US Army Corps
of Engineers

Report of
Engineering Division's
Blue Ribbon Committee:

Maintaining Technical Engineering Capability in Engineering Divisions of the U.S. Army Corps of Engineers

Summary Report 82-S05

29 July 1982

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Blue Ribbon Committee:

MAINTAINING TECHNICAL ENGINEERING CAPABILITY IN ENGINEERING DIVISIONS OF THE U.S. ARMY CORPS OF ENGINEERS

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Executive Summary
Maintaining Technical Engineering Capability

I. Introduction: What we did and how we did it

Technical engineering capability is the heart of the U.S. Army Corps of Engineers. By technical engineering capability the Committee means: the ability to design and manage the production of technical engineering designs and engineering services in a professional, timely, and cost-effective manner. For over 200 years, such design has been the Corps' professional public signature in a variety of military and civil works projects. More recently, the Chief of Engineer's White Paper has reaffirmed the Corps' commitment to maintaining necessary in-house capability to respond to national disasters, sudden increases in workload and mobilization construction. In the past, technical capability to produce engineering designs has centered in Engineering Divisions throughout the Corps. Today, resource limitations, internal organizational alignments and external social trends threaten the technical capability of both Engineering Divisions and the total Corps to perform assigned design and construction missions.

At the request of the Director of Civil Works, the Chief, Engineering Division of the Office of the Chief of Engineers (HQ/USACE) investigated: the current state of technical capability within Engineering Divisions; trends in this technical capability; and future actions to mitigate shortfalls in technical capability. The Engineering Division met this mandate by forming a Blue-Ribbon Committee of 10 Engineering Division chiefs which organized into four subcommittees, each examining a single aspect of the problem of maintaining technical capability. These were: describing how the outside architect-engineer (A-E) industry views Corps technical capability; analyzing how internal Corps career paths for professionals contributes to technical capability; examining alternative ways to organize within the Corps to maintain technical capability, and, suggesting appropriate future directions.

Subcommittee analyses were supplemented by a major survey of engineers/scientists in Engineering Divisions. The survey examined the current status of technical capability in Engineering Divisions throughout the Corps. It measured technical capability and attitudes of the professional staff toward technical capability of the organization and its management. This survey was designed and administered by the Corps' Institute for Water Resources (IWR) and received an 80 percent response from a 20 percent random sample of the more than 5,000 engineers and scientists in Engineering Divisions throughout the Corps. While our analyses, conclusions and recommendations directly apply to Engineering Divisions only, they have broader implications for the whole Corps.

II. What is the current status of technical capability in Engineering Divisions?

Based on our analyses and discussions the bottom line is: Technical capability in Engineering Divisions specifically, and the Corps generally, is diminishing. A traditional Civil Works District Engineering Division's ability to deliver full service, maintain and develop engineering capability

is jeopardized when the number of technical and administrative personnel falls below 100. For combined military and civil works districts, the threshold is about 150 technical and administrative personnel. Currently 6 Civil Works districts are below or bordering on these thresholds. Over the last 10 years the number of engineers employed in Engineering Divisions has decreased while manpower for administrative and other overhead services has increased. The percentage of A-E contract work has increased while engineering design within the Corps has both decreased and fragmented across other Corps functions.

III. What are the underlying trends creating this situation?

Workload reduction in civil works is the major trend diminishing the Corps' technical capability. Increased military construction is a good temporary "stop gap" but not a permanent solution. Workload reduction is followed by lack of appropriate advancement opportunities for technical specialists, supervisory shortcomings and increased proportion of A-E contract work in some districts. While our workforce strongly identifies with the Corps as an organization, they feel the current promotion and evaluation systems are unfair. The workforce generally, and management specifically, are pessimistic about the Corps' future. Our workforce feels, and analysis supports, a trend toward recruiting less capable engineers-scientists. At the same time, 12 percent of the workforce expect to retire and 30 percent expect to leave the Corps in the next 5 years. Most of this 30 percent are young journeymen and junior engineers.

IV. What Should be Done?

The Blue Ribbon Committee recommends 3 categories of actions: A) Major actions requiring approval of the Chief of Engineers; B) Major actions beyond the authority of the Corps alone, and; C) Important actions which may be implemented at appropriate levels throughout the Corps Districts and Divisions.

A) Major Actions Requiring Approval of the Chief of Engineers

1. Adopt the Concept of Minimum Size Engineering Division and Establish Design Centers

   ACTION: Division engineers should seek potential full function design centers within their divisions. HQ/USACE should designate further limited function design centers as appropriate.

2. Concentrate all "In-House" Engineering Design and Management of Outside Engineering Design Within Engineering Division

   ACTION: HQ/USACE should issue a policy statement to this effect.

3. Institute a Policy to Either Reduce Administrative and Overhead Support Functions or to Contract for More Support Functions While Retaining More "In-House" Engineering Expertise

   ACTION: HQ/USACE should institute a study on the potential for contracting support functions.

4. Adopt a Policy That Professional/Technical Society Meetings Qualify as Training

ACTION: HQ/USACE modify current guidance on conference attendance versus training.

5. Develop an Aggressive Policy in Seeking New Missions and Adopt the Recommendations Concerning the Federal Engineer Concept, in the Director of Civil Works, February, 1982 Memorandum to ASA (CW)

ACTION: HQ/USACE pursue with ASA (CW) and also allow FOA's to seek such work at regional levels.

6. Develop an Internal Work Referral System for the Corp's Engineering Divisions

ACTION: HQ/USACE develop necessary procedures.

7. Add "Enhancing Technical Capability" to the Corps' Command Goals

ACTION: HQ/USACE add this item at the next revision.

8. Clarify Current Procedures for A-E Contracting

ACTION: HQ/USACE issue necessary clarification.

9. Address a Centralized Manpower Allocation Policy for Engineering Divisions

ACTION: HQ/USACE investigate the viability of such a policy.

B) Major Actions Beyond the Authority of the Corps Alone

1. Examine the Potential for a Dual Career Ladder for Engineers and Scientists

ACTION: The Blue Ribbon Committee should develop a plan of action for possible implementation.

2. Foster Separate Pay Scales for Engineers/Scientists Apart from the GS System

ACTION: Blue Ribbon Committee should develop a plan of action for possible implementation.

C) Important Actions Which May be Implemented at Appropriate Levels Throughout the Corps

1. Strengthen supervisory-employee interface in: developing performance standards; individual development plans; meaning rating profiles, and; career counselling.

2. Assure broader and more enthusiastic involvement of Engineering Division engineers in total recruitment efforts.

3. Evaluate Corps recruitment programs against those of other Federal agencies and private industry in the area.

4. Develop effective internal and external public information programs which publicize positive accomplishments of the Corps and such training opportunities as the career intern programs.

5. Encourage more "on-the-job" training.

6. Improve "in-house" communication among young engineers, senior engineers and technical specialists.

7. Train more engineers and scientists in a secondary specialty area through "cross-training" programs.

8. Place more balanced emphasis on achieving technical quality when managing schedules.

9. Build training plans on the individual's professional, as well as the Corps' corporate needs.

10. Provide opportunities to participate in professional society activities.

11. Encourage and support, where possible, attaining professional registration, and attending technical courses.

12. Advocate using P.E., or other professional titles, after names.

13. Provide incentive awards, to recognize attaining registration and published articles.

14. Encourage Corps employees to be active and hold key offices in professional society activities.

15. Where possible, set aside travel funds to support professional activities.

16. Encourage the preparation and publication of Corps of Engineers design and technical innovations and grant duty time in which technical engineers and scientists can prepare documentation on new innovations and submit papers to professional journals for publication.

17. Provide opportunities for exceptionally qualified technical engineers and scientists to participate in research and study leading to new criteria and methods of design and engineering procedure.

18. Insure that lead design specialists and heads of engineering functions be present when Chief of Engineers design awards are presented to division or district commanders.

19. Insure that lead design engineers be present and officially recognized at such ceremonies or project dedications and other occasions when major design or construction accomplishments are given recognition.

Preface

As civil works manpower and dollars decline, it is evident that the single most challenging problem that the Corps will face will be how to sustain into the decades ahead, the technical and professional excellence that must be maintained to execute our current tasks, and to serve in the event of mobilization.

In December, 1981, the Director of Civil Works commissioned a study to evaluate the present and future caliber of all professional disciplines in Engineering Divisions. The study's purpose was to recommend how to maintain and improve the technical capability of engineers and scientists in Engineering Divisions specifically, and the Corps of Engineers generally. The analysis, and data in this study directly apply to only Engineering Divisions. However, they have broader implications for the whole Corps.

This is the first time that the Corps of Engineers has undertaken such a study to internally review and question its own technical capabilities in an area that the Corps is recognized as having preeminence, i.e., our ability to deliver competent engineering and design support to national, civil, and military construction programs. Many people perceive that we may be losing our most experienced engineers and scientists. If this is the case, the future of the Corps of Engineers could be in jeopardy. Since Congress and the Nation rely on the Corps for quality engineered and constructed projects, maintaining our technical capability is imperative. Failure of certain Corps-constructed projects could have massive, if not catastrophic, effects on human lives and the national economy.

Under the chairmanship of Mr. Lloyd A. Duscha, Chief, Engineering Division, Civil Works, a Blue Ribbon committee of FOA Engineering Division chiefs met in OCE 14-16 December 1981, to outline the study and develop a scope of work. The committee is comprised of the following members under the guidance of the Deputy Director of Civil Works:

L. A. Duscha, P.E.	Chairman, Chief, Engineering Division (CW)
R. C. Armstrong, P.E.	Chief, Engineering Division, ORD
P. D. Barber, P.E.	Chief, Engineering Division, MRK
A. D. Denys, P.E.	Chief, Engineering Division, SWD
P. A. Fischer, P.E.	Chief, Engineering Division, NCS
H. H. Kennon, P.E.	Chief, Engineering Division, NPD
W. N. McCormick, P.E.	Chief, Engineering Division, SAD
J. R. Niemi, P.E.	Chief, Engineering Division, LMS
J. G. Starr, P.E.,R.A.	Chief, Engineering Division, NAO
A. E. Wanket, P.E.	Chief, Engineering Division, SPD

Deliberations and analyses of the committee and its subcommittees were supported by a major survey of engineers/scientists in Engineering Divisions. This survey, directed through the Policy Studies Division of the Engineer Institute for Water Resources (IWR), was designed, administered and analyzed from March to May 1982, by Dr. Jerome Delli Priscolli and Mr. C. Mark Dunning. An 80 percent response from a 20 percent random sample of more than 5,000 engineers/scientists was received. The purpose of the survey was to develop

baseline data on our engineer's and scientist's candid opinions and feelings on the strong and weak areas of technical capability within the Corps; on problems affecting the maintenance of technical capability; and on opportunities for enhancing this capability.

During various meetings, committee members discussed results of its survey and its subcommittee reports on: A-E contracting, organizational concepts, career development and future aspects. This technical report synthesizes major points in the survey and subcommittee reports with committee views. Separate analyses of the survey and each subcommittee are included as appendices to the Technical Report.

Technical Report of Blue Ribbon Committee: Maintaining Technical Engineering Capability

1. Introduction

Technical engineering capability is the heart of the U.S. Army Corps of Engineers. It is the ability to formulate, design and manage the production of technical engineering designs and engineering services in a professional, timely, and cost-effective manner. For over 200 years, such design has been the Corps' professional public signature in a variety of military and civil works projects. In the past, technical capability to produce engineering designs has centered in Engineering Divisions throughout the Corps. Today, resource limitations, internal organizational alignments and external social trends threaten the technical capability of both Engineering Divisions and the total Corps to perform assigned design and construction missions.

At the request of the Director of Civil Works, the Chief, Engineering Division, Directorate of Civil Works, established a Blue Ribbon Committee to: describe the current state of technical capability in the Corps' Engineering Divisions; analyze trends in the capability; and suggest appropriate future actions to mitigate shortfalls in present and future technical capability. To meet this mandate, the Blue Ribbon Committee organized into four subcommittees; each examining a single aspect of the problem of maintaining technical capability. These aspects focused on: describing how the outside architect-engineering (A-E) industry views the Corps technical capability; analyzing how internal Corps career paths for engineers and scientists contribute to technical capability; examining alternative ways to organize within the Corps to maintain technical capability; and, suggesting appropriate future directions.

Reports of each of these subcommittees are found in the appendices to this overview. The overview is a melding of major points in each appendix and consensus expressed among Blue Ribbon Committee members at their final meeting of May 1982. Since the committee's mandate was to analyze only Engineering Divisions, data, analyses and recommendations are limited to that division. Since the committee's topic, technical capability, is broad, results are significant for other Corps divisions and the overall Corps design and construction missions.

Because there is little trend data on technical capability, the committee relied on previous Corps studies, comparable studies in other Federal and nongovernmental organizations, Corps Strat and COEMIS Data. In addition, the subcommittee on private industry employed a survey of A-E firms while the Blue Ribbon Committee commissioned the Institute for Water Resources (IWR) to design and develop a major survey to define the current status of technical capability in Engineering Divisions. The IWR survey, conducted during March 1982, received an 80 percent response rate from a 20 percent random sample of Engineering Division engineers and scientists across the Corps. In addition

to individual technical capability, the survey captured attitudes of the Corps engineers and scientists toward the technical capability of their organizations and its management.

Based on our analysis and discussions the bottom line is: Technical capability in Engineering Divisions specifically, and the Corps generally, is diminishing. The following pages both outline this trend and recommend policy actions.

2. What is the Current Status of Technical Capability in Engineering Divisions?

The survey of engineers and scientists in Engineering Divisions confirmed the Blue Ribbon Committee's starting perception: that technical capability is diminishing.

More than 70 percent of surveyed engineers-scientists in Engineering Divisions throughout the Corps see a "bleak" future for the Corps. This workforce substantially agrees that the Corps is losing its technical engineering capability. More than 75 percent of engineers-scientists feel: that overhead functions increase while the Corps does less actual engineering design; that more and more engineering design work is being done outside the Corps; and, that the failure to recruit highly capable professionals is likely to be a major problem for the Corps. More than 65 percent of engineers-scientists feel: that the most technically capable engineers-scientists are leaving; that the Corps is in danger of lposing its preeminent role in engineering; that technical and scientific capability is diminishing within the Corps; and, that the Corps does not recruit the best talent. More than 50 percent of the workforce feels that the Corps fails to maintain the capability it has and does not have the proper technical mix for future missions.

While the workforce agrees on the loss of technical capability it is substantially divided when diagnosing the causes of this loss. More than 70 percent of engineers-scientists feel that: diminishing new civil works starts; reducing manpower; noncompetitive salaries; increased A-E contracting, and the lack of career advancement opportunities, are major causes of the problem.

While the Engineering Division's workforce is pessimistic about the Corps technical capability, management is the most pessimistic. Overall, 70 percent of the workforce said that morale was low.

Technical capability was measured by standard indicators of: education; professional development; creativeness and innovativeness, and experience. While the overall workforce seemed evenly spread from low to high in technical capability managers were more frequently rated highly capable in technical ability than journeymen and junior engineers. Even after accounting for age and experience variations, new engineers-scientists appear less technically capable than those hired in the past.

The more technically capable engineers and scientists differed from the less technically capable in a number of other ways. A larger proportion of highly capable engineers had: prior experience in private industry; military programs

experience, and professional certification than less capable engineers. This highly capable group was also: older; higher graded; and had more government and Corps experience than their less technically capable colleagues.

A majority of the workforce felt most capable to perform journeyman level work in areas of cost estimation, specification and report preparation; and least capable to perform at this level in electrical, mechanical and architectural areas. Engineering Division's workforce sees the most important reasons for reducing Corps technical capability as: loss of experienced personnel and lack of motivation among the workforce to perform effectively.

As expected, engineering experience in project features, most important to the FOA, varied. The percentage of engineers and scientists with more than 3 years design experience in areas rated as important to their FOA ranged from 5 percent for hardened structures to 37 percent for channels. While professionals in many technical specialty areas claim little experience in designing important project features, the experience level is thinnest in hardened structures and industrial facilities.

More than 70 percent of the workforce feel that the Corps is likely to lose its most technically capable workers. Most of the engineers and scientists feel that the best are leaving while the Corps is recruiting less capable replacements. We estimate that in a few years, 13 percent of the current engineer workforce will be retired, 29 percent are likely to leave and roughly 50 percent are likely to remain. A much larger proportion of junior and journeymen engineers are likely to leave than senior and management engineers. If this occurs, the Corps' capacity to design and construct will be jeopardized.

The major factor in planning to leave is job satisfaction. Highly satisfied engineers and scientists are likely to stay while highly dissatisfied are likely to leave. The current workforce feels that better pay, opportunities for advancement and technical challenge are the principal reasons why colleagues leave the Corps. A small scale survey of engineers who recently left the Corps supports this assessment. Survey results also indicate that engineers and scientists at the junior or journeyman level are most likely to leave the Corps. Both lower and higher capability engineers are just as likely to leave. Retaining junior and journeymen engineers and scientists is important because they must fill gaps of retiring senior designers and provide a continuation of expertise to the Corps.

After several years with the Corps, the highly capable journeyman engineer is faced with the following choices: alienation, attrition or management. The worker must either look for outside work or shoot for Corps management positions. The alternative is to continue at the journeyman level with a likely decrease in technical challenge and opportunities to advance and subsequent increase in job dissatisfaction. Indeed, most of the workforce feel that the only route to advancement is management and that management is recruited on the basis of technical capability rather than management skills. Almost 70 percent said they would choose a technical rather than managerial upper grade career path if given the opportunity. Their feeling is also supported by our measurement that supervisors obtain the highest technical capability scores. Since there is little support, and some evidence contrary,

to the assumption that demonstrated technical capability is a good predictor for good management, the Corps may be trading certain technical capability for uncertain management capability. This trade-off is another factor threatening future technical capability.

3. How Does the Private Consulting and A-E Community View the Corps?

Our survey showed that A-E firms respect the Corps' technical capability and criticize some aspects of the Corps contract management. Basically, the A-E community expressed need for a larger percentage of Corps work which conflicts with the Corps' need for some "in-house" work to maintain and develop technical capability. However, the Corps' attempt to manage this tension through establishing general percentage guidelines for A-E contracting has led to some imbalance and misapplication of the guidelines by FOA's. Offices with light workloads often contract out too much design work while those with heavy workloads are often criticized for not accomplishing enough of the challenging design "in-house." In the IWR survey, 31 percent of those replying were of the opinion that 26-50 percent of the Engineering Division technical work was being done by private A-E contracts and 22 percent thought the percentage was between 51-75%. Sixty-three percent indicated they thought the level of A-E contracting would increase during the next 2 to 3 years.

Generally, private consulting engineers and architects are experiencing little difficulty in attracting and retaining competent professionals. In some cases, they are finding it difficult to maintain an adequate designer-draftsmen staff.

The Corps still enjoys the general respect of the private sector both as a Federal agency and as an engineering organization. It is viewed by most as one of the best in both categories. However, the Corps is not as well understood (as opposed to "known") as it should be. There is a need to better explain our missions and organization to the professional engineering and architectural community. This would serve to incur less opposition from the private sector to the Corps policy of performing some engineering design "in-house." Also, our professional recruiting could be enhanced.

For private A-E's the keys to attracting and retaining good people are providing technical challenge and advancement opportunity coupled with a fair and reasonable employment contract package, i.e., competitive for the geographic area. Unlike the Corps, the private sector is not experiencing difficulty with employee geographic mobility, although such mobility does represent an increasing overhead expense.

Compared to A-E firms, the existing Corps educational training, policies, programs and practices are excellent. They offer more opportunity than is available with most private companies. The concept of career management as practiced in the Corps is not found in the private sector and may not be worthwhile from their perspective.

As in the Corps, the more successful private engineering design firms are heavily committed to quality in their services. Quality assurance programs vary in form, but all include active involvement by key people. In the

smaller firms, even the principals play active roles in the management of projects and in the technical review of designs. The need for internal, independent checking and multilevel review is well recognized and addressed in nearly every firm. None of the firms interviewed offered shortcuts or innovative approaches as alternatives to the traditional checking and review techniques. Engineering competence and mature judgment applied in a systematic fashion are the key elements in quality assurance in the private sector as they are in government. The point is that technical capability is necessary for quality assurance of "in-house" design and review of A-E work as well as construction work.

The concepts of performance measurement and evaluation as embodied in Merit Pay and GPAS are not found in the private consulting sector and may not be meaningful for professional level engineering positions. None of the firms interviewed used any form of written performance standards, nor did they have a written appraisal. Employees are counseled periodically on performance expectations and details of assignments and at least one appraisal interview is held each year. Based on the supervisor's opinion of the employee's performance, appropriate pay raises, bonuses, etc., are recommended. Those recommendations are normally accepted, although monetary amounts are often adjusted by management to conform to overall corporate fiscal policies.

Project management as practiced in the private sector is quite different from that employed in the Corps. The differences lie in the scope and level of responsibility and accountability vested in the project manager (PM). The Corps' PMs typically report to a section or branch chief, have little operational control over resources in other departments, and are basically coordinators/expeditors or reporters. They are expected to assure that projects are afforded proper priority, that needed information and resources are available, and that commitments are met. Accountability is limited by authority. In other words, Corps PMs are not normally considered to be in charge of the work or the workforce. Their role is to transfer information and to report status to those in charge. The grade levels of typical PM positions in the Corps confirm the level of investment in that function. In most districts the PMs are the GS-12's with a few GS-11's. In some special purpose organizations the GS/GM-13 and even GS/GM-14 levels have been justified.

Private sector PMs, in contrast, have full authority to direct the workforce, report directly to the corporate head(s) and are held accountable for their assigned project. Organizational problems and conflicts are settled by top management within the context that project success and resulting profit are paramount. PMs are carefully selected top people and are well paid. They are selected on the basis of managerial skills as well as technical background and knowledge.

In the private sector profit is the key success indicator. No comparable measure exists in government. In fact, the quality and performance indicators used by the Corps can often act as disincentives. They warrant a review. Those indicators which relate costs of one function relative to costs of another (E&D, S&A, VE, etc.) are often misused. Quality indicators are even more elusive. In the private sector, quality is assured through a commitment

at all levels to diligently, systematically and critically review both processes and products according to sound professional standards. There are no gimmicks. Professional judgment is crucial. The committee feels it would be counterproductive and costly to devise and operate elaborate quality monitoring information systems. Rather, strengthening internal supervisory and review personnel and effort would yield greater returns.

4. Organizing to Maintain Technical Capability

Manpower reductions, dwindling new starts and increased emphasis on other functions such as overhead, O&M and planning, are pushing toward a reorganization of engineering activities. Reorganization may require more centralized control of engineering function manpower allocation and the definition of manpower threshold levels to maintain technical capability. However, the Corps must be careful not to sacrifice its "responsiveness" stemming from its decentralized organization for "efficiency" which could result from a change to centralized control. Maintaining technical capability within Engineering Divisions will require a balance between these poles. Such balance will best be achieved by establishing a manpower threshold necessary for capable technical engineering; tailoring some districts down from full service; reducing fragmentation and consolidating technical engineering within Engineering Divisions, and, establishing design centers. These are discussed below.

4.1 Manpower Thresholds

Based on our experience and previous Corps studies, the committee feels that a traditional civil works district engineering function must be involved in one or more of the following activities to qualify as fully capable:

- Dam design (new or modification)
- Lock Design (new or modification)
- Hydropower design (new or modification)
- Six to ten existing reservoirs
- Flood control design (levees and channels)
- Navigation design (coastal or inland)

Consequently, a fully capable civil works district engineering organization should involve the following expertise:

ENGINEERING DIVISION

H & H	Geotech	Design
Hydrology	Soils	Structural
Reservoir Regulation	Geology	Mechanical
Hydraulics	Materials	Electrical
Water Quality	Surveys	Architectural
Sedimentation		Estimates
Tech Evaluation of FPM		Specs
		Civil/Sanitary
		Drafting

Although individual geographical area needs may vary slightly, the expertise involved should roughly correspond to that displayed. To maintain a minimum capability level, more than one professional is required in all areas. In most areas, more than two professionals are essential. Also, actual in-house design experience is needed in order to develop expertise.

Using these assumptions, the following minimum staffing levels can be projected:

ED Chief	- 4	to	5
H & H	- 22	to	28
Geotech	- 14	to	18
Design	- 51	to	56
Total	91	to	107

This assumes at least four areas of expertise in the Corps traditional civil works mission areas shown above. If less than four areas exist, the mix and the number could be modified appropriately. As the Corps takes on new missions, we will probably need to draw from other disciplines as well. Therefore, the 100 level for a civil works district is still considered to be generally representative of the minimum number of personnel required to maintain a fully capable Engineering Division, although the mix will vary as the mission varies. Of course, there may be sound reasons for deviation of these threshold numbers.

Assuming roughly $22/hr Engineering Division chargeout for 1,800 hr/yr and 20 percent district office overhead charges, funding required for a minimum manpower range between 90 and 110 within an engineering organization can also be projected. The average cost per space, including overhead is simply multiplied by the number of spaces to obtain the total requirement.

Average Cost/Space (incl DO O/H)	X Spaces	= Requirement
$48,000	X 90	= $4.32 Million
$48,000	X 100	= $4.80 Million
$48,000	X 110	= $5.28 Million

In its 1979 evaluation of the San Francisco District, SPD reanalyzed the Engineer Study Group (ESG) study and concluded that $6 million per year (CG & O&M) for E&D effort was required to maintain a viable work force. This figure

was reaffirmed in SPD's realignment/reduction study in March 1981. (USACE March 1981 minimum was noted in the SPD report as $8 million.)

An update of the 1977 ESG value of $4 million (CG + O&M) to 1982 (assuming 10 percent escalation) results in $6.5 million for 1982. However, the analysis of minimum personnel requirements is considered more realistic for a minimum organization. Thus we conclude that a minimum E&D workload lies somewhere between and that $6 to $7 million is probably needed to sustain a traditional full service effort in the civil works (CW) engineering function.

Greater flexibility to retain and develop expertise exists in those districts with a civil works/military construction (CW/MC) assignment than in a CW only location. Manpower requirements are greater, and the ability to work in both areas gives an added dimension to the engineering workforce.

Beyond those organizational elements identified exclusively for a CW district, the following elements are required in a combined CW/MC district:

Military

Project Mgrs
Planning & Reports
Master Planning
FE Support
Programming

The following minimum staffing levels can be projected for a combined CW/MC engineering organization.

ED Chief	- 4 to 5
H&H	- 22 to 28
Geotech	- 18 to 24
Design	- 70 to 80
Service	- 5 to 8
Military	- 30 to 40
Totals	149 to 185

Based on this, a combined district needs, as a MINIMUM, 150 to 190 personnel assigned to the engineering function, or 60 to 80 more than a civil works only district. This added staff requires an annual military construction program of $100 to $120 million. This dollar volume program is based on the following considerations:

- Supervision, administration and review costs for A/E design of 2 percent.
- Total design cost for in-house design of 6 percent.
- Average cost per space, including district office overhead of $48,000.
- A/E design effort equal to 80 percent of the total program.

The workload in the military area is less predictable than in the civil works arena. HQ/USACE, in the recent military realignment effort, considered that a $75 million annual program would support a military design mission. This dollar value differs somewhat from the $100-120 million shown above, and can be attributed to different mixes of assumptions on amount of A/E versus in-house design, design cost targets, and cost per manyear.

Currently, the added emphasis on defense spending is producing more military design and construction work. Thus, the manpower required is closer to the higher number in the range. In other words, 170 to 180 manpower levels are more realistic, assuming that a larger measure of in-house design effort is utilized than heretofore.

This analysis identifies a manpower threshold, related to workload, which should be maintained in a district to retain engineering and design capability. This threshold is about 100 FTP spaces for the civil works engineering function. It should not be construed as a goal to reduce manpower at locations where workload warrants greater manpower strengths. The analysis identifies a milestone or critical decision point.

4.2 Tailoring Districts and Establishing Design Centers

The Corps' decentralized, full-service, engineering and design districts are unquestionably the most effective means of doing our business. The Corps' long history of achievements supports this assertion. However, reduced workload is causing departure from this decentralized organizational philosophy. Every district in the country was established to accomplish a significant engineering, design and construction workload. As that workload declined (or said another way, as the original mission was completed) many districts still retained their full-service character, with a resulting decline in engineering capability. Design centers are an alternative for balancing centralization and decentralization and for strengthening our engineering efficiency. However, the need to "tailor" some districts by removing their engineering function is implicit in both this alternative and the minimum manpower levels discussed above.

By design center, we mean a centralized office which designs for a geographical area and/or specific functions. It may be full-function or limited function. It is full-function when all design functions for a geographical area are performed, either for itself, or for other less staffed or tailored districts. The Engineering and Research Center (ERC) of the Bureau of Reclamation is probably the most significant full-function design center in the Federal Government. It provides virtually the entire engineering and design for the Bureau's geographically dispersed regions. The A-E industry frequently uses design centers (i.e., home office) to service their branches which are the primary contact with clients. The division offices of the Navy Facility Engineering Command are full-function military engineering design centers as are the majority of our Corps of Engineers districts.

A design center is limited function when a specific design function is performed as a service for other offices, either "tailored" districts or full service districts. A prime example of this organizational concept within the

Corps is the Hydroelectric Design Branch (HEDB) in the North Pacific Division. The Sacramento District is a limited function design center for military facilities in the South Pacific Division. Kansas City and Omaha Districts recently were assigned design responsibility for Superfund projects nationwide.

As with most organizational plans, design centers have both advantages and disadvantages. To their advantage, they would enhance technical capability, provide more significant technical challenge to professionals by concentrating E&D work, and can be located in desirable areas to attract top talent. Design centers provide opportunities to develop a highly capable, in-depth staff of engineers from trainee through journeyman to technical specialists. While the functions or activities of a proposed design center will determine the particular disciplines required by each, the concentration of engineering capability permits the retention of critical technical engineering expertise.

Design centers can accomplish a large and varied workload with corresponding engineering challenges to stimulate interest and innovativeness at all levels for architects, engineers, geologists and related professionals. These professional challenges, accompanied by financial and professional recognition are key ingredients to retention of a technical capacity.

Also, design centers provide opportunities to select a geographical location which is most suited for continued attraction of engineering talent. The long term benefits of a desirable location for family, community interests and professional involvement could offset the short-term relocation impacts of affected personnel.

To their disadvantage, design centers could: foster some loss of district control over design; widen gaps among the design-construction and engineering-planning interfaces; and, diminish engineering reputation in local areas. A district which receives engineering and design support from a design center will lose some degree of control over the performance of its mission. The district would be <u>required</u> to use the design center, rather than having the option of accomplishment "in-house" or by A-E. The extent of this loss of control will depend on whether the design center is <u>full</u> or <u>limited</u> function. The district will be concerned with the ability of the design center to perform within required schedules, and will be impacted, on occasion, when priorities of the design center change for whatever reason. This should be controllable for those full function design centers established by division offices.

The physical and organizational separation of the engineering and construction responsibilities may cause a widening gap between these two functions, with some reduction in the quality of the end product. Once an issue is identified, response time can be expected to be longer. This separation will require the establishment of a strong and positive relationship between key, top-level managers of both functions to assure properly engineered solutions to design problems which most certainly can be expected to occur.

During the engineering-construction interface, a decrease in the quality of the engineering design in the feasibility study must be avoided.

Institutional arrangements can be developed to minimize this concern; however, geographical separation between design center and district could impact the planning function. Further, this geographical separation could result in pressure to establish duplicative engineering capability at a district, which would contradict the primary purpose of engineering consolidation, i.e., retention of strong expertise.

Where districts may lose their engineering and design function to design centers, the Corps could lose its national identity as an "engineering and construction organization." At the extreme, a relatively few design centers would act as "service organizations" to 36 decentralized districts. This lack of local engineering capability could adversely impact our relationship with national, state and local interests which, in the past, looked to the Corps for engineering advice on numerous topics at their doorstep. While this advice will still be available from design centers, the logistics involved will cause delays in response. Design centers, because of their concentration of expertise and workload, can be expected to provide an economy of operations over that which would be experienced by small operations at individual districts. This efficiency, however, would be offset somewhat by the increased cost of coordination inherent in operating a project out of two geographically dispersed locations.

On balance, design centers are a viable alternative in areas of the country where diminishing workload precludes the retention of a well-rounded staff in the basic engineering disciplines. Design centers now in existence amply demonstrate their success, not only in retaining, but improving capability through concentration of talents and programs with resulting professional challenge in a variety of activities. Design centers are not a panacea, the disadvantages cited above are real. Although institutional arrangements can be developed to minimize these adverse impacts, the need for a design center, whatever its scope, must be clearly apparent before its establishment. Some considerations in evaluating the creation of design centers are:

1. An existing full service district is, by definition, a full function design center. Reducing that district to something less should be undertaken only after it has been conclusively shown that an insufficient workload exists to support an engineering activity generally of the size and function described above.

2. Notwithstanding, the obvious success of the HEDB in NPD generally, a design center should be added to the mission responsibilities of an existing <u>district</u>, with review being accomplished by the division office having jurisdiction over the project.

3. To minimize priority problems, it is preferable that full function design centers serve only one division. Available workload will govern this consideration.

4. A small liaison office should be established by a full function design center in each of the districts that the design center serves. This liaison office would form the link between the center and the serviced district, assuring a two way communication on status, funding, criteria, priority, etc.

5. For design centers handling civil works projects, program development responsibility should rest with the district office responsible for planning and operations. For design centers handling military construction projects, the design center should be responsible for all activities including project advertisement.

Design centers enhance the Corps' capacity to implement a program of dual career ladder. The workload and need for specialized expertise in the several engineering disciplines provide a strong basis for developing and compensating a cadre of technical specialists, serving both their "home" design center, and the other engineering activities throughout the Corps.

