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Report to Rep. George H. Mahon, Chairman, House Committee on Appropriations; by Elmer B. Staats, Comptroller General.

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In spite of the fact that personnel costs accounted for 61% of the Department of Defense's (DOD) outlay of funds in fiscal year 1976, a very small proportion of funds was devoted to human resources research and development. A GAO review revealed a low rate of utilization of results of such research. Reports published from 1973 through 1975 were intended to support changes to regulations, policies, training programs, or equipment. Findings/Conclusions: Thirty-eight percent of the 374 reports published were not used because of impressions that results were for information only or of questionable value, or users were unaware of results. Management of the use of this material should be improved. Recommendations: Better utilization of research and development results may be effected if DOD will: (1) establish criteria for identifying results with immediate use potential; (2) improve communications between researchers and users; (3) develop systems for monitoring of utilization; and (4) establish a management mechanism for resolving issues which prevent utilization. (HTW)

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REPORT TO THE
COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

RELEASED 4/26/77

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES



Human Resources Research And Development Results Can Be Better Managed

Department of Defense

Human resources research and development results in 38 percent of the reports GAO reviewed were not used.

Defense could eliminate many of the reasons for this by improving its management system; so it will

- identify results that could be used immediately,
- improve communication between researcher and user,
- monitor the use of results, and
- resolve issues between researchers and users preventing use of research and development results.



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-159797

The Honorable George Mahon
Chairman, Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

As requested in your November 14, 1975, letter and subsequent discussions, we are reporting on our review of human resources research and development in the Department of Defense. This report discusses that segment of the program intended by the research and development organizations for use by military managers. The report emphasizes the need for strengthened management in using these research and development results and makes recommendations to meet this need.

We discussed this report with Defense officials, and for the most part they agree with the recommendations to the Secretary of Defense. These recommendations are set forth on page 18. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We will be in touch with your office in the near future to arrange for release of the report so that requirements of section 236 can be set in motion.

Sincerely yours,

A handwritten signature in black ink, appearing to read "James R. Atchafalua".

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE COMMITTEE
ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES

HUMAN RESOURCES RESEARCH
AND DEVELOPMENT RESULTS
CAN BE BETTER MANAGED
Department of Defense

D I G E S T

Personnel is the Department of Defense's most costly resource, amounting to about \$53.6 billion in fiscal year 1976 (61 percent of total Defense outlays). For the same period, funds devoted to human resources research and development were \$65.3 million or about one-tenth of a cent for each dollar of personnel costs. Careful management is needed, and effective systems must be established if maximum use is to be made of the results of these research and development efforts.

Eight Defense research and development organizations identified 374 reports on human resources research and development published during calendar years 1973 through 1975 which were intended to support changes to

- regulations, orders, doctrines, policies, or manuals;
- courses of instruction or training programs; or
- equipment.

GAO then asked the intended users how the results were used and any reasons for not using them and found that

- 56 percent of the reports were used,
- 38 percent were not used, and
- 6 percent were being considered for possible use.

Reasons most frequently cited for not using the results were that users

- believed the reported results were intended for information only,

- had not seen or were unaware of reported results,
- questioned results or believed they were unusable,
- believed results needed further development, and
- believed the program or problem to which the results applied no longer existed.

GAO believes that Defense needs to improve its management of the use of research and development results. GAO found need for:

- Criteria to identify the research and development results intended for use by military managers.
- Improved communication between researcher and user.
- Systematic monitoring and feedback to see that usage criteria is applied, communications are taking place, and problems are given management attention.
- A management mechanism responsible for resolving issues between researchers and users, which prevents use of research and development results.

GAO recommends that Defense take immediate steps to satisfy the above needs for improved management of human resources research and development results use.

GAO also recommends that progress reports on management improvement accompany appropriation requests to the Committee.

As requested by the Committee, formal comments on this report were not obtained from the Department of Defense. The recommendations were discussed informally with Defense officials and for the most part they agreed with the recommendations to the Secretary of Defense.

C o n t e n t s

		<u>Page</u>
DIGEST		i
 CHAPTER		
1	INTRODUCTION	1
	Scope of review	1
	Approach parameters	2
2	PROGRAM OVERVIEW	3
	Perspective	3
	Program categories	4
	Program funding	5
	Program organization	6
3	POTENTIAL FOR IMPROVING USE OF RESEARCH AND DEVELOPMENT RESULTS	9
	Manifestation of problems	9
	Management system basic needs	11
	Need for usage criteria	12
	Need for improved researcher and user communications	12
	Need for improved monitoring and feedback on the use of research results	15
	Need for a mechanism to assure resolution of issues preventing utilization	17
4	CONCLUSIONS AND RECOMMENDATIONS	18
	Conclusions	18
	Recommendations to the Secretary of Defense	18
	Recommendations to the Committee	19
 APPENDIX		
I	Letter of November 14, 1975, from Chairman, House Committee on Appropriations	20
II	Research reports reviewed by GAO	21
III	Human resources research and development objectives, needs, and accomplishments	37
IV	Organizations for human resources research and development	46

APPENDIX

Page

V	Principal officials responsible for administering activities discussed in this report	53
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ABBREVIATIONS

ARPA	Advanced Research Projects Agency
DOD	Department of Defense
GAO	General Accounting Office

CHAPTER 1

INTRODUCTION

In reviewing the fiscal year 1976 Department of Defense (DOD) budget, the House Committee on Appropriations questioned the effectiveness of, and the level of funding for, human resources research and development. The Chairman on November 14, 1975, asked us to review the program to assist the Committee in its analysis of future budget requests. (See app. I.) We subsequently agreed with the Committee that our review should focus on ways that DOD could make more effective use of research and development results. We have provided the Committee with interim results of our work for use in examining DOD budget requests for the program.

SCOPE OF REVIEW

The human resources research and development program is intended to be responsive to both current operational problems and long-range needs. To achieve these goals, research and development is directed to producing results for immediate application as well as to maintaining and expanding the technology base for future applications.

Evaluating research intended to maintain or expand the technology base requires different criteria from those for evaluating research intended for application to current operational problems. We limited our review to the latter--those research results for immediate use by military managers to improve operational effectiveness or reduce cost.

Military managers receive the results of this type of research and development through oral and written reports. Due to the lag between completion of the research and publication of the results, application could be underway or completed before receipt of the formal report. Because of both the timelag and often the lack of documentation on oral presentations, we limited our review to the uses made of results included only in formal written reports published from 1973 through 1975. We defined use as any change involving

--initiation or modification of regulations, orders, doctrines, policies, or manuals,

--development or change in courses of instruction or training programs, or

--development or modification of equipment.

We advised laboratory managers and researchers of our criteria and asked them to identify reports published during calendar years 1973 through 1975 intended to make those changes. They identified 374 such reports. (See app. II.) We also asked them to identify the most likely users of these reports.

We then sent questionnaires to these users requesting information on the

--extent of their involvement with the research,

--use made of the results,

--benefits obtained,

--reasons for not using the results, and

--ways for improving use.

We also requested documentation of the claimed uses. In cases where documentation was not furnished or where we believed the responses were not clear, we contacted the respondent, either in person or by phone, to reconcile the problem.

Finally, we analyzed the responses to identify perceived constraints which prevented research and development results from being used.

APPROACH PARAMETERS

We did not try to review the entire human resources research and development program or judge its scientific merit. Neither did we attempt to distinguish between research and development results on the basis of potential for impact. Such distinctions would have been highly subjective in deciding upon realistic and consistent weighing factors.

We selected that portion of the program intended for immediate application, a very important portion in our judgment, and examined its use by military managers. We analyzed why the results were not used and recommended ways in which management could improve the situation.

CHAPTER 2

PROGRAM OVERVIEW

PERSPECTIVE

Personnel costs are a major expense of the Department of Defense. In the fiscal year 1976 budget submission to the Congress, the Secretary of Defense reported:

"The Department of Defense recognizes that its human resources--military and civilian, active and reserve--are both its most precious and its most costly asset. Making effective use of these resources, while simultaneously doing the very best that we can for our people and assuring that we adequately man our planned forces on an all-volunteer basis, represent significant challenges to which we are giving priority attention."

The magnitude of the personnel cost increases is demonstrated by comparative data over a number of years. In fiscal year 1964, personnel costs amounted to about \$24 billion and represented about 47 percent of the total defense outlays. This ratio increased to about 60 percent in fiscal year 1974 and remained at or near that level for fiscal years 1975 and 1976. In fiscal year 1976 personnel costs amounted to about \$53.6 billion.

More than 5 years ago, the Defense Science Board Task Force on Manpower Research 1/ attempted to put personnel research costs in perspective. It pointed out that in fiscal year 1971:

--One-tenth of a cent was spent on personnel research and development for each dollar spent on personnel as compared to 33 cents spent on hardware research and development for each dollar spent on hardware.

--For every dollar spent on hardware research and development, 1/2 cent was spent on personnel research and development.

The above ratios were about the same in fiscal year 1976 as in 1971.

1/Manpower Research and Management in Large Organizations, June 1971.

PROGRAM CATEGORIES

The human resources research and development program had its origin in selection and classification testing during World War I. Over the years it has been broadened to include other aspects of personnel development, education and training, human factors in systems development and operation, and overseas operations and planning factors. The purpose of the program is to develop techniques, methods, and procedures for the most effective use of military personnel at the least cost.

These research and development efforts can be generally categorized as (1) research, (2) exploratory development, or (3) advanced development. DOD defines these efforts as follows:

- Research--scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the sciences related to long-term national security needs. It provides fundamental knowledge for the solution of identified military problems and furnishes part of the base for subsequent exploratory and advanced developments in defense-related technologies and new or improved military functional capabilities.
- Exploratory development--includes all effort directed toward the solution of broadly defined problems, short-major development programs with a view to developing and evaluating technical feasibility.
- Advanced development--includes all projects that have moved into the development of hardware for test. The prime result of this type of effort is proof of design concept rather than the development of hardware for service use. Projects in this category have a potential military application.

A more relevant definition of advanced development for human resources research is in Army Regulation 70-8. According to this regulation advance development involves applying scientific knowledge gained from research and exploratory development to current or potential field problems and demonstrating or validating operational utility.

A more detailed discussion of the program, expressed in terms of objectives, needs, and accomplishments, is included in appendix III.

PROGRAM FUNDING

Human resources research and development funding by program category for the past 5 fiscal years is shown in the following table.

Human Resources Research and Development Funding

	<u>Fiscal year</u>					<u>Estimate</u>
	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977 (note a)</u>
	(millions)					
<u>Research:</u>						
Army	\$2.2	\$2.1	\$2.3	\$2.0	\$2.4	\$3.3
Navy	3.5	3.0	3.1	3.0	3.4	4.1
Air Force	1.3	1.3	1.3	1.3	1.5	2.9
Advanced Research Projects Agency (ARPA)	<u>5.2</u>	<u>4.8</u>	<u>2.7</u>	<u>2.3</u>	<u>2.5</u>	<u>2.5</u>
Total	<u>\$12.2</u>	<u>\$11.2</u>	<u>\$ 9.4</u>	<u>\$8.6</u>	<u>\$9.8</u>	<u>\$12.8</u>
<u>Exploratory development:</u>						
Army	\$9.6	\$8.0	\$7.1	\$8.0	\$9.6	\$12.7
Navy	9.1	8.8	8.8	9.5	8.4	10.4
Air Force	5.7	5.4	5.5	6.4	6.1	8.9
ARPA	-	3.0	5.5	7.0	5.9	5.7
Total	<u>\$24.4</u>	<u>\$27.6</u>	<u>\$26.9</u>	<u>\$30.9</u>	<u>\$30.0</u>	<u>\$37.7</u>
<u>Advanced development:</u>						
Army	\$ 4.4	\$ 5.7	\$ 7.3	\$ 7.0	\$ 9.0	\$12.2
Navy	4.0	3.8	7.8	9.0	10.8	13.0
Air Force	<u>6.0</u>	<u>7.2</u>	<u>6.8</u>	<u>6.3</u>	<u>5.7</u>	<u>9.0</u>
Total	<u>\$14.4</u>	<u>\$16.7</u>	<u>\$21.9</u>	<u>\$22.3</u>	<u>\$25.5</u>	<u>\$34.2</u>
Total	<u>\$51.0</u>	<u>\$55.5</u>	<u>\$58.2</u>	<u>\$61.8</u>	<u>\$65.3</u>	<u>\$84.7</u>

a/Estimates provided by Defense prior to final appropriations and apportionment.

