&E) TO ALLOW CONTRACTORS GREATER RECOVERY ON UNIVERSITY RELATED EXPENDITURES
  - CONTRACTORS TO SELECT PROGRAMS AND UNIVERSITIES FOR SUCH SUPPORT, GUIDED BY THEIR ENLIGHTENED SELF-INTEREST
  - SPECIALIZED FACULTY SHOULD BE SOUGHT AS CONSULTANTS AND PART TIME S&Es WITHIN THE ARMY
  - SCHOLARSHIPS AND TRAINEESHIPS, TARGETED AS NEEDED, SHOULD BE AWARDED IN RETURN FOR CIVILIAN SERVICE COMMITMENT

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RECOMMENDATION (3)

ARO has a history of success in funding individuals and groups of faculty researchers. These efforts have yielded useful results by carefully choosing topics, workers, and allowing the organizational structure to develop.

We use the term: "Center of Expertise" to span the spectrum of possible numbers of people, but intend that it convey stability in the funding pattern. With sufficient duration, support in a technology/science area creates a pool of talent. The talent may be the workers at the Center or its graduates, but the people are an implicit resource – – as consultants or as prospective employees. Thus the Army produces not only data and information but also the necessary personnel to make further advances in the field.

This capacity to effectively use extramural funds in a particular technical area could give the Army a head start in maturing and using new technologies. Targeted fields could be advanced and distilled in an academic arena years sooner. For example, "biotechnology" is a rapidly evolving technology. While the Army will share products and techniques as they become available, some possible developments extremely useful to the Army (e.g., quick vaccine production, detoxification agents) may never be produced through market forces.

As a current example, ARO is filling gaps in the research chain for Air/Land 2000 by starting three Centers of Excellence in Air Lift Technology.*

Another extreme is the academic equivalent of the "warm production line." This Center of Excellence is maintained to assure a stream of products/talent in a vital area. Either these fields or those where progress is painfully slow may require many years of Army support. A general rule in establishing Centers should be the expectation of an end to sole support by the Army. Periodic reviews (say, every 3 years) should be made to determine whether continued support is warranted.

Finally, creation of such Centers represents an additional task for the ARO, not a substitute for its present work. ARO must also be given appropriate additional resources.

*By use of the Long Range Research Plan, one can trace back from systems needed far in the future to 6.1 programs needed to develop the tech base. Thus can one spend a few research dollars now to protect enormous future investments in acquisition.

RECOMMENDATION (3)

RELATIVE TO UNIVERSITY & INDUSTRY RESOURCES

- SUPPORT – VIA ARO – ADDITIONAL UNIVERSITY CENTERS OF EXPERTISE IN SELECTED TECHNICAL AREAS CRITICAL TO ARMY
  - SUCH CENTERS SHOULD PRODUCE GRADUATES WITH NEEDED EDUCATION, AS WELL AS PROVIDE A CONSULATION RESOURCE FOR THE ARMY
  - FOR EMERGING TECHNOLOGIES, CREATION OF A CENTER CAN ACCELERATE THE AVAILABILITY OF THE TALENT POOL
  - FOR EXISTING TECHNOLOGIES, MAINTENANCE OF A CENTER WILL ASSURE CONTINUATION OF AVAILABILITY

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ASB SUMMER STUDY -- S&E PERSONNEL

NATIONAL TECHNOLOGICAL "LITERACY"

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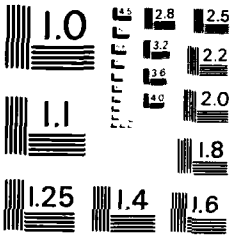

NATIONAL TECHNOLOGICAL LITERACY

Great concern has been mounting within the past few years over the lack of scientific and technological literacy, i.e., understanding technology and its potential, of high school graduates. Many factors are responsible for this dismal condition. Very few secondary students take any mathematics or science courses beyond tenth grade. This is in marked contrast to other countries such as Japan, Germany, and the Soviet Union, which provide rigorous training in math and science.* In many cases, students take only the minimum amount of credit hours in these subjects to fulfill the high school graduation requirements. Because of these minimum standards, a small number of students elect to take advanced mathematics, statistics, physics, chemistry, or calculus. Honors or advanced courses are available at some schools but they are for those few who have taken the prerequisites and who want to take those courses. Only about one-sixth of all secondary school students currently take junior and senior courses in math and science.

Another grave concern is the shortage of competent teachers of math and science in high schools. Recent surveys indicate that more than half of all math and science teachers in high schools were unqualified to teach those subjects. Even more alarming, for example, are recent results that better than 84% of newly employed math and science teachers in the Pacific States are not qualified to teach these areas.