4.3 Reducing Fragmentation

An increasing amount of technical engineering design is being done in Corps elements other than Engineering Divisions. This has diluted scarce manpower, lowered quality of work product, and reduced engineering capability. A reconsolidation of engineering functions within Engineering Divisions will reap the following benefits:

1. Consistency of Application. Rather than two elements solving similar problems in potentially dissimilar ways, the ability to apply lessons learned experience to these situations should reduce overall effort and contribute to the experience factor so necessary to improving capability.

2. Quality Product. The ability to learn from mistakes and avert repetition of approaches that have not worked in the past is a major factor in improving the quality of the product. Continued exposure to problem solving is beneficial to all professions, but is especially beneficial in the Corps of Engineers where many situations have similar solutions in a geographical area. Also the synergism of consolidating different disciplines will improve technical design quality.

3. Better Utilization of Manpower. With our declining manpower and the requirement to stretch the resource, it follows that consolidating expertise rather than performing similar functions in more than one location will assist the Corps of Engineers in dealing with this impact.

4. Improvement of Engineering Capability. The ability to develop expertise over a period of time through exposure to a variety of problems is essential to developing and retaining engineering capability. The opportunity to develop is hampered when more than one element is given or develops similar responsibilities in a single organization.

Fragmentation may create problems in engineering interface with planning, construction and operations functions. In the planning-engineering interface, the separation of planning was to strengthen the planning process. Care now needs to be taken that engineering capability is not adversely affected by that decision. The areas most susceptible to duplication or fragmentation of

engineering and planning is hydrology and coastal engineering. Hydroanalysis is involved in nearly all our civil works effort, from preauthorization studies to water control management of operating projects. Other areas of potential problems are cost estimating and determination of engineering feasibility of any particular alternative being studied.

The construction-engineering interface is more a problem of coordination to improve product quality than fragmentation. On the one hand, engineering elements must actively seek input on constructibility of the product being designed. On the other hand, field elements must be constantly aware that design decisions cannot be made in the field. When problems arise, the designer needs to be alerted and the engineer must respond with a solution in a timely manner. Cost estimating input by the engineering element into required construction modifications is another area where closer coordination between these elements is needed. Improvements of this process will have positive results on both the quality of our products and the development of the designer's capability.

The operations-engineering interface presents further problems. As the operation of projects has grown over the years, more engineering and design effort supporting the increased operations and maintenance (O&M) mission has been done in Operations Division, resulting in duplication. Examples of duplication at some locations include: surveying, development of plans and specifications for maintenance dredging activities, and operation and maintenance repairs which involve design decisions. Perhaps some Operations Division elements have done this because the Engineering Divisions historically did not respond as quickly as needed. A reconsolidation where this has occurred is needed and engineering input to the funding decisions on the O&M is essential.

5. Career Development for Maintaining Technical Capability

Technical capability is maintained and enhanced through career development among the workforce as well as through proper organization. The committee examined seven areas which it thought crucial to career development of its professionals; career paths; recruitment; training; pay and benefits; retention; use of up-to-date technology; and professional development.

5.1. Career Paths

Unlike private industry, the Corps does not provide separate career ladders for technical personnel and managers. Consequently, the top GS-12 engineer with 5-7 years experience faces a choice: try for management; stay as a technical specialist without promotion, or; search for outside employment. Except for a very limited number of positions, the option of promotion as a technical specialist does not exist. The IWR Survey discovered strong feelings on this as well as other aspects of the Corps' promotion system.

Almost one-half of the engineers and scientists within the engineering function feel dissatisfied with the Corps' career system and feel the system

is ineffective for career planning purposes. A majority (58 percent) does not believe the current promotion system is fair in the sense that the most qualified person is selected.

Seventy percent believe there is a lack of promotion opportunities within Engineering Divisions for technically capable engineers and scientists. Administrative skill is seen by 73 percent of the workforce as important to extremely important for advancement to high grades. More than 80 percent believe that technical specialists become supervisors because they have no other avenue for grade increases within the Corps. This is perceived, in many instances, as a misuse of valuable technical resources.

If promotion opportunities were available for nonsupervisory, technical engineers and scientists, 68 percent of the workforce surveyed indicate they would establish career goals in a technical rather than managerial area. A majority of the field engineer and scientist workforce (62 percent) agree that establishment of a separate career ladder for technical specialists would have highly positive results in enhancing the technical capability of Engineering Divisions.

In private industry, top technical specialists are often supervised by lower-paid management track personnel. In the Federal sector, Bonneville Power Administration (BPA) has also successfully implemented a technical career program. Establishing a special technical career track program within the Corps would produce the following positive effects.

1. It would be a valuable aid for recruiting, developing and retaining highly qualified technical engineers and scientists.

2. It would enable individuals to examine career objectives and establish goals to advance to progressively higher levels of technical challenge as they enhance their individual technical knowledge, skill and ability.

3. It would help both in establishing training needs and individual development plans for individuals to best equip them for achieving technical career goals and objectives.

4. It would be strongly supported by professional engineers in government, by the Committee on Civil Engineers in Government of ASCE and by other professional organizations.

5. It would be a significant stride to more effective utilization of engineering talent in the organization.

6. It would provide a continuing cadre of technically capable engineers and scientists.

5.2 Recruitment

Sixty-nine percent of the field respondents to the survey disagreed with the statement that, "the Corps recruits and attracts the most highly competent engineers and scientists." Eighty-two percent of these respondents agreed

that the failure to attract and recruit highly capable technical professionals is likely to be a major problem facing Engineering Divisions in the next several years.

Although reduction in civil works workload and staffing needs will reduce personnel recruitment it is necessary to replace the shortage from retirement and employment mobility. Selective recruitment will be needed to replace the loss of critical skills and to fill vacancies with the highest quality recruit possible. Recruitment must concentrate not only on the recent college graduate, but also on those entering the Corps from other sources. Our survey indicates that 34 percent of the respondents entered the Corps through college recruitment, 4 percent from the cooperative education program, 14 percent transferred from another government agency, but 47 percent were hired from an open announcement.

Both internal and external factors influence Corps recruitment. Internally, the following factors directly impact Corps recruitment.

1. The quality of official recruitment efforts and presentations of careers with the Corps.

2. A declining water resources workload fosters the perception of declining technical challenges.

3. A noncompetitive compensation system, including both lower entry salaries and relative decline in fringe benefit package.

4. The practice of contracting substantial water resources work to A-E firms increases outside competition for top professionals.

5. Lack of multiple track career paths, career advancement opportunities and effective delegation of responsibility decrease the Corps attractiveness.

The Corps' engineer career intern program and cooperative education programs are positive influences in attracting new college graduates and should be effectively described during placement interviews.

Externally, increased demand for engineers relative to supply will inhibit the Corps' ability to recruit top talent. Also, job location is becoming more important because of the high living costs in certain regions, the desirability of climate, and the decreased mobility of the workforce. The attitudes of the job applicants toward Federal employment, in general, and their perception of the Corps, in particular, as a "good" place to work is paramount. The Corps needs a solid information program which positively displays the Corps as a challenging, professional and responsive agency providing water resources, natural disaster, and national defense services to the Nation.

Results of the survey revealed that 78 percent indicated that geographic location was important in making a choice to join the Corps, 75 percent said that opportunity for professional or career advancement was important, and 71 percent said technical challenge was important. Fringe benefits, job security

and pay level follow with over 60 percent indicating them as important. Comparable percentages for these same factors were listed as important factors in choosing to remain with the Corps.

To assure the proper recruitment of professional engineers and scientists the Corps should:

1. Assure enthusiastic engineer and scientist involvement in the total recruitment effort. This effort should be both formal through participation on the recruitment team and informal through professional outside contacts.

2. Evaluate the Corps' recruitment programs against those of the other Federal agencies and private industry.

3. Work towards achieving comparability and competitiveness in entry level salaries. Appropriate starting level salary adjustments, including salary differentials based on academic achievement should be offered. Also, the adverse influence of a salary compression should be recognized and organization experience and demonstrated skill should be rewarded.

4. Develop an effective internal and external public information program to publicize the major positive accomplishments of the Corps, the challenging professional nature of our work, the stability of our organization; and to promote the fact that the Corps is a good place to make a career.

5.3 Training

Training is the one factor in technical capability most directly under the control of first and second line supervisors or managers. Effective training can have immediate and direct impact on maintaining and improving both corporate and individual technical capability. Supervisors and managers must accept responsibility for training programs as an important duty. In this context, training includes not only short- and long-term formal classroom situations, workshops, seminars, professional meetings and technical conferences, but also informal on-the-job experience, the career intern rotational training program, and self-development activities.

More than half of the respondents to the survey found rotational career intern, long- and short-term professional training to be effective or highly effective. Of the three, they found rotational intern training least effective. While over 50 percent of the respondents agreed that the Corps provided them with sufficient training opportunities to remain technically capable, almost 50 percent disagreed with the statement that, "the Corps training system is effective in recognizing training needs." The survey found that only 20 percent of the respondents agreed that the Corps has too much training for managers, and only 26 percent agreed that managers are sufficiently trained in how to give a performance appraisal. Comparing these results to interviews with architect-engineer firms, we find that the A/E firms placed less emphasis on formal technical training to maintain technical capability than do most Corps offices.

While the field was generally satisfied with training, they expressed disatisfaction with the training needs identification system and a desire for more "on-the-job" training. Over 50 percent disagreed with the statement that "the training system is effective in recognizing training needs." Sixty-five percent of respondents felt that more "on-the-job" training would positively impact the Corps.

Several factors reducing training effectiveness are emerging. These are:

1. Low travel and training funding targets.

2. Course canceling once scheduled.

3. Lack of individual mobility for long-term training.

4. Restrictions on attending professional and technical society meetings.

5. Overemphasis on schedules and deadlines with a sacrifice in engineering quality.

To mitigate these trends and to improve training, Engineering Divisions should take the following actions.

1. Emphasize career intern programs as a valuable entry training experience in annual recruitment.

2. Encourage more "on-the-job" training in soils and hydraulic laboratories, field surveys, construction inspection and other technical field activities.

3. Train more engineers and scientists in a secondary specialty area through cross-training programs with military program and other offices.

4. Improve "in-house" communication among young engineers, senior engineers and technical specialists.

5. Place more balanced emphasis on achieving technical quality when managing schedules.

6. Build training plans on the individual's professional, as well as the Corps' corporate needs.

7. Provide expanded opportunity to participate in professional society activities.

5.4 Pay and Benefits

Like engineers generally, Corps engineers experience pay compression at higher levels. Our professionals felt less well compensated than colleagues in the private sector. Seventy percent felt that Corps pay scales are not competitive with private industry. Sixty-seven percent felt that benefits are not as good as those in private industry and favored an incentive pay system.

Over 60 percent believe that the Corps' merit pay system is ineffective and unfairly managed and that their pay is not related to job performance.

Our comparative analysis, based on October 1980 pay scales, confirm some of these feelings. The "average" Federal engineer received $30,543 per annum in salary and has benefits valued at $14,489 for a total compensation of $45,032. The "average" private sector engineer received $33,682 in salary and had benefits valued at $13,354 for a total compensation of $47,036. Thus, the Federal employee was compensated about $2,000 less per annum than his private sector counterpart.

Like their counterparts outside Federal service, Corps employees rated pay as third in importance to their job. Technical challenge and advancement opportunities were more important. While control of pay is substantially outside Corps management, HQ/USACE can approach some action by working with national professional organizations such as NSPE and ASCE and other Federal engineering agencies, to establish a separate pay scale for engineers. Such scales should set pay and benefits for Federal engineers comparable to engineers in the private sector.

5.5 Retention

Retaining capable professionals is crucial to the Corps' technical capability. Our survey calculated that almost 30 percent of the current workforce feel likely to leave. Most of this potential attrition is likely to be junior and journeymen engineers and scientists and not managers. In fact, these low and mid-level engineers and scientists are likely to be replaced by less technically capable professionals.

Job satisfaction is the most important indicator of potential leaving. Technical challenge and advancement opportunities are the most important factors in satisfaction. Therefore, new missions which offer advancement opportunity and challenges are crucial to retention of a technically capable workforce.

Overall, Corps engineers and scientists are just as satisfied with their jobs as engineers in other Federal agencies. Corps management is more satisfied than other engineers and scientists. Higher graded engineers and scientists are more satisfied than lower graded. The lower graded group comes into the Corps with high expectations concerning the professional development potential and technical challenge. This group is more inclined to feel that those expectations have not been met.

Management is another key to job satisfaction. Overall, the workforce disagrees in their assessment of management's effectiveness. While over 70 percent of engineers and scientists feel they are given the freedom to do their job, more than 60 percent feel they are given responsibility without sufficient authority. While there is a tendency for engineers to say that they receive credit for work, less than 20 percent have received more than one quality step increase. More than 70 percent say they have received one or zero outstanding performance reports while 88 percent have never received recognition from professional societies.

Less than 20 percent of the workforce feel they receive frequent feedback from managers. While only 8 percent say they set performance standards with managers, most of the workforce feel that managers are not sensitive to, or trained in, performance appraisals. Close to 60 percent see the merit pay system specifically, and the promotion systems generally, as unfair. More than 50 percent see the training needs identifications system as ineffective.

5.6 Technology

An objective determination of the level of technology used within the Corps was outside the scope of this report. By technology, we mean the usage and application of up-to-date technical tools to accomplish our engineering mission. The committee, supported by the survey, feels that Corps use of the following important methods and techniques is excellent:

Mathematical Modeling
Computer-aided Design
Interactive Graphics
Computerized Drafting
Satellite Gauging

Also, the committee feels that the Corps is in the forefront of technology usage. This opinion was supported by the A-E visits made by panel members. Most A-Es felt that the Corps was up-to-date and perhaps ahead of the private sector in the above areas.

5.7 Professional Development

Professional development activities are one major dimension used by our survey, as well as most similar analyses, to gauge technical capability. To the degree professionals within the organization become recognized leaders in their fields, corporate technical capability also increases. Indeed, the Chief of Engineers has recently established professionalism and integrity as one of the highest command goals.

Interviews with the A-E industry indicated that the private sector places great emphasis on professional development activities. For example, several firms:

- Require registration of senior engineers
- Sponsor attendance at professional meetings and conventions
- Pay registration fees and EIT training
- Pay bonuses for professional registration
- Pay salaries commensurate with professional recognition

Typically professional development includes:

- Achieving certification under the rules of a state which establish the level of technical capability expected of an individual to practice within the profession in that state.

- Membership in professional societies offer an individual opportunity to associate with peers and to contribute to the body of knowledge, criteria and standards which form the basis of the profession.

- Adaptability to new processes and methods, an extent to which this knowledge is shared through publication of articles or by presentations within the profession.

- Pursuit of self-development through continuing training and educational programs.

- Achieving increased professional standing is usually reflected by the extent of recognition accorded to an individual for contributions to the profession.

Except for tracking professional registrations through personnel channels, the Corps has no systematic professional development program for its technical work force. While the policy requiring registration for key technical positions is a positive step toward improving professionalism, the field survey indicates a lack of support in other areas and a low level of professional activity. For example:

- Most members (86 percent) of the Corps' engineer and scientist workforce in Engineering Divisions have never published a technical article in a local, regional or national publication. Only 7 percent have published one article in the past 5 years.

- Almost 89 percent have no contacts with, or do not support contacts with local schools, colleges, or serve in any capacity to improve the level of teaching of engineering related subjects or to share knowledge with students about the technical professions.

- Eighty-two percent do not participate in National Engineers Week activities.

- Travel funds are usually reduced for professional development activities during application of funding constraints and there typically is no on-the-job time provided to prepare technical papers for presentation or for publication in professional journals.

To mitigate the trend toward low professional development activities and to enhance the corporate technical capability, the Corps should:

1. Provide the field authority to grant administrative leave for individuals to take professional registration examinations and for related technical courses. Provide incentive awards, bonuses, or quality step increases to recognize attaining registration. Advocate use of professional titles after registered engineers names.

2. Establish an objective to increase the number of Corps professionals holding key offices in professional societies or heading committees of society organizations.

3. Place top priority on retaining travel funds to support professional activities.

4. Consider as training, attendance at technical and speciality conferences sponsored by professional societies.

5. Encourage preparation and publication of Corps of Engineers design and technical innovations and grant duty time in which technical engineers and scientists can prepare documentation on new innovations and submit papers to professional journals for publication.

6. Provide opportunities for exceptionally qualified technical engineers and scientists to participate in research and study leading to new criteria and methods of design and engineering procedure.

7. Recognize professional engineering achievements. Utilize incentive or on-the-spot cash awards to recognize published articles and similar contributions.

8. Insure that lead design specialists and heads of engineering functions be present when Chief of Engineers design awards are presented to division and district commanders.

9. Insure that lead design engineers be present and officially recognized at such ceremonies or project dedications and other occasions when major design or construction accomplishments are given recognition.

6. Future Aspects

The Blue Ribbon Committee strongly endorses and supports the Director of Civil Works February 1982, memorandum to the Assistant Secretary of the Army on the role of the Corps as Federal Engineer. New missions are the most crucial element to maintaining technical capability. The technical challenge presented by new missions will increase job satisfaction, raise the caliber of newly recruited engineers and enhance the corporate technical expertise. This committee feels that the best route to new missions is to promote the role of the Corps as the "Federal Engineer."

The Corps has a good foundation. We are now, in effect, the "Defense engineer" (excluding Navy), the "State Department engineer" (through our foreign programs activities), and EPA's engineer. There remain loose ends but these areas are already recognized as part of the Corps' responsibility, if "Federal engineering" talent is needed.

The next steps are to move quickly to seek work from agencies being restructured. The Department of Energy is being dismantled. A significant "target-of-opportunity" appears evident for activities involving engineering and construction that will be continued. Other agencies with potential significant Corps work include:

- National Weather Service--Selected flood forecasting activities that now overlap into Corps activities

- Nuclear Regulatory Commission--Quality assurance assistance in nuclear powerplant construction

- Federal Emergency Management Administration (FEMA)--Flood Insurance Studies, Technical Assistance Program (FEMA seeking to reduce "in-house" operational staff)

- Health and Human Services (HHS)--Design and construction of facilities

- Veterans Administration--Design and construction of facilities

- General Services Administration (GSA)--All engineering support amenable (design, construct, O&M real estate); the Corps has in essence taken on the GSA's role in supporting DOD real estate acquisition efforts

7. Conclusions

7.1 Corporate Technical Capability

Technical capability in Engineering Divisions is diminishing. Unchecked, this trend threatens the viability and capability of the whole Corps. The minimum threshold level for a traditional civil works district engineering division to qualify as a technically capable entity is about 100 people. For combined military and civil works districts the threshold is about 150 technical and administrative personnel. Currently, six civil works districts are below or bordering on these thresholds. The engineer/scientist workforce within the Engineering Division has taken greater percentage of manpower cuts compared to percentages in other functional Corps areas. Over the last 10 years administrative manpower has risen for administration and support while manpower reductions in engineering as well as operating functions have occurred.

7.2 Technical Capability of Individual Professionals

Corps engineers/scientists, especially younger and newer professionals, participate very little in professional engineering activities. A substantial number of the workforce feel that Corps leadership, itself, is no longer of the national and professional status it once enjoyed.

7.3 Architect-Engineer (A-E) Contracting

While A-E contracting is a vital aspect of Corps work, increased reliance on A-E work threatens the Corps' capacity to maintain acceptable levels of technical capability. Roughly half of our field professionals feel we contract out 50 percent or more of our engineering work. Over 60 percent feel that this percentage has increased in the last few years and is likely to

increase further in the coming 2-3 years. More than 70 percent of the workforce feel that increasing A-E contracts adversely effects "in house" technical capability by diminishing necessary "hands-on" experience.

Uneven distribution of manpower and workload cuts have encouraged these trends and made A-E contracting percentage guides obsolete. Also, as Engineering Divisions have reduced and the workload across Corps functions has shifted, actual engineering work has fragmented and other Corps functions have increased engineering A-E contracting. Many FOA's have misapplied and overemphasized the A-E percentage guidelines.

7.4 Recruitment into the Corps Engineering Workforce

The engineering workforce perceives, and our data supports, a trend of failing to recruit the best engineering talent. In addition, the Chief's recent white paper has also recognized that recruitment is a crucial concern to the Corps. As the demand for engineers grows relative to their supply, this trend will intensify. Without mitigative action, the trend eventually will render the Corps less technically capable.

7.5 Promotion within the Corps Workforce

In his white paper, the Chief has recognized the importance of current advancement and development opportunities. Lack of career advancement options for technically capable engineers and scientists, along with space reductions, run counter to efforts at maintaining a technically capable workforce. For those engineers and scientists who go into management, the Corps is sure they lose a highly capable technical specialist, but unsure whether they gain a good manager. For those engineers and scientists who remain technical specialists, they either find work outside the Corps or risk increased dissatisfaction in the Corps. Evidence suggests that even those who make management, do so by sacrificing technical job interest for advancement needs. We suspect that given the opportunity a substantial number would opt for the career advancement in a technical rather than managerial job.

7.6 Attrition from the Corps Workforce

Almost 30 percent of our workforce sample feel likely to leave the Corps. Most of this potential attrition is likely to be junior and journeyman engineers and scientists and not managers. These lower and mid-level engineers and scientists are likely to be replaced by less technically capable engineers who will be managed by an increasingly inbred and immobile management caste far removed from the experience of engineering practice. Both trends are threatening the Corps' technical capability.

7.7 Morale Within the Workforce

Low workforce morale and worker dissatisfaction with crucial aspects of management threaten cooperative performance and the agency's capacity to produce technically credible work. This is compounded because the <u>most satisfied</u> engineers (i.e., managers) are also the <u>most pessimistic</u> about the

agency's future. There is little interaction among workers and management in critical job performance areas and a general perception that the promotion system is unfair.

7.8 Motivation of the Workforce

The major motivation of engineers/scientists within the Corps workforce, technical challenge, is diminishing. The workforce strongly perceives, and recent budget history confirms, this trend. The Chief's recent white paper emphasized such challenge as a major means for recruiting and retaining engineering talent. At the same time, breaking this trend of diminishing technical challenge requires an appeal for more public service missions. However, opportunity for public service was the factor least likely to motivate engineers and managers within the Corps.

7.9 Training the Workforce

Generally, our workforce feels that Corps long-term, short-term and rotational training programs are effective. However, most feel that training needs identification is ineffective. Also, there is an emergent gap between the training needed and that provided. The workforce feels that management is not trained in critical personnel areas while other workers need more "on-the-job" and technical specialist training. Our experience suggests that little training is available and taken by managers, in those management skills which the workforce feels are critical to supervisors; i.e., communication with, coordination of, and motivation of people.

7.10 Future

New missions are the key to maintaining technical capability. Following and to some degree, driven by this, is reorganization. New missions are needed for technically challenging jobs and reorganization to meet these challenges and respond to professional career development needs of the workforce.

7.11 Workforce Identification with the Corps: A Major Strength

An exclusive focus on problems, risks conveying an unbalanced pessimism. As we met our mandate to describe and assess major problems, certain strengths of the Corps workforce also emerged. Most engineers/scientists have a strong attachment to the organization. Even those recent leavers who we interviewed were positive and would work again for the Corps. A substantial portion of the workforce feel free to do their job well and feel some influence on the organization. Also, more than half the workforce is satisfied with their job. These strengths can be effectively tapped to form and implement actions which address the above problems. The following recommendations have been formed on this principle.

8. Recommendations

8.1 Adopt the Concept of Minimum Size Engineering Divisions and Establish Design Centers

A threshold of about 100 personnel in Engineering Division should be established for a traditional civil works district to qualify as capable for engineering design. Additionally, design centers should be defined and designated. This action primarily addresses problems 7.1, 7.5, 7.6 and secondarily 7.7. It would maximize the use of dwindling expertise by the total Corps and more effectively use the expertise which already exists within the Corps. Also, the action would open an avenue for establishing a dual career ladder for technical specialists. It should substantially increase the quality of technology transfer within the Corps and help the Corps do more with less.

ACTION: Division engineers should seek potential, full function design centers within their divisions. HQ/USACE should designate further limited design centers as appropriate.

8.2 Concentrate All "In-House" Engineering Design and Management of Outside Engineering Design Within Engineering Divisions

This action will reduce fragmentation, consolidate existing capability, and mitigate the trend to increased A-E contracting. It will also reduce the trend to duplicating engineering skills in other functional areas at a time of manpower cuts.

ACTION: HQ/USACE should issue a policy statement to this effect.

8.3 Institute a Policy to Either Reduce Administrative and Overhead Support Functions or Contract More of Such Support Functions While Retaining More "In-House" Engineering Expertise

More that 80 percent of the engineering workforce saw support overhead rising while engineering design work was decreasing. The Corps of Engineers will cease to function as a preeminent engineering and design organization if administrative and support manpower continue to grow at the expense of diminishing engineer and scientist spaces. In this context, the recent white paper of the Chief of Engineers suggest increased contracting of such functions. Most likely, centralized and contracted administrative support functions would produce better and more efficient administrative services and freetime for managers: "to manage" and technical specialists to practice technical specialties. Secondarily, the action would stem attrition of technical capability, and could also improve morale.

ACTION: HQ/USACE institute a study on the potential for contracting support functions.

8.4 Adopt a Policy That Professional/Technical Society Meetings Qualify as Training

This action would substantially improve the level of individual technical capability, and consequently, the corporate capability within the Corps. It should also improve morale, motivation and training. OCE should establish a guideline that 2-4 percent of a professional's manhours per year should be allocated to training and/or such legitimate professional society activities.

ACTION: HQ/USACE modify current guidance on conference attendance versus training.

8.5 Develop an Aggressive Policy on Seeking New Missions

An active program should be established to pursue new missions as recommended in the Director of Civil Works February 1982 memorandum to the Assistant Secretary of the Army for Civil Works.

ACTION: HQ/USACE pursue with ASA (CW) and also allow FOAs to seek such work at regional levels.

8.6 Develop an Internal Work Referral System for the Corps' Engineering Divisions

This action should help the Corps to better distribute workload among districts, a goal supported by more than half the workforce. An internal referral system would work like the Commerce Business Daily (CBS) and would alert other Corps districts of work before the home district contracts the work. The action would also reduce fragmentation, and strengthen existing technical capability.

ACTION: HQ/USACE develop necessary procedures.

8.7 Add "Enhancing Technical Capability" to the Corps' Command Goals

Develop a subitem in the command goals program which states that, "Division and district commanders must maintain the requisite engineering skills involved in planning, design, construction and operations."

ACTION: HQ/USACE add this item at the next revision.

8.8 Clarify Current Procedures for A-E Contracting

A general statement is needed to clarify the misunderstanding and misuse concerning breakout of "in-house" vs. contractor percentage. In this statement, targets should be omitted and FOAs should be encouraged to contract those activities that least impact on our long-term technical capability and to refer to the full service districts or to design centers E&D work beyond the owning district's capability that should logically be accomplished in-house. The wording of any such policy statement must be carefully chosen to avoid further alienation of the private sector. In addition, it may be advisable to precede issuance of such a policy with a series of meetings with the professional societies to better explain our motives and objectives. This action primarily addresses problem 7.3.

ACTION: HQ/USACE issue necessary clarification.

8.9 Address a Centralized Manpower Allocation Policy for Engineering Divisions

Benefits from minimum level standards for Engineering Divisions, design centers and improved work distribution cannot be achieved without

more centralized manpower allocation. The committee feels that the present system for allocating spaces to the FOAs, although decentralized, is contributing to the long-term degradation of our technical capability. The only positive way to assure protection of a viable in-house design capability and force tailoring in those districts which can no longer afford viable Engineering Divisions in the face of increasing pressures to contract and reduce manpower totals, is to institute mandatory limits on manpower space allocations in engineering and other technical functions. Recognizing that some latitude at the field level is practically essential, such restrictions should be judiciously applied. As a measure of performance of district and division commanders in increasing or at least maintaining the organization's technical capability, we should consider standards and indicators. The committee recognizes manpower allocation is difficult, but feels it essential to effectively deal with problems 7.1 and 7.3.

ACTION: HQ/USACE investigate the viability of such a policy.

8.10 Examine the Potential for a Dual Career Ladder for Engineers and Scientists

This action, which has substantial workforce support, principally addresses problems 7.1, 7.2 and 7.5 and secondarily 7.6 and 7.7. It would increase career options by servicing the need for career progress in technical specialties. Secondarily, it would improve management by filtering those who are not really management oriented and reduce the attrition of highly capable junior and journeyman engineers. The action should improve workforce morale, reduce the sense of unfairness in the promotion system, and increase individual and corporate technical capability.

ACTION: Blue Ribbon Committee should develop a plan of action for possible implementation.

8.11 Foster Separate Pay Scales for Engineers/Scientists Apart from the GS System

This action primarily addresses problems 7.4-7.8. It seeks to equalize entry level pay and mitigate upper-level pay compression.

ACTION: Blue Ribbon Committee should develop plan of action for implementation.

8.12 Implement All Following Actions at the Appropriate Levels of Engineering Divisions Management

- Strengthen supervisory-employee interface in: developing performance standards; individual development plans; meaningful rating profiles, and; career counciling.

- Assure broader and more enthusiastic involvement of Engineering Division engineers in total recruitment efforts.

- Evaluate Corps recruitment programs against those of other Federal agencies and private industry in the area.

- Develop effective internal and external public information programs which publicize positive accomplishments of the Corps and such training opportunities as the career intern programs.

- Encourage more "on-the-job" training.

- Improve "in-house" communication among young engineers, senior engineers and technical specialists.

- Train more engineers and scientists in a secondary specialty area through "cross-training" programs.

- Place more balanced emphasis on achieving technical quality when managing schedules.

- Build training plans on the individual's professional, as well as the Corps' corporate needs.

- Provide opportunities to participate in professional society activities.

- Encourage and support where possible attaining professional registration, and attending technical courses.

- Advocate using P.E., or other professional titles, after names.

- Provide incentive awards, to recognize attaining registration and published articles.

- Encourage Corps employees to be active and hold key offices in professional society activities.

- Where possible, set aside travel funds to support professional activities.

- Encourage the preparation and publication of Corps of Engineers design and technical innovations and grant duty time in which technical engineers and scientists can prepare documentation on new innovations and submit papers to professional journals for publication.

- Provide opportunities for exceptionally qualified technical engineers and scientists to participate in research and study leading to new criteria and methods of design and engineering procedure.

- Insure that lead design specialists and heads of engineering functions be present when Chief of Engineers design awards are presented to division or district commanders.

- Insure that lead design engineers be present and officially recognized at such ceremonies or project dedications and other occasions when major design or construction accomplishments are given recognition.

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APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

by

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and

C. Mark Dunning

APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

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EXECUTIVE SUMMARY

APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

Executive Summary

I. Introduction

This survey was designed to supplement Engineering Division's "Blue Ribbon" Committee study which is assessing the technical capability of Engineering Divisions. Specifically, this survey: identifies whether engineers/scientists in the Engineering Division workforce perceive problems in maintaining technical capability; describes how the engineering workforce perceives causes of, and solutions to, possible problems of maintaining and developing technical engineering capability; and, assesses the individual and corporate technical capability within the Engineering Division workforce.

The survey was designed, pretested, administered and analyzed during a 4-month period. Where possible, the 43-page instrument used standard social science questions and indicators. An 80 percent response rate from a one-fifth random sample of the Engineering Division workforce produced a sample profile almost identical to the total 5,091 person engineer and scientist workforce. Therefore, the level of confidence for statistical analyses is very high.

In the following pages we summarize our analysis of responses to the following questions which the Blue Ribbon Committee felt were important:

- What is the state of technical capability within Corps Engineering Divisions?

- Does the field perceive a problem in maintaining technical engineering capability?

- How does the field perceive possible causes of problems in maintaining such capability?

- What possible actions should the Corps take to alleviate or mitigate problems in maintaining technical capability?

- Is the Corps likely to lose its most technically capable workers?

- Is the Engineering Division workforce satisfied with their jobs?

- How effective is the Engineering Division management system in satisfying its workforce?

- What are the key problems in maintaining technical engineering capability as we see them?

- What are the major strengths of the Engineering Division workforce?

II. Does the Field Perceive a Problem?

Yes. More than 70 percent of engineers/scientists in Engineering Divisions throughout the Corps see a "bleak" future for the Corps. This workforce

substantially agrees that the Corps is losing its technical engineering capability, that is, the ability to design and manage the production of technical engineering designs in a professional and timely, cost-effective manner. More than 75 percent of engineers/scientists feel: that administrative and management overhead increases while the Corps does less actual design; that more and more design work is being done outside the Corps; and, that the failure to recruit highly capable professionals is likely to be a major problem for the Corps. More than 65 percent of engineers/scientists feel: that capable Engineer-Scientists are leaving; that the Corps is in danger of losing its preeminent role in engineering; that technical and scientific capability is diminishing within the Corps; and, that the Corps does not recruit the best talent. More than 50 percent of the workforce feels that the Corps fails to maintain the capability it has and does not have the proper technical mix for future missions.

III. How Does the Field Perceive the Causes of this Problem?

While the workforce agrees on the loss of technical capability, it is substantially divided when diagnosing the causes of this loss. More than 70 percent of engineers/scientists feel that: diminishing new civil works starts; reducing manpower; noncompetitive procedures; increased A/E contracting, and lack of opportunities for advancement are major causes of the problem. They disagree on: whether technical challenges are diminishing; whether too much duplication among Corps organization exists; whether too much fragmentation exists within districts; whether too many engineers/scientists become managers: and, whether the loss of technical capability is due to an increase in noneng neering services.

IV. What Possible Actions Should the Corps Take?

Engineers/scientists in Engineering Divisions substantially agree about the impact of a number of possible actions. More than 80 percent feel that: more "on-the-job" training; a new Corps management concept; and, limiting increased A/E work would benefit the Corps. More than 65 percent feel that: establishing dual-career tracks; instituting strict rules for professional registration; delegating more responsibility to younger engineers/scientists, establishing centers of competence, requiring all engineering to be done within Engineering Divisions, seeking work from other agencies; sharing more work among districts; instituting incentive pay; and, avoiding unionization would positively impact the Corps. More than 50 percent of the workforce feel that combining civil and military construction would be positive. Most engineers felt that eliminating SKAP systems would either have no impact or would be positive for the Corps.