The annual level of funding for the entire program as may be observed above has gradually increased so that fiscal year 1976 funding was \$14.3 million more than 1972. However,

it is in the distribution of the increase that program emphases may be observed. For example:

- Research has decreased by \$2.4 million, with most of the reduction occurring in ARPA while the military services funding remained relatively constant.
- Exploratory development has increased by \$5.6 million, with
 - ARPA increased by \$5.9 million,
 - Navy decreased by \$.7 million, and
 - Air Force increased by \$.4 million.
- Advanced development has increased by \$11.1 million, through increases for the Army of \$4.6 million and for the Navy of \$6.8 million and a decrease of \$.3 million for the Air Force.

The proportionate distribution of funds over the same period indicates a trend toward increased advanced development.

Proportionate Distribution of Funds

	Fiscal year	
	<u>1972</u>	<u>1976</u>
Research	23.9%	15.0%
Exploratory development	47.9	45.9
Advanced development	28.2	39.1
	<u>100.0%</u>	<u>100.0%</u>

Defense estimates for fiscal year 1977 funding levels are about the same proportionate distribution as fiscal year 1976.

PROGRAM ORGANIZATION

General supervision of the human resources research and development program, and all other research and engineering activities in DOD, is provided by the Director of Defense Research and Engineering. Each service manages its own human resources research and development program to solve personnel and training problems and to meet operational mission requirements.

Within the Army, the program has three segments:

- Non-systems-training devices, the responsibility of the Program Manager for Training Devices;
- Behavioral and social sciences research in individual training and performance and in organizations and systems, the responsibility of the Army Research Institute for the Behavioral and Social Sciences;
- Human factors research and engineering, the responsibility of the Army Materiel Development and Readiness Command carried out at the Human Engineering Laboratory.

The Army Deputy Chief of Staff for Personnel is responsible for staff supervision over human performance research and development. This program is carried out by the Army Research Institute and the Army Materiel Development and Readiness Command. The Program Manager for Training Devices is responsible to the Materiel Development and Readiness Command.

The Army does about 50 percent of its program in-house and 50 percent by contract.

Within the Navy, research and development activities are managed by type of effort, as shown below:

<u>Type of effort</u>	<u>Managing agency</u>
Research	Office of Naval Research
Exploratory development	Naval Material Command
Advanced development	Office of the Chief of Naval Operations

The human resources research and development program is carried out by several Navy laboratories and centers.

The Navy performs about 44 percent of its program in-house and 56 percent by contract.

Within the Air Force, the Office of Scientific Research has primary responsibility for the research effort. The Air Force Human Resources Laboratory of the Systems Command is the principal organization responsible for planning and executing the exploratory and advanced development human resources efforts.

The Air Force does about 45 percent of its program in-house and 55 percent by contract.

More detailed information about DOD and the military services' organizations is included in appendix IV.

CHAPTER 3

POTENTIAL FOR IMPROVING USE OF RESEARCH AND DEVELOPMENT RESULTS

There seems to be general agreement that the objective of research and development is to provide useful results. Achieving maximum use from human resources research and development is a complex management task. For example, the user is generally mission oriented rather than research oriented and may not have a full understanding of the research and development processes. He may also need answers quickly to problems which do not lend themselves to quick solutions. On the other hand, the researcher tends to focus his attention on methodologically sound solutions and to be less concerned with a quick answer. These sometimes conflicting values require moderation by management if maximum use of research and development results is to be achieved.

Research and development results in 38 percent of the 374 reports reviewed were not used. Many of the reasons given for non-use manifested problems which we believe could have been avoided or resolved if Defense had a system for managing implementation of research and development results.

Weaknesses in Defense's management of implementation of research and development results include the following

- the absence of accepted or acceptable usage criteria to identify those research and development efforts intended to be used by military managers,
- inadequate communications between researcher and user,
- an effective monitoring and feedback system to assure that results are used and if not, the reasons, and
- the absence of clear lines of responsibility and authority for resolving problems inhibiting use.

In our judgment these weaknesses contributed substantially to the non-use of research and development results.

MANIFESTATION OF PROBLEMS

The research and development results selected for this review were identified by Defense research officials as

intended for use, as defined in chapter 1, and disseminated by written reports to be applied by military managers.

Of the 374 reports in our review, the results in 141 or 38 percent, were not used; an additional 23, or 6 percent, were being considered for possible use; and 210, or 56 percent, were used. The following table summarizes user-reported reasons for non-use.

	<u>Number of reports</u>
1. Reported results intended for use but interpreted by user as for information only	38
2. User had not seen or was unaware of reported results	24
3. User questioned results or believed results were unusable	21
4. User believed the results needed further development	14
5. User said that results were rejected by higher authority	4
6. Supports existing policy/procedure-recommendation already policy	9
7. Program or problem to which research was addressed no longer existed	12
8. Funding was not available or recommendations were too expensive to implement	9
9. Other	<u>10</u>
Total unused	<u>141</u>
Being considered for possible use	<u>23</u>
Total	<u><u>164</u></u>

Most of these reasons are symptomatic of management problems which can be resolved. The two most frequently cited, 1 and 2 above, can be viewed as examples.

- In 38 instances intended users viewed reported results as informational only and not intended for immediate application. This situation may be explained by the lack of recommendations in 82 percent of these reports or that researcher and user communication was absent or ineffective.
- In 24 instances intended users had not seen or were not aware of the reported results. This suggests a breakdown of coordination and interaction between the research organization and user.

Our study was not the first to disclose management problems preventing use of research and development results. A study at a Navy laboratory identified the following barriers to use:

- A tendency to prolong research programs and keep them in the research (v. the implementation) phase.
- Turnover of consumer personnel. A research requirement is specified by one group of persons and results are delivered to the succeeding group.
- Poor communications techniques by researchers and research organization before, during, and after a project.
- Insufficient planning to anticipate costs (to consumer) of implementing results.
- Unusable, inconclusive, or unsatisfactory research (as perceived by the consumer).
- The consumer is too low in the organizational level to implement results (particularly those requiring funds).

We believe that Defense needs to design and implement a system to better manage research and development implementation. This system should be capable of avoiding or resolving these problems throughout the Department.

MANAGEMENT SYSTEM BASIC NEEDS

A system for managing implementation of human resources research and development results should

- clearly identify those results which are intended for use,
- provide for improved communication channels and processes between researchers and users,
- monitor implementation progress, and
- have a mechanism to quickly resolve problems preventing implementation.

Need for usage criteria

Not all research and development results are intended for use outside the research community. Some results are merely the starting points for or input to exploratory or advanced development. The distinction between human resources research and development results intended for use by military managers and the results of more basic efforts is not always made clear. Laboratories, in a broad sense, consider most of their research and development results useful. In the long run, this may well be true. Many results, however, can and should be used by military managers as soon as they are available. Urgently needed are criteria to identify results intended for implementation as opposed to those intended to serve the needs of knowledge generating or technological base efforts.

We believe our definition of use in chapter 1 offers a reasonable starting point for Defense to develop criteria to clearly and consistently identify research results intended for immediate use by military managers. The 1976 revision of Army Regulation 70-8, which deals in part with managing the use of human resources research and development results, cites examples of similar usage criteria. The guidance in this regulation should be considered in the Defense-wide criteria definition task.

Criteria to assess utilization would establish accountability for research and development results. Such criteria would better serve Defense's management needs and the need to provide to the Congress information on program effectiveness and results.

Need for improved researcher and user communications

Any system to manage the use of research and development must assure that the results are needed, understood,

and provided to prospective users in a timely fashion. These essential elements of a management system for research and development have been a topic of Defense discussion for a number of years.

A June 1971 task force report by the Defense Science Board cited the tenuous linkages between policy and planning staffs in need of the results, and the scientists and supporting staff who provide the results. The report stated:

"Another untoward consequence of the lack of a continuing and close relationship between top policy staff and laboratory researchers has been the difficulties the scientists have had in obtaining support to insure that a good research result is translated into new policies, programs, and procedures. * * *"

The problem of liaison between scientists and potential users of their research and development results was also addressed at a Navy sponsored Symposium/Seminar on Personnel Research and Development, Planning, and Management in December 1971. The proceedings of this meeting, published in August 1972, include a speech which points out the need for an improved flow of ideas and information between researchers and users. The speaker suggested, and participants at a semi-formal seminar concurred, that some kind of a third-party "translator" or "change agent" be developed to make these improvements.

The problem of researcher and user communication has not been resolved. The task force on training technology, in its February 1976 report, also addressed this topic stating:

"The lag in implementation of Training Technology R&D [research and development] findings by the training and operational commands* * *can be attributed largely to insufficient working arrangements between the R&D and user communities* * *."

Some researchers also believe more active communication with users is necessary. In a survey of the problem of using research results, an Army research manager asked researchers to describe how they got a user to use a product. His data suggested that the most successful method to get the user to use the product properly is "to stick around and see that he does."

Users of human resources research and development results also see a need for a better understanding of the potential improvements they could realize. We asked users throughout Defense to describe the extent to which their organization was actually involved in four stages of research and development efforts and to describe the extent they felt user organizations should be involved to improve the utilization of results.

Table 1

User Involvement in Research

<u>Stage</u>	<u>Actual involvement great or very great</u>	<u>Involvement should be great or very great</u>
Planning	44%	90%
Design	16	27
Analysis	14	28
Recommendations	23	62

We also asked users to describe (1) the frequency of communications during the research and development effort and (2) the frequency of communications appropriate to improve utilization of research results.

Table 2

Communication Between Users and
Researchers

<u>Type of communication and frequency</u>	<u>Did happen</u>	<u>Should happen</u>
Telephone calls, monthly or more often	58%	85%
Written communications, every 2 months or more often	54	82
Personal visits, every 6 months or more often	71	96
Formal briefings, every 6 months or more often	43	76
Conference/Workshops, every 6 months or more often	42	56

The need for improved communications has been generally acknowledged for years. Effective communications must be an integral part of the research and development results management system. In developing this part of the system, consideration should be given to user involvement and type of communication described in tables 1 and 2.

Need for improved monitoring and feedback
on the use of research results

Defense does not require, and most of the laboratories reviewed do not have, formalized monitoring procedures for assessing the use of their research and development results. Laboratory personnel sometimes assisted in implementing the results but generally ascertained the use of results through informal contact. These informal contacts included discussion between researchers and users, letters from users, and meetings and conferences.

We believe informal efforts, such as the above, are helpful but not fully satisfactory. They do not

- establish a management process which assures feedback on the use of all research and development results intended for use,
- provide evidence to verify claimed uses, and
- necessarily provide accurate information.

We asked both users and researchers to describe the use of research and development results included in our study. Comparative information was available for 360 reports. In 34 percent of these, the uses reported by the researcher differed substantially from that reported by the user. For example:

- One researcher said a piece of equipment was developed for and used in an aircraft simulator. The user acknowledged that the equipment was developed but stated it was too expensive and had technical problems under some conditions. A less expensive piece of equipment was used which sacrificed some of the research product's refinement.
- Another researcher told us the results of research on the state of discipline in the U.S. Army were used in policy decisions affecting screening preservice delinquents from service in the military. Also, he

stated the contractor that performed the research was officially commended by both the research laboratory and the user. The user stated the research was initiated in response to a stated user need but that it did not satisfy the need. The user made a formal review of the implementation potential of the reported research results and found them worthless. No use was made of the results.