Related to the previous concern over the quality of math and science teachers is the fact that more and more college students are shying away from careers in teaching; and in math and science teaching the problem is even more severe. Education careers are perceived as careers of the last resort and it is difficult to both attract and offer competitive salaries to good math and science candidates.

Finally, classroom laboratory facilities are obsolete and inadequate at most schools. Thus, students are not trained with the modern equipment being used in the field.

*For example, Japan has a national guideline that 25% of instruction time in grades 7-9 be devoted to math and science. The Soviet Union has national elementary and secondary curricula in math and science, and Germany has a standard curriculum for all students.

NATIONAL TECHNOLOGICAL LITERACY

FINDINGS

- MOST STUDENTS TAKE NO MATH OR SCIENCE BEYOND GRADE 10
- ONLY ONE-THIRD OF 17,000 SCHOOL DISTRICTS REQUIRE MORE THAN ONE YEAR OF MATH OR SCIENCE TO GRADUATE
- MANY MATH AND SCIENCE TEACHERS ARE UNQUALIFIED TO TEACH THOSE SUBJECTS
- CLASSROOM LABORATORY FACILITIES AND EQUIPMENT ARE OBSOLETE AND / OR UNSUITABLE FOR MODERN TECHNICAL TRAINING

CONCLUSION

- THE DETERIORATING STATUS OF MATH AND SCIENCE EDUCATION IN THE U.S. PRIMARY AND SECONDARY SCHOOLS, UNLESS TURNED AROUND, WILL SERIOUSLY IMPACT
  - ARMY'S CAPABILITY TO RECRUIT TECHNICALLY LITERATE SOLDIERS
  - ARMY'S CAPABILITY TO MAINTAIN PERSONNEL WHO CAN SUCCESSFULLY FUNCTION IN A HIGHLY TECHNICAL ENVIRONMENT
  - LEVEL OF TECHNICAL LITERACY OF THE PRIVATE SECTOR, INCLUDING DEFENSE INDUSTRY EMPLOYEES

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RECOMMENDATIONS

Because Army laboratories and installations are geographically dispersed, many opportunities exist for the Army to alleviate the national problem of technological literacy in math and science. Contributions can be made directly by both the Army and its science and engineering personnel through a variety of mechanisms. Some examples of these are: providing release time to Army scientists and engineers to teach in public schools, either for whole semesters or through team teaching approaches; providing equipment and laboratory facilities to local schools; initiating enrichment programs, during the school year and/or summer, to motivate students to pursue scientific careers; and, support the work of existing commissions which are directing their attention to math, science, and technology education, e.g., National Science Board, National Commission on Excellence in Education, and others.

Other national, technology-oriented organizations with local operations could be induced to assist the Army. An example might be the local telephone company or the local power utility. Also, efforts of industry and professional organizations to prepare material to help motivate student interest in science and engineering should be used. For example, the ASME, with the help of Bendix, Bell Labs, Proctor & Gamble, and Digital Equipment Corporation, are developing a 27-minute film targeted at junior high school students, which demonstrates the rewards and benefits of being an engineer.

State and local certification requirements to teach may make it difficult for Army personnel to gain immediate access into the schools. However, provisional or temporary certificates may be granted for short-term teaching opportunities. The success of these efforts will necessitate close cooperative relationships between the Army and state and local school authorities.

RECOMMENDATIONS
RELATIVE TO NATIONAL TECHNOLOGICAL LITERACY

- THE ARMY SHOULD INSTITUTE AN ORGANIZED EFFORT TO ASSIST IN IMPROVING THE MATH AND SCIENCE EDUCATION IN LOCAL COMMUNITIES WHERE THE ARMY HAS INSTALLATIONS BY PROVIDING
  - RELEASE TIME TEACHING (ARMY S&Es)
  - EQUIPMENT AND LAB FACILITY LOANS
  - ENRICHMENT PROGRAMS FOR STUDENTS
  - SUPPORT FOR THE WORK OF EXISTING COMMISSIONS IN THIS AREA

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IN CONCLUSION

THE ABILITY OF THE ARMY TO IMPLEMENT ITS PRESENT THRUSTS IS TIED INEXTRICABLY TO THE ABILITY OF THE ARMY -- WORKING WITH INDUSTRY AND UNIVERSITIES, AND THE CONGRESS -- TO ALLOCATE CRITICAL RESOURCES TO DO THE JOB

- MONEY
- PEOPLE
- FACILITIES
- EQUIPMENT

WITHOUT QUALITY PEOPLE THE OTHER RESOURCES CANNOT BE EFFECTIVELY UTILIZED -- AND THE OPPORTUNITY TO CAPITALIZE ON U.S. STRENGTHS WILL BE LOST

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