The engineering workforce was sharply divided over the impact of: establishing collective bargaining; instituting mandatory periodic licensing; administering special Corps competency tests; achieving more formally the ASCE code of ethics; instituting total design centers; and, instituting matrix management.

V. What is the State of Technical Capability Within Corps Engineering Divisions?

While the Engineering Division workforce is pessimistic about the Corps' technical capability, management is the most pessimistic segment. Overall, 70 percent of the workforce said that morale was low.

Individual technical capability was measured by standard indicators of: professional development activities; creativeness and innovativeness; and, experience. While the overall workforce seemed evenly spread from low to high on the technical capability measure, managers were more frequently rated highly capable than journeymen and junior engineers. Even after accounting for age and experience variations, new engineers/scientists appear less technically capable than those hired in the past.

The more technically capable engineers and scientists differed from the less technically capable in a number of ways. A larger proportion of highly capable engineers and scientists had: prior experience in private industry; military programs experience; and, professional certification than less capable engineers and scientists. This highly capable group was also older, higher graded, and had more government and Corps experience than their less technically capable colleagues. There is little difference in technical capability between engineers and scientists, and among engineering disciplines themselves.

While engineers and scientists rated no technical function area in their district or division as having poor technical capability, the sanitary and architectural technical function areas were frequently rated below average. A majority of the workforce felt most capable to perform journeyman level work in areas of cost estimation, specification and report preparation; and least capable to perform at this level in electrical, mechanical and architectural areas. Engineering Division workforce sees the most important reasons for reducing Corps technical capability as: loss of experienced personnel and lack of motivation among the workforce to perform effectively.

As expected, engineering experience in project features most important to districts varied. Engineers and scientists with more than 3 years design experience in areas rated as important to their districts ranged from 5 percent for hardened structures to 37 percent for channels. While professionals in many technical speciality areas claim little experience in designing important project features, the experience gap is widest in hardened structures and industrial facilities.

VI. Is the Corps Likely to Lose its Most Technically Competent Workers?

More than 70 percent of the workforce says yes. Most of the engineers and scientists feel that the best are leaving while the Corps is recruiting less capable replacements. We estimate that in a few years, 13 percent of the current engineer and scientist workforce will be retired, 29 percent are likely to leave and roughly 50 percent are likely to remain. A much larger proportion of junior and journeymen engineers are likely to leave than senior and management engineers.

Both lower and higher capability engineers appear just as likely to leave. The major factor in planning to leave is job satisfaction. Highly satisfied engineers are likely to stay while highly dissatisfied are likely to leave. The current workforce feels that better pay, opportunities for advancement and technical challenge are the principal reasons why colleagues leave the Corps.

After several years with the Corps, the highly capable journeyman engineer is faced with the following choices: alienation, attrition or management. The worker must either look for other work or shoot for Corps management positions. The alternative is to continue at journeyman level with a likely decrease in technical challenge and subsequent increase in job dissatisfaction. Indeed, most of the workforce feel that the only route to advancement is mangement and that management is recruited on the basis of technical capability rather than management skills. Almost 70 percent said they would choose a technical rather than a managerial upper grade career path if given the opportunity. Their feeling is also supported by our measurement that supervisors obtain the highest technical capability scores. Since there is little support that demonstrated technical capability is a good predictor of good management ability, the Corps is trading certain technical capability for uncertain management performance. This trade-off is another factor threatening future technical capability.

VII. Is the Engineering Divisions Workforce Satisfied with their Job?

Based on proven indicators, the Engineering Division workforce is rather evenly distributed from low to high satisfaction. Actually, satisfaction among the Corps engineers/scientists workforce is similar to other groups of Federal engineers and scientists. Roughly 43 percent of the Engineering Division workforce is dissatisfied and 58 percent is satisfied. Management is the most satisfied, while the lower grade levels are proportionally less satisfied. Job satisfaction is the crucial indicator of potential leavers and stayers, and consequently, for maintaining a technically capable workforce. The most important elements of job satisfaction are: using present knowledge; growth and learning; technical challenge; freedom to do the job; recognition of work; and, opportunity for future advancement.

VIII. How Effective is the Corps' Management in Satisfying its Workforce?

Overall, the workforce disagrees in their assessment of management's effectiveness. While over 70 percent of engineers and scientists feel they are given the freedom to do their job, more than 60 percent of them feel they are given responsibility without sufficient authority. While there is a tendency for engineers and scientists to say that they receive credit for work and that they have some influence, less than 20 percent have received more than one quality step increase. More than 70 percent say they have received one or zero outstanding performance awards.

Less than 25 percent of the workforce feel they receive frequent feedback from managers, while only 8 percent say they set performance standards with managers. Most of the workforce feel that managers are not sensitive to, or trained in, performance appraisals. Close to 60 percent see the merit pay systems specifically, and the promotion systems, generally, as unfair. More than 50 percent see the training needs identifications system as ineffective.

The Key Problems in Maintaining Technical Capability:

1. Recruitment into the Corps Engineering Workforce

The Engineering Division workforce perceives, and our data support, a trend of failing to recruit the best engineering talent. As the demand for engineers and scientists grows relative to their supply, this trend will intensify. Without mitigative action, the trend eventually will render the Corps less technically capable.

2. Promotion Within the Corps Workforce

Lack of opportunities for advancement options for technically capable engineers and scientists, along with space reductions, run counter to efforts at maintaining a technically capable workforce. For those engineers who go into management, the Corps is sure they lose a highly capable technical specialist, but unsure whether they gain a good manager. For those engineers and scientists who remain technical specialists, they either find work outside the Corps or risk increased dissatisfaction in the Corps. Evidence suggests that even those who make management, do so by sacrificing technical job interest and the ability to apply their skills for advancement needs. We suspect that given the opportunity, a substantial number would opt for the advancement in a technical rather than managerial job.

3. Attrition from the Corps Workforce

Almost 30 percent of the current workforce feel likely to leave the Corps. Most of this potential attrition is likely to be junior and journeyman engineers and scientists and not managers. These lower and mid-level engineers and scientists are likely to be replaced by less technically capable professionals who will be managed by an increasingly inbred and immobile management caste far removed from the experience of engineering practice. Both possibilities threaten the Corps' technical capability.

4. Morale Within the Workforce

Low workforce morale and worker dissatisfaction with crucial parts of the management system threaten cooperative performance and the agency's capacity to produce technically credible work. This is compounded because the most satisfied engineers and scientists (i.e. managers) are also the most pessimistic about the agency's technical capability. There is little interaction among workers and management in critical job performance areas and a general perception that the promotion system is unfair.

5. Motivation of the Workforce

The major motivation of engineers/scientists within the Corps workforce, technical challenge, is diminishing. The workforce perceives, and recent budget history confirms, this trend. Actions which can improve the technical challenge of Engineering Division jobs such as providing more military work to greater numbers of engineers and scientists, or providing work of greater

complexity and responsibility for junior graded engineers and scientists is likely to improve workforce morale.

6. Training the Workforce

There is an emergent gap between the training needed and that provided. The workforce feels that management is not trained in critical personnel areas such as giving performance appraisals, while other workers need more "on-the-job" training. Our experience suggests that little training is available and taken by managers in those management skills which the workforce feels are critical to project management: communication with, coordination of, and motivation of people.

7. What are the Major Strengths of the Engineering Division Workforce?

An exclusive focus on problems, may convey an unbalanced pessimism. As we met our mandate to describe and assess major problems, certain strengths of the Corps workforce also emerged. Most engineers/scientists have a strong identification and attachment to the organization. Even those recent leavers who we interviewed were positive and would work again for the Corps. A substantial portion of the workforce feel free to do their job well and feel some influence on the organization. Also, more than half the workforce is satisfied with their job. These strengths can be effectively tapped to form and implement actions which address the above problems.

TECHNICAL ANALYSIS

APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

INTRODUCTION

1.1 Research Objectives

The primary purpose of this survey is to assess the corporate and individual technical capability of the Corps of Engineers Engineering Division engineers and scientists workforce. The study was prompted by a concern on the part of the Director, Civil Works, and Chief, Engineering Division (CW) about the maintenance of the proper level of technical skills in the workforce in a time of decline of traditional Corps work in water resources development at the same time that a commitment to a mobilization role for the workforce is increasing. The major objectives of the research are:

1. To assess in a general fashion current levels of technical capability among Corps engineers and scientists in the Engineering Divisions.

2. To identify problems in the management, motivation, retention and the development of a technically capable engineer and scientist workforce within Engineering Divisions.

3. To identify the field's perception of the causes of problems related to the maintenance of technical capability in the workforce.

4. To obtain the views of the workforce on possible solutions to the problems related to maintaining a technically capable engineer and scientist workforce in Engineering Divisions.

1.2 Background to the Research

1.2.1 Blue Ribbon Committee

The present survey is part of a larger study commissioned by the Director, Civil Works and instituted by an OCE Blue Ribbon committee of Engineering Division chiefs to examine the past and present status of individual and corporate technical capability in Engineering Divisions. In addition to the survey, other areas of study undertaken by the committee include an investigation of career development and training procedures employed in Engineering Divisions; an examination of management practices and personnel recruitment, development, and retention policies employed by private architect-engineer firms; an analysis of appropriate numbers and mix of professional skills to maintain full technical design capability in Engineering Divisions; and an assessment of likely future design missions for which Engineering Divisions may be tasked to ascertain the range of skills needed to perform such missions.

1.2.2 Prior Studies of Corps Engineers and Scientists Personnel

The Corps workforce has been studied on several occasions. A comprehensive study of the entire workforce was performed by the Corps of Engineers' Engineer Studies Center (Taylor, et. al., 1980). The purpose of this study was to analyze Corps workforce requirements for the 1980's and to suggest investments in employee development and management procedures to enable the workforce to meet future work requirements. This study provides background

and trend information on general workforce characteristics and identifies occupational job series where shortages may be likely. Several studies of Corps management selection procedures have been performed by the Institute for Behavioral Research in Creativity (IBRIC). The goal of this research has been to identify procedures for selecting individuals with high management potential. As part of the research several questionnaire schedules measuring management and technical skills, aptitude, and performance have been developed and given to personnel at several Corps districts (IBRIC, 1979). Several of these measures have been employed in the present study.

1.3 Research Questions

The following questions listed below have been derived from the general research objectives specified in 1.1. Providing answers to these questions forms the basis for analyses presented in chapters 2 through 9.

1. What is the current level of individual technical capability of Corps Engineering Division engineers and scientists? How does technical capability vary by grade discipline and by location (i.e., district, division, OCE level)?

2. What is the general level of job satisfaction among engineers and scientists? How does job satisfaction vary by grade and by technical capability?

3. What specific aspects of the job are engineers and scientists most satisfied with?

4. What specific aspects of the job are engineers and scientists least satisfied with?

5. What aspects of the job are most technically capable individuals dissatisfied with?

6. What proportion of Corps engineers and scientists expects to leave the Corps in the near future?

7. What proportion of the most technically capable engineers and scientists expects to leave the Corps in the near future?

8. What aspects of management practices are Corps engineers and scientists most satisfied with?

9. What aspects of management practices are the most technically capable engineers and scientists most dissatisfied with?

10. What potential solutions to job problems are evaluated most positively by engineers and scientists?

11. What potential solutions to management problems are evaluated most positively by engineers and scientists?

1.4 Study Design and Execution

This section consists of three major parts. Section 1.4.1 defines the major variables used in the research; Section 1.4.2 describes the design of the sampling process used to select the respondents for the survey; Section 1.4.3 presents information on the questionnaire used for the survey.

1.4.1 Measurement of Variables

This study is primarily concerned with several major groups of variables. These groups of variables are:

1. Individual technical capability.
2. Job satisfaction variables.
3. Organization effectiveness practices.
4. Potential management options.
5. Expectation about leaving the Corps.
6. General pessimism/optimism about Corps technical capability.
7. Factors affecting technical capability.
8. Demographic characteristics.
9. Organizational technical capability.

The specification of the variables and their operational definition and measurement procedures are discussed below.

1.4.1.1 Individual Technical Capability

As used in this report the concept of individual technical capability refers to the ability of individuals to design and manage the production of technical engineering designs and engineering services in a professional, timely and cost effective manner.

a. Dimensions of Technical Capability

Several major components of technical capability are evident in the literature. A widely recognized requisite of technical capability is adequate, professional preparation in the discipline in which the individual is working. A survey of 44 professional certification programs indicated that the great majority required specific academic training certification (Weiss and Young, 1981). Other examinations of certification programs for surveyors and civil engineers also show that professional education and preparation are important for certification (Blythe, 1977, ASCE, 1976).

Beyond academic preparation however, experience in performing technical functions is recognized by many as being of crucial importance in developing technical capability. (ASCE, 1976; Weiss and Young, 1981; Blythe, 1977; Block and Nolan, 1977). Experience in performing technical functions within the context of the organization is seen to be particularly important since organizations are typically likely to define capability in ways that are peculiar to their own needs and procedures (cf Landis, 1969). Thus, certain aspects of technical performance may be emphasized and more highly valued than other aspects. This point is important since it is quite possible that an individual with a given level of skills and qualifications would be perceived to have different levels of technical capability by organizations which place different values on the ensemble of skills the individual possesses.

Another frequently appearing indicator of technical capability is the amount of continuing professional development activities undertaken by the individual (Blythe, 1977; ASCE, 1976; Weiss and Young, 1981; Block and Nolan, 1977; Ingersolls, 1977). As technical fields advance, skills learned in academic training may become less current. Continued reading, interaction with professional societies, and other self-development activities such as attending short or longer term technical training, and preparation of technical papers evidence actions taken to maintain or enhance technical capability.

Finally, attitudes such as creativity and innovativeness may be important in differentiating levels of technical capability. Many technical problems involve conflicting design requirements, or situations where there may be few precedents. In these situations the ability to innovate and creatively synthesize diverse pieces of technical information may distinguish the highly technically capable individual from those capable of performing more routine well-formulated tasks. Distinctions drawn between engineers who advance to high professional levels from those who remain at lower levels as reflected in model job descriptions certainly reflect the importance placed on such attitudes (NSPE, 1982).

b. Indicators of Technical Capability

Each dimension of technical capability presented above was measured using an index constructed from a composite of questionnaire items. The professional background index is composed of questions IV-7 through IV-10; the experience index consists of questions IV-1 through IV-6, and IV-43; the professional development index consists of questions IV-11, 12, 13, 27, 29, 30-33, 35-36, 46 and 47; while the professional attitudes index is composed of questions IV-18, 38, 39, 41, and X-34 through X-39.

Individual question items used to construct the indices were taken wherever possible from existing questionnaires. In particular, schedules developed by IBRIC for the Corps, and the instrument used in the 1976 ASCE survey of civil engineers were heavily used (IBRIC, 1979; ASCE, 1976).

Individual questions were subject to an item analysis with the overall index, and all measures yielded correlations indicating statistical significance (at $p=.05$). Intercorrelations of the four indices show a high degree of interrelation among the indices measuring professional development activities,

attitudes, and experience. This finding indicates the likelihood that the three intercorrelated indices are measuring a common trait. Background education factors, however, show little association with the other three indices. Educational background may only be important in individual technical capability as a threshold. Since all respondents were college educated, this educational threshold was surpassed.

In view of these findings, the composite technical capability index has been derived from the indices measuring professional development activities, attitudes and experience. Table 1-1 presents the intercorrelations of the three indices and the composite technical capability index.

Table 1.1 Intercorrelations of Technical Capability Indices

	Experience	Professional Development	Attitudes
Professional Development	.24		
Attitudes	.26	.39	
Composite Technical Capability	.69	.78	.71

N = 749

c. Validation

In order to ascertain with confidence that technical capability is being measured it is necessary to move beyond internal consistency. Following generally accepted approaches, validation of the technical capability index was approached in three ways (See Babbie, 1979; DeNeufville, 1978). First, it can be asserted that the individual components of the measure are logical and are consistent with factors which appear in the literature on the subject of technical capability. Second, a limited test of the measure against subjective assessments of technical capability has been performed. Finally, several internal checks have been built into the questionnaire to test consistency of response patterns.

To test the index of technical capability against perceptions of technical proficiency the questionnaire was given to all Engineering Division professional staff in the Norfolk District. Respondents were asked to sign their questionnaires. After questionnaires had been completed, section chiefs and senior technical personnel were invited to participate in a rating exercise. For this exercise raters were asked to provide a numerical score of the technical capability of those in the Engineering Division for whom the raters felt they had enough personal knowledge to make such a judgment. In most cases an individual was rated by 8-10 persons. Table 1-2 presents the general guideline provided the raters for use in making their assessments.

Table 1.2 Guidelines Used for Subjective Rating of Technical Capability

Scale	Description
95-99	Outstanding: Recognized leader and authority in COE technical specialty. Is consulted frequently by associates and others with a high degree of reliance placed on scientific interpretations and advice. Typically will have contributed inventions, new designs or techniques regarded as major advances.
80-94	Exceptionally Competent: Can perform almost any job in the technical specialty. Can handle nonroutine problems requiring unconventional or novel approaches requiring sophisticated research techniques in situations where available guides and precedents may contain critical gaps or to be directly applicable.
20-79	Fully Competent: Can effectively perform work which involves conventional and routine tasks, but which may include a variety of complex features such as conflicting design requirements, etc. Has a broad knowledge of precedents in the specialty area and a good knowledge of principles and practices of related specialties.
1-19	Marginally Competent: Can only perform very routine technical tasks which are heavily formatted "by the numbers" procedures.

Ratings were averaged for individuals and a composite rating attached to each questionnaire which had an individual's name on it. Because of the sensitive nature of some of the questions only 21 out of the 53 Norfolk District respondents signed their names to the questionnaire. The composite technical capability index achieved a correlation of .33 with the numerical ratings assigned by raters. While this is an acceptable correlation for a test of association between the variables, inspection of the Norfolk data revealed one extreme value which, when removed, resulted in a correlation of .44 between ratings and the technical capability index. This latter correlation more accurately portrays the association of the technical capability measure with ratings of capability. This moderate correlation indicates that those individuals achieving high scores on the index were also likely to have been viewed as highly technically capable by the raters.

Internal checks in the questionnaire consisted of several questions which would appear to differentiate less technically capable from more technically capable individuals. These questionnaire items and the correlation with the composite technical capability index score are shown in Table 1.3. As can be seen, the moderate correlations indicate that those individuals responding in the direction in which a technically proficient person would be expected also tended to score highly on the technical capability index.

Table 1.3 Correlation of Internal Check Variables With Technical Capability Index

	Composite Technical Capability Index	N
Professional Activities Scale[1] (Questions IV 48-IV 70)	.53	698
Peers Request Technical Advice (IV-19)	.51	698
Technical Advice Requested by Those Outside Corps (IV-21)	.45	697

[1]Index taken from Baltimore ASCE publication.

As a final cross check, it could be hypothesized that individual technical capability ratings assigned by Norfolk District personnel would show significant association with the variables used as internal checks. This is also the case (Table 1.4). These findings indicate that it is likely that the index of technical capability used in this study is in fact a valid measure of individual technical capability as this variable has been conceptualized.

Table 1.4 Correlation of Internal Check Variables With Ratings of Technical Capability

	Peer Ratings	N
Professional Activities Scale[1] (Questions IV 28-IV 70)	.36	21
Peers Request Technical Advice (IV-19)	.71	21
Technical Advice Requested by Those Outside Corps (IV-21)	.39	21

1.4.1.2 Job Satisfaction

Following Price (1972), job satisfaction is the degree to which engineers and scientists have a positive orientation toward membership in Corps Engineering Divisions. Job satisfaction is generally seen to be a function of how well an organization meets an ensemble of personal needs (Badawy, 1978; Greenwald, 1978; Rotondi, 1980). Traditionally, organizations have been oriented to addressing needs related to pay, benefits and status recognition (Badawy,

[1]Index taken from Baltimore ASCE publication.

1971). Such needs still reflect the expectations of a majority of the American workforce according to some recent evidence (Yankelovich, 1979). However, distinctions are frequently drawn in the literature of the special needs of the highly trained technical professional worker. In addition to the basic expectations concerning pay, benefits and status; knowledge workers -- a term encompassing both engineers and scientists -- are seen to have greater needs for challenge, autonomy, and to participate in the creation of knowledge (Delmar, 1979; Yankelvich, 1979; Imberman, 1976). While some studies appear to indicate that scientists have higher levels of such "professional" needs than engineers, the evidence is by no means conclusive (Badawy, 1971; Greenwald, 1978). It is clear, however, that a broader spectrum of needs beyond pay, benefits and status is likely to be important in motivating a highly trained, professionally oriented workforce.

General job satisfaction is measured in this survey using the index of job satisfaction developed by Hoppock (1935); and an index of identification with organization based on a scale developed by Patchen (1965). The Hoppock index has been extensively used and allows comparisons with other studies. Items in the index consist of questions VIII-4 and XII-19 thru XII-21. Index values range from 100 indicating that the "least satisfied" attributes have been selected for all 4 items, to a score of 700 when the "most satisfied" attributes have been selected.

The organizational identification index consists of questionnaire items XI-1 thru XI-6. The original index was employed by Patchen in a study of morale at the Tennessee Valley Authority (TVA). The index was found to correlate significantly with employee behavior indicating identification with TVA (e.g., expectation of remaining with TVA), as well as with supervisory personnel subjective evaluations of individual's sense of "belonging to the organization" (ISR, 1969:212).

Moving beyond a concern with general job satisfaction, an index of work orientation developed by Pelz and Andrews (1966) was employed to identify the Corps' ability to service a range of potential job satisfaction needs. This index was originally developed for a study of the work orientation of scientists so the index addresses the fulfillment of both "traditional" needs (pay, benefit, status) and professional needs (to apply technical knowledge, build professional reputation, challenge and autonomy). Questionnaire items XII-1 thru XII-18 contain the index.

Several other items tap needs which may be important in employee satisfaction. Questions VI-9, 10, 11, 17, 18, 19, 31 and 32 obtain views on the adequacy of feedback and recognition provided by supervisory personnel. These needs are also indicated as important in job satisfaction (Imberman, 1978; Read, 1981). Questions X-1 thru X-16 in some sense duplicates the Pelz and Andrews index; however, it frames the question of meeting a range of potential needs from the standpoint of their importance in influencing individuals to remain with the Corps.

1.4.1.3 Organization Effectiveness Concerns

This group of variables is concerned with the degree to which the Corps meets goals of developing and maintaining a highly capable workforce via personnel

career planning, evaluation, and supervisory selection procedures via training opportunities offered and by the dissemination of R&D products to its employees.

The SKAP system is the major evaluation and supervisory selection tool in use in the Corps today. Questions X-24, 27, and 28 are Likert-scaled items which measure views about the effectiveness and equity of the SKAP system. Similarly, items X-17 thru X-21 and 26, and VI-7, 8 and 12 measure perceptions of the importance of management recruitment practices as well as evaluations of the quality of management personnel produced by management selection processes and how well managers are trained in the performance appraisal process. The efficacy of Corps training is measured in items VI-15, X-25 and X-40, while the importance of Corps R&D products in facilitating Corps technical work is measured in VI-16, VI-21 and VI-22.

1.4.1.4 Potential Management Options

Section V consisting of questions V-1 thru V-23 measures the desirability of various policy options for enhancing the technical capability of Corps Engineering Divisions. These options include both those which focus on modifying the organizational context and those which focus on changing the behavior of individuals. An example of the former policy actions includes establishing separate technical and managerial career ladders within the Corps; while an example of a policy option which seeks to change individual behavior is the design and administration of special competency tests for Corps engineers and scientists. All items in this section are Likert-scaled ranging in value from 9, indicating highly positive impact on the Corps to 1, indicating a highly negative impact.

1.4.1.5 Expectation About Leaving the Corps

This variable was measured by two items. Question VIII-1 was used in the 1976 ASCE survey, and thus, provides some comparative base. Question VIII-2 provides a more detailed distribution of possible alternative employment locations. By aggregating attributes for non-Corps, nonretirement employment expectations a general measure of the proportion of Corps employees who expect to leave the Corps for other positions within the next five 5 years was developed.

Question VIII-3 measures perceptions of why professional colleagues have been leaving the Corps. The range of factors provided corresponds to the job satisfaction factors described above. While there is no certainty that the perceptions are accurate, insofar as people act on the basis of their perceptions the factors may be important in identifying potential areas for policy intervention to correct or change such perceptions.

1.4.1.6 General Pessimism/Optimism About Corps Technical Capability

Section I of the questionnaire consists of 15 items which provide a general expression of optimism/pessimism concerning the engineering and scientific capability of the Corps. Each Likert-scaled item receives 5 for the most optimistic response and 1 for the most pessimistic response, forming an index ranging in value from 15 to 75 points.

1.4.1.7 Factors Affecting Corps Technical Capability

Section II of the questionnaire presents a series of Likert-scaled items measuring attitudes about the effects of workload changes and organization structure on Corps technical capability.

1.4.1.8 Organizational Technical Capability

Section III of the questionnaire provides a perceptual assessment and inventory of corporate technical capability. This section consists of three major parts. First, respondents were asked to assess the capability of their Engineering Division in major technical specialty areas (e.g., hydrologic engineering, electrical engineering, etc.) on a five-point scale ranging from poor to outstanding. Respondents also identified their own level of experience in performing in these functional specialty areas. Experience levels range from 0 to more than 5 years of experience. These assessments are used to identify those technical functional areas felt to be weak or without much depth of experience.

Secondly, respondents identified the most important project features constructed in their districts or divisions. Respondents were also asked to indicate the amount of experience they had in technical design activities. Those activities listed as <u>important</u> but which have low levels of onboard experience in technical design have been identified by districts. A composite of such district disjunctures represents an inventory of potential problem areas of corporate technical capability.

Third, perceptions of the amount of Engineering Division technical work being contracted to private A/E firms were obtained using a six-point scale. Finally, the use of state-of-the-art methods for technical design and management work was measured on a four-point scale ranging from never to very often. These items are summed to form an index of organizational progressiveness.

1.4.1.9 Background Information

Information on the following variables was obtained:

- age
- grade
- years and types of Federal/private industry experience
- method of entry into the Corps
- prior employment status
- professional certification status
- functional designation (civil works/military programs)
- occupational series
- educational background
- supervisory status
- awards received
- name of section assigned in Engineering Division
- name of district, division, OCE assigned to

1.4.2 Population and Sampling Procedure

The population for this survey consisted of all career status personnel in engineering and scientific occupational series assigned to Corps Engineering Divisions in OCE, the 10 Corps divisions in the United States, and the Pacific Ocean and the Middle East Divisions. The population was identified by the Engineer Automated Support Agency using the Corps Personnel Management Information System (COEMIS-PA). Using the most recent COEMIS-PA data, a total of 5,091 engineering and scientific personnel were listed as employed in Engineering Divisions as of 31 December 1981.

A proportionate stratified random sample was drawn from this population. The sample was stratified on grade level and by Corps organization (district, division, OCE). A ratio of sample size to population of 0.2 was employed which yielded a target sample size of 1,018 persons. This sample size provided adequately for variables expressed as proportions with accuracy of approximately $\pm$ 2.5 percent at a 95 percent confidence level. This size sample also permits numerous disaggregations and cross-tabulations to be performed on the data while still insuring sufficient numbers of cases for tests of statistical significance to be performed.

Surveys were sent directly to each individual in the sample at their Corps address. The cover letter to respondents (see Appendix A) stresses that the survey was anonymous and that participation was voluntary. A self-addressed mailer was provided so that respondents could return the form directly to the Institute for Water Resources. Of the 1,018 questionnaires mailed 39 were returned because of errors in the data base or because individuals selected in the sample were deceased or had left the Corps. Of the 979 valid questionnaires sent, a total of 769 surveys were returned for a completion rate of 79 percent.[1]

In general, those responding to this survey are quite representative of the population of Engineering Division engineers and scientists in terms of grade, age and supervisory status. Appendix B presents comparative data on the characteristics of those responding to the survey with the population of Engineering Division engineers and scientists.

1.4.3 Questionnaire

As described previously, the instrument used for this survey is a 43-page questionnaire. This instrument was developed in February and March 1982 as a result of intensive interaction with OCE technical staff assisting the OCE Blue Ribbon panel as well as direct consultation with panel members. A number of preliminary versions of the questionnaire were pretested with the BERH planner associates, OCE Blue Ribbon Panel, and with engineers and scientists in the Engineering Division of the Norfolk District. Appendix A contains a copy of the questionnaire in which frequency tabulations of survey responses have been filled in.

[1] At the time of analysis for this report 749 surveys had been processed. This is the sample figure for subsequent analyses.

2. Individual Technical Capability

This chapter identifies who and where in Engineering Divisions the most technically capable individuals are. For the Corps Engineering Division engineers and scientists workforce as a whole, the average scores on the individual technical capability index was 52 points where the range of possible scores were a minimum of 13 and a maximum of 123. Conceptualization and measurement of individual technical capability is described in Section 1.4.1 of this report. The score of 52 should be interpreted as a norm for the population having meaning for comparisons which will be drawn and should not be interpreted as a percentage "grade" on an absolute scale of individual technical capability.

Recent writings on technical capability indicate that the property is likely to be a normally distributed variable much like IQ (Landis, 1969). The individual technical capability index scores for the sample do in fact form a normal distribution with a standard deviation of 11.

While for some subsequent analysis technical capability will be treated as an interval level variable, it will also be presented at an ordinal level of measurement. For this operation the categories of low technical capability, low medium, high medium and high technical capability were created. Low technical capability corresponds to scores falling below -1 standard deviation from the mean. Low medium corresponds to scores falling within -1 standard deviation of the mean. High medium corresponds to technical capability scores within 1 standard deviation of the mean, while the high technical capability category contains all scores beyond +1 standard deviation of the mean (Table 2.1, Land Figure 2-1).