Army Regulation 70-8 is apparently the only regulation which requires monitoring the use of human resources research and development results. It requires each Army agency or major command stating a need for an advanced development effort to report the utilization of the results to the Army Research Institute. In cases where the results have broad application, the Institute may request utilization information from other users. Because the reports are required only for advanced development results, we do not believe the regulation is sufficiently encompassing. Only 28 percent of the research and development results in our study were from advanced development efforts. Most were from exploratory efforts.

Four of eight research organizations in our review were developing formal systems for determining the use of their research results by military managers. One of these laboratories had not made sufficient progress to be specific, but the other three had made enough progress to discuss their program with us.

--One laboratory intends to comply with Army Regulation 70-8 by receiving and reviewing utilization reports from users of advanced development research results.

--One laboratory is planning to establish a separate applications unit. The unit's responsibilities will include participating with users in assuring proper and efficient utilization of research results, assisting users in reporting the benefits from implementing the research results, and assisting users in identifying new or potential problems and requesting additional research.

--One laboratory established a Research and Development Application Group in November 1974. The purpose is to help introduce research and develop end products into operational use, determine why end products are not used and if they can be made useful, and develop

new methods and techniques to disseminate and use research results. As of mid-1976, the Group had not completed any specific application actions, but had 13 in process.

The efforts of these individual laboratories are worthwhile and may improve monitoring and feedback of research and development results. We believe, however, that a more comprehensive and formal Defense-wide procedure is necessary. The experience of the laboratories, the provisions of Army Regulation 70-8 concerning monitoring and feedback, and the usage criteria discussed in this report could form the basic principles for a comprehensive Defense-wide procedure.

Need for a mechanism to assure resolution of issues preventing utilization

The responsibility of research organizations for utilization of research and development results ends when the results are communicated to potential users. They rely on user organizations to implement the research and development results and to request any needed technical assistance. Research organizations have no authority to direct the use of the results. User organizations, on the other hand, are responsible for considering the research and development results and determining whether they should be implemented. They have authority to accept or reject the results.

Neither type of organization has authority to resolve problems outside their own area of responsibility. The net result is that many problems preventing utilization discussed in this report are not identified and resolved.

We believe there is need for a linking management mechanism within each service charged with the responsibility for identifying and resolving issues preventing the utilization of research and development results. The most appropriate location for the management linking responsibility might be at the service headquarters level; however, vesting problem-resolving authority at lower echelons, where researcher and user interaction is closer to the problems, should be considered.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Defense needs to develop and implement a more effective system to manage implementation of human resources research and development results intended for use by military managers. There has been too much reliance upon the informal relationships of the researcher and user. The result has been a failure to recognize and give formal management attention to those problems preventing better utilization of research and development results.

Several things need to be done by Defense to improve utilization management.

- Criteria need to be developed to identify research and development results with immediate use potential. Without such criteria results cannot be identified and tracked, and related implementation problems cannot be identified.
- Communications between researchers and users must be improved. Better communications will serve to identify problems and provide more timely solutions rather than postponements to later times when the problems become too difficult to resolve.
- A management monitoring and feedback system needs to be developed and implemented. The system can be used to see that usage criteria is applied and projects are identified; communications are taking place; and problems are given management attention.
- A management mechanism should be established for resolution of issues between researchers and users preventing use of research and development results. Because researchers and users have different missions and motivations, it is not effective to assign them the task. Linkage at a higher management level is more appropriate and could be more effective.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that the Secretary of Defense take the necessary action to strengthen the management of the use

of human resources research and development results. Such action should provide for establishing

- criteria to identify results with immediate use potential,
- improved communications between researchers and users,
- effective monitoring of utilization, and
- a management mechanism for resolution of issues between researchers and users preventing use of research and development results.

The above recommendations were discussed with Defense officials and they indicated substantial agreement. We were also advised that some implementing action was already underway.

RECOMMENDATIONS TO THE COMMITTEE

We further recommend that the Committee request the Secretary of Defense to report specific progress in the management of the human resources research and development program when submitting appropriation requests. Such reports should be helpful to the Committee in deliberations about the level of funding for the program.

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Congress of the United States
House of Representatives
Committee on Appropriations
Washington, D.C. 20515

November 14, 1975

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Honorable Elmer B. Staats
Comptroller General of the
United States
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Staats:

During its review of the fiscal year 1976 Department of Defense budget, the Committee questioned the effectiveness and the level of funding requested for the various Human Resources, Manpower Effectiveness, and Education and Training research and development programs in the Army, Navy, and Air Force. We understand that the Federal Personnel and Compensation Division is currently doing work in this area. Since the funding level for this effort has become a controversial issue, we request that your office make a detailed review of these programs so a more complete analysis of the fiscal year 1977 Defense budget request can be made.

Your assistance is greatly appreciated.

Sincerely,


Chairman

APPENDIX II

APPENDIX II

**LIST OF REPORTS IN GAO REVIEW ON USING
HUMAN RESOURCES RESEARCH AND
DEVELOPMENT RESULTS**

ARMY

**Army Research Institute for the
Behavioral and Social Sciences**

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Research Toward the Design, Development and Evaluation of a Job-Functional Literacy Training Program for the United States Army	Sept. 1973	Paper
Guidelines for the Conduct of Performance Oriented Training	Oct. 1973	Pamphlet No. 600-11
Individualized Course Completion Time Predictions: Development of Instruments and Techniques	Nov. 1973	Technical Report 73-25
The Value of Special Training and Job Aids for Improving Unattended Ground Sensor Operator Performance	Jan. 1974	Contract DAHC 19-73-C-24
Selected Elements of a Battalion Integrated Sensor System Device and Mix Effectiveness	Jan. 1974	Contract DAHC 19-74-0001
A Comparison of Three-Subtest AFQT and Four-Subtest AFQT	Mar. 1974	Research Memorandum 74-5
The Effects of Work-Rest, Target Activity, Background Noise, and String Size on Operator Interpretation of Unattended Ground Sensor Records	Mar. 1974	Contract DAHC 19-73-C-24
Student Manual: Individual and Group Problem-Solving Workshop	Mar. 1974	Research Product RP-WD(TX) 74-1
Evaluation of High Density Format for AFQT Answer Sheet	Apr. 1974	Research Memorandum 74-6
Systems Engineering of Training for Eight Combat Arms MOSs	June 1974	Technical Report 74-12
The Validation of the Task Inventory of the Tank Company, Platoon, and Crew and the Development of Conditions and Standards of the Task Inventory	June 1974	Research Product RP-D2-74-3
Guidebook for the Development of Army Training Literature	Nov. 1975	Contract DAHC 19-73-C-0051
Student Manual: Performance Management Workshop	Feb. 1975	Research Product RP-WD(TX) 75-1
Optimum Patching Technique for Seismic Sensors Employed in a Grid Array	Feb. 1975	Contract DAHC 19-74-C-30
Student Manual: Management by Objectives Workshop	Mar. 1975	Research Product RP-WD(TX) 75-2
PLANIT Support and Utility Programs Test Procedure	Mar. 1975	Contract DAHC 19-74-C-006
PLANIT Support and Utility Programs Flow Charts	Mar. 1975	Contract DAHC 19-74-C-006
PLANIT Support Programs Operator/User Manual	Mar. 1975	Contract DAHC 19-74-C-006
PLANIT Utility Program Operator/User Manual	Mar. 1975	Contract DAHC 19-74-C-006
Total System Accuracy for APPS (APPSAC)	May 1975	Contract DAHC 19-74-C-006
A Procedure for Screening Discussion Leaders for the Racial Awareness Program (A Report and a Handbook for Commanders)	May 1975	Contract 74-C-0055

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
An Evaluation of the Utilization, Maintenance and Perceived Benefits of the Training Extension Course (T&C)	June 1975	Technical Report 75-18
Self-Pacing a Gross Motor Skills Course: Crawler Tractor Operator	June 1975	Technical Report 75-19
Self-Paced Instruction in a Cognitively Oriented Skills Course: Supplyman	June 1975	Technical Report 75-20
Establishing the Concepts and Techniques of Performance-Oriented Training in Army Training Centers. A Summary Report	June 1975	Technical Report 75-21
Development, Field Test, and Refinement of Performance Training Programs in Armor Advanced Individual Training	June 1975	Final Report PR-WD(CA)-75-8
The Development of An Open-Access, Performance Oriented Curriculum for Training the Military Policeman (MOS 95B20)	June 1975	Final Report PR-WD(CA)-75-9
A Program of Army Functional Job Reading Training, Development, Implementation, and Delivery Systems	June 1975	Final Report PR-WD(CA)-75-7
Mission Suitability Testing of an Aircraft Simulator	June 1975	Technical Report 75-12
a. Racial Harmony Training for Unit Leaders	July 1975	Contract 75-C-0035
b. Four-hour module on the Development of Communication Skills		
Associate Evaluations: Improving Field Acceptance	July 1975	Research Memorandum 75-5
Performance Test Development for Skill Qualification Testing: A Manual	Aug. 1975	Contract DAHC 19-75-C-0016
Tank Crew Training Assessment	Sept. 1975	Contract 75-C-0017
Enlistment Motivation and the Disposition of Army Applicants	Mar. 1974	Technical Report 74-5
Results of Study of Potential Uses of Assessment Results by Infantry School	Apr. 1974	Hum RRO Report IR D4-74-10
A Program for Testing Fundamentals of Personnel Assessment	May 1974	Hum RRO Report IR D4-74-13
Student Text, Selected Aspects of Leadership	May 1974	Hum RRO Report RP D4-74-14
Instructor's Manual: Selected Aspects of Leadership	May 1974	Hum RRO Paper
The Effects on Training Requirements of the Physical and Performance Characteristics of Weapons	June 1974	Technical Report 74-10
Factor Analysis of Leadership Measures from a Training Program	Oct. 1974	Research Memorandum 74-12
Research on Assessment Criteria and Counseling Methods	Dec. 1974	Technical Report 74-25
Student Text: Fundamentals of Personnel Assessment	Feb. 1974	Contract DAHC 19-74-C-0011
Guide for Fundamentals of Personnel Assessment	Feb. 1974	Contract DAHC 19-74-C-0011
Research on Utilization of Assessment Results and Methods	June 1974	Contract DAHC 19-74-C-0011
The Effect of Workload on Unattended Ground Sensor Operator Performance	Feb. 1975	Contract DAHC 19-73-C-30
Speed Listening for Message Classification	Mar. 1975	Research Memorandum 75-2

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
LESSON MONIFORM - An Authoring Aid for the PLATO IV CAI System	Apr. 1975	Research Product PP-ED-75-6
MONIFORMS As Authoring Aids for the PLATO IV CAI System	May 1975	Technical Report 75-5
A Further Examination of Enlistment Motivation and the Disposition of Army Applicants	June 1975	Technical Report 75-15
Development of Performance Tests as Supplementary Enlistment Screening Measures; An Interim Report	July 1975	Research Memorandum 75-8
A Cost Assessment of Army Training Alternatives	Aug. 1975	Research Preliminary Review 75-3
Acceptability of Associate Ratings at Branch Basic Schools	Oct. 1975	Technical Paper 268
Development of a Model Job Performance Test For a Combat Occupational Specialty. Vol 1. Test Development	Nov. 1975	Contract DAHC 19-74-C-0054
Training Individuals in Army Units; Comparative Effectiveness of Selected TEC Lessons and Conventional Methods	Dec. 1975	Research Report 1188
The Social Representativeness of the Volunteer Army	Dec. 1975	Research Memorandum 75-12
The Value of Special Training for the Interpretation of U.G.S. Employed in a Grid	Dec. 1975	Contract DAHC 19-75-C-0023
Research on the State of Discipline in the U.S. Army	Sept. 1974	Contract DAHC 19-74-C-0052
Common Area Demarcation, Target Annotation, and Target Lists as Aids in Change Detection	Mar. 1973	Technical Research Note 238
Coordinate Determination of SLAR Imaged Features	Apr. 1973	Technical Research Note 234
Effect of Training on Coordinate Determination of SLAR Imaged Features	Apr. 1973	Technical Research Note 235
Development of Leadership Assessment Simulation	Sept. 1973	Technical Report 73-21
Development of the NCO Evaluation Battery	Nov. 1973	Research Memorandum 73-1
Feasibility of Assessment Methods in Leadership Training	Dec. 1973	Hum RRO Report IR D4-73-19
Relevance of Infantry School Curriculum to Assessment Dimensions	Jan. 1974	Hum RRO Report IR D4-74-2
Comparison of Four Displays For Use in an Unattended Ground Sensor Grid Deployment Situation	Jan. 1974	Contract DAHC 19-74-C-24
Manual for Administration and Interpretation of the Racial Attitudes and Perceptions Survey (RAPS)	Mar. 1974	Contract DAHC 19-73-C-0037
Measuring the Impact of Race Relations Programs in the Military	Mar. 1974	Contract DAHC 19-73-C-0037
COURSE OUTLINE; Instruction for Unit Trainers in How to Conduct Performance Training	Sept. 1975	Special Publication
Development of Performance Objectives and Evaluation of Prototype Performance Tests for Eight Combat Arms MOSs	Oct. 1975	Contract DAHC 19-74-C-0043
Elements of a Battalion Integrated Sensor System: Operator and Team Effectiveness	Dec. 1975	Research Report 1187
REALTRAIN: A New Method for Tactical Training of Small Units	Dec. 1975	Research Report TR-S-4