Table 2.1 Individual Technical Capability

	N	(%)
Low	81	(11)
Low medium	229	(33)
High medium	251	(36)
High	137	(20)
TOTAL	698	(100)

Missing Cases = 51 (indicates nonresponse to one or more of the questions forming the technical capability index)

2.1 Individual Technical Capability and Grade

Technical capability shows variation by grade with the more junior grade (5-9) having lowering technical capability scores than journeymen (11) and senior technical (12) grades. First and second tier management have technical capabilities scores above those of junior engineers and scientists (Table 2.2). As Figure 2-2 shows the lowest technical capability category has high

FIGURE 2-1 INDIVIDUAL TECHNICAL CAPABILITY

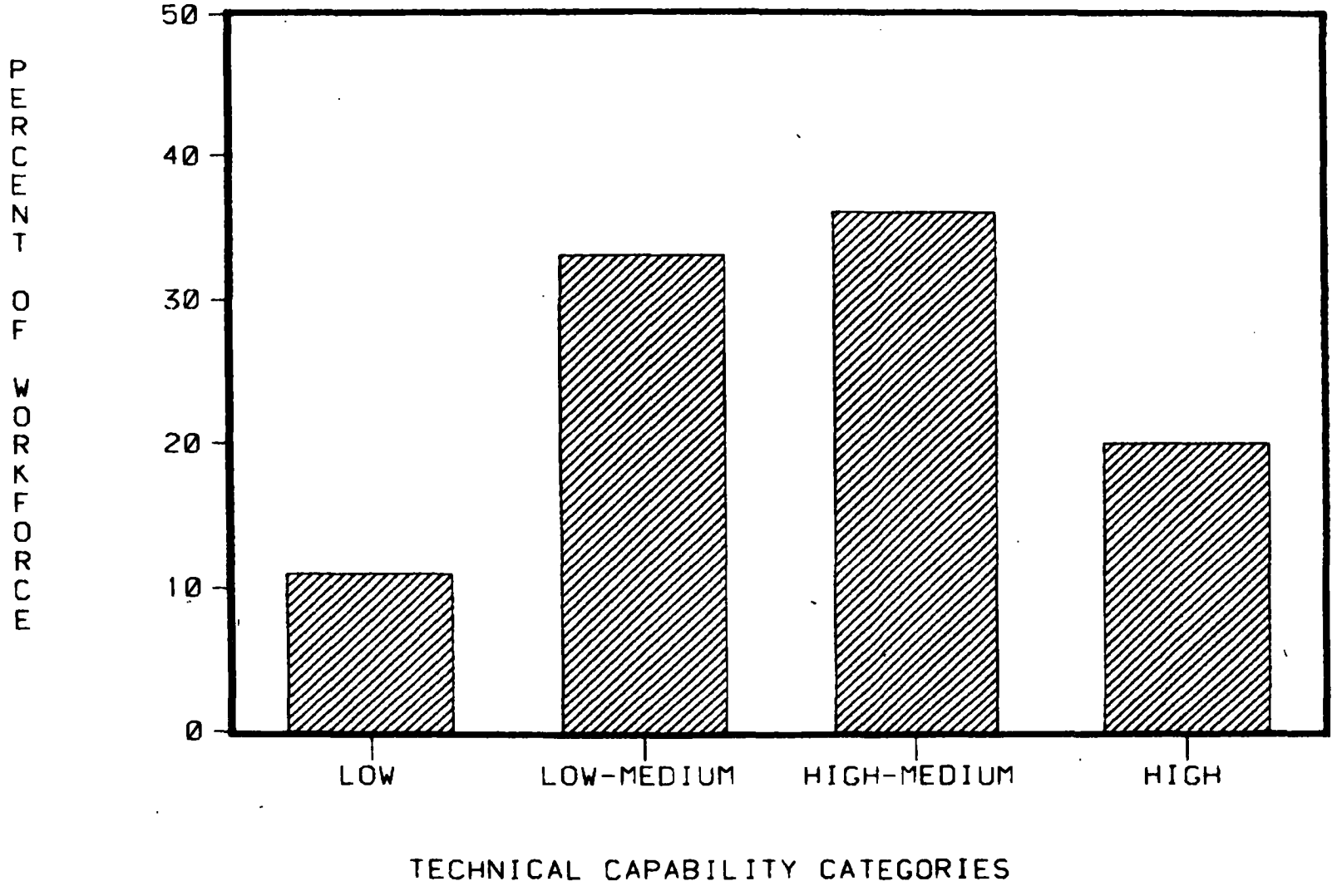


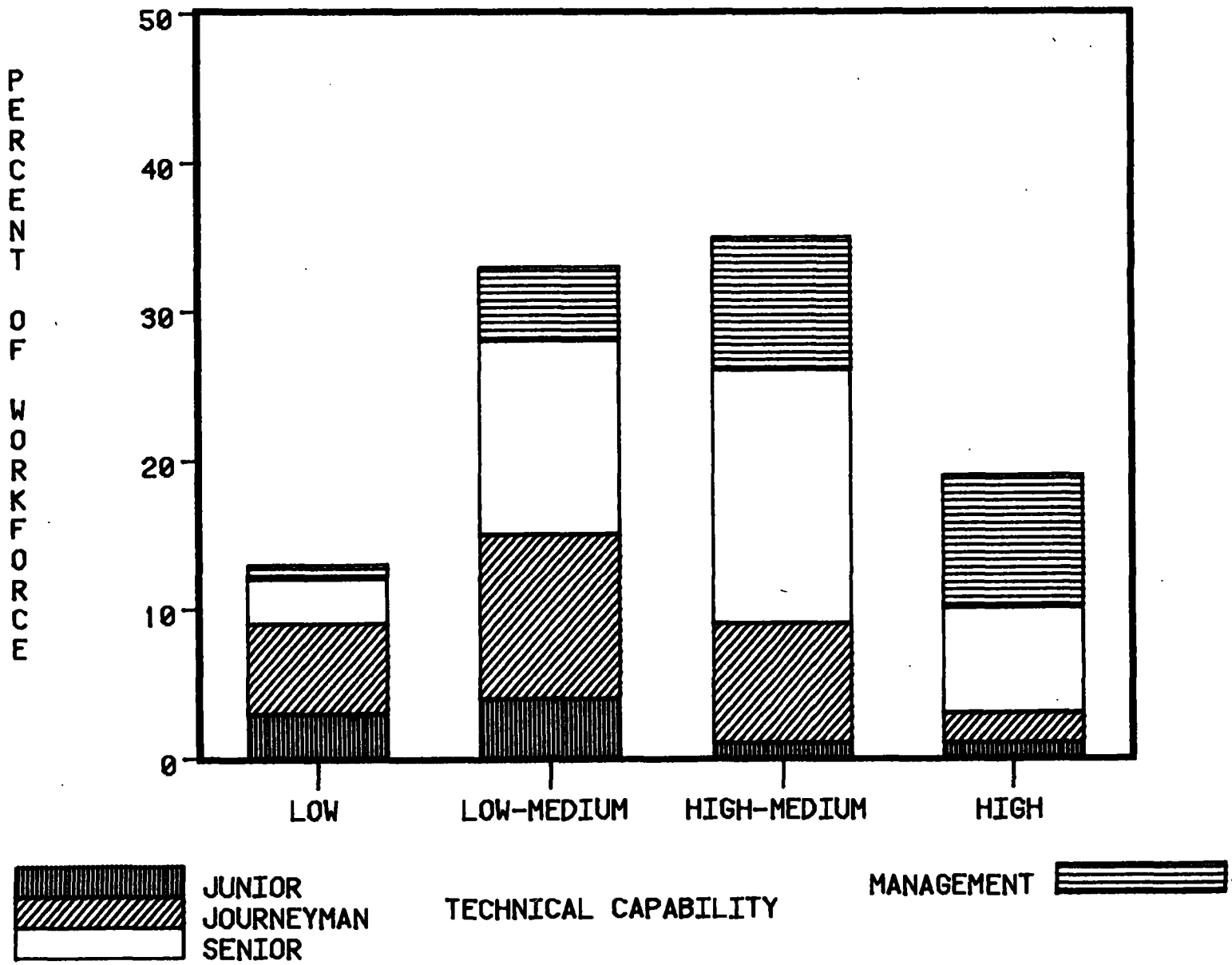
Table 2.2 Technical Capability and Grade

	Technical Capability									
	Low		Low Medium		High Medium		High		Total	
Grade	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Junior (GS 5-9)	19	(32)	28	(47)	7	(12)	6	(10)	60	(100)
Journeyman (GS 11)	37	(19)	77	(40)	61	(32)	16	(8)	191	(100)
Senior Technician (GS 12)	23	(8)	92	(33)	117	(42)	48	(17)	280	(100)
Management (GS 13-14)	2	(1)	31	(20)	65	(41)	61	(38)	159	(100)
Total	81		228		250		131		690	

Missing = 59
X^2 = 123 sign = .0001
gamma = .47

FIG 2-2 TECHNICAL CAPABILITY

PROPORTIONATE TO GRADE LEVEL



relative proportions of junior-graded engineers and scientists, while the high technical capability category is predominately composed of higher graded individuals. Two possible reasons seem plausible for the differences observed.

First, it is likely that junior personnel do not have as much experience as journeymen and above personnel. It should be noted that there is a significant association between age and grade (r=.49). By and large, lower graded engineers and scientists are younger than higher graded engineers and scientists. Keeping in mind that the measurement of the amount and diversity of experience is one of the subindices forming the technical capability index, it could be hypothesized that the lower experience of younger personnel accounts for the lower technical capability scores of junior graded engineers and scientists. Another hypothesis, however, relates to concern expressed by management that the Corps appears to be having difficulty in recent years in attracting "the cream of the crop" of engineering and scientific graduates. Under this hypothesis, lower technical capability scores are likely to reflect not only differences in experience levels, but differences in attitudes relating to creativity and innovativeness as well as general professional development activities. These hypotheses were tested by comparing the indices forming the composite technical capability by grade level. Under the first hypothesis it could be expected that only the experience index would show differences by grade, while under the second hypothesis, lower grades would have lower scores on the professional attitude and professional development indices as well. Table 2.3 presents the results of this test.

As can be seen, junior level personnel were significantly different from the average score for all three indices forming the composite technical capability index. The implication of this finding is that recently hired engineers and scientists may in fact be different in technical capability from engineers and scientists hired in the past. This finding supports the belief held by a large majority of the engineers and scientists workforce (77 percent question I-8) that the Corps is not attracting the most highly competent engineer and science graduates.

Another possible explanation, however, is that factors such as decline in Engineering Division workloads and trends toward contracting out design and technical work may present fewer opportunities for younger (and hence, lower graded) personnel to exercise their creativity, and to encourage engineers and scientists to enhance and develop their skills in technical areas via professional development activities. This hypothesis was tested by comparing districts which contract out more than 50 percent of their Engineering Division work to A/Es with districts which contract less than 50 percent of Engineering Division work. By keeping more design and technical work in-house, districts would probably provide greater opportunities for challenging work for junior personnel. Under this view, the junior graded workforce of such districts could be expected to have higher technical capability scores. A comparison of individual technical capability scores, however, showed junior graded engineers and scientists in districts which contract less Engineering Division work have the same technical capability

Table 2.3 Analysis of Variance Results
Individual Technical Capability Indices

Deviation from Grand Mean

Grade Level	Composite Technical Capability	Subindices		Professional Development
		Experience	Attitudes	
Junior Level (GS-5 - GS-9)	-7.9	-4.9	-1.2	-1.8
Journeyman (GS-11)	-4.2	-2.7	-1.1	-.6
Senior Technical (GS-12)	.4	.9	.2	-.7
Management (GS-13 - GS-14)	7.3	3.4	1.4	2.5
Grand Mean	51.4	11.9	21.8	17.7
F-Value	51.5*	77.6*	12.4*	14.3*

*Significant at >.01 level

scores as junior personnel in districts which contract the majority of their engineering work to A/Es.

It is also interesting to note that senior management (Grades 13-14) has higher scores on all three indices forming the technical capability index then do senior technical personnel. One of the most important criteria for advancement into management has been technical excellence (IBRIC, 1979). These results support the view that the management ranks are composed of the most technically capable individuals. One possible reason for this finding is that there are few opportunities for advancement beyond GS-12 for technically capable individuals besides supervisory positions (except for technical R&D lab work or staff work at divisions and OCE). Once again, a large majority of the engineer and scientific workforce (84 percent) believe that technical specialists go into management primarily because there are few other opportunities for advancement. Fully 70 percent of engineers and scientists indicate that if higher graded technical positions were made available, they would establish career goals in technical rather than managerial areas.

2.2 Technical Capability and Occupation

Tables 2.4 and 2.5 present comparisons of technical capability broken down by occupation. In the first table the technical capability of engineers is compared with that of scientists. As can be seen, there is no statistically significant difference in average technical capabilities scores.

Table 2.4 Average Technical Capability of Engineers and Scientists

Individual Technical Capability	Occupational Category: Engineers	Occupational Category: Scientists
mean	51.5	51.6
standard deviation	11.1	11.2
N	580	118

T = test: difference in means = 0.1
T value = -.16
DF = 167
Probability = .90; not significant

In Table 2.5 the technical capability of engineering disciplines is compared. This table shows that, on balance, electrical engineers appear to achieve higher technical capability scores than do civil, mechanical or sanitary engineers. However, this difference is not statistically significant.

Table 2.5 Average Technical Capability of Engineering Disciplines

Discipline	Deviation from Grand Mean	N
Civil	-.3	458
Electrical	3.7	28
Mechanical	.9	44
Sanitary	.5	11
Other	-.7	33
Grand Mean	51.5	574
F Value	.98 (Not Significant)	

2.3 Technical Capability and General Background

Section XIII of the questionnaire contains several questions on the background of respondents. Those respondents of higher than average technical capability differed from lower than average technically capable respondents on the following items:

1. Their prior employment experience: A higher proportion of technically capable individuals have had prior experience in private industry than less technically capable individuals (30 percent vs. 23 percent).

2. Whether they were now in civil works or military programs: A slightly higher proportion of engineers and scientists in military programs are above average in technical capability than those in civil works (53 percent vs. 45 percent).

3. Professional certification status: A much higher proportion of highly technically capable individuals are professionally certified than those highly technically capable individuals who are not (82 percent vs. 5 percent).

4. Supervisory status: More than 73 percent of engineers and scientists with some supervisory duties scored above average on the technical capability index compared with 47 percent of the workforce with no supervisory duties. In this context it appears that displayed technical capability is likely to be rewarded in the Corps with supervisory duties. Of the most highly technically capable engineers and scientists, 4 percent of this group are executives, 18 percent are middle managers, 34 percent are first line supervisors, and 43 percent have no supervisory duties.

5. Age: The most technically capable individuals are likely to be older than the least technically capable individuals (45 years vs. 36 years).

6. Grade: The most technically capable individuals are likely to be higher graded than the least technically capable individuals (Grade 12 vs. Grade 9-11).

7. Years in Government Service: The most technically capable individuals have more than twice as many years in government service as the least technically capable individuals (19 years vs. 9 years).

8. Years in the Corps: The most technically capable individuals have more than twice as many years of Corps experience as the least technically capable individuals (17 years vs. 7 years).

9. Awards Received: The most technically capable individuals have received more sustained superior performance awards, outstanding performance, and other Corps awards than the least technically capable individuals (1.8 vs. 0.4); and the most technically capable individuals have received more awards from professional societies than the least technically capable individuals (0.3 vs. 0.1).

10. Organizational level: On average, individuals in OCE had the highest individual technical capability scores (58); individuals in division offices had intermediate scores (56); and individuals in districts had the lowest average scores (51). The most important factors differentiating the average scores of these groups were the amount and diversity of experience, and professional development activities undertaken.

2.4 Comparison of Individual Technical Capability with Other Groups

Several of the questions used to develop the technical capabilities index were employed in the 1976 survey of ASCE membership. Comparisons of responses to these questions by Corps engineers and scientists and those engineers responding to the 1976 survey can provide a limited answer to the question of "How do Corps engineers and scientists compare to other engineer and scientist groups on the basis of technical capability?" (Table 2.6) In some instances the 1976 survey questions contained significant numbers of "no answer" responses. It appears that such no answer responses should in fact have been coded as representing the numeral 0. In the tables below, the frequency of 0 responses for the ASCE survey has been recomputed showing the no answer responses as 0. In addition, several modifications were made in the wording of questions used in the Corps of Engineers survey. For example, the ASCE questions ask for responses on the basis of "an average year" while the Corps survey items asked for answers based on the past years experience. Figures 2-3 and 2-4 compare ASCE and Corps responses on questions IV-3 and IV-36.

One of the striking things about the table is that a larger proportion of Corps engineers and scientists do nothing on all of the items than those ASCE members answering the 1976 survey except the number of hours spent in training. Eighty-seven percent of the Corps engineers and scientists workforce has not published a technical and professional paper in the last 5 years compared with 66 percent of ASCE members. Seventy-four percent of the Corps engineers and scientists workforce did not instruct at seminars or formal lectures compared with 49 percent of ASCE members. On all the questions except those related to attendance at meetings (IV-30 and IV-32), on average, ASCE members responding to the 1976 survey spent more time engaged in professional development activities than did the Corps engineers and scientist workforce. These questionnaire items are part of the individual technical capability index. While comparisons drawn between the two groups should only be done keeping in mind differences in wording of questions, as well as time differences, the implication is that the groups of ASCE members responding to the 1976 ASCE survey would probably have scored higher, on average, on the professional development subindex than the Corps engineers and scientists workforce average.

2.5 Summary

This section has focused on identifying who and where in Engineering Divisions the most highly technically capable individuals are. The analysis reveals that technical capability involves a process of maturation and gaining experience with Corps procedures and policies. This conclusion seems reasonable. The Corps is a very complex, highly decentralized organization with a large variety of missions. In order for an individual to perform effectively it is likely that an extended period of learning is required to begin to understand the organizational context of the Corps.

There is some reason to suspect that recently hired engineers and scientists may be less creative and innovative than engineers and scientists hired less recently. Certainly, engineers and scientists are in great demand by private industry. The competition may have reduced the Corps' ability to attract as many highly qualified young engineers and scientists as in the past. There is

Table 2.6 Comparison of Technical Capability Questions

	Item		Hrs. 0	1-8	9-40	>40
IV-29	About how many hours outside regular work hours during the last year did you spend reading technical/professional literature in your field?	ASCE (%)	.1	18	52	29
		Corps (%)	7	24	36	33
IV-30	About how many hours during the last year did you spend attending technical or professional meetings?	ASCE (%)	21	38	29	11
		Corps (%)	23	31	31	14
IV-31	About how many hours of self-study were required to carry out your job in the past year?	ASCE (%)	16	14	31	39
		Corps (%)	26	18	32	22
IV-32	How many hours of agency sponsored technical courses or seminars did you attend during the past year?	ASCE (%)	35	33	23	9
		Corps (%)	30	10	32	27
IV-35	How many hours of lectures, seminars or other formal instruction did you give during the past year?	ASCE (%)	49	33	14	4
		Corps (%)	74	16	6	4
			0	1	2-3	>3
IV-36	How many technical or professional papers have you published in the last 5 years?	ASCE (%)	66	15	9	10
		Corps (%)	87	7	4	2

(Totals may add to more than 100 percent due to rounding errors.)

FIGURE 2-3 HOURS SPENT ATTENDING TECHNICAL OR PROFESSIONAL MEETINGS

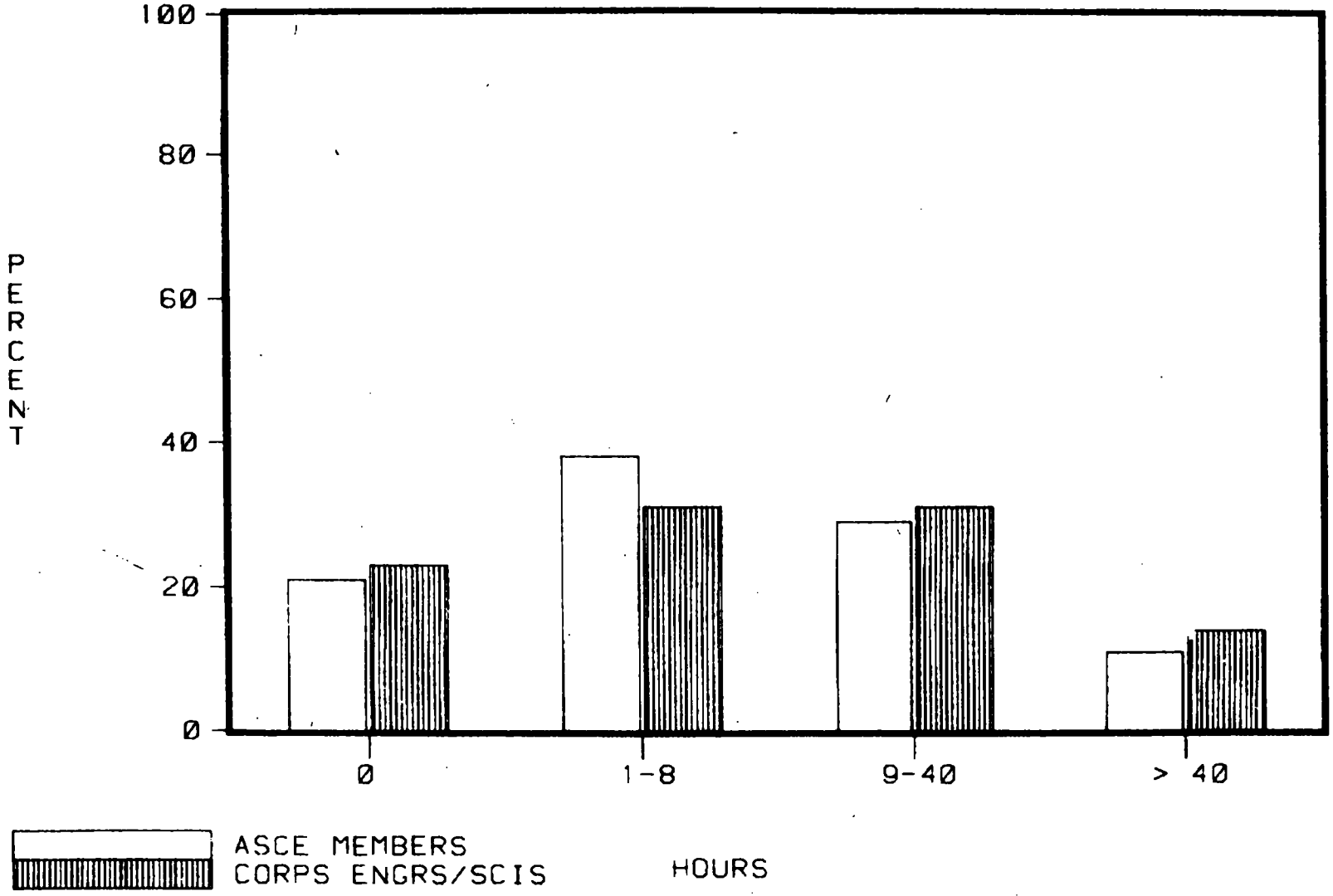
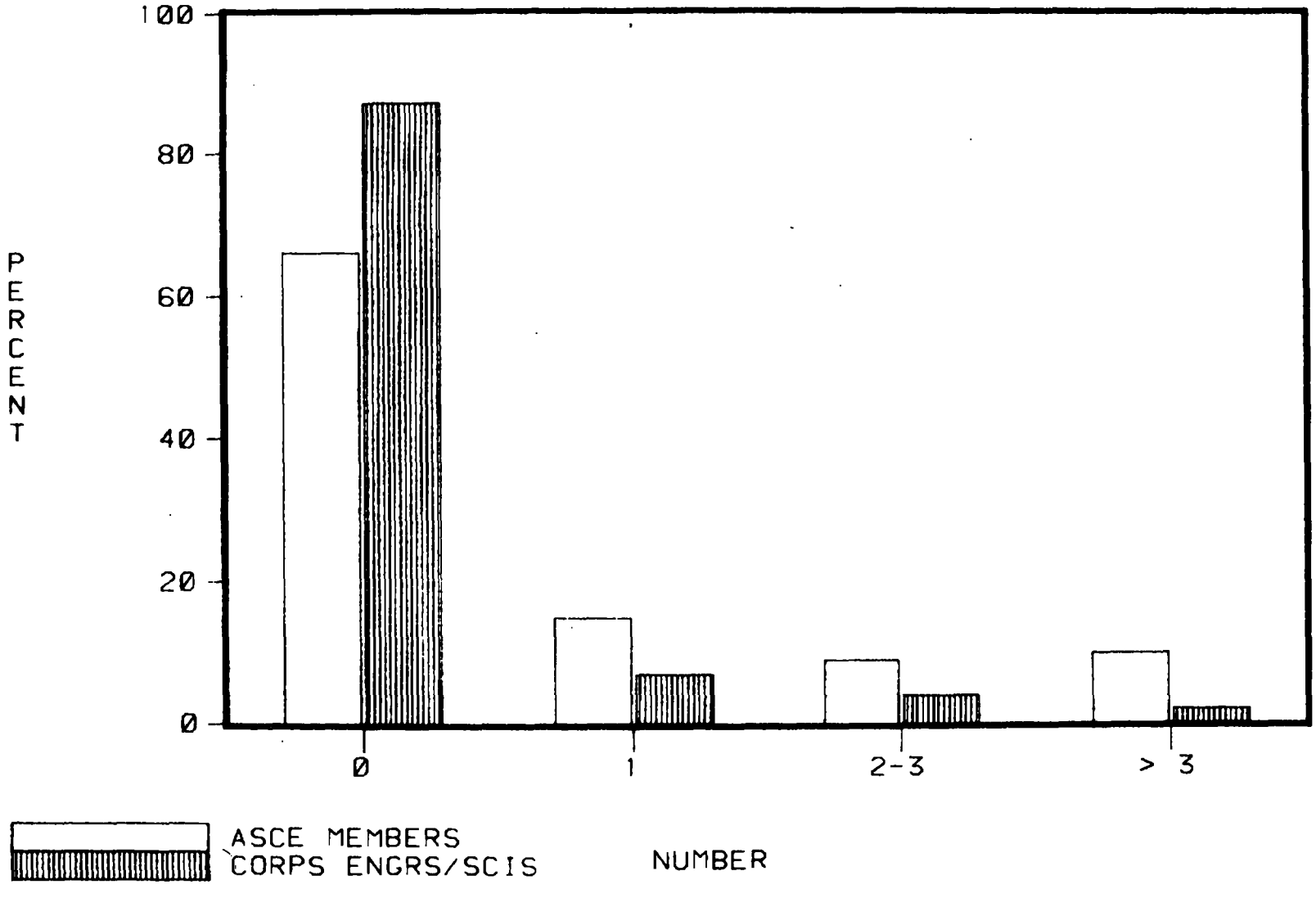


FIGURE 2-4 NUMBER OF TECHNICAL OR PROFESSIONAL PAPERS PUBLISHED



reason to believe, however, that factors such as diminished workloads and contracting out technical/design work may reduce the opportunities to enhance and develop technical capability among junior engineers and scientists. The finding, however, that younger engineers and scientists are seemingly less technically capable would appear to be consistent with the perception among the engineering and scientific workforce that the Corps may not be attracting the most highly qualified graduates.

Technical capability is rewarded with higher grades and supervisory duties. It is doubtful however, whether those with supervisory duties have the time to provide technical input to all activities. In this context it may be that having a large proportion of the most technically capable individuals in supervisory positions amounts to a misuse of a valuable resource. As noted previously, a large proportion of Corps engineers and scientists would opt for technical positions rather than management positions if higher grades were available for technical specialists.

3. General Pessimism/Optimism About Corps Technical Capability

Section I of the questionnaire consists of 15 items which provide a general expression of optimism/pessimism concerning the engineering and scientific capabilities of the Corps. These items were combined into an index having a minimum value of 15 points indicating the most optimistic view and a maximum of 75 points indicating the most pessimistic view. For the workforce as a whole the average score for the index is 52 points.

As Table 3.1 shows, a significantly greater proportion of senior level (that is, senior technical and management) personnel are more pessimistic about the state of Corps technical capabilities than more junior graded personnel. Similarly, more highly technical capable individuals are likely to be less optimistic about the overall state of technical capability in the Corps (Table 3.2).

Table 3.1 Optimism/Pessimism by Grade Level

Grade	Optimism Index Mean Score	S.D
Junior	51.6	7.0
Journeyman 51.0	7.7	
Senior	52.0	8.0
Management 53.4	8.1	

F = 2.9, sign at .05 level

Table 3.2 Optimism/Pessimism by Technical Capability

Technical Capability	Optimism Index Mean Score	S.D.
Low	50.3	7.6
Low medium 50.9	7.7	
High medium	52.8	7.8
High	53.6	7.9

F = 5.3, sign at .01 level

4. General Factors Affecting Corps Capability

Section II of the questionnaire contains a series of items measuring attitudes about the effects of workload changes, organizational structure, benefit levels, and contracting policies on Corps technical capability. In general, the engineers and scientists workforce overwhelmingly agreed with the following statements:

II-1. Diminished new civil works starts adversely affects technical capability (84 percent)

II-2. Reductions in manpower has reduced technical capability (70 percent)

II-5. There are now fewer technical challenges for engineers and scientists in the Corps (65 percent)

II-6. Pay scales for engineers and scientists are not competitive to those in private industry (70 percent)

II-8. Outside contracting reduces in-house technical capability (74 percent)

II-10. There is too much duplication of technical skills at the district/division/OCE level (62 percent)

II-14. Benefits for engineers and scientists are not as good as those in private industry (66 percent)

II-15. There is a lack of upward mobility for technically capable engineers and scientists in Engineering Divisions (70 percent)

While a majority of the workforce agreed to these statements, several of the items showed significant difference in the response pattern when the variables of grade and individual technical capability were introduced. Senior grade personnel and individuals of higher technical capability were more likely to agree that reductions in manpower have reduced the technical engineering and scientific capability in Engineering Divisions. Similarly, senior personnel were more inclined to feel that contracting of Engineering Division work to A/Es reduces in-house capability. Junior grade personnel and individuals of lower technical capability were more inclined to feel that there are now fewer technical challenges for engineers and scientists in the Corps; that there is too much duplication of technical skills at the division/district and OCE level; and there is a lack of upward mobility in Engineering Divisions for technically capable individuals.

5. Job Satisfaction

For the Corps Engineering Division engineers and scientists workforce as a whole, the average job satisfaction score on the Hoppock index of job satisfaction was 486. The minimum value was 200 and the maximum value on the scale was 675. The Hoppock index has been extensively used and it is possible to compare this figure with scores of other groups. A recent study of Air Force engineers and scientists, for example, showed that the average for this groups was 500 (Agnew and Jennings, 1976). Based on this study, it appears that the Corps average is similar to that of another group of Federal engineers and scientists. As with technical capability, the general job satisfaction index scores have been turned into an ordinal level variable for some of the subsequent analysis by creating low, low medium, high medium, and high job satisfaction categories (Table 5.1 and Figure 5-1) using the procedure described in the previous chapter.

Table 5.1 General Job Satisfaction

Category	N	%	Scale Range
Very Satisfied	125	(18)	573-700
Medium-High Satisfaction	281	(40)	488-572
Medium-Low Satisfaction	176	(25)	404-487
Very Dissatisfied	122	(17)	100-403
Total	704	(100)	

Missing = 45

5.1 Job Satisfaction and Grade

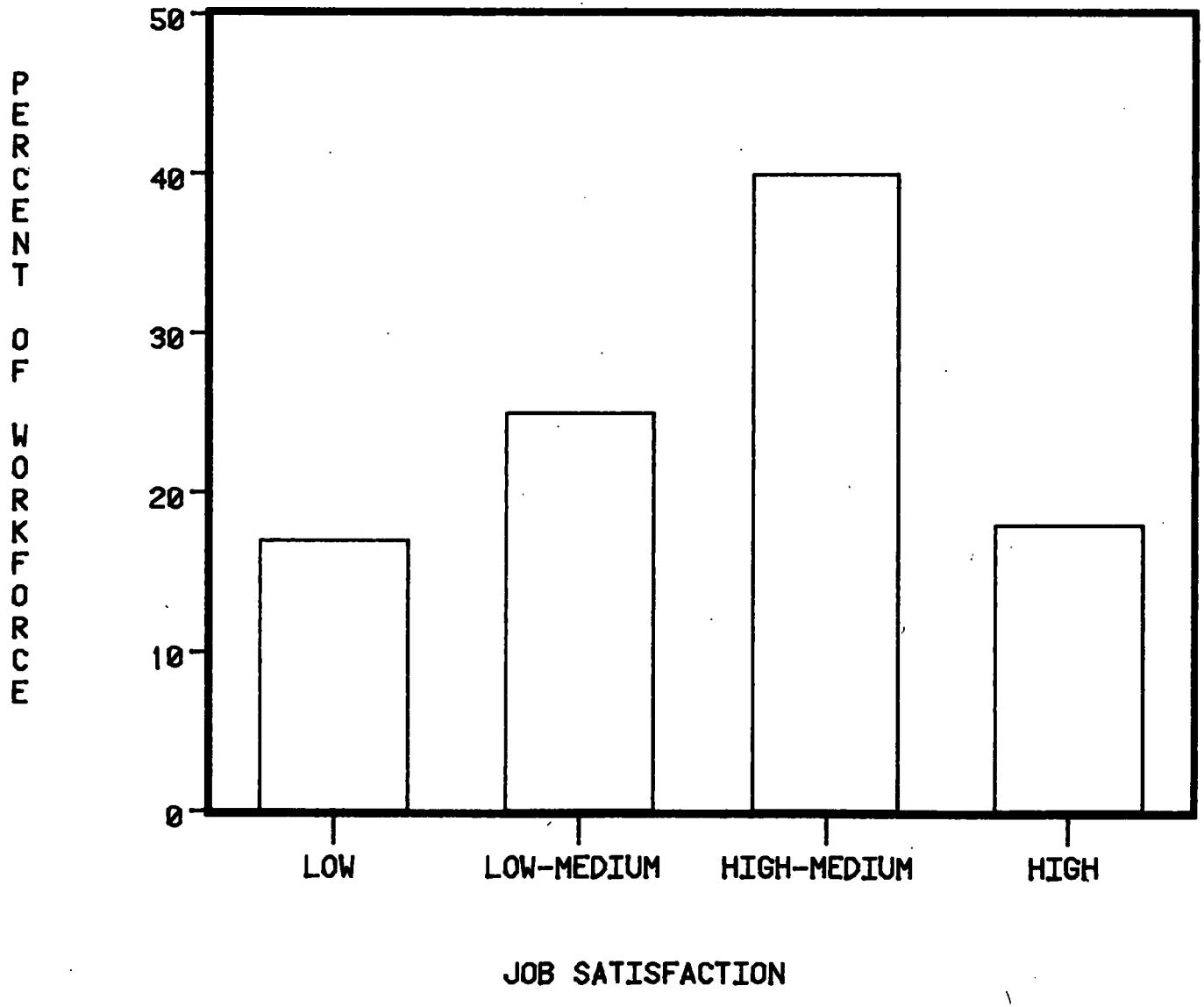
In general, management is more satisfied with their jobs than other engineers and scientists. Lower graded personnel are more dissatisfied with their job than higher graded engineers and scientists (Table 5.2).

Table 5.2 Job Satisfaction by Grade

Grade	Job Satisfaction Average Score	S.D.
Junior (GS 5-9)	465	92
Journeyman (GS 11)	470	84
Senior-Tech (GS 12)	491	79
Management (GS 13-15)	512	84

F value = 9.0, sign. at .001 level

FIG 5-1 GENERAL JOB SATISFACTION



5.2 Job Satisfaction and Technical Capability

The most dissatisfied engineers and scientists in Corps Engineering Divisions tend to be less technically capable. On average, more than 60 points separate individuals with low technical capability from highly technically capable individuals on the Hoppock job satisfaction index (Table 5.3).

Table 5.3 Job Satisfaction by Individual Technical Capability

Technical Capability	Job Satisfaction	S.D.
Low	450	94
Low-Medium	480	75
High-Medium	494	86
High	512	81

F value = 10.0, sign at .001 level

When the effects of grade and technical capability are considered jointly, each variable exerts an independent influence on job satisfaction. The least satisfied segment of the engineers and scientists workforce when viewed in terms of grade and technical capability appear to be junior grade engineers and scientists of low and high technical capability as well as journeymen engineers and scientists of low technical capability. These groups have job satisfaction scores which are well below the average for the entire sample as well as scores below the average for the respective grade and technical capability groups.

5.3 Job Satisfaction and Cohesion

The identification with the Corps index (questions XI-1 through XI-6) showed a close association with general job satisfaction scores (r = .62). That is, the most satisfied engineers and scientists are likely to identify most strongly with the Corps. This basic relationship did not change when controlling for the grade level, occupation and technical capability of individuals.

5.4 Components of Job Satisfaction

The literature on job satisfaction of engineers and scientists indicates a number of job characteristics which are likely to be important in satisfaction. These characteristics include obtaining recognition of one's work; obtaining feedback about the quality of one's work; a perception that one's job is preparing the individual for greater opportunity and responsibility; having freedom to control the performance of tasks, having some level of technical challenge associated with the tasks, providing the opportunity for enhancing one's professional reputation and providing the opportunity to earn a good salary. These items were measured in questions XII-1 through XII-9.

Table 5.4 presents a tabulation of the importance of each of these job satisfaction characteristics for the engineers and scientists workforce. As the table shows some characteristics are more important than others. The ability of the job to allow the individual to grow and learn new knowledge and skills; the ability of the job to make use of present knowledge and skills; to provide a good salary; the technical challenge provided by the job; and, the opportunity provided to build a professional reputation are all rated as being at least fairly important by a majority of engineers and scientists.