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Elements of A Battalion Integrated Sensor System Operator and Team Effectiveness	Dec. 1975	Contract DAHC 19-74-C-0001
Development of A System of Aircrew Training in Nap-of-the-Earth Navigation	Jan. 1975	Contract DAHC 19-74-C-0015
<u>Human Engineering Laboratory</u>		
HELAST I - A Field Study of Target Presentation and Defender Reaction	Jan. 1973	Technical Memorandum 3-73
Human Factors Evaluation of the USMC M 1955 Armored Vest and the Proposed Titanium Nylon Improved Conventional Munitirs Protective Armored Vest (48 plate)	Mar. 1973	Technical Memorandum 8-73
HELHAT-1 - The Effect of Observer Position on Target Detection	Mar. 1973	Technical Memorandum 7-73
A Human Factors Engineering Assessment of an Automatically Conforming Aircrew Body Armor System	June 1973	Technical Memorandum 9-73
Automatic Rifle (XM-19) Burst Dispersion Versus Cyclic Rate	June 1973	Technical Memorandum 11-73
HELAST II - A Field Study of the Effects of Mobility/Agility on Target Presentation and Defender Reaction	July 1973	Technical Memorandum 12-73
Comparison of Three Shooting Techniques in the Daylight Employment of Tracer	Sept. 1973	Technical Memorandum 15-73
Flight Information Scale Test for Heads up and Panel Mounted Displays	Oct. 1973	Technical Memorandum 22-73
Detection of Laser Designators by Moving Tank Crewman Using Infrared Binoculars	Oct. 1973	Technical Memorandum 27-73
Human Engineering Evaluation of Two Fixed-Format Message-Entry Devices	Jan. 1974	Technical Memorandum 2-74
HELHAT II - Scout Crew/Observer Target Detection Flight Tests	Jan. 1974	Technical Note 1-74
Three Computer Programs for Analysis of Small Arms Field Test Data	Jan. 1974	Technical Memorandum 1-74
Dragon Night Sight (AN/TAS-3) Acquisition/Tracing Test	Feb. 1974	Technical Memorandum 3-74
The Effectiveness of Color Deficient Individuals in Detecting and Identifying Targets with Varying Degrees of Concealment	Feb. 1974	Technical Memorandum 7-74
Summary of the Human Engineering Laboratory's Air-to-Ground Target Detection Studies Using Stationary Targets	Mar. 1974	Technical Note 5-74
The Use of Tracer as a Marksmanship Aid With Unzeroed Rifles in Daylight	Apr. 1974	Technical Memorandum 8-74
The Effects of Measurement Resolution on the Description of Target Visibility	Apr. 1974	Technical Memorandum 11-74
AN/PSQ-73 Symbology	July 1974	Letter Report 171
Human Engineering Laboratory Assessment of the Airborne Laser Location Designator Control Display Arrangement	July 1974	Letter Report 173

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Performance of Air Defense Operators: 2 Dynamic Symbolology: Variation of Symbols, Cursors, and Devices on Monochromatic and Color Displays	Aug. 1974	Letter Report 176
Field Experiment on Designator Survivability (FEDS) After Action Report	Sept. 1974	Letter Report 177
Human Factors Evaluation of Two Proposed Infantry Fragmentation Protective Systems	Oct. 1974	Technical Memorandum 24-74
Dispersion Versus Cyclic Rate Test of 4.32 mm Cartridge	Oct. 1974	Technical Note 8-74
Program of Applied Research in Personal Defense Weapon System	Jan. 1975	Technical Memorandum 3-75
Infantry Applications of the Night Vision Goggles, AN/PVS-5 (A Pilot Study - September 1974)	Feb. 1975	Technical Note 3-75
An Evaluation of the Impact of AN/TTC-39 () (V) Signalling Tones on Call Processing Effectiveness	Feb. 1975	Letter Report 187
Speech Intelligibility in Combat Vehicle Noise Environment	Mar. 1975	Letter Report 190
An Analysis of the Divergence Between Objective Data and Subjective Opinion of the Combat Effectiveness of Tracer Ammunition	June 1975	Technical Note 8-75
Comparison of Operator Performance on Three Tactical Input-Output Devices	June 1975	Letter Report 197
Effects of Helmet Weight on Complex-psychomotor Performance: 1. Symetrically Distributed Weight	Aug. 1975	Technical Note 4-75
A Comparison of the Original and Revised Automatic Hook Procedures Being Considered for SAM-D	Dec. 1975	Letter Report 202
Human Factors Comparison of the M60E2, and the Belgian FN Mag 58 Armor Machine Gun	Dec. 1975	Letter Report 203
Air-to-Ground Target Identification Using Stabilized Optics	Jan. 1973	Technical Memorandum 2-73
Human Factors Evaluation of XM56/XM58 Aircraft Installation	Feb. 1973	Letter Report 152
Accoustical Evaluation of the M60A1 Tank During Typical Operations	Mar. 1973	Technical Memorandum 6-73
Evasive Target Tank Project (TETAM)	Apr. 1973	Letter Report 155
Sources of Range Underestimation in the M72 LAW and Other Stadiametric Sights	June 1973	Letter Report 156
Non-cooperative Target Vehicle (HELBAT 4)	Sept. 1973	Letter Report 157
Central Office, Telephone, AN/TTC-38 Traffic Engineering Techniques	Sept. 1973	Letter Report 158
The Effects o. Weight and Length on the Portability of Anti-tank Systems for the Infantryman	Oct. 1973	Technical Memorandum 20-73
HELBAT 3 Moving Targets Human Engineering Laboratory Battalion Artillery Tests	Oct. 1973	Technical Memorandum 23-73
A Design Study to Standardize Collective Stick Controls in U.S. Army Helicopters: A Human Factors Engineering (HFE) Evaluation	Oct. 1973	Technical Memorandum 24-73
HELBAT 4 Laser Counterfire Experiment	Feb. 1974	Technical Note 3-74

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Human Factors Evaluation of Communications Unit (CCU) Design	Apr. 1974	Letter Report 161
Human Factors Observations During TACFIRE RMRT Testing	June 1974	Letter Report 162
Investigation of Crew Overburden in the M60A2	June 1974	Letter Report 163
Manned Target Tank DRAGON OT 111	July 1974	Letter Report 174
Performance of Air Defense Operators: 1 Static Symbology Variations of Symbols, Cursors, and Control Devices on Monochromatic and Color Displays	Aug. 1974	Letter Report 175
USAHEL Helicopter Cockpit Lighting Study Phase 1 - An Evaluation of Current and Potential Instrument Panel Lighting Techniques For Use in Army Helicopters	Aug. 1974	Technical Note 7-74
SMAWT Signature Test	Oct. 1974	Technical Memorandum 25-74
Human Factors Evaluation of the Communications Control Unit (CCU)	Oct. 1974	Letter Report 17
Human Factors Evaluation of the Digital Message Devices	Dec. 1974	Letter Report 18
Determining Human Performance Reliability with Infantry Weapons: Part One	Oct. 1974	Technical Memorandum 22-74
Observation Test of External Tracer Ammunition	Feb. 1975	Technical Memorandum 5-75
A System for Determining Helmet Moments of Inertia	Mar. 1975	Technical Note 6-75
Development of Improved Eye Protection for Goggles, Sun, Wind and Dust	Apr. 1975	Letter Report 19
An Evaluation of the Hydraulic Pump System of the XM198, 155mm, S-N1 and S-N5	Apr. 1975	Letter Report 19
An Exploration of the Contribution of Strike Feedback to Combat Effectiveness With Ball and Tracer Ammunition	May 1975	Technical Memorandum 14-75
A Simulation of the Human Shoulder	May 1975	Technical Memorandum 15-75
COAX Machine Gun M60 MOD	May 1975	Letter Report 19
Firing from Enclosures with LAW, Dragon and TOW	June 1975	Technical Memorandum 16-75
Threshold of Audibility with Infantry Helmets	June 1975	Letter Report 19
Collective-Control Head Design Proposed for Standardization in U.S. Army Helicopters	Oct. 1975	Letter Report 20
Static Design Evaluation and Recommendations for the Belgian F.M. "Minimi" 5.56 Light Machine Gun	Dec. 1975	Letter Report 20
<u>NAVY</u>		
<u>Navy Personnel Research and Development Center</u>		
Impact of Electronics Packaging on Cryptographic Manning and Training Requirements-Preliminary Analysis	Jan. 1973	Developmental Analysis Report
An Initial Approach to Evaluation of Personnel Performance in Operation and Maintenance of Small Lift Devices - STAMP	Jan. 1973	Special Report
An Evaluation of a Vocational Interest Test in Recruiting Offices	Apr. 1973	Special Report 73-16

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Occupational Analysis: Application of Billet Evaluation Criteria to Naval Occupational Task Analysis Program Data	Apr. 1973	Technical Report 73-24
A Multivariate Comparison of Drug Users and Non-Users	Apr. 1973	Technical Report 73-22
Updated Identification of Manning and Training Requirements for Operation/Maintenance of Satellite Communication Subsystems	May 1973	Developmental Analysis Report
Occupational Analysis: Transition of the Naval Occupational Task Analysis Program (NOTAP) from Research to Operational Status - Evaluation of Program and Summation of Results	June 1973	Technical Report 73-37
Attitudes of Naval Personnel Toward Policy Changes Initiated Through Z-Grams	June 1973	Technical Report 73-45
Navy Occupational Task Analysis Program Data Bank Information: Its Use in Development/Updating of Qualifications For Advancements	June 1973	Technical Report 73-32
Description and Preliminary Training Evaluation of an Arc Welding Simulator	June 1973	Special Report 73-23
Relative Roles of Experience/Learning and Visual Factors on Radiographic Inspector Performance	June 1973	Special Report 73-22
Enlisted Rotation: Users Guide to the Computerized Equilibrium Flow Model	Sept. 1973	Technical Report 74-1
Electronic Technician Direct Procurement Petty Officer (DPPO) Pilot Program: Phase I	Mar. 1974	Technical Report 74-20
Development of a Social Distance Scale	Apr. 1974	Technical Report 74-23
Problems Reported by Officer Personnel Assigned to the Combat System Department	Apr. 1974	Special Report 74-5
Effects of Sending Minority Personnel Classified as Non School Eligible to "A" School	June 1974	Special Report 74-6
Exposition of Significant Manpower Planning Decisions in a Major Navy Command Organization	July 1974	Special Report 75-5
Navy Manpower Planning and Programming: Basis for Systems Examination	Oct. 1974	Technical Report 75-19
Hydrofoil Manning Reduction and Human Performance Implications	Oct. 1974	Technical Report 75-9
Use of the Operation Sequence Diagram as a Planning Monitoring and Control Tool in Resource Planning	Oct. 1974	Technical Report 75-10
Effects of Sending Minority Personnel Classified as Non School Eligible to "A" School. Part II: Performance in Fleet Assignments	Oct. 1974	Special Report 75-4
Combat System Division of Labor: Officer Personnel	Apr. 1975	Special Report 75-7
Computer Applications in Education and Training: Status and Trends	Apr. 1975	Technical Report 75-32