More highly technically capable individuals tended to place greater importance on opportunities a job afforded; to grow and learn new knowledge and skills to advance in authority; to associate with top executives to build professional reputations; to work on difficult problems; to have freedom to carry out their own ideas and to contribute to broad technical knowledge than did less technically capable individuals. Senior-graded personnel also tended to place greater importance on the opportunity to have the freedom to carry out their own ideas than did more junior graded engineers and scientists, while junior graded personnel placed greater importance on the opportunity the job provided them to grow and learn new knowledge and skills.

5.5 Ability of the Corps to Provide Job Satisfaction

The ability of the Corps to provide job satisfaction is measured in two ways: first in a general sense, and then in a more personal sense. In the first more general sense, job satisfaction is measured by the individual judgment of the Corps' ability to provide for the range of job satisfaction factors indentified in questions XII-1 through XII-9. Table 5.5 presents judgments of the Corps' ability to provide for these job satisfaction factors. These items were measured in questions XII-10 through XII-18. The table shows that, in general, the Corps' ability was rated fair to good on its ability to service job satisfaction needs. A slightly higher proportion of engineers and scientists rated the Corps' ability to help individuals make full use of their present knowledge (XII-10), and to work on challenging and difficult problems (XII-16) as better, while the ability of the Corps to enable an individual to advance in administrative authority and status (XII-13), and to contribute to broad technical knowledge (XII-18) was rated somewhat lower. More highly technically capable individuals and senior grade engineers and scientists were more satisfied with the Corps' ability to help provide all the job satisfaction characteristics except to earn a good salary (XII-12). For this variable all groups had approximately the same distribution of responses.

However, some job satifaction characteristics may not be personally important to individuals; therefore, a relative sense of job satisfaction is measured by comparing the judgments of the Corps' ability to provide job satisfaction characteristics with the individual's own judgments of the importance of those characteristics. This is done by subtracting the score given by an individual of the ability to provide for a job satisfaction factor from the score given for the personal importance attached to that characteristic. A score for any item could range from minus three to plus three. A value of plus three (+3) indicates a situation where an individual assigned a value of four indicating "a great deal of importance" to a factor but in the individual's judgment, the Corps' ability to provide for this characteristic was rated "poor" (1). A

Table 5.4 Importance of Job Satisfaction Factors

	Ratings (percent)					
	Little Importance	Some Importance	Fair Importance	Great Deal of Importance		
Factors	1	2	3	4	Average Score	N
Make full use of knowledge & skills	0.5	7	35	57	3.5	744
Grow & learn new knowledge & skills	0.4	4	36	59	3.5	744
Earn a good salary	0.1	6	42	51	3.4	743
Advance in admin. authority	10	25	32	27	2.8	743
Associate with top executives	14	29	35	21	2.6	744
Build professional reputation	6	20	41	33	3.0	744
Work on difficult & challenging problems	1	8	43	46	3.4	744
Freedom to carry out ideas	1	10	46	42	3.3	743
Contribute to broad technical knowledge	7	28	41	23	2.8	742

value of 0 indicates a situation of a match between the importance an individual assigns to the component and the individual's assessment of the Corps' ability to provide for that characteristic. A score of minus three indicates a situation where an individual assigned low personal importance to a characteristic but in the individual's judgment the Corps provides well for that characteristic. A score of plus three is likely to indicate high dissatisfaction since a personally important job satisfaction characteristic is not being provided; a score of 0 is likely to indicate satisfaction since there is congruence between individual needs and the provision of that need by the organization; while a score of minus three is likely to indicate a situation of indifference or no relevance to job satisfaction since there is little negative impact on individual needs.

The ability of the Corps to service need controlling for importance ascribed by individuals to those needs is presented in Table 5.6. This table shows that the engineers and scientists workforce were more dissatisfied with the Corps' ability to enable individuals to make full use of knowledge and skills; to grow and learn new skills; to earn a good salary; and to have freedom to carry out their own ideas, relative to the importance personally ascribed to the job satisfaction characteristics.

Comparing the responses by grade and technical capabilities, junior graded personnel were more dissatisfied than other grade levels with the ability of the Corps to provide the opportunity for making use of present knowledge, to grow and learn new knowledge, to advance in administrative authority and status; and to work on difficult and challenging problems. For the variable of technical capability, highly technically capable individuals were more dissatisfied than less technically capable engineers and scientists with the opportunity provided them to build their professional reputation.

Once again, the more junior graded segment of the engineers and scientists workforce appears to be less satisfied with their jobs. It appears that this group comes into the Corps with high expectations especially concerning the professional development potential and technical challenge aspects of their job. This group appears more inclined to feel that these expectations have not been met.

Highly technically capable individuals placed greater importance on most job satisfaction characteristics. However, these individuals are apparently receiving the desired level of satisfaction to a greater extent than less technically capable individuals.

5.6 Feedback and Recognition

The majority of the Corps engineers and scientists workforce feel that they do not always get recognition from management for doing a good job. This perception runs throughout the organization and does not vary by grade level or individual technical capability (Table 5.7). Corps engineers and scientists feel in general, supervisors only rarely provide them feedback about their job performance. Fully 40 percent of the workforce reported that they were never or only seldom given such feedback. Once again, this perception showed little variation by grade level or by technical capability.

Table 5.5 Ability of Corps to Provide for Job Satisfaction Factors

Job Satisfaction Factors	Rating (Percent) Poor 1	Fair 2	Good 3	Excellent 4	Ave.	N
Knowledge	10	34	44	11	2.2	743
Growth in Skills	13	39	40	8	2.4	743
Salary	12	44	39	4	2.4	743
Advancement	23	46	27	4	2.1	741
Associate with Top Executives	22	42	29	6	2.2	741
Professional Reputation	21	43	31	5	2.2	743
Technical Challenge	10	34	45	10	2.6	743
Freedom	16	42	35	6	2.3	740
Contribute to Technical Knowledge	23	47	26	3	2.1	740

Table 5.6 Relative Job Satisfaction Ratings

(Percent)

Factor	Indifference -3	-2	-1	Satisfaction 0	1	2	Dissatisfaction 3	Ave.	N
Knowledge		1	5	28	40	19	7	.9	733
Growth in Skills			5	23	39	25	9	1.1	733
Salary			5	25	35	25	10	1.1	732
Advancement		3	12	28	32	19	7	.7	730
Associate with Top Executives		3	15	37	27	14	4	.5	731
Professional Reputation		1	7	34	32	19	7	.8	733
Technical Challenge			5	37	36	16	6	.8	733
Freedom		1	5	26	40	23	7	1.0	729
Contribute to Technical knowledge		1	8	34	36	18	3	.7	728

Table 5.7 Other Job Satisfaction Characteristics

	Percent
VI-17 Feedback: How often are you given feedback from your superiors about your job performance?	
Never	7
Seldom	33
Sometimes	39
Frequently	19
Always	2
N	= 749
VX-31 Recognition: I am given credit for the work I have done.	
Never	2
Infrequently	17
Sometimes	32
Most of time	43
All of time	2
N	= 749

5.7 Job Satisfaction Model

Having presented a variety of job satisfaction characteristics and identified their association to grade and individual technical capability, it is possible to construct a model of general job satisfaction. Using multiple regression the independent contribution of each of the job satisfaction characteristic variables to general job satisfaction can be assessed. For the model the variables measuring the ability of the Corps to provide the job satisfaction characteristics of knowledge, learning new skills, earning a good salary, advancement in status, access to top executives, developing professional reputation, technical challenge, freedom, and contributing to technical knowledge, were employed as well as variables measuring the perception of the frequency of feedback and recognition. Finally, the variables of technical capability and grade level are also included to assess their independent contribution to job satisfaction.

Table 5.8 presents the multiple regression coefficients of the model. The model explains 40 percent of the variation in general job satisfaction (Hoppock index). The major components of the job satisfaction model as indicated by the standardized regression coefficients (Beta weights) are the opportunity to make full use of present knowledge, to build one's professional reputation, the technical challenge provided by the job, the recognition received for one's work, freedom to do the job, as well as the technical ability of the individual. Several variables have coefficients which are not statistically different from zero. Initial association of these variables with job satisfaction was spurious and based on their joint relationship to the other variables which show significant relationship with job satisfaction. It is noteworthy that when controlling for the effects of the job satisfaction variables, the independent influence of grade level is no

Table 5.8 Regression Model of Job Satisfaction of Engineering Division Engineers and Scientists

Independent Variables		B	Beta
XII-10	Use percent knowledge	19.8*	.19
XII-11	Grow and Learn	16.7*	.16
XII-12	Earn Good Salary	1.1	.01
XII-13	Advance in Authority	2.1	.02
XII-14	Associate with Executives	-3.0	-.03
XII-15	Build Professional Reputation	8.5	.08
XII-16	Technical Challenge	14.2*	.14
XII-17	Freedom	8.7**	.08
XII-18	Contribute to Technical Knowledge	4.6	.04
X-31	Recognition	11.4*	.12
VI-17	Feedback	2.4	.03
	Individual Technical Capability Index	0.7*	.09
VLL2	Grade	3.9	.04
	Constant	199.5	

R^2 = .398 F = 32.3

* Significant at .01 level
**Significant at .05 level

longer statistically significant on job satisfaction. That is, lower-graded individuals are seen to be more dissatisfied than higher-graded engineers and scientists because of perceived differences in the job satisfaction variables enumerated in this model.

The major components of the job satisfaction model include individual technical capability, the perception that the Corps provides individual freedom to carry out job assignments, the perception that the job provides the opportunity to build a professional reputation, the perception that the job is technically challenging, and the perception that the job allows the individual to make full use of his present knowledge. Individuals with jobs in Engineering Divisions which provide technical stimulation and challenge and in which individuals have some latitude to develop their own work plan and in which they receive some recognition and encouragement for these efforts are likely to be the most satisfied with their jobs. Conversely, jobs which are technically unchallenging and which may be seen to be "dead end" and jobs where management provides little recognition and encouragement are likely to be the least satisfying to Corps engineers and scientists.

It is important to note that of these characteristics which explain a large measure of the variation in job satisfaction, almost all are dependent upon management's ability to create an organizational climate which motivates individuals. Certainly, almost all of the factors identified as important to job satisfaction can be influenced positively or negatively by the management style and procedures Corps supervisors and executives adopt.

In view of the association of grade level with job satisfaction it appears that lower graded jobs in Corps Engineering Divisions do not provide as much technical challenge, encouragement, freedom and other job satisfaction characteristics for lower graded employees as for higher-graded employees. While some differences are probably justified in view of junior-graded employees' relative lack of experience, the issue merits close examination since the group of junior-graded employees represents the future of the Corps.

6. Expectation of Leaving the Corps

Fully 29 percent of the Corps of Engineers engineers and scientists workforce now employed in Engineering Divisions expects to be working somewhere else besides the Corps within the next 5 years. Another 13 percent expects to be retired. Of the number of employees who expect to leave the Corps for other employment, 31 percent plan to go to another Federal or state government agency, and 69 percent plan to be either self-employed or working in private industry (Table 6.1 and Figure 6-1). Of the workforce surveyed, only 7 percent are now actively seeking employment, however, another 12 percent of engineers and scientists are "somewhat actively seeking" other employment. The 1976 ASCE survey asked whether respondents to that survey were then seeking employment but only allowed for the responses of "yes" or "no." In the 1976 survey, 15 percent of those engineers employed by the Federal Government indicated they were actively seeking employment (ASCE, 1976). While direct comparisons cannot be made, it would appear that no greater proportion of the Corps engineers and scientists workforce is now looking for other employment than the average for Federal engineers in 1976.

Table 6.1 Expectation of Leaving the Corps

Category	N	%
Leave Corps	220	29.4
Remain w/Corps	386	51.5
Retired	93	12.5
No Answer	50	6.6
Total	749	100.0

6.1 Expectation of Leaving the Corps and Grade

A greater proportion of junior and journeymen-level graded engineers and scientists anticipate leaving the Corps than more senior upgraded employees (Table 4.2 and Figure 6-2). Almost 6 of 10 GS-5-7-9 engineers and scientists expect to be working elsewhere in the next 5 years while for the journeymen grade level almost 1 of 2 expect to leave the Corps. For senior and management grades only about one in four engineers and scientists do not expect to remain with the Corps.

FIGURE 6-1 EXPECTATION OF LEAVING CORPS WITHIN FIVE YEARS

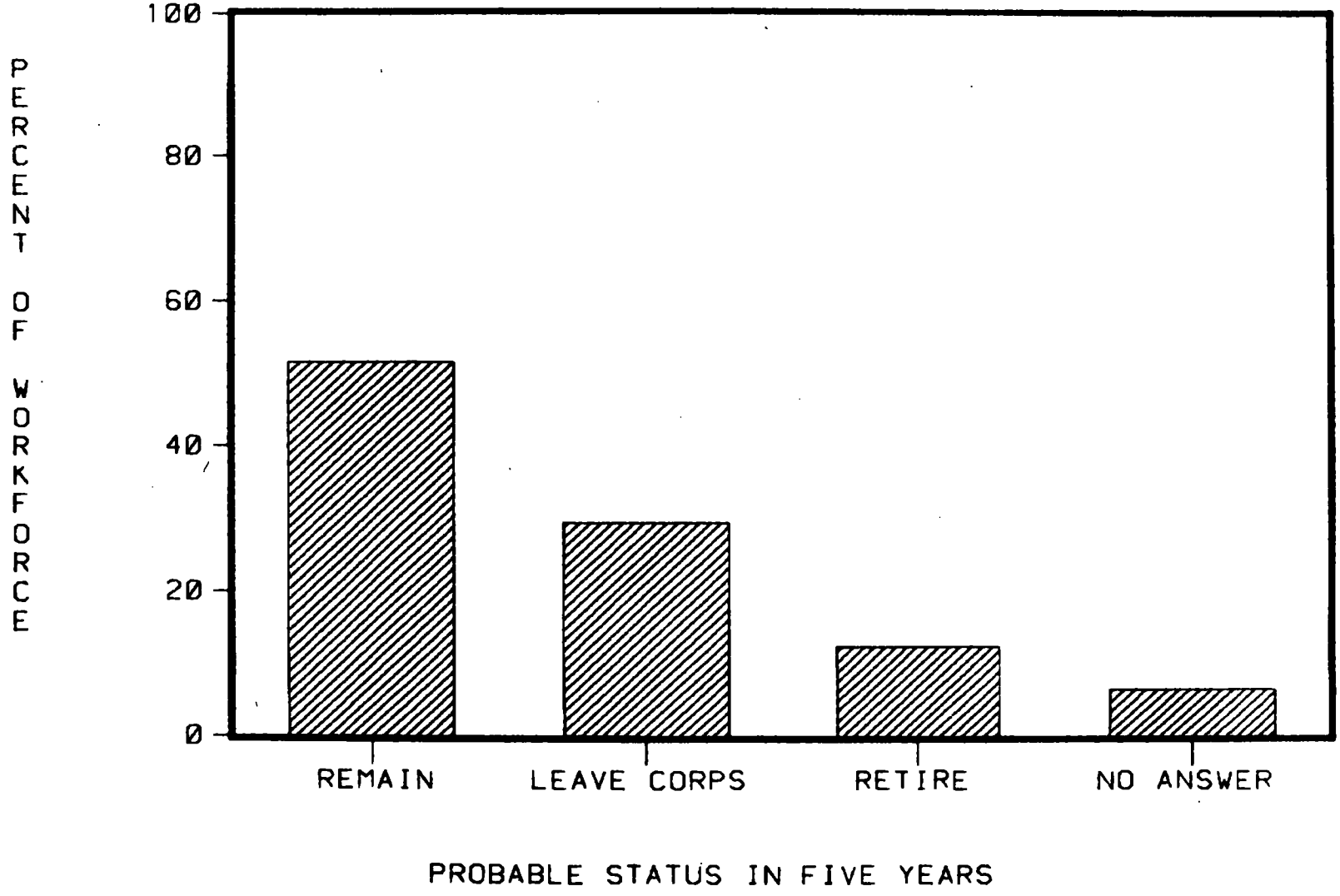


FIG 6-2 EXPECTATION OF LEAVING BY GRADE

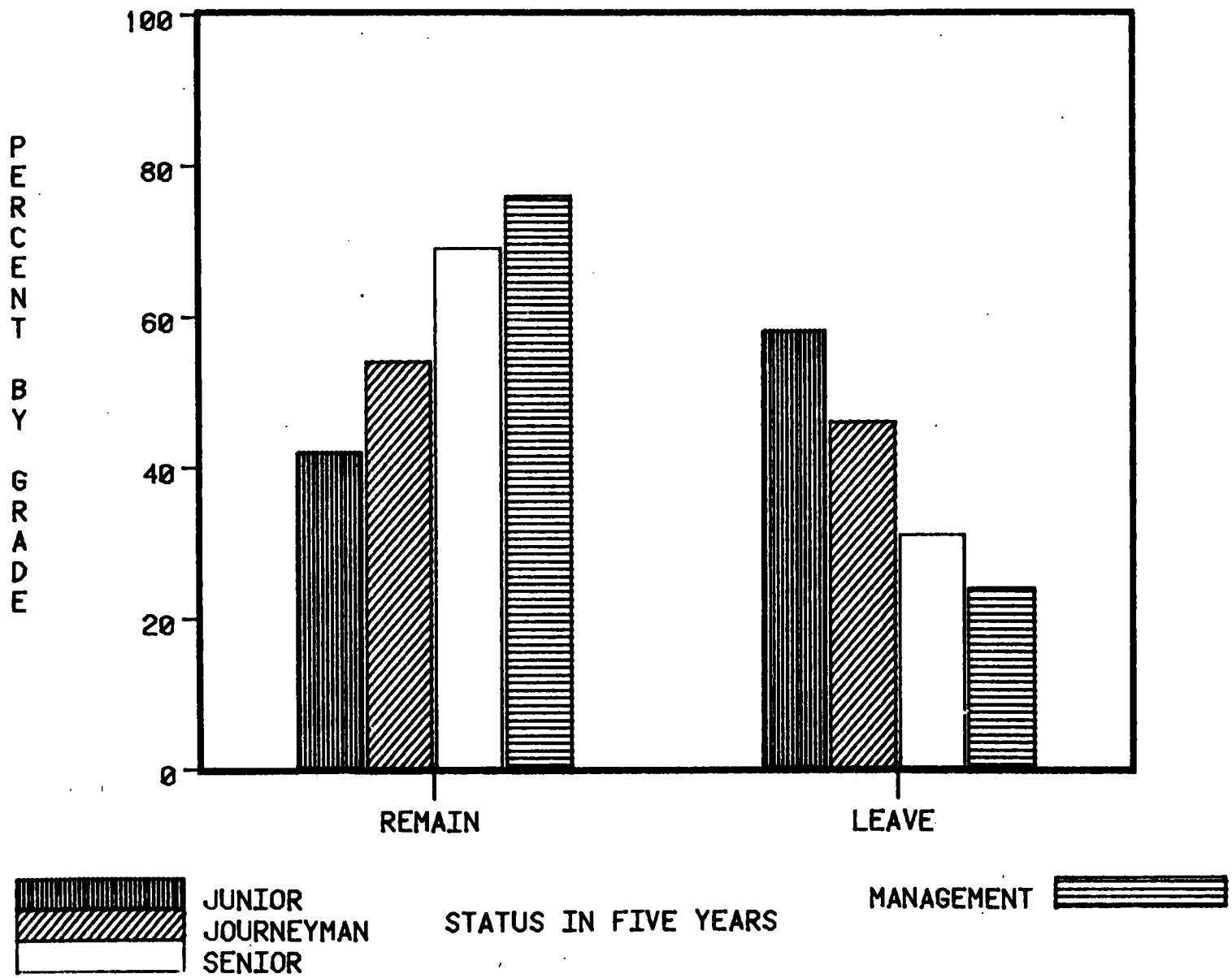


Table 6.2 Expectation of Leaving by Grade

Grade	Remain N	Remain %	Leave N	Leave %	Total N	Total %
Junior (GS 5-9)	24	(42)	33	(58)	57	(100)
Journeyman (GS 11)	95	(54)	81	(46)	176	(100)
Senior Tech. (GS 12)	163	(69)	72	(31)	235	(100)
Management (GS 13-15)	99	(76)	32	(24)	131	(100)
Total	381	(64)	218	(36)	599	

Missing = 150 (includes 93 retired; 50 no opinion)

X^2 = 29, sign = .0001
Gamma = -.35

6.2 Expectation of Leaving the Corps and Technical Capability and Discipline

One of the crucial questions with which the OCE Blue Ribbon Committee is concerned is whether Engineering Divisions are likely to lose their most highly technically capable individuals. In general, individual technical capability does not appear to be associated with the expectation of leaving the Corps (Table 6.3 and Figure 6-3). That is, it appears that approximately the same proportion of highly technically capable individuals as individuals of low technical capability expect to leave the Corps. As Table 6.3 shows, this average percentage is approximately 37 percent of the workforce when "no answers" and those expecting to retire are removed from the total.

Figure 6-4 illustrates the impact of removing those who expect to leave the Corps, and those who expect to retire in the next 5 years from the distribution of technical capability. As the figure shows, there is a considerable reduction in the workforce; however, the distribution of technical capability remaining is almost exactly the same as the distribution which is now present in Engineering Divisions.

Thus, based on the above analysis, it appears that Engineering Divisions are not losing a disproportionate share of their most highly qualified personnel. Rather, it appears that a fairly significant proportion of the workforce (almost one-third) expects to be employed elsewhere; however, the most highly technically capable individuals are neither more nor less likely to expect to leave the Corps than their less technically capable colleagues.

FIGURE 6-3 EXPECTATION OF LEAVING CORPS BY INDIVIDUAL TECHNICAL CAPABILITY

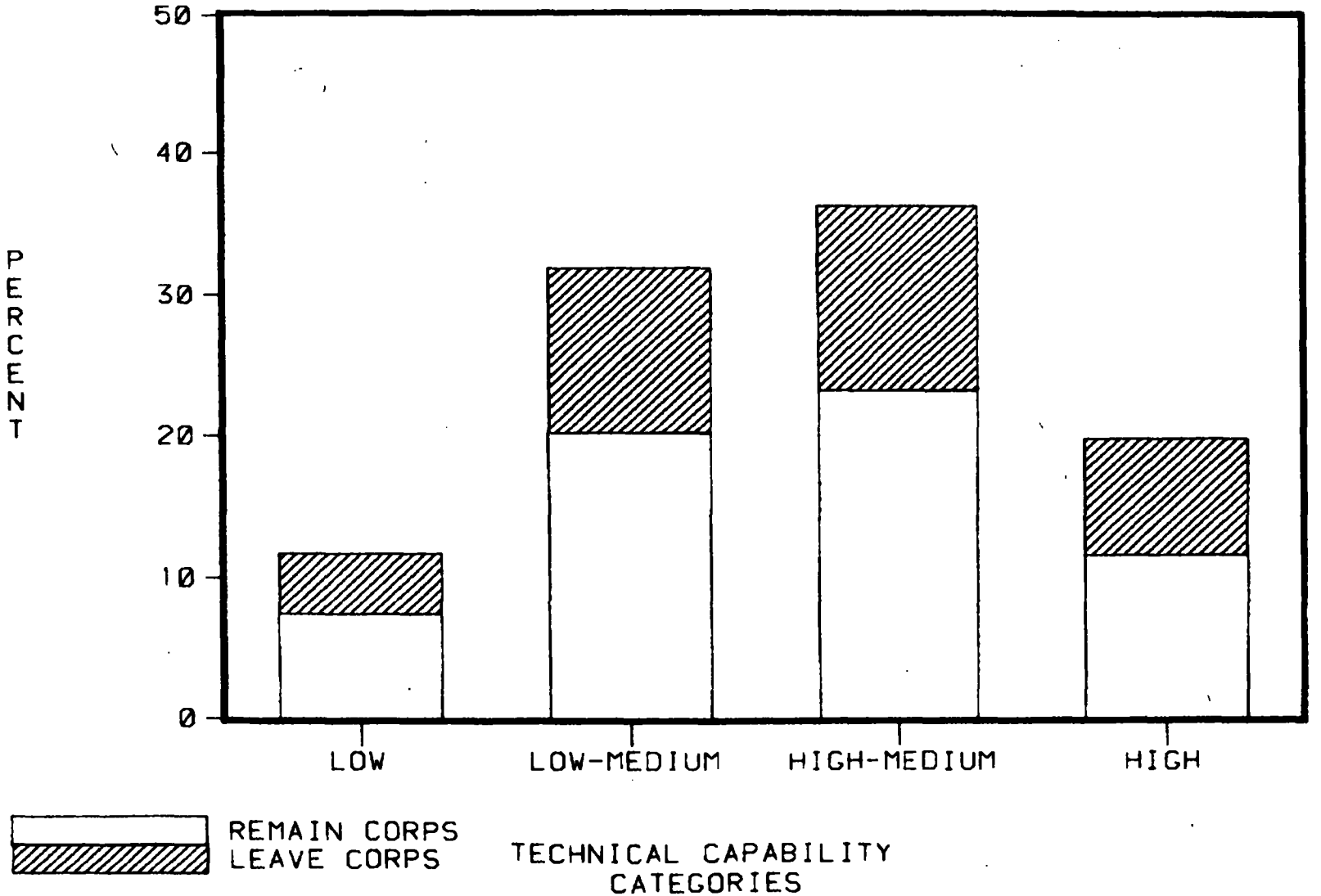


FIGURE 6-4 TECHNICAL CAPABILITY DISTRIBUTION OF THOSE REMAINING, LEAVING AND RETIRING WITHIN NEXT FIVE YEARS

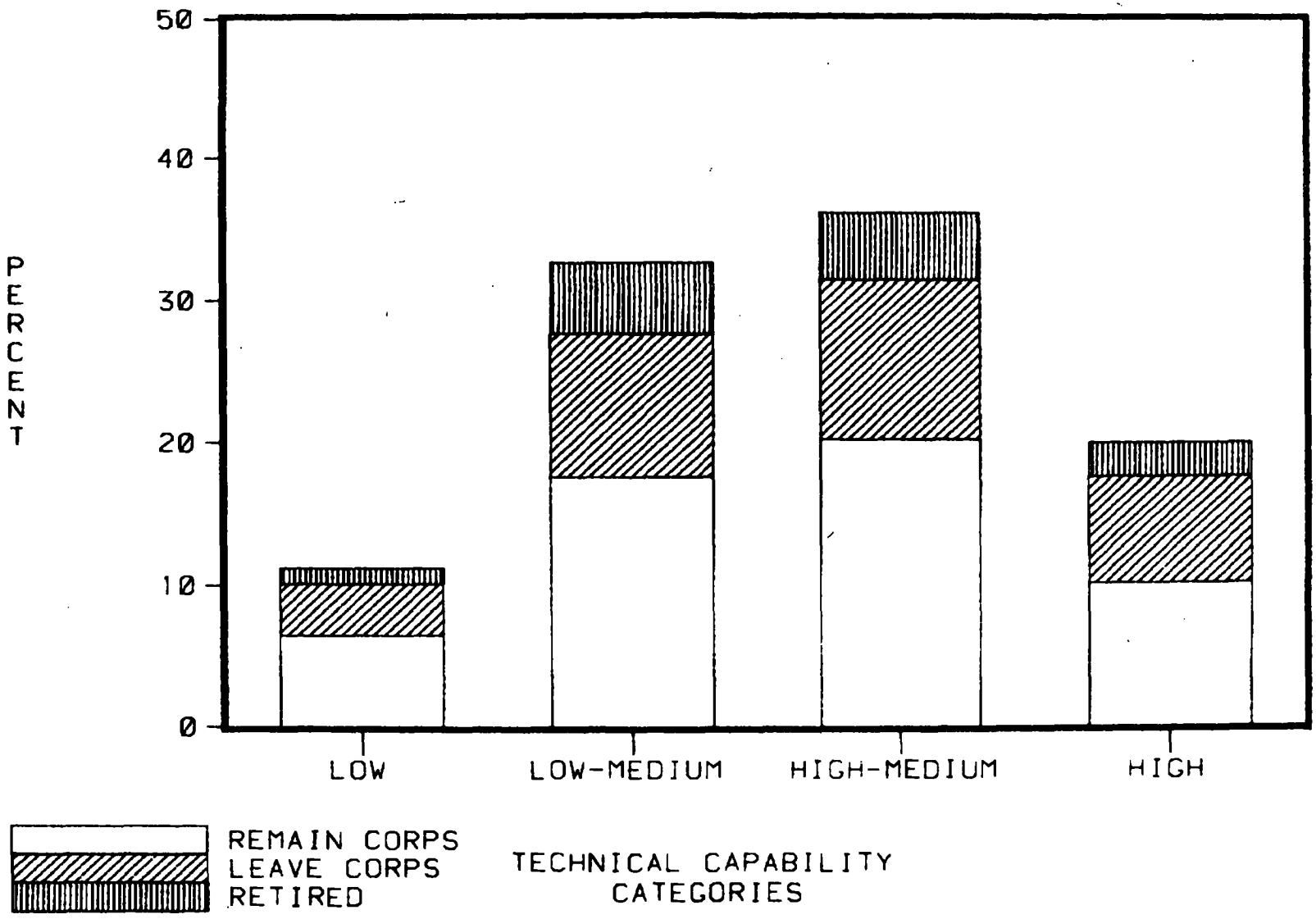


Table 6.3 Expectation of Leaving Corps by Technical Capability

Technical Capability	Remain N	Remain %	Leave N	Leave %	Total N	Total %
Low	43	(64)	24	(36)	67	(100)
Low Medium	116	(64)	66	(36)	182	(100)
High Medium	133	(64)	74	(36)	207	(100)
High	67	(58)	49	(42)	116	(100)
Total	359	(63)	213	(37)	572	

Missing = 177 (Retired, No Answer)

X^2 = 1.5, sign = .67
gamma = .05

6.3 Expectation of Leaving the Corps and Job Satisfaction

By far the strongest association between the major variables examined in this study and expectation of leaving the Corps is job satisfaction. As Table 6.4 shows, only about 31 percent of the most dissatisfied with their jobs plan to remain with the Corps, while 81 percent of the most satisfied expect to remain with the Corps (Figure 6-5).

Table 6.4 Expectation of Leaving by Job Satisfaction

Job Satisfaction	Remain N	Remain %	Leave N	Leave %	Total N	Total %
Low	32	(31)	70	(69)	102	(100)
Low Medium	74	(49)	78	(51)	152	(100)
High Medium			181	(81)	43	(19)224(100)
High	80	(81)	19	(19)	99	(100)
Total	367		210		577	

X^2 = 101, sign = .00001
gamma = -.58

To identify what specific job satisfaction characteristics were most closely associated with the expectation of leaving the Corps, the mean responses on the job satisfaction characteristics variables of those expecting to leave the Corps, and those engineers and scientists who expect to remain with the Corps, were compared. Those expecting to leave the Corps had significantly lower scores than those expecting to remain with the Corps on all job satisfaction characteristic variables. Of the job satisfaction characteristics variables, the distribution of perceptions that the job is technically challenging showed the greatest difference between the group expecting to leave and the group expecting to stay (Table 6.5). That is, while all job satisfaction

FIGURE 6-5 EXPECTATION OF LEAVING CORPS BY JOB SATISFACTION

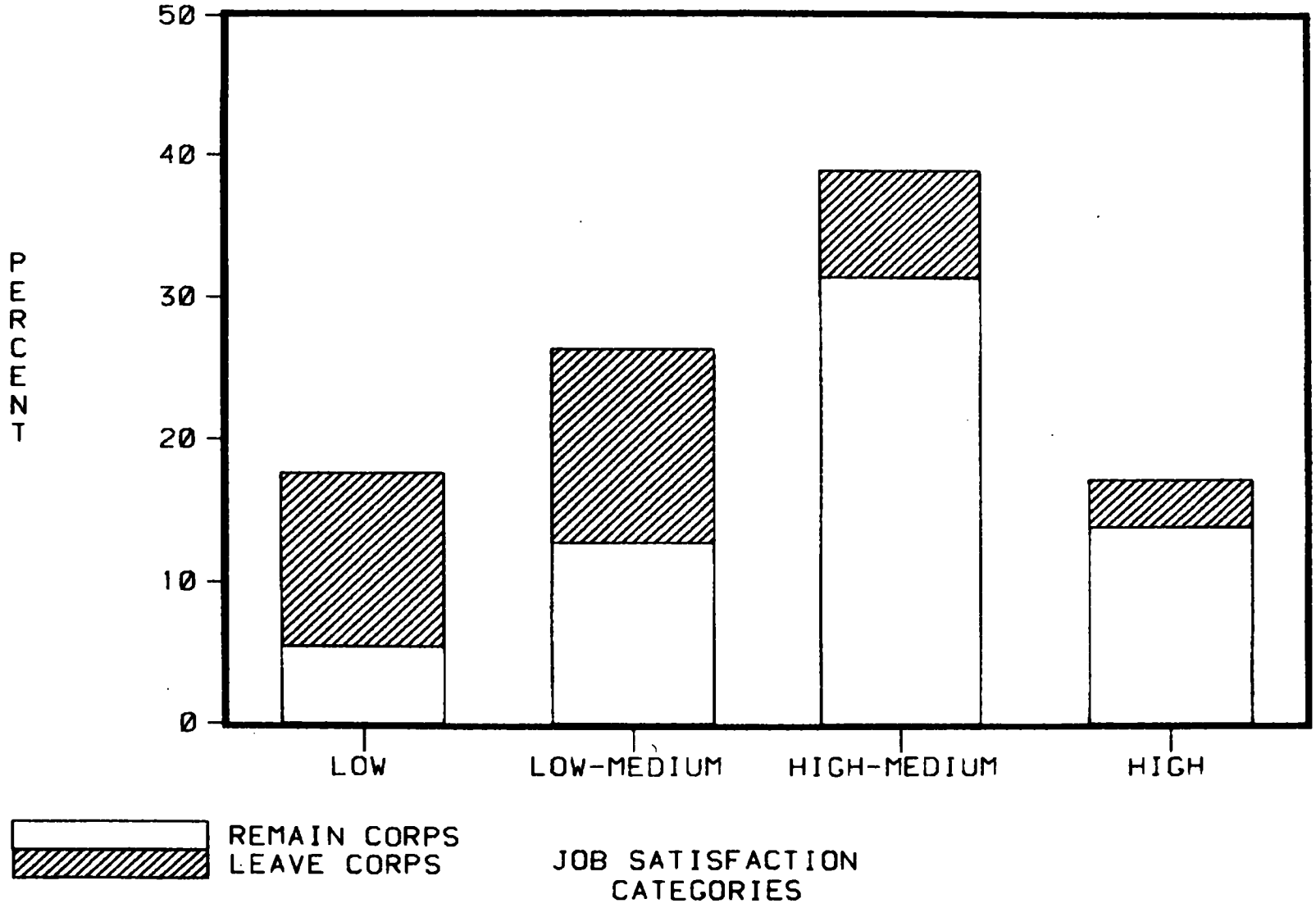


Table 6.5 Comparison of Importance of Job Satisfaction Characteristics of Those Who Expect to Leave Corps with Those Who Expect to Stay

Variable	Mean Score Leaving	Mean Score Staying	Difference	F Value
VX 31 Recognition	3.1	3.5	0.4	4.7*
VI-17 Feedback	2.7	2.8	0.1	2.3*
XII-10 Use Knowledge	2.3	2.7	0.4	6.0*
XII-11 Grow and Learn	2.2	2.6	0.4	5.1*
XII-12 Earn Good Salary	2.1	2.5	0.4	5.6*
XII-13 Advance in Authority	1.9	2.2	0.3	5.3*
XII-14 Associate with Top Executives	2.0	2.3	0.3	5.2*
XII-15 Build Professional Reputation	2.0	2.3	0.3	5.2*
XII-16 Technical Challenge	2.3	2.7	0.4	5.5*
XII-17 Freedom	2.1	2.4	0.3	3.6*
XII-18 Contribute to Technical Knowledge	1.9	2.2	0.3	3.2*

* Significant at .01 level.

characteristic variables appear to be important in differentiating potential "leavers" from "stayers" the factors upon which the two groups could be most clearly differentiated were disagreement about the level of technical challenge their jobs provided, the ability to use their knowledge and skills, and their ability to earn a good salary with the Corps. Those expecting to leave the Corps felt that their jobs were not technically challenging and that they were not earning as much as they might elsewhere, while those planning to stay with the Corps were more likely to believe that their jobs were technically challenging, and that the Corps enabled them to earn a good salary.