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Combat Systems Performance Based on J-M Maintenance Data	Apr. 1975	Technical Report 75-25
Electronics Technician Direct Procurement Petty Officer (DPPO) Pilot Program: Phase II	May 1975	Technical Report 75-37
An Evaluation of Computer-Managed Instruction in Navy Technical Training	June 1975	Technical Report 75-33
Attitudinal and Demographic Characteristics of Company Commanders: A Comparative Analysis Across Recruit Training Centers	July 1975	Technical Report 76-4
The Effects of Practice and Position Variables in the Acquisition of a Physically Complex Psychomotor Skill	July 1975	Technical Report 76-7
Survey of Enlisted Personnel Assigned to DLG Combat System Department	July 1975	Technical Report 76-2
Validation of the Delinquent Behavior Inventory as a Predictor of Basic Training Attrition	Aug. 1975	Technical Report 76-3
Human Resource Management and Non-Judicial Punishment Rates on Navy Ships	Aug. 1975	Technical Report 76-5
Shipboard Computer Integrated Instruction in General Damage Control: Development Phase	Sept. 1975	Technical Report 76-17
A Comparison of Adaptive and Non-Adaptive Training Strategies in the Acquisition of a Physically Complex Psychomotor Skill	Dec. 1975	Technical Report 76-24
Survey of Navy Drug Usage	Jan. 1973	Technical Report 73-12
The Use of Shipboard Training Tapes in Teaching Advanced Submarine Sonar Classification Skills	Mar. 1973	Special Report 73-14
Evaluation of the Fundamental Audio Classification Training System (FACTS)	Mar. 1973	Special Report 73-15
Occupational Analysis: Report of Analysis from Field Test of Air Controlmen Rating	Apr. 1973	Technical Report 73-16
Military Personnel Requirements for the Amphibious Assault Landing Craft Program Experimental Test Unit	Apr. 1973	Technical Report 73-21
Computer Models for Manpower and Personnel Management: State of Current Technology (With Emphasis on Navy Operational Models)	Apr. 1973	Technical Report 73-25
Computer Models for Manpower and Personnel Management: State of Current Technology (With Emphasis on Navy Operational Models) - Appendix "A" - Compendium of Models and Related Manpower/Personnel Programs and Studies	Apr. 1973	Technical Report 73-25A
Attitudinal Changes in Category IV Perceptions of the Navy During Recruit Training	May 1973	Technical Report 73-17
Lateral Entry Recruitment at Advance Paygrades	June 1973	Technical Report 73-29
Operational Analysis: Final Report on the Design of a Navy Officer Occupational Analysis System	June 1973	Technical Report 73-31
Occupational Analysis of the Aircrew Survival Equipment (PR) Rating	June 1973	Technical Report 73-33

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Interpretation and Training Uses of Computer Printout Data of Naval Occupational Task Analysis Program (NOTAP)	June 1973	Technical Report 73-34
Occupant Opinion of Navy Family Housing: A Study of the Livability and Attractiveness of Navy Family Dwellings, Environments and Services	June 1973	Technical Report 73-38
A Method for Correcting the Bias Due to Non-Response in a Mail Survey	June 1973	Technical Report 73-44
Sources of Error in Naval Personnel Surveys: An Investigation	June 1973	Technical Report 73-46
The PPI and Audio Displays of the SOS-23 Sonar During LORA Operation	Oct. 1973	Technical Report 74-8
STFN Attitudes Towards the Shore Support Group Concept	Dec. 1973	Special Report 74-1
A Study of the Factors Influencing Career Motivation Among Physicians and Dentists	Feb. 1974	Technical Report 74-17
Apprenticeship Personnel Shipboard Work Evaluation: Statistical Analysis	Mar. 1974	Technical Report 74-18
An Evaluation of the Use of Chemically Treated Answer Sheets	Mar. 1974	Technical Report 74-9
Task Data Gathering Sampling Techniques Statistical Analysis	Mar. 1974	Special Report 74-3
Personnel Subsystem Criteria and Standards for the Amphibious Assault Landing Craft (AALC): Navy Trials	Apr. 1974	Technical Report 74-30
Perceptions of Discrimination in Non-Judicial Punishment	June 1974	Technical Report 74-22
A Prototype Computer-Assisted Distribution and Assignment (CADA) System for Application in the Bureau of Naval Personnel. Part I: System Description, Part II: Program Listings and Documentation	July 1974	Special Report 75-2
Identification of Naval Academy Applicants with Engineering and Science Interests	Aug. 1974	Technical Report 75-7
Advancing the Application of Job Performance Aids Within the Navy: II Mailout Surveys of Machinery Repairman and Commissarymen Ratings	Oct. 1974	Technical Report 75-14
Technique for Interactive Systems Analysis (TISA)	Oct. 1974	Technical Report 75-22
Evaluation of a Pilot Course in Tactical Decision Making During Defensive Combat: Measuring TAO Performance	Dec. 1974	Technical Report 75-16
Analysis of Training Requirements in Landing the Force Training Commands (NASP Project PHIB-6-73)	Apr. 1975	Technical Report 75-26
Post Service Attitudes and Experiences of Nuclear-Power-Trained Navy Officer Resignees	Apr. 1975	Technical Report 75-29
Recommendations for Marine Corps Training Support System	Apr. 1975	Special Report 75-6
Personnel Readiness Training Program: Initial Project Development	Apr. 1975	Special Report 75-8
Racial Differences in the Prediction of Class "A" School Grades	June 1975	Technical Report 75-39
A Systematic Sequence for Logogram Analysis: A Training Program Based on Films Describing the Gram Analysis Logic Tree (GALT)	June 1975	Special Report 76-1

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Evaluation of Revised Navy Occupational Information	Aug. 1975	Technical Report 76-8
Investigation of the Navy Workweek at Sea	Sept. 1975	Special Report 76-2
Workweek of Shipboard Enlisted Personnel During In-Port Periods	Nov. 1975	Special Report 76-5
Department of Defense Family Housing Preference Survey	Nov. 1975	Technical Report 76-20
Problem Drinking and Attitudes Toward Alcohol Among Navy Recruits	Nov. 1975	Technical Report 76-21
Development of S-3A Instructional Materials: Task Listing, Learning Requirements Analysis, and Passive Acoustic Logic Tree	Dec. 1975	Technical Report 76-27
Workweek of Navy Military Personnel in CONUS	Dec. 1975	Special Report 76-6
<u>Office of Naval Research</u>		
Optimal Control of a Graded Manpower System	Apr. 1973	Research Report ORC 73-8
Longitudinal Manpower Planning Models	Aug. 1973	Research Report ORC 73-15
Coordination and Integration of Military Education with National Career Education: Phase I: Career Development in Selected Occupations	Oct. 1973	Technical Report 795
Naval Officer Retention in an All Volunteer Force: Job Proficiency and Organizational Climate	Dec. 1973	Technical Report
Application of the Navy Average Grade Model to the Naval Underwater Systems Center	Mar. 1973	Technical Report
Dynamic Multi-Attribute Models for Mixed Manpower Systems	Mar. 1973	Technical Report
Alternate Formulations for Static Multi-Attribute Assignment Models	Apr. 1973	Technical Report
An Integrated Workload and Manpower Planning System for the Naval Air Rework Facility, North Island	Nov. 1974	Technical Report 21
Application of Civilian Manpower Models to the Naval Facilities Engineering Command	Jan. 1974	Research Report 16
A Prototype Test of a Multi-Level Model for Military-Civilian Manpower Planning	May 1974	Research Report 19
Longitudinal Budget Planning Models	Aug. 1974	Research Report ORC 74-24
Impact of Navy Career Counseling on Personnel Satisfaction and Reenlistment: Phase II	Feb. 1974	Technical Report TM-5031/003/00
Differences in Organizational Practices and Preferences in the Navy by Race	Dec. 1974	Technical Report
DAISY: A Decision-Aiding Information System	Jan. 1975	Working Paper 75-01-05
Decisions Aiding Information System (DAISY) User's Guide	Jan. 1975	Working Paper 75-01-02
Work in the Navy - Description of Navy Officer and Enlisted Occupations	June 1975	Technical Report 923
Navy Recruitment Potential in Junior Colleges	July 1975	Technical Report 76-1

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
A Brief Survey of Potential Decision Aids for the Task Force Commander and His Staff	Aug. 1975	NWRC-RM-84
Decision Analysis as an Element in an Operational Decision Aiding System (Phase II)	Nov. 1975	Technical Report 75-13
The All Volunteer Navy and the Schools: Recommendations for Integration of Navy Careers Into Career Education	Feb. 1973	Technical Report 76
Impact of Navy Career Counseling on Personnel Satisfaction and Reenlistment	Feb. 1973	Technical Report 2
Development of Utility Measures for Manpower Planning	Mar. 1973	Technical Report 3-177
Navy Retention Rates and Human Resources Management	May 1973	Technical Report
Comparative Profiles of True Volunteer and Draft-Motivated Navymen	June 1973	Technical Report
Socialization and Accommodation Mechanisms for Achieving Goal Integration	June 1973	Technical Report
The Navy as a Functioning Organization: A Diagnosis	June 1973	Technical Report
Values and Their Impact for Navy and Civilian Respondents	June 1973	Technical Report
Values, Preferences and Perceptions Concerning Military Service	June 1973	Technical Report
Technological Sophistication and Organizational Practices	June 1973	Technical Report
Expressed Preferences and Organizational Practices Experiences by Navy Officers	Dec. 1973	Technical Report
Integrated Manpower and Program Planning Models for Laboratory Management	Oct. 1973	Research Report 17
Organizational Practices and the Decision to Reenlist	Dec. 1973	Technical Report
Minority Recruiting in the Navy and Marine Corps	Sept. 1974	Technical Report 2
Values, Preferences and Perceptions Concerning Military Service: Part II	Feb. 1974	Technical Report
Military Manpower and Modern Values	Oct. 1974	Technical Report
Hierarchical Differences in Navy Functioning	Feb. 1974	Technical Report
A Computer Support System for Large-Scale Manpower Planning	Mar. 1974	Research Report 18
Managerial Tests of Conversational Manpower Planning Models	Apr. 1975	Technical Report 22
Navy Manpower: Values, Practices and Human Resources Requirements	June 1975	Final Report
Minority Upgrading and Mobility in the Navy and Marine Corps	Aug. 1975	Technical Report 3
A Multi-Objective Model for Planning Equal Employment Opportunities	Oct. 1975	Technical Report 23
Utility Theory and Optimization in Military Personnel Management	Jan. 1975	Technical Report 3-135
The Navy's Personnel Retention Communication Campaign	Mar. 1973	Exploratory Study