Questions VIII-3 asked respondents their views on how important several factors where in influencing engineers and scientists to leave the Corps. While the views of engineers and scientists now in the Corps may or may not accurately reflect the views of those who have already left, the responses do provide information on factors which may be important to respondents regarding their own decision on whether or not to remain with the Corps. Under this view, responses to those questions can be seen to provide a reflection of the respondents own state of job satisfaction. By comparing the responses of leavers and stayers, it is possible to identify differences which may be particular to one group from areas of general agreement.

As Table 6.6 indicates both those planning to leave the Corps as well as those planning to remain felt that the factors of pay and opportunity for advancement were the most important reasons why professional colleagues have left the Corps.

The group of potential leavers and stayers agreed on the importance of all factors in questions VIII-3 <u>except</u> the technical challenge question. Potential leavers felt that the lack of technical challenge in the job was of greater importance in influencing engineers and scientists to leave than did those expecting to stay with the Corps. Again, if, in fact, the responses of individuals in these two groups reflects their own internal states, it appears that leavers have greater dissatisfaction with the technical challenge aspects of their job than do those expecting to remain with the Corps.

Table 6.6 Perception of Factors Influencing Engineers & Scientists to Leave the Corps

Variable	Expect to Leave		Expect to Remain		F Value Difference of Mean Score
	Rank	Mean	Rank	Mean	
VE 3 Technical Challenge	3	2.8	3	2.6	9.8*
VE 4 Pay	2	3.2	2	3.2	0.5
VE 5 Fringe Benefits	4	2.6	4	2.5	0.1
VE 6 Advancement Opportunities	1	3.4	1	3.3	0.5
VE 7 Job Security	5	2.0	5	2.0	0.1

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*Significant at .01 level

7. Organizational Effectiveness Concerns

This section examines the views of the engineers and scientists workforce on the manner in which the Corps meets goals of developing and maintaining a highly capable workforce via personal career planning, evaluation and supervisory selection procedures; via training opportunities offered; and by the dissemination of R&D products to its employees.

7.1 Effectiveness of the SKAP System

The SKAP is the major evaluation and supervisory selection tool in use in the Corps. For the engineers and scientists workforce as a whole, 47 percent feel dissatisfied with the SKAP system (Question X-24) and feel that the system is ineffective for career planning purposes (Question X-27). Only a minority (13 percent) feel satisfied with the system or consider it effective in career planning (10 percent).

7.2 Perceptions of Advancement and Management Recruitment Practices

A majority of the workforce does not believe the promotion system is fair in the sense that the most qualified person is generally promoted (58 percent - Question X-26). Promotion to management ranks is seen to be a function of administrative skills as well as the visibility of projects which an individual is assigned to work on in his career. Over 73 percent of the workforce classified the former factor to be important or extremely important, while the latter factor was similarly rated by 69 percent of the workforce. Of somewhat less importance are technical proficiency (65 percent) and human relation skills (63 percent) (Questions X-17 thru X-21).

While there is skepticism about the equity of promotion policies, a significant portion of the engineers and scientists workforce believe that overall the management of the Corps is competent and effective (44 percent); 16 percent are undecided; and 37 percent disagree (Question VI-8). A majority (55 percent) of the workforce believes that their positions are preparing them for positions of greater responsibility (Question X-22).

These figures indicate that roughly one third to one half of the engineers and scientists workforce is skeptical of the efficacy and equity of the promotion system and about the capability of management the system produces. In general, it appears that individuals of low technical capability are more skeptical of the equity of advancement opportunities as well as of the competency of the management, while more highly technically capable individuals are inclined to perceive opportunities for advancement and to evaluate management's capability in a more positive light. Individual grade level does not seem to be important in differentiating between those who are skeptical from those who are not. As might be expected, those planning on leaving the Corps are more inclined to be skeptical of the equity of the promotion system and the capability of Corps management.

7.3 Efficacy of Corps Training

Respondents were asked to assess the effectiveness of vocational career interns, and long term and short term professional training in enhancing Corps

technical capability on a four-point scale ranging from "not effective" to "highly effective" (Question X-40). A majority of the workforce felt that all three programs were effective or highly effective. The rotational career intern program received the largest number of "marginally effective" or "not effective responses" being so rated by approximately one in three respondents. A majority of the engineers and scientists workforce felt that the Corps provided enough opportunties to maintain technical capability (51 percent, Question X-25); however, over 40 percent felt that they did not receive enough opportunities. Once again, the majority of individuals holding views critical of the availability of training opportunities tended to be concentrated among more junior grade engineers and scientists, and among those who expect to leave the Corps. Finally, the majority of the engineers and scientists workforce felt that the training needs identification system was not effective (53 percent, Question VI-15). Approximately 33 percent of the workforce felt adequately served by the training needs identification system. The group critical of the training needs system is more likely to be composed of lower graded individuals, less technically capable individuals and engineers and scientists who expect to leave the Corps.

7.4 Importance of R&D in Corps Technical Work

The importance of R&D products provided by the Corps and other sources in maintaining technical capability was evaluated in Questions VI-16, VI-21 and VI-22. Overall, it appears that the Corps R&D program is not well-known to the majority of the engineers and scientists workforce. Almost 64 percent of the respondents had no opinion as to whether the Corps R&D program was working on the right subjects (VI-16). Thirty-nine percent had no opinion as to how effective the Corps R&D program was in enhancing and advancing Corps technical capability (Question VI-21); 26 percent felt that the program was highly effective while 30 percent felt the program was only marginally effective.

While there appears to be lack of knowledge about the overall R&D program, the majority of engineers and scientists rate Corps lab products as important or very important to their own professional work (68 percent, Question VI-22). Corps R&D products were rated as more important than any other R&D source followed in importance by private industry R&D and academic R&D (both 57 percent), and professional society R&D (45 percent).

7.5 Summary

The findings of this section indicate that there is significant skepticism concerning the equity of promotion and management selection procedures and that there is dissatisfaction about the efficacy of training opportunities provided engineers and scientists. Such skepticism and discontent is concentrated among junior graded engineers and scientists and among individuals of lower technical capability. The majority of these individuals expect to leave the Corps within the next 5 years.

In large measure the characteristics of these findings are similar to those concerning job satisfaction. Indeed it is the same group who is most dissatisfied with their job who are likewise skeptical of the effectiveness of Corps organizational promotional and training policies.

There appears to be a broad lack of knowledge about the R&D program in general. However, engineers and scientists use Corps R&D products in their own professional work and consider these products to be of greater relative importance than R&D products from other sources.

8. Solutions

This section describes how engineers and scientists in the Engineering Division workforce feel about possible actions which address organizational problems related to maintaining technical capability. While the views of the workforce as a whole are important, the analysis thus far has revealed several categories of individuals whose views may be critical. Principally these groups include those who intend to leave, in particular the most highly technically capable segment of this group; in addition, the more junior graded engineers and scientists have been identified as more dissatisfied with job satisfaction aspects of their position.

Table 8.1 provides average ratings for each of the 23 potential options considered in the survey in questions V-1 through V-23. The range of values in each option was from one indicating the action would have a highly negative impact on the Corps to nine indicating a highly positive impact. A score of five indicated no impact. Twelve of the 23 options received ratings of 6.0 or higher indicating, in general, the workforce felt that these options would produce positive changes in the Corps. These options included the creation of separate technical and management career ladders, encouraging professional registration through better incentives and stricter rules, delegating more responsibility to younger engineers and scientists, establishing centers of of competency in various specialties, achieving 100 percent professional registration in the workforce, consolidating all design work in Engineering Divisions, encouraging districts to seek work from non Corps-agencies, encouraging more interdistrict sharing of work, instituting a major program of on the job training, investigating new concepts of organization and management effectiveness for the Corps, eliminating the SKAP system, and instituting an incentive pay system.

Table 8.1 Ratings of Potential Options

Question	Option	Average	N
V-1	Separate Technical Career Ladder	6.7	739
V-2	Unionize E & S	3.5	739
V-3	Establish Collective Bargaining	4.5	735
V-4	Periodic Relicensing	4.8	738
V-5	Administer Competency Tests	4.6	739
V-6	Enforce ASCE Ethics Code	5.8	730
V-7	Encourage Professional Registration	6.6	737
V-8	Delegate Responsibility to Younger E & S	6.5	739
V-9	Establish Centers of Competence	6.1	738
V-10	Achieve 100 percent professional resigration	6.1	738
V-11	Increase A/E work	2.6	739
V-12	Total Design Centers	5.3	695
V-13	Matrix Management	5.1	649
V-14	Combine Civilian & Military Constructions	5.6	716
V-15	Combine Engineering & Construction Division	5.1	711
V-16	All Design in EDs	6.3	720
V-17	Work from non-Corps Agencies	6.4	722
V-18	Interdistrict Work	6.9	724

V-19	OJT	7.0	722
V-20	Apply New OE Concepts	7.1	719
V-21	Eliminate SKAP	6.2	679
V-22	Incentive Pay	6.4	720
V-23	Contract Out AS	4.4	717

In general, those options which junior graded individuals evaluated more positively than the general workforce were also those which were rated more positively by those leaving the Corps, once again reflecting the findings that the largest proportion of those expecting to leave the Corps are junior graded individuals. In general, highly technically capable individuals who expect to leave the Corps could not be differentiated from the rest of the individuals expecting to leave the Corps in terms of their views on the importance of potential policy options except that this group was more positive than the average rating for the option of combining civil and military construction and for the option of contracting out administrative services. For combining civil and military construction this group provided an average rating of 6.5 compared with the overall average of 5.6 for the rest of the workforce.

Junior graded employees and management evaluated one option higher than other segments of the engineers and scientists workforce - that of formally enforcing the ASCE code of ethics. Management gave greater support for the option of achieving 100 percent professional registration and eliminating the SKAP system than did the rest of the workforce.
Based on this analysis, those highly rated potential policy options which enjoy the greatest support from the general engineers and scientists workforce as a whole are the following:

- Establishing separate technical and management career ladders.
- Concentrating all design work in Engineering Divisions.
- Encouraging interdistrict sharing of work.

Those highly rated policy options which appeal more to lower graded engineers and scientists are:

- Delegating responsibility to younger engineers and scientists.
- Establishing centers of competency throughout the Corps.
- Developing a major on the job training program.
- Applying new organizational effectiveness concepts.

Those highly rated options appealing more to management are:

- Achieving 100 percent professional registration.
- Eliminating the SKAP system.

Those highly rated options appealing more to those who expect to leave the Corps are:

- Encouraging professional registration.
- Delegating responsibility to younger engineers and scientists.
- Establishing centers of competency.
- Encouraging districts to obtain work from their own Corps agencies.
- Applying new organizational effectiveness concepts.
- Developing an incentive pay system.

9. Organizational Technical Capability

Respondents were asked to provide judgments of the technical capability of their district or division. Taking together these responses represent a perceptual inventory of corporate technical capability.

9.1 Capability and Technical Specialty Areas

Table 9.1 presents the distribution of ratings of the technical capability of the major technical specialty areas in Engineering Divisions. Several functional areas received ratings of "above average" or "outstanding" by a majority of respondents. These areas included hydraulics, hydrologic engineering, general civil engineering, geotechnical, structural and coastal engineering. While no technical area was perceived to have poor aggregate capability, the areas rated as "below average" or "poor" most frequently were sanitary and architectural.

Respondents were asked to judge the historical and projected direction of trends in technical capabilities of each of the technical specialty areas. The majority of respondents anticipate no change in the level of technical capability of the functional areas over the next several years. Of those who do see some change as likely, more engineers and scientists feel that the level of technical capability in the functional areas will decrease. In general, the same patterns hold for the perception of changes in the recent past as well.

The assessments of the technical capability of technical specialty areas is presented by district and division in Table 9.2. The ratings represent the judgments of individuals about the capability of technical functions within their own organizations.

9.2 Capability of the Workforce in Technical Specialty Areas

Questions III-115 to III-126 asked respondents to identify the technical specialty areas in which they consider themselves to be qualified at the journeyman level. As Table 9.3 shows, a majority of the workforce considers itself capable to perform journeymen level work in the areas of cost estimation, specification and report preparation. Those areas having the lowest proportion of journeymen level capable individuals included electrical, mechanical and architectural.

9.3 Factors Reducing Corps Technical Capability

Respondents were asked to select the three most important factors contributing to reducing Corps technical capability from among 12 factors. Table 9.4 identifies these factors and the importance assigned to them by those answering the survey. The table identifies the number of "first", "second", "third" importance ratings assigned by individuals as well as the total of all ratings assigned. From the table it can be seen that in the view of the Engineering Division engineers and scientists workforce, the most important factors contributing to a reduction of Corps technical capability include the loss of experienced personnel, a lack of motivation among the workforce to perform at an effective level, and heavy workloads which prevents good performance.

Table 9.1 Organization Technical Capability of Technical Functional Areas

Technical Function	Percent Rated					
	Outstanding	Above Average	Average	Below Average	Poor	N
Hydraulics	17	46	29	7	2	530
Hydrologic Engr.	18	49	27	5	1	491
Electrical Engr.	5	36	40	15	4	392
General Civil Engr.	6	44	44	5	1	603
Mechanical Engr.	6	36	43	11	4	399
Survey/Mapping	4	34	42	15	4	465
Sanitary Engr.	3	29	43	19	7	359
Geotechnical	14	53	25	7	1	444
Structural	9	46	36	8	1	507
Architectural	4	25	48	20	4	387
Cost Engr.	8	38	40	11	3	403
Specs.	6	40	42	10	2	465
Project Mgmt.	6	34	43	14	4	513
Instrumentation	5	37	44	9	6	243
Coastal Engr.	11	39	33	13	5	210
Materials Engr.	3	36	43	14	4	249
Tech. Support	4	33	46	14	3	413

Table 9.2 Rating of Technical Function Areas by Districts and Divisions

Organization	Hydraulics	Hydrologic Engr.	Electrical	General Civil	Mechanical	Surveys	Sanitary	Geo-Tech	Structural	Architectural	Cost Engr.	Specs.	Proj. Mgmt.	Instrumentation	Coastal Engr.	Materials Engr.	Tech. Support
	Technical Function																
HND	+	+	+	+	+	+	+	+	+		+	+		+	■	■	+
LMVD	+		+											+		+	+
Memphis	+		+		+		■	+		■	+						
New Or.					+					■				+			
St. Louis	+	+		+			+	+	+			+		+		+	
Vicksburg	+	+					+		+					■			■
MRD	+	+	+	+	+		+	+	+		+	+	+			+	+
Kansas C.		+		+		+		+	+						■		+
Omaha	+	+	+	+			+	+	+		+	+	+				+
NED	+	+			+		■			■					+	■	
NAD	+	+			+		+	+	+					■	+	■	+
Balto.	+					■		+		■				+			
Phila.			■				■	+	+	■			■				
New York	+	■	■					■	■			■				■	
Norfolk																	
NCD	+	+		+									+		+		
Buffalo	+	+	■					■			+				+	■	
Chicago				■		■		■					■		+		■
Detroit	+	+	■		■		■	+			+		+		+	+	+
Rock Is.	+	+	■	+				+	+	■		+					
St. Paul	+	+									+			■			
NPD	+	+	+	+	+			+	+		+		+	+	+	+	+
Alaska			■									+			+		
Portland						+	■	+	+						+		
Seattle		+	■			+		+									+
Walla Walla		+				+		+			+			+		+	
ORD	+	+		+				+	+		+		+			+	
Huntington	+	+	+	+	+	+		+	+		+	+					
Louisville	+	+			+			+	+		+						+
Nashville	+	+			+			+	+			+					
Pittsburg	+	+	+	+	+			+	+		+	+	+				
POD			■	■		■				■			+	■	■	■	■
SAD	+	+			+			+	+	+	+		+	+		+	
Charleston	+	+															
Jacksonvl.				+				+	+								
Mobile	+	+	+						+			+					
Savannah			+		+		+	+	+				+				
Wilmington		+							+								
SPD	+	+	+	+			+										
LA		+						+						■	■		
Sacramento	+	+	+	+		+		+	+			+	+		■		+
San Fran	+									■		+	+		+	■	

Table 9.2 Rating of Technical Function Areas by Districts and Divisions
(continued)

Organization	Hydraulics	Hydrologic Engr.	Electrical	General Civil	Mechanical	Surveys	Sanitary	Geo-Tech	Structural	Architectural	Cost Engr.	Specs.	Proj. Mgmt.	Instrumentation	Coastal Engr.	Materials Engr.	Tech. Support
	Technical Function																
SWD	+	+				+		+		*	*				+	+	
Albuquerque	+	+	*	+	*		*	+	+	*					*		
Ft. Worth	+	+				+		+								+	
Galveston						+		+								+	
Little Rock	+	+								*	+			+			
Tulsa	+	+		+				+	+		+			+		+	*
MED			+	+					+	+	+		*	*			
OCE	+	+	+		+	+		+	+	*	*	+	+	+	+		+

* More than 50% rated technical function as below average or poor
\+ More than 50% rated technical function as above average or outstanding

Table 9.3 Capability of Workforce in Technical Specialty Areas

Technical Specialty Area	Percent	
	Capable at Journeyman Level	Not Capable at Journeyman Level
H&H	43	57
Structural Engineering	40	60
Electrical	9	91
Mechanical	14	86
Geotech	28	72
Sanitary	27	73
Water Quality	24	76
Architecture	14	86
Cost Estimation	53	47
Specs	56	44
Surveys	46	54
Report Preparation	86	14

Table 9.4 Factors Reducing Corps Technical Capability

	Factors	Percent Rating Factor in Importance 1st	2nd	3rd	Total N	(%)
1.	Lack professional qualifications	5	4	4	116	5
2.	Lack motivation to perform at effective level	15	10	10	258	11
3.	Heavy workload prevents good performance	10	9	8	262	11
4.	Poor organization of functional elements	5	8	8	158	7
5.	Lack of use of state-of-the-art technology	4	5	5	110	5
6.	Loss of experienced personnel	20	14	11	332	15
7.	Manpower reductions	6	11	8	181	8
8.	Lack of adequate training	2	5	8	116	5
9.	Demoralized workforce from diminished workloads	4	6	5	107	5
10.	Demoralized workforce from increased contracting out of technical work	7	9	10	196	9
11.	Workload does not justify capability in some areas	2	3	5	72	3
12.	Internal regulations inhibit good work	3	5	8	113	5
13.	Other factors	17	10	8	259	11
	N =	739	735	725	2280	100

9.4 Important Project Features

Table 9.5 indicates a large array of project features the Corps constructs. While there is no doubt wide regional variation in the importance of project features, several were judged to be "important" or "very important" by the majority of the engineers and scientists workforce. These features include bank protection, channels, dams and embankments, levees and spillways. It is likely that such features are important in almost every district.

9.4.1 General Level of Experience in Important Project Features

A tabulation of the level of design experience of respondents for those project features rated as "important" or "very important" is shown in Table 9.6. Those features rated as important but which have low levels of on-board experience can be identified in this table. As can be seen for those individuals rating embankment protection as important or very important in their districts or divisions 57 percent had less than 1 year of experience in the design of this feature. As the table shows, over 50 percent of the engineers and scientists workforce have no experience in the design of bridges, rock-filled dams, marine structures, power generation facilities, hospitals, shore protection structures, airfield pavements, hardened structures, fish and wildlife facilities, aerospace facilities or industrial structures. The percentage of experienced engineers and scientists (those with greater than 3 years of design of the feature) ranges from a low of 5 percent for hardened structures to a high of 37 percent for channels.

9.4.2 Experience in Important Project Features by Technical Function Area

Table 9.7 continues the analysis presented above by identifying the experience level of individuals in the various technical function areas in designing project features identified as being important to their districts or divisions. As the table shows, many technical function areas have little experience in designing important project features. Some of these areas are no doubt appropriate. For example, it would not be expected that an individual in the architectural section would have had much, if any, experience in designing bank protection structures. Other gaps in experience, however, appear more severe. For example, the lack of anyone with experience in hardened structures or industrial facilities. These latter experience gaps would appear to be potential problem areas of corporate technical capability.

9.5 A/E Contracting Work

Respondents were asked about their perception of the amount of Engineering Division technical work being done by A/E contracts. Overall an estimate that less than 50 percent was being done by A/E was made by 65 percent of the engineers and scientists workforce, while 35 percent estimated that their districts or divisions contracted out more than 50 percent of technical Engineering Division work. The majority of respondents felt that contracting out technical work to A/Es has increased in the past few years (67 percent), and that this trend would continue to increase over the next several years (63 percent).

Table 9.5 Importance of Project Features

Project Feature	Importance (%) Very	Important	Average	Rarely	Unimp.	N
Bank Protection	19	37	34	8	3	689
Bridges	3	17	38	35	8	676
Buildings	22	18	21	20	20	665
Channels	26	39	26	7	2	691
Conduits	8	26	32	23	12	661
Dams, Concrete	22	23	19	19	17	687
Dams and Embank	31	34	23	9	3	701
Dams, Rock-fill	15	23	25	22	14	675
Coffer Dams	15	28	35	16	6	663
Jetties	15	31	29	16	9	663
Levees	28	35	23	9	5	692
Locks	22	23	16	14	25	692
Marine Structure	8	16	25	22	29	624
Power Generation	13	22	24	23	19	668
Pump Stations	14	26	32	21	7	692
Rec. Sites	12	36	35	13	4	718
Site Planning	14	34	42	8	3	696
Spillways	19	37	31	10	4	699
Outlet Works	18	35	32	11	4	677
Water Supply	7	19	38	22	14	673
Road, Railroads	5	23	42	19	11	680
Hospitals	9	17	18	16	41	640
Shore Protection	10	26	27	17	20	667
Floodwalls	17	25	29	20	9	666
Airfield Pavement	5	19	18	18	41	640
Hardened Structure	5	14	20	24	37	497
Fish & Wildlife Fac.	4	20	37	28	12	642
Aerospace	7	15	15	13	50	604
Industrial	4	9	18	19	51	571

Table 9.6 Level of Experience of Engineers and Scientists in Design of Project Features Rated as Important or Very Important in District or Division

Project Feature	Level of Experience (%)				
	0	1-11 mos	1-3 yrs	>3 yrs	N
Bank Protection	33	24	16	27	429
Bridges	56	18	10	16	194
Buildings	34	16	16	36	334
Channels	21	20	23	37	486
Conduits	39	25	17	20	288
Dams, Concrete	42	20	14	24	358
Dams & Embank	31	21	17	32	491
Dams, Rock-fill	52	21	10	17	319
Jetties	48	18	13	21	369
Levees	34	18	20	30	482
Locks	45	17	17	21	359
Marine Structures	65	13	11	12	255
Power Generation	58	15	11	16	303
Pump Stations	35	23	17	25	328
Recreation Sites	32	20	21	28	364
Site Planning	39	20	13	28	373
Spillways	39	20	17	24	430
Outlet Works	37	20	20	24	416
Water Supply	45	19	12	24	236
Roads, Railroads	42	13	15	29	248
Hospitals	62	13	9	16	260
Shore Protection	51	20	15	14	314
Floodwalls	43	23	14	20	353
Airfield Pavement	69	14	11	7	251
Hardened Structures	78	11	6	5	321
Fish and Wildlife Fac.	57	17	14	12	249
Aero-Space	69	11	8	12	262
Industrial	66	6	6	22	262

Table 9.7 Experience in Design of Important Project Features by Technical Function Area

Organization	Hydraulics	Hydrologic Engr.	Electrical	General Civil	Mechanical	Surveys	Sanitary	Geo-Tech	Structural	Architectural	Cost Engr.	Specs.	Proj. Mgmt.	Instrumentation	Coastal Engr.	Materials Engr.	Tech. Support
	Technical Function Area																
Bank Protection		*	*	*	*				*	*		*	*				*
Bridges	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*
Buildings	*	*		*			*	*						*	*	*	*
Channels			*		*		*		*	*				*			*
Conduits			*	*	*	*	*	*	*	*		*	*	*	*	*	*
Dams, Concrete	*	*	*	*	*		*			*	*	*	*	*	*		*
Dams & Embank.		*	*		*		*		*	*		*		*	*	*	
Dams, Rock Fill	*	*	*	*	*	*	*		*	*		*	*	*	*	*	*
Jetties, Groins		*	*	*	*		*	*	*	*	*	*	*	*			
Levees			*		*				*	*				*			*
Locks	*	*	*	*			*			*	*		*	*	*		*
Marine Struts	*	*	*	*	*		*	*	*	*	*	*	*	*		*	*
Power Generation	*	*		*		*	*	*	*	*			*	*	*	*	*
Pump Sta.	*	*	*	*					*	*	*	*		*			*
Rec. Sites	*	*	*		*				*					*	*	*	
Site Plan.	*	*	*		*		*	*	*		*			*	*	*	*
Spillways			*	*	*		*			*			*	*	*	*	*
Outlet Works			*		*					*		*	*	*	*	*	*
Water Supply Wastewater Plants	*	*		*	*			*	*	*				*	*	*	*
Roads/RRs	*	*	*		*		*		*	*			*	*	*	*	*
Hospitals	*	*	*	*		*	*	*	*		*	*	*	*	*	*	*
Shore Protection	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*
Flood Walls	*	*	*	*	*		*		*	*	*	*	*	*			*
Airfield Pavement	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*
Hardened Structures	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
F & W Fac.	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	
Aerospace	*	*		*	*	*	*	*	*		*	*	*	*	*	*	*
Industrial	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

* Indicates 50% of the workforce in Specialists area answering question had less than 1 year of experience in design of project feature.

9.6 Organizational Progressiveness

Questions III-132 to III-141 asked respondents about the frequency that state-of-the-art methods and techniques for technical design and management were used. These questions were combined into an index ranging in value from 12 to 48. The average value of this index was 27. High and low ordinal categories were created for this variable on the basis of scores beyond ± 1 standard deviation from the mean score. On the basis of this procedure the following districts and divisions were perceived by respondents as highly progressive: LMVD, MRD, NCD, Buffalo; while the following were perceived to be nonprogressive: POD, SPD, Little Rock, MED and OCE.

APPENDIX I

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APPENDIX A:

Questionnaire

APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

22 MAR 1982

DAEN-CWE-BU

SUBJECT: Engineer and Scientist Questionnaire, Study of Technical Capability of the Engineering Function

TO: Selected Engineering Division Engineers and Scientists

1. Your name has been selected as part of a random sample of 1,000 engineers and scientists within the Engineering Divisions to receive and complete the attached questionnaire on the technical capability of the engineering function. Responses will remain anonymous, and will be used to produce statistical summaries.

2. The questionnaire is an integral part of an OCE study entitled: "Maintaining the Technical Capability of the Engineering Function". By technical capability we mean; the ability to design and manage the production of technical engineering designs and engineering services in a professional, timely, and cost-effective manner. The questionnaire seeks your candid opinions and feelings on the strong and weak areas of technical capability within the Corps; problems affecting the maintenance of technical capability, and; opportunities for enhancing this capability. Although this survey is currently addressed to a random sample of engineers and scientists in the Engineering Divisions, the questionnaire may serve as a basis for a future Corps-wide survey of all engineers and scientists.

3. Most of the questions are "closed-ended" and require only a few moments to answer. Pre-tests have indicated that you should spend about 1 to 1 1/2 hours in completing the questionnaire. There are no right or wrong answers. Please answer the questions carefully and honestly, but do not spend too much time on any one question. Do not sign the questionnaire.

4. Results of this questionnaire along with results of other parts of the OCE Study will be assessed and a final report presented to the Chief of Engineers by 1 July 1982. Questionnaire results should be available to those interested by 1 June 1982.

DAEN-CWE-BU

SUBJECT: Engineer and Scientist Questionnaire, Study of Technical Capability of the Engineering Function

5. To assure the most valid reflection of the views of our engineer/scientist workforce, your voluntary participation is needed. Under a separate letter, I have requested all Commanders and Engineering Division Chiefs to fully support this survey. Please return the completed questionnaire in the inclosed self-addressed postage paid envelope no later than 2 April 1982.

FOR THE COMMANDER:

1 Incl
as

E. R. HEIBERG III
Major General, USA
Director of Civil Works

PLEASE RETURN THIS QUESTIONNAIRE TO:

INSTITUTE FOR WATER RESOURCES
KINGMAN BLDG.
FT. BELVOIR, VA 22060
ATTN: SURVEY RESEARCH

I. GENERAL OPINIONS OF THE CORPS TECHNICAL CAPABILITY

Based on your experience, how do you feel about the following statements? (Please check one box per line)

(6-14)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
I-1. The capability of the Corps of Engineers to both design engineering structures and manage the production of engineering designs has been decreasing in the last 5 years.	15 [ ]	43 [ ]	13 [ ]	25 [ ]	4 [ ]
I-2. More and more capable engineers and scientists are leaving the Corps.	24 [ ]	46 [ ]	13 [ ]	17 [ ]	1 [ ]
I-3. The Corps is in danger of losing its claim to being a pre-eminent engineering organization.	16 [ ]	42 [ ]	14 [ ]	25 [ ]	2 [ ]
I-4. The Corps of Engineers has the correct level of technical capability for meeting its most likely future roles.	2 [ ]	27 [ ]	18 [ ]	47 [ ]	6 [ ]
I-5. Technical engineering and scientific capability in Corps engineering divisions is diminishing.	12 [ ]	55 [ ]	10 [ ]	21 [ ]	2 [ ]
I-6. Engineering divisions are properly maintaining the engineering capability already "on-board".	1 [ ]	24 [ ]	13 [ ]	53 [ ]	9 [ ]
I-7. Generally it is the most technically capable designers who seem to leave the Corps.	13 [ ]	42 [ ]	21 [ ]	23 [ ]	1 [ ]
I-8. On balance, the Corps recruits and attracts the most highly competent engineers and scientists.	1 [ ]	14 [ ]	16 [ ]	53 [ ]	16 [ ]
I-9. The failure to attract and recruit highly capable technical professionals is likely to be a major problem facing engineering divisions in the next several years.	27 [ ]	55 [ ]	8 [ ]	10 [ ]	1 [ ]

(15-20)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
I-10. The Corps administrative and management overhead seems to constantly increase, while we do less and less actual engineering designs.	38 [ ]	47 [ ]	10 [ ]	5 [ ]	1 [ ]
I-11. The Corps is currently able to meet most National Mobilization Requirements.	2 [ ]	37 [ ]	42 [ ]	15 [ ]	3 [ ]
I-12. More and more engineering design work is being done outside engineering division.	18 [ ]	57 [ ]	15 [ ]	12 [ ]	0 [ ]
I-13. Generally, administrative support functions within the Corps are providing timely and quality service.	2 [ ]	29 [ ]	13 [ ]	40 [ ]	17 [ ]
I-14. The Corps has too much training for managers.	5 [ ]	15 [ ]	30 [ ]	41 [ ]	9 [ ]
I-15. The Corps has enough training for technical specialists.	2 [ ]	33 [ ]	9 [ ]	43 [ ]	13 [ ]

II. FACTORS IMPACTING THE CORPS TECHNICAL CAPABILITY

Based on your own experience, how do you feel about the following statements? (Please check one box per question)

(21-29)		Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
II-1.	Diminishing new Civil works starts will have no appreciable effect on technical engineering and scientific capability in engineering divisions of the Corps.	1 [ ]	8 [ ]	7 [ ]	58 [ ]	27 [ ]
II-2.	Reduced manpower has caused reduced technical engineering and scientific capability in engineering divisions	14 [ ]	56 [ ]	10 [ ]	18 [ ]	1 [ ]
II-3.	Engineering Divisions are losing technical capability due to increased demands within the Corps for non-engineering and scientific services.	10 [ ]	42 [ ]	23 [ ]	25 [ ]	1 [ ]
II-4.	Too many top technical engineers and scientists become managers in engineering divisions.	10 [ ]	30 [ ]	19 [ ]	35 [ ]	5 [ ]
II-5.	There are less and less technical engineering challenges for an engineer/scientists in the Corps engineering divisions.	13 [ ]	42 [ ]	9 [ ]	31 [ ]	5 [ ]
II-6.	In general, I feel pay scales for engineers/scientists in the Corps <u>are</u> competitive with private industry.	2 [ ]	24 [ ]	5 [ ]	41 [ ]	29 [ ]
II-7.	In general, I think an engineer/scientist in the Corps can rise as fast as one in other Federal Agencies.	4 [ ]	39 [ ]	13 [ ]	31 [ ]	13 [ ]
II-8.	Experience shows that increasing the outside contract work with A/E firms has little or no effect on in-house technical engineering and scientific capability of the Corps Engineering Divisions.	1 [ ]	15 [ ]	10 [ ]	47 [ ]	27 [ ]
II-9.	I feel that the future of Civil Works functions of the Corps looks "bleak".	22 [ ]	52 [ ]	13 [ ]	12 [ ]	1 [ ]

(30-35)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
II-10. Too much duplication of technical engineering and scientific skill exists among District, Division & OCE levels within the Corps.	11 [ ]	32 [ ]	20 [ ]	35 [ ]	3 [ ]
II-11. Too much fragmentation of engineering design and scientific analysis responsibility exists within the Corps' District and Divisions.	10 [ ]	38 [ ]	21 [ ]	29 [ ]	2 [ ]
II-12. Since surveying, mapping and general lab work are valuable training grounds for young engineers, they should be done "in house" by scientific and engineering professionals within the Corps.	13 [ ]	53 [ ]	14 [ ]	18 [ ]	3 [ ]
II-13. Less than 50% of the engineers and/or scientists in my engineering division do actual engineering design related work.	10 [ ]	38 [ ]	11 [ ]	36 [ ]	5 [ ]
II-14. Benefits for a technically capable engineer or scientist within the Corps are as good as those in private industry.	2 [ ]	24 [ ]	7 [ ]	45 [ ]	22 [ ]
II-15. There is a lack of upward mobility within Engineering Division for technically capable engineers/scientists.	20 [ ]	50 [ ]	10 [ ]	20 [ ]	1 [ ]

III. IN-HOUSE TECHNICAL CAPABILITY

The following questions ask for your personal perceptions and opinions of the "In-House" technical capability of the Engineering Division in the district and/or division where you work. Since a good cross-section of Corps opinions is needed, please answer regardless of whether you are a recent or longer term employee.