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
<u>Naval Training Equipment Center</u>		
Chart Interpretation in Low Altitude Flight	Mar. 1973	Contract 70-C-0306-2
Description and Initial Evaluation of a Computer Based Individual Trainer for the Radar Intercept Observer	Nov. 1973	Contract 71-C-0219-1
Guidelines for Implementing Training Effectiveness Evaluations	Apr. 1974	Contract 72-C-0209-3
Forward Looking Infrared Simulation	July 1974	Report Number TN-39
Acoustic Tablet Data Input From Instructor Consoles - An Interim Report on Computer Display Interactive Scenario Development	Oct. 1974	Report Number IH-239
Field Evaluation of Model II of the Computer-Based Individual Trainer for the Radar Intercept Officer	Oct. 1974	Contract 73-C-0065-2
Math Model for Naval OOD Ship Handling Trainer	Dec. 1974	Report Number IH-243
Use of Computer Assisted Instruction for Inter-Personal Skill Training - A Pilot Study	Mar. 1975	Contract 73-C-0133-1
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Device 2F9U Flying Qualities and Performance Evaluation and Discrepancy Correction	Sept. 1975	Report Number IH-245
Analysis of Acoustic Synthesizers for Passive Sonar Simulation	Dec. 1975	Report Number IH-242
A Technique for Shipboard Sonar Echo Simulation for Training	Oct. 1975	Report Number IH-231
Radar Image Generation Software	May 1974	Contract 73-C-0167-1,2
Mathematical Model of an Air Cushion Vehicle	May 1975	Contract 73-C-0138-1
New Concepts in Maintenance Trainers and Performance Aids	Oct. 1975	Report Number IH-255
Radar Landmass Simulation Computer Programming	Jan. 1973	Report Number IH-212
Digital Radar Landmass Simulation	Feb. 1973	Report Number IH-196
Photo Optical Design Observed Fire Trainer	Mar. 1973	Report Number IH-218
The Evaluation of Two Automated Systems for Teaching Typo-Writing	Mar. 1973	Report Number IH-220
Simulation System Programming Design Manual	Apr. 1973	Report Number 1089-1 Revision 1
A Study of the Impact of SSM Class Submarine Design on a Generalized Advanced Casualty Ship Control Training Device	June 1973	Contract 71-C-0200-1
Training Effectiveness Evaluation of a Prototype Waterspray Smoke Abatement System for Fire Fighting Training	Nov. 1973	Contract 72-C-0209-1
Digital Radar Landmass Simulator	Jan. 1974	Contract 71-C-0207-1,2
Training Effectiveness Evaluation: Device ID23, Communications and Navigation Trainer	Mar. 1974	Contract 72-C-0209-2

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Laser Air-to-Air Gunnery	Apr. 1974	Report Number 1H-23
Advanced Officer Tactics Training Device Needs and Performance Measurement Technique	Apr. 1974	Contract 72-C-0053-1
Basic and Advanced Submarine Officers Tactical Training Device Requirements - Executive Summary	Apr. 1974	Contract 72-C-0053-1(A)
<u>Naval Aerospace Medical Research Laboratory</u>		
Brief Vestibular Disorientation Test as an Assessment Tool For Non-Pilot Aviation Personnel	Oct. 1974	NAMRL-1210
Naval Flight Officer Function Analysis, Final Report - Commonality of Operational Functions	Nov. 1973	NAMRL-1194
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AIMIS RFP Review	Sept. 1975	Memo 5313A3: JCH
<u>Naval Ship Research and Development Center</u>		
System Specification for the Modified Engineering Plant Control System for the DE-1052 Class Ship. Revision "A"	June 1974	Contractor Report
Findings of the Pilot Program for the CNO Shipboard Automation and Manpower Reduction Project	Sept. 1973	Technical Report 17
Design of an Integrated Bridge Intended to Reduce Bridge Manning on Navy Ships, Volumes I and II	Mar. 1974	Contractor Report 1475
Deck Log and Quartermaster's Notebook Investigation as a Part of the CNO Pilot Program for Reduced Bridge Manning	Apr. 1974	NSRDC Report 27-734
CNO Pilot Program for Reduced Bridge Manning, Manpower Equipment Integration and Procedural Development	Apr. 1974	NSRDC Report 27-744
Reduced Bridge Manning Without Equipment Augmentation - Results of Ship Reports and Comments	Apr. 1974	NSRDC Report 27-756
CNO Pilot Program for Reduced Bridge Manning - Equipment Report	May 1974	NSRDC Report 4281
Prime Item Development Specification for an Integrated Bridge System Revision "A"	July 1975	Contract N00024-75-C-7056
Ship Controlmen Rating for U.S. Navy Ships	Sept. 1975	CCDGTWO/D0G Technical Report 09-75
Development of a Draft Specification for Technical Manual Quality Assurance	Dec. 1975	Contractor's Report
<u>AIR FORCE</u>		
<u>Air Force Human Resources Laboratory</u>		
Automatic Data Processing System and Procedures Computerized Academic Counseling System	June 1973	Technical Report 73-06
The Air Reserve as an All-Volunteer Force	Sept. 1973	Technical Report 73-12
Comparison of Volunteer Attitudes and Career Motivation Among Officer and Airman Personnel	Oct. 1973	Technical Report 73-28

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Reevaluation of the Operational Weighted Airman Promotion System for Grades E-5 through E-7	Nov. 1973	Technical Report 73-25
Development of a Data Base for Direct Analysis of Airman Loss Rates	Dec. 1973	Technical Report 73-37
The Development and Evaluation of an Optimized Video Output From a Wide Angle Optical Probe	Dec. 1973	Technical Report 73-22
Development of the Weighted Airman Screening System for the Air Reserve Forces	Mar. 1974	Technical Report 74-18
A Survey of Student Measurement and Course Evaluation Procedures Within the Air Training Command	July 1974	Technical Report 74-05
Individualized Instruction for the Precision Measuring Equipment Specialists	Aug. 1974	Technical Report 74-46
Systematic Method for Establishing Officer Grade Requirements Based upon Job Demands	July 1975	Technical Report 75-36
Undergraduate Pilot Training Task Maneuver Times Study	Sept. 1975	Technical Report 75-42
Undergraduate Navigator Training Attrition Study	Nov. 1975	Technical Report 75-62
Simulation Techniques for Airborne Electro-Optical Imaging Systems	Dec. 1975	Technical Report 75-43
An Analysis of Factors Related to Desertion Among FY 1968 and FY 1969 Army Accessions	Jan. 1973	Technical Report 73-63
Attitude of Airmen Toward the Weighted Airman Promotion System	Apr. 1973	Technical Report 73-2
Development of the E-2 Weighted Airman Promotion System	Apr. 1973	Technical Report 73-3
Comprehensive Occupational Data Analysis Programs: Group Membership and Automated Diagramming Programs	Apr. 1973	Technical Report 73-05
Attitudes of Youth Toward Military Service: Selected Data from Four Surveys, May 1971 to November 1972	June 1973	Technical Report 73-66
Validity of Armed Services Vocational Aptitude Battery, Form 1, to Predict Technical School Success	Mar. 1973	Technical Report 73-7
Analysis of Air Force Institute of Technology Course #475 "Laboratory Management of R&D"	Aug. 1973	Technical Report 73-27
Relative Validity of Two Item Formats for Obtaining Length of Service Data From Job Inventories	Sept. 1973	Technical Report 73-34
Trends in Enlistment Motivation: Results of APES Surveys of Enlisted Men from April 1971 to April 1972	Sept. 1973	Technical Report 73-58
Test and Evaluation of Multi-Media Cadet Career Information and Counseling Center	Oct. 1973	Technical Report 73-45
Human Resources Sensitivity to System Design Tradeoff Alternatives: Feasibility Test with Jet Engine Data	Nov. 1973	Technical Report 73-21
Felt Utilization of Talent and Training in Two Civil Engineering Career Ladders	Nov. 1973	Technical Report 73-32
Variables Related to Pre-Service Cannabis Use in a Sample of Air Force Enlistees	Nov. 1973	Technical Report 73-33
The Electronic Career Ladder Evaluation Project: An Aptitude Requirements Study	Dec. 1973	Technical Report 73-35
Fully Proceduralized Job Performance Aids: Vol I: Draft Military Specification for Organizational and Intermediate Maintenance, - Vol II: Handbook for JPA Developers, - Vol III: Handbook for JPA Managers and Training Specialists	Dec. 1973	Technical Report 73-43

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
An Analysis of AF Reading Improvement Programs: Results of USAF Survey Number 73-89	Jan. 1974	Technical Report 73-54
Review and Implications of Job Satisfaction and Work Motivation Theories for AF Research	Jan. 1974	Technical Report 73-56
Preliminary Evaluation of the Effectiveness of Air Force Advertising	Jan. 1974	Technical Report 73-62
Media Adjunct Programming: An Individualized Media - Managed Approach to Academic Pilot Training - Vol I Executive Summary and Vol II	Jan. 1974	Technical Report 73-71
Comparability Study of Armed Services Vocational Aptitude Battery Scores from Answer Sheet and Answer Card Administration	Jan. 1974	Technical Report 73-55
Young Men and Military Service	Jan. 1974	Technical Report 73-70
Career Potential of Enrollees in PLC, ROC, and AVROC: A Comparison of Surveys Conducted in May 1972 and May 1973	Nov. 1973	Technical Report 74-38
Career Potential Among ROTC Enrollees: A Comparison of 1972 and 1973 Survey Results	Nov. 1973	Technical Report 74-39
Enrollment Potential for College-Based Military Officer Training Programs: A Comparison of Results Conducted in May 1972 and May 1973	Jan. 1974	Technical Report 74-23
Attitudes of Youth Toward Military Service in a Zero-Draft Environment: Results of a National Survey Conducted in November 1972	Feb. 1974	Technical Report 74-37
A New Method for Long Range Forecasting of F Type PCS Moves of Airmen	Feb. 1974	Technical Report 74-1
Regression Prediction of Airmen E Type PCS Moves	Feb. 1974	Technical Report 74-2
Development and Feasibility Test of a Method to Study Location Assignment Preference of Airmen	Apr. 1974	Technical Report 74-40
Cost Estimates and Implications of Alternate Configurations of an Advanced Personnel Procurement System (APPS)	June 1974	Technical Report 74-82
The Attractiveness of Air Force Non-Monetary Benefits	July 1974	Technical Report 74-68
Computer-Based Enlistment Quota Reservation System Using the General Data Management System 2000	Aug. 1974	Technical Report 74-62
Incentive Motivation Techniques Evaluation in Air Force Technical Training	Nov. 1974	Technical Report 74-24
Procedure for Determining Grades of Officer Positions	July 1975	Technical Report 75-31
An Analysis of APROTC Detachment Viability	Aug. 1975	Technical Report 75-18
Assignment Location Preference of Airmen	Oct. 1975	Technical Report 75-50
Preferred Job Assignment Effect on Job Satisfaction	Dec. 1975	Technical Report 75-77
Computer-Based Enlistment Quota Reservation System Using the General Data Management System 2000: Programming and Implementation Details	Dec. 1975	Technical Report 75-71
Advanced Development Work Resulting in Inventory Management (IM) Individualized Instruction Materials	Feb. 1974	Technical Report 74-17
A Comparison of Task Difficulty Ratings Made by Nurses and Medical Service Corpsmen	Mar. 1974	Technical Report 74-07
Improving Job Performance Aids Through Condensation, Dual-Level Presentation, Promotion of Learning, and Entry by Malfunction Systems	Mar. 1974	Technical Report 74-12

APPENDIX II

APPENDIX II

<u>Report title</u>	<u>Published</u>	<u>Report number</u>
Development and Standardization of the Air Force Officer Qualifying Test Form M	Mar. 1974	Technical Report 74-16
Documentation of the 1973 DOD Personnel Survey	May 1974	Technical Report 74-80
Syllabus and Syllabus Development Techniques Used in Evaluating the A/P 37A/T-4G Flight Simulator	June 1974	Technical Report 74-44
Use of the T-4G Simulator in USAF Undergraduate Pilot Training (UPT) Phase I	July 1974	Technical Report 74-61
Evaluating Maintenance Performance (Four Volumes)	July 1974 to Jan. 1975	Technical Report 74-57
Increasing and Evaluating the Readability of Air Force Written Materials	Aug. 1974	Technical Report 74-28
CODAP: Source Program Listings for the UNIVAC 1108	Oct. 1974	Technical Report 74-83
CODAP: Control Card Specifications for UNIVAC 1108	Oct. 1974	Technical Report 74-84
CODAP: Programmer Notes for the Subroutine Library on the UNIVAC 1108	Oct. 1974	Technical Report 74-85
T-4G and T-4 Ground Training Services in USAF Undergraduate Pilot Training (UPT)	Nov. 1974	Technical Report 74-78
Action-Oriented Review of the On-the-Job Training Literature	Dec. 1974	Technical Report 74-66
T-4G Methodology Implementation T-37 Phase of Undergraduate Pilot Training	Dec. 1974	Technical Report 74-107
Impact of Design Trade Studies on Systems Human Resources	Dec. 1974	Technical Report 74-89
Determining the Literacy Skills and Requirements in 56 Air Force Career Ladders	Dec. 1974	Technical Report 74-90
Maintenance Manpower Management During Weapon Systems Development. (Four Additional Volumes on Simulating the Maintenance Manning Required for New Weapon Systems)	Dec. 1974	Technical Report 74-97
Simulation Design Manual for the EC-11 Simulator	May 1975	Technical Report 75-14
Operational Tryout of a General Purpose Simulator	May 1975	Technical Report 75-13
Functional Integrated System Trainer: Volume II Technical Design and Operation	June 1975	Technical Report 75-6
Evaluation of the Job Inventory Approach in Analyzing USAF Officer Utilization Fields	June 1975	Technical Report 75-22
Airborne Electro-Optical Sensor Simulation	July 1975	Technical Report 75-35
Comprehensive Occupational Data Analysis Programs (CODAP): Ordering of Hierarchically Grouped Case Data (KPATN) and Print KPATN (PRKPTH) Programs	Aug. 1975	Technical Report 75-32
Undergraduate Pilot Training Task Frequency Study	Aug. 1975	Technical Report 19
USAF Evaluation of an Automated Adaptive Flight Training System	Oct. 1975	Technical Report 75-55
Occupational Analysis of Air Force Reserve and Air National Guard Nurses	Nov. 1975	Technical Report 75-65
Techniques for Generating Instructional Slides	Nov. 1975	Technical Report 75-68
Development of a Prototype Human Resources Data Handbook for Systems Engineering: An Application to Fire Central Systems	Dec. 1975	Technical Report 75-64

HUMAN RESOURCES RESEARCH AND DEVELOPMENT OBJECTIVES,
NEEDS, AND ACCOMPLISHMENTS

This appendix describes DOD's and the services' research and development objectives, needs, and accomplishments, as reflected in DOD's Technology Coordinating Paper and through other information provided to us by DOD.

OBJECTIVES AND NEEDS

One of DOD's principal methods of cataloging and organizing human resources research and development objectives is its Human Resources Technology Coordinating Paper. The initial and currently used Human Resources Technology Coordinating Paper was published March 30, 1973.

This document is a management device intended to define

- areas of research and development where advances are needed to meet future military requirements and to solve current manpower problems;
- current and planned programs by the Military Departments and Defense Agencies to satisfy the requirements;
- important technology gaps, if any, which exist at the level of spending for projects shown in the Five-Year Defense Program;
- new initiatives which would strengthen the technology area.

The Technology Coordinating Paper includes five specific research areas dealing with

- education and training,
- personnel systems and contemporary personnel problems,
- manpower systems management,
- human factors in system development and operation, and
- overseas operations and planning factors.

Education and training

DOD's direct cost of education and training is about \$6 to \$7 billion a year. The amount funded for research and development in this area averaged about \$42 million a year for fiscal years 1974 through 1976. The Technology Coordinating Paper identifies the following statistics:

- About 20 percent of the personnel in the Services are in training at any one time.
- Many servicemen spend 25 percent of their service careers in direct training.
- Pilot training for about two and one half percent of DOD's manpower accounts for about 25 percent of DOD's education and training budget.

The coordinating paper cites a need for research and development in areas which could insure the required level of human performance with less training. These include motivation of workers and maintenance instructions or job performance aids detailing step-by-step action for completing tasks. It also cites a need for developing models to evaluate the total impact of certain facets of educational/training programs.

The need for further research and development in how to teach was cited. The services use a variety of media for instruction. Extensive use is made of simulators for training purposes. These devices support the rapid development of a high proficiency level at many complex jobs. Also, simulators provide practice of tasks that simply could not be practiced on operational equipment because of costs or dangers, e.g., launch of missiles and emergencies in aircraft or submarines. Despite the great benefits of the current technology, an expanded technology is required in order to meet near or future requirements for a wide variety of training simulators. Also cited are the problems of developing better means to evaluate trainees, ways to use technological advancements in educational and training programs, and ways to achieve full use of lower aptitude personnel.

Personnel systems and contemporary personnel problems

The Technology Coordinating Paper identifies problems of racial tension, drug abuse, dissent, lowered morale, lack of

confidence in appointed leaders and discipline in varying degrees in each Service. By diverting manpower, time, money, and energy from primary missions, these problems lower the operational effectiveness of the Services.

Problems in this area needing research and development included the following:

- Recruiting without the pressure of the draft.
- Selection and classification of the people available to get the best available person for each job.
- Performance evaluation and promotion objectivity.
- Retention, especially of those service members whose training represents significant investments.
- Identification and elimination of the factors relating to differences between blacks and whites in terms of assignments, promotions, disciplinary actions, and career retention.
- The effects of drug abuse on performance and the effectiveness of related education and training programs,
- Identification, development, and measurement of leadership potential.

Manpower systems management

This area involves development and improvement of technology for projecting manpower inventories, forecasting personnel requirements, planning and programing to meet manpower objectives, and evaluating results.

Seven general topics requiring research and development were identified as follows:

- Gathering information on characteristics of the national manpower resources available for military service.
- Providing computer technology and management science for possible application to manpower planning and management systems.

- Improving methods for collecting and analyzing information about military jobs.
- Developing manpower flow models using the present state-of-the-art in computer science to assist in management planning.
- Providing management planning and decision models to harness the potential power of modern computers for more effective forecasting of manpower requirements, work flow simulations, and other areas.
- Developing systems to assure timely assignment and reassignment of military personnel with appropriate characteristics.
- Assimilating new organizational theory into the military system to allow for improved communications and social changes to derive the greatest benefit from military manpower.

Human factors in system development and operation

Weapon systems require human operators and are no more than extensions of man's sensory, muscular, and intellectual capabilities. Man can be trained to operate and maintain extremely complex weapon systems, but it is important to design weapon systems for optimum man/machine capability to make them most effective. The very nature of military operations demands effective man/machine capabilities.

Research and development needs in this area were identified for the following topics:

- Human engineering for man/machine systems.
- Models and methods for system design and operation.
- Human performance capability and adaptability.
- Human performance in unusual environments.
- Personnel, training, and manpower factors in systems development.

Overseas operations and planning factors

Military forces are planned for and deployed in many nations. According to DOD, research and development is required to develop methods to evaluate the meaning of information about these nations.

The research program in this area is organized around the need for research and development in:

- Training U.S. personnel for performance in overseas environments.
- Human factors in overseas operations with emphasis on civil affairs programs and psychological operations.
- Methods to improve DOD ability to predict threats to national security and to simulate strategic problems to improve realism for training and prediction.

Program changes

Both Appropriations Committees made major reductions in the fiscal year 1976 budget request for the human resources research and development program. As a result the Director of Defense Research and Engineering directed a thorough examination of the program. Research and development funding for some needs such as psychological operations and drug abuse set forth in the Technology Coordinating Paper was eliminated. Also, the program was formally separated into three categories of work:

- The technologies for training, simulation, training equipment, and human engineering.
- Personnel and manpower.
- The social science area of race relations, improved adjustment of minority groups in the military, equal opportunity, and other contemporary issues.

ACCOMPLISHMENTS

DOD provided a synopsis of a series of accomplishments from its human resources research and development program. The following demonstrate the nature of some research program results.

Army

--The Army developed and implemented a model for training small combat units to overcome the lack of realism in field training. Using low-cost techniques for simulating the effects of infantry weapons the model allows realistic battlefield engagement including casualty assessment. The Army claims that when the model is used:

1. Extremely effective and motivating tactical training can be achieved to a degree not previously realized.
2. Learning of individual and group tactical skills is enhanced in terms of the ability to engage the enemy.
3. Troop motivation and interest increases significantly.

--Five tests concerned with total system performance of field artillery have resulted in outstanding improvements in artillery equipment and procedures. The feasibility of using new artillery automation concepts and procedures to achieve direct hits against moving targets (10 mph) from distances of 4 to 5 kilometers has been demonstrated. Future savings of over one hundred million dollars in hardware research and development funds, and a reduction of 5 to 6 years in the development time for automating some artillery procedures have been achieved.

Navy

--The Navy developed a system of computer managed instruction for use in some naval technical training courses. This computer managed instructional system, which has been implemented in training courses at Memphis, Great Lakes, and San Diego, has produced a net reduction of 50 percent in training time with higher test performance. Navy analysis has indicated that almost \$9 million in training costs were saved in fiscal year 1975 because of shortened courses, revision of training objectives and individualization of instruction associated with the conversion to computer managed instruction.

--The Navy has developed and used interest tests to aid in the selection of candidates for Naval ROTC and Naval Academy programs. Retention gains due to the use of these interest tests have reduced the average cost to train a Naval Career Officer by approximately \$12,000

with an annual cost avoidance of approximately \$2.5 million. Similar interest tests and other selection techniques have been developed for the Naval Academy which will help them meet their needs for a 15 percent increase in science and engineering majors at the Academy. These techniques are also expected to result in an 11 percent decrease in total class attrition.

Air Force

- The Air Force developed a methodology to determine the critical tasks performed by individuals in various job categories and to related training required to prepare the individual to perform the job. The methodology has been transferred from the laboratory to the Occupational Measurement Center of the Air Training Command, where it is currently being used to survey approximately 55 job categories per year, with the goal of revising the training courses in these job categories. As a result, the reduced time spent in training has resulted in \$3.5 million cost avoidance per year.
- An advanced simulation system was developed and installed at Williams Air Force Base. The completion of the program represented two major accomplishments: (1) the successful development of the most sophisticated flight training simulation system ever undertaken and (2) the advancement of simulation technology in the areas of visual, motion, and flight simulation. This system has been used as an R&D test bed to define the visual simulation requirements for the A-10 full mission simulator and to develop training programs for the new undergraduate pilot training simulators which are currently being procured.

ORGANIZATIONS FOR HUMAN RESOURCESRESEARCH AND DEVELOPMENT

Under the general supervision of the Director of Defense Research and Engineering each of the Services has a unique organization to carry out its human resources research and development responsibilities. This appendix identifies the major organizations involved in human resources research and development included in our review of the program.

DEPARTMENT OF DEFENSE

Responsibilities for human resources research and development at the DOD level include general supervision of the program and advancing technology to resolve military and national security issues which could confront DOD.

Office of the Director of Defense
Research and Engineering

The Director of Defense Research and Engineering is responsible for

- approving, modifying, or disapproving defense system programs,
- recommending major new programs,
- providing policy and guidance for the research and development effort,
- coordinating actions within DOD and with agencies outside DOD,
- reporting status, progress, and problems in research and development programs,
- presenting the research and development program and budget to the Congress, and
- establishing policies for improving research management.

The Office of the Director of Defense Research and Engineering reviews documented problems and examines the existing research programs to determine their adequacy. Through annual budget and apportionment reviews it examines requirements,

existing work, projected work, timeliness, and milestones for the research and development program.

Defense Advanced Research Projects Agency

The Agency was established to explore new concepts in research and development for the purpose of advancing technology and resolving military and national security issues which could confront DOD. The Agency's Human Resources Research Office is responsible for planning, directing, and managing research and development in areas such as manpower, performance under stress, and man/machine interactions. The Human Resources Research Office does no in-house research work but operates through service agents including many of the organizations we reviewed.

Army

The Army human resources research and development program is primarily the responsibility of the Deputy Chief of Staff for Personnel. Specific tasks under the program are carried out by Army Research Institute or Army Materiel Development and Readiness Command subactivities. More detailed information on the responsibilities of the Deputy Chief of Staff for Personnel, the Army Research Institute, the Development and Readiness Command and its Human Engineering Laboratory are shown below.