A) General Level of Technical Capability

Below you are asked to provide two ratings:

First, please rate, according to your perception, the capability of your engineering division in providing technical functions important to Corps missions. Please rate the capability only in those functional areas in which you have some personal knowledge or experience. If a particular technical area is not in your Engineering Division leave that item blank. Please rate according to the following scale.

(5) Outstanding: The quality of outputs measured in terms of timeliness and technical excellence could not be duplicated by other government agencies or private firms with this functional capability.

(4) Above Average: The quality of outputs measured as above is better than what most other organizations with the functional capability could provide.

(3) Average: Quality of outputs is about the same as what other organizations could provide.

(2) Below Average: Quality of outputs is less than what could be provided by most other organizations with the functional capability.

(1) Poor: Quality of outputs is such that any other organization with the functional capability could be expected to perform in a superior manner.

Second, please indicate your opinion on whether the engineering division's capability to provide the technical services listed is likely to increase or decrease or not to change in the next 2-3 years. Once again, please answer only for those areas where you have some personal knowledge or experience.

TECHNICAL FUNCTION	(36-52) Capability Level: Out-standing 5	Above Average 4	Average 3	Below Average 2	Poor 1	(55-71) Likely Change: Increase 1	Decrease 2	No Change 3
III-16. Hydraulics	17 [ ]	46 [ ]	29 [ ]	7 [ ]	2 [ ]	11 [ ]	38 [ ]	52 [ ]
III-17. Hydrologic Engr.	18 [ ]	49 [ ]	27 [ ]	5 [ ]	1 [ ]	7 [ ]	36 [ ]	55 [ ]
III-18. Electrical Engr.	5 [ ]	36 [ ]	40 [ ]	15 [ ]	4 [ ]	12 [ ]	31 [ ]	57 [ ]
III-19. General Civil Engr.	6 [ ]	44 [ ]	44 [ ]	5 [ ]	1 [ ]	11 [ ]	37 [ ]	52 [ ]

TECHNICAL FUNCTION	Capability Level: Outstanding 5	Above Average 4	Average 3	Below Average 2	Poor 1	Likely Change: Increase 1	Decrease 2	No Change 3
III-20. Mech. Engr.	[6]	[36]	[43]	[11]	[4]	[12]	[31]	[57]
III-21. Surveying/ Mapping	[4]	[34]	[42]	[15]	[4]	[5]	[41]	[54]
III-22. Sanitary Engr.	[3]	[29]	[43]	[19]	[7]	[13]	[25]	[62]
III-23. Geotechnical	[14]	[53]	[25]	[7]	[1]	[12]	[33]	[55]
III-24. Structural	[10]	[46]	[36]	[8]	[1]	[12]	[31]	[58]
III-25. Architectural	[4]	[25]	[48]	[19]	[4]	[17]	[25]	[59]
III-26. Cost Engr.	[8]	[39]	[40]	[11]	[3]	[12]	[27]	[61]
III-27. Specs.	[6]	[40]	[42]	[10]	[2]	[13]	[23]	[64]
III-28. Project Mgmt.	[6]	[34]	[43]	[14]	[4]	[20]	[25]	[55]
III-29. Instrumentation	[5]	[37]	[44]	[9]	[6]	[13]	[28]	[60]
III-30. Coastal Engineering	[11]	[39]	[33]	[13]	[5]	[14]	[24]	[63]
III-31. Materials Engineering	[3]	[36]	[43]	[14]	[4]	[11]	[31]	[59]
III-32. Technical Support	[4]	[33]	[46]	[14]	[3]	[9]	[35]	[56]

(53-54)
III-33. Please circle the one Technical Function, of those listed above, which comes closest to your specialty area.

B) Historical Level of Technical Capability

In your opinion, has the capability of your engineering divisions to provide the technical services listed increased, decreased or remained about the same over the last few years? (Please check one box per line for those areas in which you have some personal knowledge or experience.)
(2/6-7)

	Capability over Last few years: Increased 1	Decreased 2	Remained about Same 3
III-34. Hydraulics	[25]	[26]	[48]
III-35. Hydrologic Engr.	[26]	[24]	[51]

(8-22)	Capability over Last few years Increased 1	Decreased 2	Remained about Same 3
III-36. Electrical Engr.	[ ]13	[ ]34	[ ]52
III-37. Civil Engr.	[ ]15	[ ]32	[ ]53
III-38. Mech. Engr.	[ ]16	[ ]35	[ ]51
III-39. Surveying/Mapping	[ ]11	[ ]46	[ ]44
III-40. Sanitary Engr.	[ ]21	[ ]26	[ ]53
III-41. Geotechnical	[ ]26	[ ]25	[ ]50
III-42. Structural	[ ]17	[ ]33	[ ]50
III-43. Architectural	[ ]16	[ ]28	[ ]55
III-44. Cost Engr.	[ ]16	[ ]21	[ ]63
III-45. Specs	[ ]15	[ ]24	[ ]62
III-46. Project Management	[ ]29	[ ]26	[ ]45
III-47. Instrumentation	[ ]24	[ ]22	[ ]54
III-48. Coastal Engineering	[ ]21	[ ]17	[ ]62
III-49 Materials Engineering	[ ]14	[ ]27	[ ]60
III-50. Technical Support	[ ]14	[ ]33	[ ]54

C) Factors Which Reduce Technical Capability

From among the factors listed below, please rank the three most important factors which contribute to reducing the Corps' Technical capability (i.e. its ability to design engineer structures and to manage the production of technical engineering designs). Please select the item and place its number in the appropriate box below.

III-51. First in Importance _____ (23-24)

III-52. Second in Importance _____ (25-26)

III-53. Third in Importance _____ (27-28)

Factors List

1. Personnel lack adequate professional qualifications to perform at an acceptable level.

2. Personnel lack motivation to perform at an effective level.

3. Heavy workload prevents good performance.

4. Organization of division functional elements hinders good performance.

5. State-of-the-art technology not being used.

6. Experienced personnel have left and have reduced the organization's capability.

7. Manpower reductions have prevented the hiring of qualified personnel.

8. Personnel have not received adequate training in the particular functional area.

9. Personnel have been demoralized by diminished workloads.

10. Personnel have been demoralized by increased contracting out of technical work.

11. Workload does not justify capability in certain areas.

12. Internal regulations inhibit good technical work.

13. Other _____

14. Other _____

D) Important Project Features

Below we have listed major project features which the Corps constructs. Since a good cross-section of Corps opinion is needed, please answer regardless of whether you work in Military, or Civil Works, or, you are a recent or longer term employee. Indicate your perception of the current importance of each feature to Your Districts and/or Division's engineering efforts using the following scale: (Please check only one box per line.)

Very important: (5)	=	Feature is among the most frequently occurring structure in Corps projects. More engineering funds are spent for the design of this feature than for any other structure.
Important: (4)	=	Feature is a frequently occurring structure in projects. Design of this feature accounts for more engineering costs than most other structures.
Average: (3)	=	Feature occurs about as frequently as most other structures. Engineering costs of this feature are about the same as for other structure.
Rarely Important: (2)	=	Feature is seldom found in projects. Engineering design cost of structures is less than that of other features.
Unimportant: (1)	=	Feature never found in District projects.
Don't Know: (9)	=	Have no idea of importance of feature compared with other structures listed.

Project Feature (29-52)	Very Important 5	Important 4	Average 3	Rarely Important 2	Unimportant 1	Don't Know 9
III-54. Bank Protection	[ ]17	[ ]34	[ ]31	[ ]7	[ ]3	[ ]6
III-55. Bridges	[ ]3	[ ]15	[ ]34	[ ]31	[ ]7	[ ]8
III-56. Buildings (Post Offices, Barracks, Mess Halls, etc)	[ ]20	[ ]16	[ ]19	[ ]17	[ ]17	[ ]9
III-57. Channels	[ ]24	[ ]36	[ ]24	[ ]6	[ ]2	[ ]6
III-58. Conduits and Tunnels	[ ]7	[ ]23	[ ]28	[ ]20	[ ]10	[ ]9
III-59. Dams, Concrete	[ ]20	[ ]21	[ ]18	[ ]17	[ ]16	[ ]7
III-60. Dams, and Embankment	[ ]29	[ ]32	[ ]22	[ ]8	[ ]3	[ ]5
III-61. Coffer Dams	[ ]14	[ ]24	[ ]31	[ ]14	[ ]5	[ ]9
III-62. Dams, Rock-Fill	[ ]14	[ ]21	[ ]22	[ ]20	[ ]13	[ ]8
III-63. Jetties/Groins/Dikes	[ ]30	[ ]27	[ ]26	[ ]14	[ ]8	[ ]9
III-64. Levees	[ ]26	[ ]33	[ ]21	[ ]8	[ ]5	[ ]6
III-65. Locks	[ ]21	[ ]21	[ ]15	[ ]13	[ ]23	[ ]6
III-66. Marine Structures	[ ]6	[ ]14	[ ]21	[ ]18	[ ]24	[ ]14
III-67. Power generation & transmission	[ ]11	[ ]20	[ ]22	[ ]20	[ ]17	[ ]10
III-68. Pump Stations	[ ]13	[ ]24	[ ]30	[ ]19	[ ]6	[ ]7
III-69. Recreation Sites/Facilities	[ ]12	[ ]34	[ ]34	[ ]13	[ ]3	[ ]3
III-70. Site Planning & Development	[ ]13	[ ]31	[ ]39	[ ]7	[ ]2	[ ]6
III-71. Spillway	[ ]18	[ ]34	[ ]29	[ ]9	[ ]4	[ ]6
III-72. Outlet Works	[ ]16	[ ]31	[ ]29	[ ]10	[ ]4	[ ]8
III-73. Water Supply & Wastewater Treatment	[ ]6	[ ]17	[ ]34	[ ]20	[ ]13	[ ]8
III-74. Roads and Railroads	[ ]4	[ ]21	[ ]38	[ ]18	[ ]10	[ ]8
III-75. Hospitals	[ ]8	[ ]14	[ ]16	[ ]13	[ ]35	[ ]13
III-76. Shore Protection	[ ]9	[ ]24	[ ]24	[ ]15	[ ]18	[ ]10
III-77. Flood Walls	[ ]15	[ ]22	[ ]26	[ ]18	[ ]8	[ ]10

Project Feature (53-59)	Very Important 5	Important 4	Average 3	Rarely Important 2	Unimportant 1	Don't Know 9
III-78. Airfield Pavement	[ ]5	[ ]16	[ ]15	[ ]15	[ ]35	[ ]13
III-79. Hardened Structures	[ ]4	[ ]9	[ ]13	[ ]16	[ ]25	[ ]30
III-80. Fish & Wildlife Facilities	[ ]4	[ ]17	[ ]31	[ ]23	[ ]10	[ ]12
III-81. Aerospace/Missile Facilities	[ ]6	[ ]12	[ ]12	[ ]10	[ ]41	[ ]18
III-82. Industrial	[ ]3	[ ]7	[ ]17	[ ]14	[ ]40	[ ]20
III-83. Others _____	[ ]3	[ ]2	[ ]2	[ ]-	[ ]-	[ ]4
III-84. Others _____	[ ]1	[ ]1	[ ]1	[ ]-	[ ]-	[ ]4

D) Technical Area Experience

1) How much experience do you have with the following project features? (Please check one box per line)

(3/6-18)

Project Feature	0 0	1-6 mos. 1	7-11 mos. 2	1-3 yrs. 3	> 5 years 4
III-85. Bank Protection	[ ]37	[ ]19	[ ]5	[ ]16	[ ]23
III-86. Bridges	[ ]58	[ ]17	[ ]5	[ ]10	[ ]11
III-87. Buildings (e.g. Post Offices, Barracks)	[ ]49	[ ]11	[ ]6	[ ]12	[ ]22
III-88. Channels	[ ]30	[ ]14	[ ]7	[ ]20	[ ]30
III-89. Conduits & Tunnels	[ ]50	[ ]16	[ ]6	[ ]15	[ ]13
III-90. Dams/Concrete	[ ]57	[ ]13	[ ]4	[ ]11	[ ]15
III-91. Dams & Embankments	[ ]36	[ ]15	[ ]6	[ ]16	[ ]26
III-92. Coffer Dams/Rock-Fill	[ ]58	[ ]15	[ ]5	[ ]9	[ ]13
III-93. Jetties/Groins/Dikes	[ ]57	[ ]14	[ ]5	[ ]10	[ ]13
III-94. Levees	[ ]41	[ ]12	[ ]6	[ ]17	[ ]24
III-95. Locks	[ ]63	[ ]7	[ ]4	[ ]11	[ ]12
III-96. Marine Structures	[ ]73	[ ]10	[ ]5	[ ]8	[ ]6
III-97. Power Generation & Transmission	[ ]67	[ ]10	[ ]4	[ ]9	[ ]10

(3/19-35)

Project Feature	0 0	1-6 mos. 1	7-11 mos. 2	1-3 yrs. 3	> 5 years 4
III-98. Pump Stations	[ ]43	[ ]18	[ ]7	[ ]15	[ ]17
III-99. Recreation Sites/ Facilities	[ ]33	[ ]17	[ ]8	[ ]19	[ ]22
III-100. Site Planning Development	[ ]44	[ ]15	[ ]6	[ ]13	[ ]23
III-101. Spillway	[ ]45	[ ]15	[ ]7	[ ]15	[ ]18
III-102. Outlet Works	[ ]45	[ ]14	[ ]7	[ ]17	[ ]17
III-103. Water Supply and Wastewater Treatment Plants	[ ]53	[ ]15	[ ]7	[ ]12	[ ]13
III-104. Roads and Railroads	[ ]45	[ ]13	[ ]8	[ ]14	[ ]17
III-105. Hospitals	[ ]77	[ ]6	[ ]3	[ ]6	[ ]7
III-106. Shore Protection	[ ]62	[ ]13	[ ]5	[ ]10	[ ]10
III-107. Floodwalls	[ ]53	[ ]14	[ ]7	[ ]13	[ ]13
III-108. Airfield Pavement	[ ]77	[ ]8	[ ]3	[ ]7	[ ]5
III-109. Hardened Structures	[ ]81	[ ]6	[ ]4	[ ]5	[ ]4
III-110. Fish & Wildlife Facilities	[ ]62	[ ]13	[ ]7	[ ]10	[ ]3
III-111. AeroSpace/Missile Facilities	[ ]79	[ ]5	[ ]3	[ ]6	[ ]6
III-112. Industrial	[ ]75	[ ]4	[ ]2	[ ]1	[ ]12
III-113. Others _____	[ ]72	[ ]-	[ ]1	[ ]3	[ ]4
III-114. Others _____	[ ]97	[ ]-	[ ]-	[ ]1	[ ]2

2) In which of the following technical speciality areas do you consider yourself capable to at least the journeyman level?

(36)	Yes I am capable at journeyman level 1	NO I am not capable at journeyman level 2
III-115. H & H (Hydraulics & Hydrologic Engr.)	[ ]43	[ ]53

(37-47)	Yes I am capable at journeyman level 1	NO I am not capable at journeyman level 2
III-116. Structural Engineering	[ ] 40	[ ] 55
III-117. Electrical Engineering	[ ] 9	[ ] 85
III-118. Mechanical Engineering	[ ] 14	[ ] 80
III-119. Geo-Technical	[ ] 28	[ ] 65
III-120. Sanitary Engineering	[ ] 27	[ ] 66
III-121. Water Quality	[ ] 24	[ ] 70
III-122. Architecture	[ ] 14	[ ] 77
III-123. Cost Estimation	[ ] 53	[ ] 43
III-124. Specs	[ ] 56	[ ] 40
III-125. Surveying/Mapping	[ ] 46	[ ] 54
III-126. Preparation of Reports (eg. DM's, EIS, etc.)	[ ] 86	[ ] 14

F) A/E Contracting Work

The following questions address your perceptions and opinions of the percentage of technical work done by private A/E contracts. The answers are only your best estimate, based on your experience, so do not spend a long time on the questions. Please answer regardless of whether you are a recent or longer term Corps employee.

(48-49)

III-127. In your opinion, what is the percentage of Engineering Division technical work being done by private A/E contracts in your district? (Please check only one box)

0%	1	[ ] 0
1-25%	34	[ ] 1
26-50%	31	[ ] 2
51-75%	22	[ ] 3
76-99%	13	[ ] 4
100%	–	[ ] 5

III-128. In your opinion, has the percentage of Engineering Division technical work done by private A/E contracts increased, decreased or remmained about the same over the last few years? (Please check only one box)

Increased	67	[ ] 1
Decreased	7	[ ] 2
Remained About the Same	25	[ ] 3

(50)

III-129. In your opinion, will the percentage of Corps work done by private A/E contracts increase, decrease, or remain about the same during the next 2-3 years. (Please check only one box).

Increase	63 [ ] 1
Decrease	11 [ ] 2
Remain About the Same	26 [ ] 3

G. Use of New Methods and Techniques

In your experience, how often does your division and/or district use the following techniques?

(51-62)	Very Often 4	Sometimes 3	Rarely 2	Never 1	Don't Know 9
III-130. Mathematical Modeling	30 [ ]	32 [ ]	14 [ ]	6 [ ]	17 [ ]
III-131. Computer Aided Design	47 [ ]	31 [ ]	11 [ ]	5 [ ]	6 [ ]
III-132. Flow Charting of Jobs	41 [ ]	35 [ ]	10 [ ]	4 [ ]	12 [ ]
III-133. Video Conferencing	3 [ ]	12 [ ]	21 [ ]	34 [ ]	30 [ ]
III-134. Computer Conferencing	2 [ ]	11 [ ]	17 [ ]	26 [ ]	42 [ ]
III-135. Inertial Surveying	1 [ ]	7 [ ]	10 [ ]	14 [ ]	65 [ ]
III-136. At-Desk Micro Computers	21 [ ]	22 [ ]	16 [ ]	21 [ ]	14 [ ]
III-137. Interactive Graphics	13 [ ]	25 [ ]	18 [ ]	15 [ ]	28 [ ]
III-138. Computerized Drafting	10 [ ]	19 [ ]	17 [ ]	36 [ ]	16 [ ]
III-139. Management Information Systems	16 [ ]	23 [ ]	16 [ ]	7 [ ]	37 [ ]
III-140. Landsat and/or other Satellite Data	10 [ ]	28 [ ]	16 [ ]	13 [ ]	32 [ ]
III-141. Computerized Network Analysis	13 [ ]	23 [ ]	14 [ ]	9 [ ]	30 [ ]

IV. INDIVIDUAL TECHNICAL CAPABILITY

The following questions address your own professional and technical background.

A) Experience in the Corps

How much experience do you have in each of the following functions listed below:

(63-68)		None 0	<1 Yr. 1	1-3 yrs. 2	3-5 yrs. 3	5-10 yrs. 4	>10 yrs. 5
IV-1.	Engineering Design in Civil Works	17 [ ]	9 [ ]	17 [ ]	10 [ ]	16 [ ]	31 [ ]
IV-2.	Engineering Design in Military Programs	53 [ ]	12 [ ]	11 [ ]	5 [ ]	7 [ ]	12 [ ]
IV-3.	Project Planning	29 [ ]	18 [ ]	16 [ ]	11 [ ]	13 [ ]	13 [ ]
IV-4.	Construction Management	61 [ ]	20 [ ]	11 [ ]	3 [ ]	3 [ ]	3 [ ]
IV-5.	Operations and Maintenance (O&M)	60 [ ]	17 [ ]	11 [ ]	4 [ ]	4 [ ]	4 [ ]
IV-6.	Research and Development (R&D)	76 [ ]	11 [ ]	6 [ ]	2 [ ]	3 [ ]	2 [ ]

B) Educational and Professional Background

(69-70)

IV-7. How much formal education have you completed?

Did not graduate from college	1 [ ]	1
B.A. or B.S. degree	41 [ ]	2
Some graduate work	30 [ ]	3
M.A. or M.S. degree	27 [ ]	4
Ph.D. degree	1 [ ]	5

IV-8. What was your overall undergraduate grade point average?

B+ or better	25 [ ]	1
B	24 [ ]	2
B-	33 [ ]	3
C+ or lower	18 [ ]	4
Did not attend college	– [ ]	5

(71-76)

IV-9. Which best describes your undergraduate class standing at graduation? (Please check the one most appropriate box.)

Top Ten Percent	17	[ ] 1
Top Third	33	[ ] 2
Middle Third	40	[ ] 3
Lower Third	9	[ ] 4
Did not graduate from college	1	[ ] 5

IV-10. What was your undergraduate grade point average in your major field courses?

B+ or better	44	[ ] 1
B	31	[ ] 2
B-	20	[ ] 3
C+ or lower	5	[ ] 4
Did not attend college	–	[ ] 5

C) Interest in Technical/Professional Matters

IV-11. How many books on engineering did you read in the past year?

None	33	[ ] 0
1-3	49	[ ] 1
4-7	13	[ ] 2
8-11	3	[ ] 3
12 or more	3	[ ] 4

IV-12. How many professional journals do you read regularly?

None	14	[ ] 0
1 or 2	47	[ ] 1
3 or 4	29	[ ] 2
5 or 6	6	[ ] 3
7 or more	4	[ ] 4

IV-13. How many books on business or management did you read in the past year?

None	50	[ ] 0
1-3	41	[ ] 1
4-7	7	[ ] 2
8-11	1	[ ] 3
12 or more	1	[ ] 4

IV-14. At your own expense, how many business or management courses have you taken during the last 5 years, outside of Corps- or government-sponsored courses?

None	73	[ ] 0
1	12	[ ] 1
2	7	[ ] 2
3	3	[ ] 3
4 or more	5	[ ] 4

(77-80)

IV-15. At your own expense, how many social science sociology, psychology, anthropology, etc. courses have you taken during the last 5 years, outside of Corps- or government sponsored courses?

None	85	[ ] 0
1	8	[ ] 1
2	3	[ ] 2
3	2	[ ] 3
4 or more	2	[ ] 4

IV-16. During the last 5 years, how many Corps- or government-sponsored business or management courses have you completed?

None	39	[ ] 0
1 or 2	33	[ ] 1
3 or 4	19	[ ] 2
5 or more	8	[ ] 3

IV-17. During the last 5 years, how many Corps- or government-sponsored courses have you taken in the social sciences (sociology, psychology, anthropology, etc.)?

None	87	[ ] 0
1 or 2	10	[ ] 1
3 or 4	2	[ ] 2
5 or more	1	[ ] 3

IV-18. Among your peers, do you have a reputation for initiating improvements, developing new ideas or methods, or in other ways pushing for innovations?

Not really	7	[ ] 0
To a small extent	15	[ ] 1
Somewhat, but not especially	28	[ ] 2
Yes, definitely	43	[ ] 3
I don't know	7	[ ] 4

(4/6-7)

IV-19. How often do your peers ask you for technical advice on a problem?

Very often	24	[ ] 5
Often	37	[ ] 4
Sometimes	34	[ ] 3
Rarely	4	[ ] 2
Very rarely	2	[ ] 1

V-20. How would you describe your technical competence inside your specialty area?

Very complete mastery	13	[ ] 5
Stronger than average working knowledge	55	[ ] 4
Average working knowledge for a specialist	19	[ ] 3
Knowledgeable, but could use more experience	9	[ ] 2
Still learning	3	[ ] 1

(8-13)

IV-21. How often are you asked for assistance in your technical/professional area by people and/or projects outside the Corps?

Very often	9 [ ] 5
Often	20 [ ] 4
Sometimes	39 [ ] 3
Rarely	15 [ ] 2
Very rarely	16 [ ] 1

IV-22. Rate your ability, compared to your peers, to apply comprehensive technical knowledge to the solution of complex problems.

Outstanding	1 [ ] 5
Exceptionally competent	5 [ ] 4
Fully competent	58 [ ] 3
Marginally competent	27 [ ] 2
Somewhat weak	8 [ ] 1

IV-23. Among your peers, do you have a reputation for superior skill in solving technical problems?

Not really	10 [ ] 1
Somewhat, but not especially	33 [ ] 2
Yes, definitely	44 [ ] 3
I don't know	12 [ ] 4

IV-24. How many years of experience have you had in a foreign country or overseas with the Corps of Engineers?

None	87 [ ] 0
1	4 [ ] 1
2	2 [ ] 2
3	1 [ ] 3
4 or more	4 [ ] 4

IV-25. How many different positions have you occupied for at least 1 year during the last 10 years?

1	31 [ ] 1
2	30 [ ] 2
3	24 [ ] 3
4 or more	14 [ ] 4

IV-26. How many patents have you received? _____

0 - 99%
≥1 - 1%

(14-21)

IV-27. Please name 1 to 5 major innovations that have occurred in your technical specialty field(s) in the last 5 years.

1. _____ 0 - 35%
2. _____ 1 - 19
3. _____ 2 - 16
4. _____ 3 - 12
5. _____ 4 - 8
5 - 10

D) Continuing Professional Development

IV-28. How long has it been since you last attended a professional development course?

1 Year	55	[ ] 1
2 Years	16	[ ] 2
3 Years	9	[ ] 3
4 Years	3	[ ] 4
5 Years	3	[ ] 5
Over 5 years	12	[ ] 6

	0 hrs. 1	1-8 hrs. 2	9-40 hrs. 3	>40 hrs. 4
IV-29. About how many hours outside regular work hours during the last year did you spend reading technical/professional literature in your field?	[ ]7	[ ]24	[ ]36	[ ]33
IV-30. About how many hours during the last year did you spend attending technical or professional meetings?	[ ]23	[ ]31	[ ]32	[ ]14
IV-31. About how many hours of self-study are required to carry out your job in the past year?	[ ]26	[ ]18	[ ]32	[ ]22
IV-32. How many hours of Corps-sponsored technical courses or seminars did you attend during the past year?	[ ]30	[ ]10	[ ]32	[ ]27
IV-33. About how many hours of attendance at non-credit continuing education courses, seminars or workshops conducted by a college, university, professional society or other organization did you have in the past year?	[ ]61	[ ]16	[ ]15	[ ]7
IV-34. How many credit hours of college or university courses did you take during the past year?	[ ]82	[ ]12	[ ]4	[ ]1

(22-28)

	0 hrs. 1	1-8 hrs. 2	9-40 hrs. 3	>40 hrs. 4
IV-35. How many hours of lectures, seminars or other formal instruction did you give during the last year?	[ ]24	[ ]16	[ ]6	[ ]4

IV-36. How many technical or professional papers have you published in the last five years?

0	87	[ ] 0
1 Paper	7	[ ] 1
2-3 Papers	4	[ ] 2
More than 3 papers	2	[ ] 3

IV-37. When you were in college, in comparison with others in your classes, to what extent did you question your professors on subject matter?

Considerably more often than average	12	[ ] 5
Somewhat more	18	[ ] 4
About average	51	[ ] 3
Somewhat less	14	[ ] 2
Considerably less	5	[ ] 1
Did not go to college	_	[ ] 9

IV-38. How well informed are you in fields other than your own?

Very well	10	[ ] 4
Well	32	[ ] 3
Fairly well	47	[ ] 2
Not very well informed	10	[ ] 1

IV-39. How often do you tend to suggest somewhat "wild ideas" during a discussion with your associates?

Frequently	11	[ ] 4
Occasionally	52	[ ] 3
Rarely	32	[ ] 2
Never	5	[ ] 1

IV-40. How persistent or aggressive are you in gaining recognition for your ideas?

Very persistent	7	[ ] 4
Quite persistent	28	[ ] 3
Somewhat persistent	47	[ ] 2
I'm not very persistent	12	[ ] 1

IV-41. In your past job activities, how often have you been an advocate for some new procedure?

Seldom, if ever	9	[ ] 4
Occasionally	51	[ ] 3
Often	30	[ ] 2
Very often	9	[ ] 1

(29-34)

IV-42. How much field experience (construction or O & M) have you had?

None	30	[ ] 0
Less than 1 year	28	[ ] 1
1-3 years	24	[ ] 2
3-10 years	12	[ ] 3
>10 years	5	[ ] 4

IV-43. In how many districts have you had 1 or more years of experience?

None	17	[ ] 0
1	65	[ ] 1
2	15	[ ] 2
3	3	[ ] 3
≥ 4	1	[ ] 4

IV-44. How many years of experience have you had at the Division office level?

None	82	[ ] 0
1	3	[ ] 1
2	2	[ ] 2
3	2	[ ] 3
≥ 4	11	[ ] 4

IV-45. How many years of experience have you had at the OCE level?

None	98	[ ] 0
1	1	[ ] 1
2	1	[ ] 2
3	–	[ ] 3
≥ 4	1	[ ] 4

IV-46. How many professional societies do you belong to?

None	38	[ ] 0
1	36	[ ] 1
2	18	[ ] 2
3	6	[ ] 3
≥4	2	[ ] 4

IV-47. How many offices in professional societies have you held in the last 5 years?

None	88	[ ] 0
1	8	[ ] 1
2	3	[ ] 2
3	1	[ ] 3
≥4	1	[ ] 4

F) Professional Activity

Please check the appropriate box after each question.

(35-50)		Yes 1	No 0
IV-48.	Have you offered your services to the local professional engineering or scientific society for assistance in career guidance for young people in your community's schools?	17 [ ]	83 [ ]
IV-49.	Are you familiar with the Engineering Pipeline or other such scientific high school clubs?	14 [ ]	86 [ ]
IV-50.	Have you ever done anything to assist such clubs in their work?	12 [ ]	89 [ ]
IV-51.	Have you served in any capacity in your community to improve the level of teaching of science and mathematics in the secondary schools?	11 [ ]	89 [ ]
IV-52.	Have you visited, or had other contacts with you college in the past five years to see whether they are inculcating professional climate in engineering and scientific employment practices?	32 [ ]	68 [ ]
IV-53.	Can you enumerate five criteria necessary to create a professional climate in engineering and scientific employment practices?	59 [ ]	41 [ ]
IV-54.	Have you done anything to determine whether your employer meets these criteria?	27 [ ]	73 [ ]
IV-55.	Do you know the name of the United States Congressman for your District?	92 [ ]	9 [ ]
IV-56.	Have you ever discussed with him, or written to him, about legislative matters affecting the engineering or scientific professions?	13 [ ]	87 [ ]
IV-57.	Are you currently a registered Professional (Engineer or other)?	61 [ ]	24 [ ]
IV-58.	Do you designate your professional status by use of the Suffix "P.E., M.A., Ph.D.," etc.?	25 [ ]	75 [ ]
IV-59.	Do you encourage other engineers and scientists to become registered—particularly the younger men/women?	76 [ ]	24 [ ]
IV-60.	Have you spoken before any formal group outside the Corps on professional subjects within the past two years?	25 [ ]	75 [ ]
IV-61.	Have you ever had published an article on a professional subject in local, state or national publication?	14 [ ]	86 [ ]
IV-62.	Have you ever participated in the national observation of Engineers' Week through any related activity?	38 [ ]	62 [ ]
IV-63.	Do you attempt to keep up, either through reading or attendance at meetings, with the professional advances in your field?	86 [ ]	14 [ ]

(51-57)		Yes 1	No 0
IV-64.	Are you familiar with the Engineering Code of Ethics?	79 [ ]	21 [ ]
IV-65.	Do you have a copy available?	48 [ ]	52 [ ]
IV-66.	Are you familiar with the classic "The Second Mile" by Dr. Wickenden?	6 [ ]	94 [ ]
IV-67.	Do you know what the Second Mile refers to?	12 [ ]	88 [ ]
IV-68.	Are you a member of an engineering or other professional society?	63 [ ]	37 [ ]
IV-69.	Have you ever protested the misuse of the term "scientific", engineer", and/or "engineering" by newspapers (or other media) so as to enhance the image of the engineer as a professional man?	17 [ ]	83 [ ]
IV-70.	Have you really examined the advantages, both tangible and intangible, to promoting engineering and scientific professionalism through your professional society?	24 [ ]	76 [ ]

V. VIEWS ON POSSIBLE FUTURE ACTIONS

The following questions address possible future actions or policies which the Corps could initiate. Please share your best judgement on what you think the impact of the following actions would be on the U.S. Army Corps of Engineers. (Please circle the most appropriate number in each line.)