Deputy Chief of Staff for Personnel

The Deputy Chief of Staff for Personnel is responsible for planning, programing, budgeting, and evaluating the Army human resources research and development program. It is responsible for supervision of its field operating agency, the Army Research Institute. It sponsors research in the areas of personnel recruitment, individual training, distribution, and sustainment and separation so that a properly trained and motivated individual is provided and maintained for each task that needs to be accomplished in the Army.

In conjunction with the management of the Research Institute, this organization reviews statements of need submitted by other Army commands and prepares an advanced development work program. This program, and the technology base program, are reviewed by both military and civilian committees. The committees study the programs and recommend any changes they believe appropriate.

Army Research Institute for the Behavioral and Social Sciences

The Institute does research, exploratory, and advance development in the social and behavioral sciences to promote maximum levels of performance throughout the Army. Its purpose is to establish a base of social science knowledge relevant to the Army and to use this base to help the Army solve problems.

The Institute is organized into two laboratories, the Individual Training and Performance Research Laboratory and the Organizations and Systems Research Laboratory, and nine field units.

Army Materiel Development and Readiness Command

The Materiel Development and Readiness Command provides general supervision for the Army Human Engineering Laboratory. The Command's Office of Laboratory and Development Center Management is responsible for this activity. We were advised that most of the decisions concerning what research is to be done are made at the laboratory level. Office personnel provide broad guidance as to the Army's current research priorities, review reports submitted by the laboratory, and participate in the annual peer group review of the laboratory's work program.

U.S. Army Human Engineering Laboratory

The Human Engineering Laboratory is a separate activity reporting to the U.S. Army Materiel Development and Readiness Command. Its mission is to do basic and applied research in human factors engineering and to provide direct design support to all materiel development programs sponsored by the Materiel Development and Readiness Command. The Laboratory has three Directorates and six field detachments to perform its research and exploratory and advanced development work.

The laboratory is the Army's lead laboratory for Human Factors Engineering Technology, which is defined as comprehensive technical efforts to integrate all manpower characteristics (personnel skills, training implications, behavioral reactions, human performance, anthropometric data, and biomedical factors) into all Army systems.

Navy

Responsibilities for management and performance of Navy human resources research are in several commands, offices, and laboratories. For most of these organizations human resources research is not a major responsibility. The organizations and functions discussed below are limited to the human resources research area.

Office of Naval Research

The Office of Naval Research's Psychological Sciences Division is responsible for administering all of the Navy's research category funds for human resources research. The Division also receives exploratory and advanced development funds. The Division does no in-house research, but contracts all work with private industry, universities, and other institutions.

The Psychological Sciences Division programs are designed to improve understanding and predicting of human performance in military environments. The Division investigates proposed new manpower/personnel management systems to deal with problems of estimating personnel needs and meeting those needs with qualified volunteers under current and projected economic, technical, and social conditions. The division expects reduced manpower costs and increased personnel effectiveness through better man/machine and man/job designs based on information concerning interaction between human factors and hardware, software, environmental, and social factors.

Naval Material Command

The Naval Material Command has overall management responsibility for the Navy's human resources exploratory development program. The Command's exploratory development program is based on formal Science and Technology Objectives and input from laboratories and Naval systems commands. The priority of all requests is determined using five criteria included in a Navy procedure manual.

The laboratories and systems commands are responsible for determining the objectives, scope, and cost of each exploratory development task. The laboratories are responsible for day-to-day management of the program.

Chief of Naval Operations

The Chief of Naval Operations is responsible for management of the Navy's advanced development appropriation. This is accomplished through mission, resource, program, and appropriation sponsors, each responsible for specific parts of the advanced development program. The primary document for initiating advanced development is the Navy Decision Coordinating Paper. These papers may be prepared by sponsors, and/or organizations that need the advanced development work.

The day-to-day management of the advanced development program is the responsibility of the laboratories. Chief of Naval Operations personnel meet with laboratory officials twice a year in conjunction with formal reviews, review administrative reports, and maintain personal contact with laboratory personnel.

Naval Sea Systems Command

The primary objective of the Command's human resources research program is to reduce manpower cost on ships. The Command determines what research and development is necessary and assigns priorities. The laboratories determine, with the Command's approval, the amount to be spent for each segment of the effort. A Command official advised us the Command manages the research and development for which it is responsible by frequent phone conversations, frequent visits to local laboratories and at least, semiannual visits to out-of-town laboratories, and review of administrative reports.

Naval Air Systems Command

The Command receives funds for human resources research and development, determines what efforts are necessary, and selects a laboratory to perform the work. The laboratories are responsible, subject to the Command's approval, for determining the objectives, scope, and cost of specific research and development efforts. The Command controls its research and development efforts by frequent discussions with the laboratories and by making semiannual reviews. The Command also prepares an annual exploratory development report which shows progress, milestones, and expected return on investments for that part of the overall program.

Naval Research Advisory Committee

The Committee is the senior scientific advisory group to the Secretary of the Navy, the Chief of Naval Operations, the Commandant of the Marine Corps, the Chief of Naval Development, the Chief of Naval Research, and the Director of Navy Laboratories. The general task of the Committee is to know problems of the Navy and Marine Corps, to keep abreast of the research and development which is being carried on in relation to the problems and to offer a judgment to the Navy and Marine Corps as to whether the efforts are adequate.

The Department of the Navy RDT&E Management Guide states that a part of the Committee mission is to advise about the use of research results by the Navy.

Navy Personnel Research and Development Center

The Center was created from the 1973 merger of the Naval Personnel Research and Development Laboratory and the Naval Personnel and Training Research Laboratory. Some functions of the Personnel Research Division of the Bureau of Naval Personnel were also assigned to the Center.

The Center is the principal Navy activity for conducting human resources research, development, test and evaluation in the areas of manpower, personnel, education and training; and serves as the coordinating activity for all human resources research, development, test and evaluation for the Navy. It is also to provide support and services to the various Navy Systems Commands and to the Chief of Naval Material Laboratories as necessary to augment and stimulate human factors efforts in the design, development, test and evaluation of new systems for operational use. The Center carries out its mission by in-house research and development, and by contracts.

Naval Ship Research and Development Center

The Center is the principal Navy center for research, development, test, and evaluation of naval vehicles and logistics. It also provides support to the U.S. Maritime Administration and the maritime industry.

All human resources research and development is done on a cost reimbursable basis for specific sponsors. This is a contractual arrangement where specifics such as milestones,

goals, approaches, and types of products are agreed to by the parties.

Human resources research is a very small part of the Center's effort, amounting to less than three percent of the total budget in fiscal year 1975.

Naval Training Equipment Center

The Center's mission is to contribute to the Navy's operational readiness by improving the effectiveness of the naval training and training material support programs by research, design, development, test, evaluation, procurement, fabrication, maintenance, alteration, conversion, repair, overhaul, and logistic support of training devices, equipment and assigned training material; and to perform other tasks specifically assigned by the Chief of Naval Education and Training and the Chief of Naval Education and Training Support.

The Research and Technology Department does all of the human resources research and development at the Center. The Department's mission is to plan, initiate, and execute programs in exploratory and advanced development regarding training equipment and devices, human factors, training systems training techniques, methodology, and the broad spectrum of training simulation technology as applied to training materials through in-house laboratory effort and contract programs.

Naval Air Development Center

The Center is the principal Navy research, development, test and evaluation center for naval aircraft systems. The Center's Human Factors Engineering Division has the duty and authority to initiate human resources research and development programs.

The Division's human resources efforts attempt to:

- Develop human engineering data and guidelines for advanced airborne systems, display/control technology, and airborne panels and crew station design.
- Provide baseline support for planning and managing research and development programs in airborne systems, subsystems, and display/control equipment.

--Develop, test, and evaluate human engineering aids, techniques, and methods for performing human engineering tasks on all weapon system development programs.

Division officials advised us that they use human resources research and development funds to develop a technology base and then apply these results to weapon systems human engineering problems under different funding sources.

Naval Aerospace Medical Research Laboratory

The Laboratory is under the command of the Naval Medical Research and Development Command and the support of the Bureau of Medicine and Surgery. Its mission is to conduct research, development, test and evaluation in aerospace medicine and related scientific areas applicable to aerospace systems. The Laboratory's Aerospace Psychology Department is responsible for all its human resources research and development. The Department's assigned mission is to develop and prosecute research, development, test and evaluation programs leading to improved effectiveness of man as a functional component of naval aviation systems.

At the time of our review the Department was working on two human resources projects; one in exploratory development, the other in advanced development. Both projects were funded by the Naval Air Systems Command.

Air Force

The Air Force Human Resources Laboratory, a Systems Command laboratory, is the principal organization responsible for planning and executing the Air Force exploratory and advanced development human resources research and development program. The Air Force Office of Scientific Research has primary responsibility for the research phase of the program.

Air Force Office of Scientific Research

The Office is the primary agency in the Air Force for the support of extra-mural research. Its mission states that its research program will be designed to provide new scientific knowledge and understanding in those areas of

science which offer the greatest potential for improving the Air Force's present and future operational capability. The goal of the Office's research is to understand a phenomenon or group of phenomena, rather than to seek application of its results.

The Office, which receives only research funds, has been designated the Air Force's single manager for these efforts and, effective in fiscal year 1976, was the only organization reporting to the Air Force Systems Command Director of Laboratories on the research effort.

Air Force Systems Command

The Command provides general supervision over the Air Force Human Resources Laboratory. In this role the Command takes part in the planning, management, and budgeting of the laboratory's efforts. Included in the Command's management activities are investment strategy, which establishes a rationale for allocating resources among the Systems Command technology programs, review of the Laboratory's work program, and review of periodic administrative reports.

Air Force Human Resources Laboratory

The Laboratory is the principal Air Force Systems Command organization charged with planning and executing the Air Force's exploratory and advanced development programs in personnel selection, management, career development, motivation, and retention; personnel force structures and composition; training and training equipment; personnel and training requirements for advanced systems; career education; technical or management assistance in these areas in support of studies, analyses, development planning activities, acquisition, test evaluation, modification or operation of aerospace systems, and related equipment.

In addition to exploratory and advanced development funds, the Laboratory receives research funds for contracts and for use at the discretion of the laboratory Commander. The latter funds are intended to promote new efforts which the Commander believes will be of benefit to the Air Force, provide additional funds for on-going programs where a major breakthrough is expected, or fund new projects that address a major Air Force need.

PRINCIPAL OFFICIALS
RESPONSIBLE FOR ADMINISTERING
ACTIVITIES DISCUSSED IN THIS REPORT

Tenure of office
From To

DEPARTMENT OF DEFENSE

Secretary of Defense:

Harold Brown	Jan. 1977	Present
Donald H. Rumsfeld	Nov. 1975	Jan. 1977
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements, Jr. (acting)	Apr. 1973	July 1973
Elliot L. Richardson	Jan. 1973	Apr. 1973

Deputy Secretary of Defense:

Charles W. Duncan, Jr.	Jan. 1977	Present
William P. Clements, Jr.	Jan. 1973	Jan. 1977

Director of Defense Research
and Engineering:

Albert N. Parker (acting)	Jan. 1977	Present
Malcom R. Currie	June 1973	Jan. 1977

DEPARTMENT OF THE ARMY

Secretary of the Army:

Clifford L. Alexander, Jr.	Jan. 1977	Present
Martin R. Hoffman	Aug. 1975	Jan. 1977
Norman R. Augustine (acting)	July 1975	Aug. 1975
Howard H. Callaway	May 1973	July 1975

DEPARTMENT OF THE NAVY

Secretary of the Navy:

W. Graham Clayton, Jr.	Feb. 1977	Present
J. William Middendorf II	Apr. 1974	Jan. 1977
John W. Warner	May 1972	Apr. 1974

DEPARTMENT OF THE AIR FORCE

Secretary of the Air Force:

Thomas C. Reed	Jan. 1976	Present
James W. Plummer (acting)	Nov. 1975	Jan. 1976
John L. McLucas	May 1973	Nov. 1975
Robert C. Seaman, Jr.	Jan. 1969	May 1973