(58-68)

	Highly Positive				No Impact				Highly Negative
	9	8	7	6	5	4	3	2	1
V-1. The establishment of separate technical and managerial career track ladders within the Corps.	25	17	24	9	8	5	6	2	4
V-2. Unionize engineers/scientists within the Corps.	4	4	9	6	10	10	12	15	30
V-3. Establish some form of collective bargaining procedure throughout the Corps.	5	7	15	12	11	8	10	11	18
V-4. Institute a mandatory periodic relicensing procedure for engineers/scientists.	6	6	16	12	18	11	12	8	12
V-5. Design and administer special engineer competency tests for Corps engineers.	5	6	16	13	14	9	13	10	14
V-6. Formally enforce the ASCE Code of Ethics.	10	8	18	14	32	5	3	3	4
V-7. Adopt stricter rules and better incentives for registration of engineers/scientists working in the Corps.	14	17	24	14	13	3	4	2	3
V-8. Delegate more responsibility to the younger Corps engineers/scientists	10	14	33	17	11	8	4	7	1
V-9. Establish centers of competence in various specialities throughout the Corps to consolidate technical expertise.	12	16	24	15	10	7	7	4	5
V-10. Achieve 100 % professional registration for Corps engineers/scientists	14	11	19	17	21	5	4	4	4
V-11. Increase the percentage of design work done by outside A/E firms.	1	1	2	3	6	12	21	21	34

(69-80)

	Highly Positive				No Impact				Highly Negative
	9	8	7	6	5	4	3	2	1
V-12. Institute Total Design Centers throughout the Corps.	5	9	20	14	14	10	11	5	7
V-13. Institute a Matrix Management System.	2	2	10	14	36	9	6	3	4
V-14. Combine Civil and Military construction.	10	12	19	13	12	7	7	6	7
V-15. Combine construction and engineering divisions.	9	9	15	11	13	10	13	8	8
V-16. Require all engineering design work to be done in Engineering Division.	17	17	21	10	11	9	7	3	3
V-17. Encourage Corps Districts to seek work from agencies outside the Corps.	17	17	24	11	10	6	5	4	3
V-18. Encourage more Inter-District sharing of work.	16	16	28	17	11	5	2	2	1
V-19. Begin a major program of "on the job" training throughout the Corps	16	19	30	17	12	2	1	1	–
V-20. Look at applying new concepts of organization and management to the Corps.	22	20	24	14	11	1	2	–	–
V-21. Eliminate the SKAP System.	20	7	9	12	30	6	4	2	1
V-22. Institute an Incentive pay system.	17	15	22	12	12	4	5	4	4
V-23. Contract out a large portion of administrative-suport functions	8	5	9	12	10	11	17	13	12

VI. ATTITUDES ABOUT MANAGEMENT

How do you feel about the following statements?

		Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
	(5/6-17)					
VI-1.	Engineers/scientists in the Corps are promoted to managers primarily because of demonstrated technical competence and not managerial skill	19 [ ]	38 [ ]	10 [ ]	26 [ ]	4 [ ]
VI-2.	To achieve high management positions within the Corps, you must be a civil engineer	19 [ ]	33 [ ]	9 [ ]	30 [ ]	6 [ ]
VI-3.	Technical specialists become managers because they have no other avenue for grade-increase within the Corps	41 [ ]	41 [ ]	8 [ ]	7 [ ]	1 [ ]
VI-4.	Corps managers at my District are at least as effective as those in private industry	8 [ ]	34 [ ]	18 [ ]	29 [ ]	7 [ ]
VI-5.	Morale among engineering/scientific Corps employees in engineering division is high	1 [ ]	16 [ ]	11 [ ]	49 [ ]	20 [ ]
VI-6.	The Corps of Engineers is a highly innovative engineering organization	4 [ ]	25 [ ]	14 [ ]	44 [ ]	11 [ ]
VI-7.	Top leadership in the Corps is no longer of the recognized national and technical professional stature as in the past	7 [ ]	39 [ ]	29 [ ]	20 [ ]	2 [ ]
VI-8.	Overall, the management of the Corps is competent and effective	3 [ ]	42 [ ]	16 [ ]	32 [ ]	5 [ ]
VI-9.	I take most of the risks and blame for failures while my boss takes credits for successes	7 [ ]	15 [ ]	18 [ ]	50 [ ]	9 [ ]
VI-10.	I am always given a "pat-on-the-back" for a good job by my boss	4 [ ]	32 [ ]	12 [ ]	40 [ ]	10 [ ]
VI-11.	I frequently seem to have a great deal of responsibility but little authority	16 [ ]	44 [ ]	11 [ ]	26 [ ]	1 [ ]
VI-12.	In my opinion, Corps managers are sufficiently trained in how to give a performance appraisal	1 [ ]	25 [ ]	17 [ ]	41 [ ]	13 [ ]

(18-29)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
VI-13. In my opinion, Corps managers do not fully realize the impact of performance appraisals on employees	11 [ ]	40 [ ]	22 [ ]	25 [ ]	1 [ ]
VI-14. The Corps' merit-pay system is effectively and fairly managed	– [ ]	6 [ ]	33 [ ]	38 [ ]	22 [ ]
VI-15. The Corps' training system is effective in recognizing training needs	1 [ ]	33 [ ]	12 [ ]	38 [ ]	15 [ ]
VI-16. The Corp's Research and Development (R&D) program is working on the right research subjects.	– [ ]	19 [ ]	64 [ ]	12 [ ]	4 [ ]

VI-17. How often are you given feedback from your supervisor about your job performance?

Never	7 [ ]	1
Seldom	33 [ ]	2
Sometimes	39 [ ]	3
Frequently	19 [ ]	4
Very frequently	2 [ ]	5

VI-18. How often do you and your supervisor get together to set your personal performance objectives?

Never	19 [ ]	1
Seldom	38 [ ]	2
Sometimes	34 [ ]	3
Frequently	8 [ ]	4
Very frequently	1 [ ]	5

VI-19. Are you given the freedom you need to do your job well?

Never	2 [ ]	1
Seldom	6 [ ]	2
Sometimes	22 [ ]	3
Frequently	41 [ ]	4
Very frequently	29 [ ]	5

VI-20. Please rank the following factors in their order of importance to performing as a Project Manager (e.g., place 1 in the box of the most important factor, 2 in the box of second in importance, etc.)

	Your Rank (1 to 5)				
	1	2	3	4	5
Being a top technical scientist/engineer	14	14	15	13	42
Being a good motivator of other people	24	15	22	25	13
Being a good delegator of tasks	7	19	21	24	27
Being a good coordinator	32	21	19	19	8
Being a good communicator	24	29	20	17	8

(30-38)

VI-21. In your opinion, how effective is the Corps' Research and Development (R&D) program in enhancing the Corps' technical capability? (Please check one box)

It is highly effective	4 [ ]	4
It is effective	27 [ ]	3
It is only marginally effective	25 [ ]	2
It has no effect	5 [ ]	1
I have no opinion	38 [ ]	9

VI-22. How important are the following sources of research results to your own technical and professional work in the Corps of Engineers?

	Not Important 1	Rarely Important 2	Important 3	Very Important 4
Private Industry Research	10 [ ]	29 [ ]	44 [ ]	14 [ ]
Corps Laboratory Research	7 [ ]	22 [ ]	50 [ ]	18 [ ]
Academic/University Research	9 [ ]	31 [ ]	45 [ ]	13 [ ]
Professional Society Research	14 [ ]	37 [ ]	39 [ ]	8 [ ]
Non-Corps Federal Laboratory Research	16 [ ]	47 [ ]	31 [ ]	4 [ ]
Non-Profit Institution Research	26 [ ]	46 [ ]	21 [ ]	2 [ ]
Non-Federal, State or other Public Research	22 [ ]	48 [ ]	24 [ ]	3 [ ]
Foreign Laboratory Research	37 [ ]	44 [ ]	15 [ ]	2 [ ]

VII. VIEWS ON BASIC "TRADE-OFFS" FOR THE WATER RESOURCES FIELD

The following statements describe several basic "trade-offs". Please circle the number that best describes how you personally feel about each trade-off.

(39-47)

VII-1. Generally speaking, I prefer a policy which:

	7	6	5	4	3	2	1	
	3	9	17	28	22	12	7	
Emphasizes preserving nature for its own sake								Emphasizes using nature to produce the goods we use

VII-2. Assuming that we have to settle for somewhat higher unemployment in order to protect the environment, is it more important to protect jobs or to protect the environment?

	7	6	5	4	3	2	1	
	6	12	21	26	19	10	6	
More important to protect jobs								More important to protect environment

VII-3. The effective long-range solution of environmental problems depends on:

	7	6	5	4	3	2	1	
	6	10	12	24	14	18	15	
Changing lifestyle								Developing better technology

VII-4. In general I favor a Natural Resource Policy which:

	7	6	5	4	3	2	1	
	23	35	22	12	4	2	2	
Emphasizes foresight and planning for public good								Relies on supply and demand market to maximize public good

VII-5. In general I favor a Natural Resource Policy which:

	7	6	5	4	3	2	1	
	2	5	10	23	30	20	9	
Encourages people to remake their environment to suit their needs.								Encourages people to adapt to to their natural environment

VII-6. Generally, I believe that:

	7	6	5	4	3	2	1	
	2	6	15	37	26	9	7	
Economic growth is more important than protecting the environment								Protecting the environment is more important than economic growth

	Strongly Agree 5	Agree 4	No Opinion 3	Disgree 2	Strongly Disagree 1
VII-7. Overall, the U.S. is experiencing a shortage of engineers.	13 [ ]	48 [ ]	13 [ ]	23 [ ]	3 [ ]
VII-8. Engineers are not well understood by the general public.	17 [ ]	15 [ ]	10 [ ]	12 [ ]	1 [ ]
VII-9. Engineering education in the U.S. is excellent and has few problems.	2 [ ]	38 [ ]	18 [ ]	39 [ ]	3 [ ]

VIII. EXPECTATIONS OF LEAVING CORPS

(48-54)

VIII-1. Are you actively seeking employment outside the Corps? (Please check the appropriate box.)

Yes, definitely	7 [ ]	1
I am somewhat actively seeking	12 [ ]	2
I have thought about it but am not actively seeking	53 [ ]	3
Definitely am not seeking employment	28 [ ]	4

VIII-2. Which of the following best describes where you see yourself in 5 years? (Please check only the most appropriate box.)

Retired	12 [ ]	1
In private industry	14 [ ]	2
Consulting practice	6 [ ]	3
With another Federal agency	7 [ ]	4
With a state, local or other public agency	2 [ ]	5
With the Corps	52 [ ]	6
I haven't thought about it and cannot answer	5 [ ]	9

VIII-3. In your opinion, how significant are the following factors in the decision of professional colleages to leave the Corps?

	Not Important 1	Slightly Important 2	Important 3	Extremely Important 4
Lack of technical challenges	11 [ ]	29 [ ]	45 [ ]	14 [ ]
Level of pay	3 [ ]	13 [ ]	45 [ ]	38 [ ]
Fringe benefits	16 [ ]	39 [ ]	36 [ ]	17 [ ]
Better opportunities for advancement	1 [ ]	6 [ ]	44 [ ]	47 [ ]
Lack of job security	40 [ ]	29 [ ]	18 [ ]	11 [ ]

(55-57)

VIII-4. Check the ONE of the following which best tells how you feel about changing your job:

I would quit this job at once if I could get anything else to do.	1 [ ]	1
I would take almost any other job in which I could earn as much as I am earning now.	2 [ ]	2
I would like to change both my job and my occupation.	8 [ ]	3
I would like to exchange my present job for another job in the same career field.	18 [ ]	4
I am not eager to change my job, but I would do so if I could get a better job.	51 [ ]	5
I cannot think of any jobs for which I would exchange.	11 [ ]	6
I would not exchange my job for any other.	6 [ ]	7

VIII-5. In how many years will you reach retirement eligibility? (Please check the most appropriate box

Within 2 years	10 [ ]	1
2 - 5 years	7 [ ]	2
5 - 10 years	14 [ ]	3
> 10 years	65 [ ]	4

VIII-6. If I had an "early out", I would leave my current job. (Please check one box only.)

Strongly Agree	14 [ ]	5
Agree	27 [ ]	4
No Opinion	26 [ ]	3
Disagree	21 [ ]	2
Strongly Disagree	13 [ ]	1

IX. JOB BEHAVIOR

(58-67)

IX-1. On the average, how much of your on-the-job time is spent on the following activities?

Supervise staff	12 %
In-house design of engineering solutions to problems	31 %
Coordinating in-house, with other agencies, public and private groups	19 %
Managing A/E contract work	10 %
Review and evaluate	23 %
	100% Total

X. RECRUITMENT/ADVANCEMENT/MOBILITY

How important were each of the following factors in your choosing to join the Corps? (Please check one box per line)

(68-75)		Not Important 1	Slightly Important 2	Important 3	Extremely Important 4
X-1.	Technical Challenge	7 [ ]	20 [ ]	55 [ ]	16 [ ]
X-2.	Level of Pay	10 [ ]	27 [ ]	51 [ ]	7 [ ]
X-3.	Fringe Benefits	8 [ ]	25 [ ]	51 [ ]	13 [ ]
X-4.	Public Service Opportunity	27 [ ]	34 [ ]	20 [ ]	5 [ ]
X-5.	Job Security	9 [ ]	20 [ ]	49 [ ]	19 [ ]
X-6.	Geographic Location	7 [ ]	13 [ ]	42 [ ]	36 [ ]
X-7.	Opportunity for Professional/Career Advancement	5 [ ]	18 [ ]	59 [ ]	16 [ ]
X-8.	Lack of Alternatives for Employment	52 [ ]	22 [ ]	14 [ ]	10 [ ]

How important are each of the following factors in your choosing to <u>remain</u> with the Corps? (Please check one box per line)

(6/6-13)		Not Important 1	Slightly Important 2	Important 3	Extremely Important 4
X-9.	Technical Challenge	7 [ ]	20 [ ]	49 [ ]	21 [ ]
X-10.	Level of Pay	5 [ ]	18 [ ]	55 [ ]	20 [ ]
X-11.	Fringe Benefits	5 [ ]	22 [ ]	51 [ ]	19 [ ]
X-12.	Public Service Opportunity	35 [ ]	34 [ ]	23 [ ]	4 [ ]
X-13.	Job Security	8 [ ]	19 [ ]	48 [ ]	21 [ ]
X-14.	Geographic Location	8 [ ]	13 [ ]	43 [ ]	34 [ ]
X-15.	Opportunity for Pprof./career advancement	8 [ ]	24 [ ]	44 [ ]	21 [ ]
X-16.	Lack of Alternatives for Employment	47 [ ]	23 [ ]	18 [ ]	7 [ ]

How important are each of the following factors in the promotion of engineer/scientists to senior ranks in Corps? (Please check only one box per line)

(14-25)	Not Important 1	Slightly Important 2	Important 3	Extremely Important 4
X-17. Technical Proficiency in Engineering	5 [ ]	22 [ ]	53 [ ]	17 [ ]
X-18. Administrative Skills in Project Management	4 [ ]	20 [ ]	51 [ ]	22 [ ]
X-19. Human Relations Skills in Project Management	8 [ ]	27 [ ]	41 [ ]	23 [ ]
X-20. Visibility of Projects to which assigned	5 [ ]	22 [ ]	44 [ ]	26 [ ]
X-21. Engineering/Scientific field of Specialization	8 [ ]	32 [ ]	46 [ ]	11 [ ]

X-22. Do you think your present job is preparing you to assume future positions of greater responsibility?

Definitely no	10 [ ]	1
Probably no	21 [ ]	2
Undecided	11 [ ]	3
Probably yes	38 [ ]	4
Definitely yes	19 [ ]	5

How do you feel about the following statements?

	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
X-23. My pay is clearly related to my job performance	2 [ ]	23 [ ]	9 [ ]	46 [ ]	19 [ ]
X-24. I am satisfied with the Corp's SKAP system	– [ ]	13 [ ]	37 [ ]	28 [ ]	19 [ ]
X-25. The Corps provides me with sufficient training opportunities to remain technically competent	4 [ ]	47 [ ]	6 [ ]	31 [ ]	11 [ ]
X-26. The promotion system is fair, that is the right and most qualified person is generally promoted	1 [ ]	26 [ ]	12 [ ]	41 [ ]	18 [ ]
X-27. The SKAP system is effective in my career planning	1 [ ]	10 [ ]	40 [ ]	32 [ ]	16 [ ]
X-28. The SKAP system currently works to the advantage of general managers rather than technical engineers/ scientists	8 [ ]	24 [ ]	55 [ ]	9 [ ]	2 [ ]

(26-31)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
X-29. I would find a technical engineer/ scientist career path useful in my own career planning	15 [ ]	47 [ ]	21 [ ]	13 [ ]	1 [ ]
X-30. If promotion opportunities were available for non-supervisory technical engineers/scientists at GS 13, 14, and 15 levels, I would establish career goals in a technical rather than managerial area	32 [ ]	36 [ ]	11 [ ]	15 [ ]	3 [ ]

X-31. I am given credit for work I have done.

Never	2 [ ]	1
Infrequently	17 [ ]	2
Sometimes	32 [ ]	3
Most of the time	43 [ ]	4
All of the time	5 [ ]	5

X-32. In my organizational unit I have the opportunity to influence major decisions.

To a considerable degree.	19 [ ]	1
To some degree.	36 [ ]	2
Somewhat.	22 [ ]	3
I don't have much influence	18 [ ]	4
I have no influence whatsoever	3 [ ]	5

X-33. Compared to individuals with similar education and training working in industry, my salary is:

Considerably higher.	1 [ ]	1
Somewhat higher.	6 [ ]	2
About the same.	30 [ ]	3
Somewhat lower.	46 [ ]	4
Considerably lower.	15 [ ]	5

Please express your feelings on the following statements by placing ONE check per answer.

X-34. In your kind of work, if a person tries to change his usual way of doing things, how does it generally turn out?

Usually turns out worse; the tried and true methods work best in my work.	15 [ ]	1
Usually doesn't make much difference.	36 [ ]	2
Usually turns out better; our methods need improvement.	46 [ ]	3

(32-36)

X-35. Some people prefer doing a job in pretty much the same way because this way they can count on always doing a good job. Others like to go out of their way in order to think up new ways of doing things. How is it with you on your job?

I always prefer doing things pretty much in the same way.	1 [ ] 1
I mostly prefer doing things pretty much in the same way.	53 [ ] 2
I mostly prefer doing things in new and different ways.	41 [ ] 3
I always prefer doing things in new and different ways.	3 [ ] 4

X-36. How often do you try out, on your own, a better or faster way of doing something on the job?

Once a week or more often	5 [ ] 5
Two or three times a month	35 [ ] 4
About once a month	30 [ ] 3
Every few months	20 [ ] 2
Rarely or never	8 [ ] 1

X-37. How often do you get chances to try out your own ideas on your job, either before or after checking with your supervisor?

Several times a week or more	30 [ ] 5
About once a week	27 [ ] 4
Several times a month	24 [ ] 3
About once a month	7 [ ] 2
Less than once a month	9 [ ] 1

X-38. In my kind of job, it's usually better to let your supervisor worry about new or better ways of doing things.

Strongly agree	31 [ ] 5
Mostly agree	46 [ ] 4
No opinion	10 [ ] 3
Mostly disagree	8 [ ] 2
Strongly disagree	2 [ ] 1

X-39. How many times in the past year have you suggested to your supervisor a different or better way of doing something on the job?

Never had occasion to do this during the past year	7 [ ] 1
Once or twice	23 [ ] 2
About three times	19 [ ] 3
About five times	20 [ ] 4
Six to ten times	16 [ ] 5
More than ten times had occasion to do this during the past year	12 [ ] 6

(37-39)

X-40. In your opinion, how effective are the following Corps training programs in enhancing the Corps' technical capability? (i.e. the Corps' ability to design engineering structures and to manage the production of technical engineering design.)

	Highly Effective 4	Effective 3	Marginally Effective 2	No Effect 1	No Opinion 9
Rotational Career Interns	13 [ ]	37 [ ]	25 [ ]	11 [ ]	11 [ ]
Long Term Professional Training	17 [ ]	41 [ ]	24 [ ]	5 [ ]	10 [ ]
Short Term Professional Training	15 [ ]	47 [ ]	24 [ ]	4 [ ]	8 [ ]

XI. IDENTIFICATION WITH THE CORPS

How do you feel about the following statements?

	(40-45)	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
XI-1.	If I had the decision to make again, I would come to work for the Corps.	14 [ ]	55 [ ]	11 [ ]	15 [ ]	4 [ ]
XI-2.	Management and employees are committed to the same goals in the Corps.	3 [ ]	38 [ ]	16 [ ]	36 [ ]	7 [ ]
XI-3.	I am inclined to defend the Corps when I hear someone criticizing it.	22 [ ]	66 [ ]	6 [ ]	5 [ ]	1 [ ]
XI-4.	I identify myself as an employee of the Corps when stating my profession in conversation.	24 [ ]	65 [ ]	4 [ ]	6 [ ]	1 [ ]
XI-5.	I would advise other engineers that the Corps is a professionally rewarding organization for which to work.	9 [ ]	46 [ ]	20 [ ]	20 [ ]	4 [ ]
XI-6.	I am inclined to frequently wear and/or use Corps symbols such as lapel pins, buttons, buckles, etc.	4 [ ]	16 [ ]	16 [ ]	43 [ ]	20 [ ]

XII. JOB SATISFACTION

A) Factors in Satisfaction

Listed below are different kinds of opportunities which a job might afford. If you were to seek a job, how much importance would you personally attach to each kind of opportunity (disregarding whether or not your present job provides them)? Check the box marked:

1 if you would attach little or no importance
2 if you would attach some importance
3 if the opportunity is fairly important
4 if you would attach a great deal of importance

(46-61)		LI 1	SI 2	FI 3	GDI 4
XII-1.	To make full use of my present knowledge and skills	1[ ]	7[ ]	35[ ]	57[ ]
XII-2.	To grow and learn new knowledge and skills	-[ ]	4[ ]	36[ ]	59[ ]
XII-3.	To earn a good salary	-[ ]	6[ ]	42[ ]	51[ ]
XII-4.	To advance in administrative authority and status	10[ ]	25[ ]	37[ ]	27[ ]
XII-5.	To associate with top executives or engineer/scientists in the organization	14[ ]	29[ ]	35[ ]	21[ ]
XII-6.	To build my professional reputation	6[ ]	20[ ]	41[ ]	33[ ]
XII-7.	To work on difficult and challenging problems	1[ ]	8[ ]	43[ ]	47[ ]
XII-8.	To have freedom to carry out my own ideas	1[ ]	10[ ]	42[ ]	42[ ]
XII-9.	To contribute to broad technical knowledge in my field	7[ ]	28[ ]	41[ ]	23[ ]

How would rate the Corp's ability to help you:

		Poor 1	Fair 2	Good 3	Excellent 4
XII-10.	To make full use of your present knowledge	10[ ]	34[ ]	44[ ]	11[ ]
XII-11.	To grow and learn new knowledge and skills	13[ ]	38[ ]	40[ ]	9[ ]
XII-12.	To earn a good salary	12[ ]	44[ ]	39[ ]	4[ ]
XII-13.	To advance in administrative authority and status	23[ ]	46[ ]	27[ ]	4[ ]
XII-14.	To associate with top executives in the organization	22[ ]	42[ ]	29[ ]	6[ ]
XII-15.	To build your professional reputation	21[ ]	43[ ]	31[ ]	5[ ]
XII-16.	To work on difficult and challenging problems	10[ ]	34[ ]	45[ ]	11[ ]

(62-67)	Poor 1	Fair 2	Good 3	Excellent 4
XII-17. To have freedom to carry out your own ideas	16 [ ]	42 [ ]	40 [ ]	6 [ ]
XII-18. To contribute to broad technical knowledge in your field	23 [ ]	47 [ ]	26 [ ]	3 [ ]

XII-19. Choose the ONE of the following statements which best tells how well you like your job. Place a check mark in front of that statement.

I hate it.	1 [ ] 1
I dislike it.	2 [ ] 2
I don't like it.	5 [ ] 3
I am indifferent to it.	12 [ ] 4
I like it.	52 [ ] 5
I am enthusiastic about it.	24 [ ] 6
I love it.	4 [ ] 7

XII-20. Check one of the following to show HOW MUCH OF THE TIME you feel satisfied with your job.

All the time.	2 [ ] 1
Most of the time.	35 [ ] 2
A good deal of the time.	26 [ ] 3
About half of the time.	21 [ ] 4
Occaionally.	12 [ ] 5
Seldom.	4 [ ] 6
Never.	– [ ] 7

XII-21. Check ONE of the following to show how you think you compare with other people.

No one likes his job better than I like mine.	1 [ ] 1
I like my job much better than most people like theirs.	18 [ ] 2
I like my job better than most people like theirs.	52 [ ] 3
I like my job about as well as most people dislike theirs.	23 [ ] 4
I dislike my job more than most people dislike theirs.	3 [ ] 5
I dislike my job much more than most people dislike theirs.	1 [ ] 6

XII-22. Over the past few years working conditions have: (Please check one box)

Deteriorated significantly	17 [ ] 1
Deteriorated somewhat	31 [ ] 2
Pretty much remained the same	38 [ ] 3
Improved somewhat	13 [ ] 4

(68)

XII-23. My immediate physical working enviroment is adequate. (Please check one box)

Strongly Agree	10	[ ] 5
Agree	42	[ ] 4
No Opinion	7	[ ] 3
Disagree	24	[ ] 2
Strongly Disagree	11	[ ] 1

XIII. GENERAL INFORMATION

XIII-1. What is your age? (7/6-7) 41 years old

XIII-2. What is your current GS (GM) level? (8-9) 11.7

XIII-3. How many years have you been at your current grade level (for less than one year, put 1)? (10-11) 5

XIII-4. How many years have you been employed in public service at any governmental level? (12-13) 15

XIII-5. How many years have you been employed by the Federal Government? (14-15) 14

XIII-6. How many years have you been employed by the Corps? (16-17) 13

XIII-7. How did you enter the Corps: (18)

- College recruitment 34 [ ] 1
- Co-op 4 [ ] 2
- Transfer from another government agency 14 [ ] 3
- Open announcement 47 [ ] 4

XIII-8. My employment status before joining the Corps was: (19)

- Student 43 [ ] 1
- Worked for another government agency 19 [ ] 2
- Worked for private business 28 [ ] 3
- Worked for educational institution 2 [ ] 4
- Active military 6 [ ] 5
- Other 3 [ ] 6

XIII-9. I am now assigned to: (20)

- Civil Works 78 [ ] 1
- Military Programs 22 [ ] 2

XIII-10. How many years of experience do you have in Corps Civil Works? (21-22) 11

XIII-11. How many years of experience do you have in Corps Military Programs? (23-24) 7

XIII-12. How many years of experience do you have in private industry? (25-26) 5

XIII-13. Are you professionally licensed? (27)

- Yes 61 [ ] 1
- No 14 [ ] 2
- Currently in licensing program e.g., (EIT, NCARB, etc.) 18 [ ] 3
- Not applicable to my profession 7 [ ] 4

XIII-14. Supervisory position status: (28)

Executive who reports to Commander	1	[ ] 1
Middle Manager	9	[ ] 2
First-Line Supervisor	23	[ ] 3
No Supervisory Duties	66	[ ] 4

XIII-15. What is your occupational series (see Appendix A at back of questionnaire for number)? (29-32) _____

XIII-16. Please refer to Appendix B of this questionnaire and identify the code for the academic discipline of your highest educational degree. Enter the code in the space to the right. (33-36) _____

XIII-17. How many quality step increases have you received: (37)

None	60	[ ] 0
1	22	[ ] 1
2	6	[ ] 2
3	5	[ ] 3
≥4	7	[ ] 4

XIII-18. How many outstanding performance ratings, sustained superior performance and other awards have you received? (38)

None	45	[ ] 0
1	26	[ ] 1
2	12	[ ] 2
3	7	[ ] 3
≥4	10	[ ] 4

XIII-19. Mark the ONE box corresponding most closely to the section in which you work in Engineering Division. (39-40)

Military	5	[ ] 1
Hydrology & Hydraulics	15	[ ] 2
Program Development	1	[ ] 3
Planning	11	[ ] 4
Survey	1	[ ] 5
Relocations	1	[ ] 6
General Engineering	4	[ ] 7
Civil	5	[ ] 8
Flood Plain Management Services	1	[ ] 9
Mechanical/Electrical	8	[ ] 10
Specifications	2	[ ] 11
Estimates	3	[ ] 12
Levees & Waterways	2	[ ] 13
Coastal Engineering	2	[ ] 14
Structures	8	[ ] 15
Geotechnical	11	[ ] 16
Water Control/Quality	2	[ ] 17
Environmental/Sanitary Engineering	2	[ ] 18
Project Management	8	[ ] 19
Architectural	2	[ ] 20
Other: _____	8	[ ] 21

XIII-20. How many awards have you received from professional societies? (41)

None	88 [ ]	0
1	9 [ ]	1
2	2 [ ]	2
3	1 [ ]	3
≥4	— [ ]	4

XIII-21. Where do you work? (42)

District	84 [ ]	1
Division	15 [ ]	2
OCE	1 [ ]	3

XIII-22. If you are assigned to a District or Division please write in the name of the office (43-44) _____

XIII-23. What percentage of your workload in Engineering Division is related to military construction? (45-46) 59 %

XIII-26. How active are you in community affairs where you live? (Please check one box only) (47)

Very Active	Fairly Active	Do Very Little
1	2	3
11	38	51
[ ]	[ ]	[ ]

XIII-27. What do you think is the Corps greatest strength? (Please be specific and briefly describe only one item!)

_____

_____

XIII-28. What do you think is the Corps greatest weakness? (Please be specific and briefly describe only item!)

_____

_____

XIII-29. If you could institute one policy change in the Corps, what would it be? (Please be brief and to the point.)

_____

_____

XIII-30. Do you have any further thoughts, ideas or suggestions which you would like to share?

_____

_____

APPENDIX B:

Sample-Population Comparison

APPENDIX I:

Survey of Engineering Division Engineer and Scientist Workforce

APPENDIX B

Sample-Population Comparison

In general the sample is quite representative of the Engineering Division engineer and scientist workforce. Overall a response rate of 79 percent was achieved. Table B-1 presents a frequency distribution of response rates of each District, Division, and OCE comprising the population for this survey.

Table B-2, and Figure B-1 compare sample and population grade level distributions. As the chi-square statistic shows, the two distributions are slightly different from one another. The sample has a relatively greater proportion of GS-12s than the population and is under-represented in grades 7 and 9. As the figure illustrates, however, these differences, while statistically significant, are quite small.

The distribution of responses by organization level is compared in Table B-3. As the chi-square statistic shows the sample and population have the same proportion of individuals in Districts, Divisions, and OCE.

Table B-4 compares the distribution of engineers and scientists in the sample and population. Overall, 86 percent of the population are engineers and 14 percent are scientists. For the sample 82 percent were engineers, and 18 percent were scientists. Once again, while this difference is quite small it is statistically significant. The sample is slightly over-represented in scientists relative to engineers.

As Table B-5 shows, however, the sample and population are the same in terms of the distribution of engineering disciplines represented.

Table B-1 Response Rates by Corps Elements Surveyed

Element	Number Returned	Pct. of Sample	No. in Sample	Response Rate (%)
HND	16	2.1	22	73
LMVD	8	1.1	9	89
Memphis	18	2.4	22	82
New Orleans	29	3.9	34	85
St. Louis	23	3.1	34	68
Vicksburg	21	2.8	26	81
MRD	6	.8	8	75
Kansas City	25	3.3	34	74
Omaha	34	4.5	45	76
NED	14	1.9	15	93
Baltimore	21	2.8	27	78
Philadelphia	9	1.2	13	69
New York	6	.8	16	38
NCD	5	.7	5	100
Buffalo	8	1.1	9	89
Chicago	3	.4	10	30
Detroit	5	.7	11	45
Rock Island	10	1.3	17	59
St. Paul	25	3.3	27	93
NPD	17	2.3	23	74
Alaska	16	2.1	20	80
Portland	22	2.9	30	73
Seattle	15	2.0	29	52
Walla Walla	15	2.0	21	71
ORD	6	.8	6	100
Huntington	10	1.3	17	59
Louisville	17	2.3	19	89
Nashville	14	1.9	20	70
Pittsburg	18	2.4	19	95
POD	3	.4	24	13
SAD	4	.5	8	50
Charleston	5	.7	6	83
Jacksonville	14	1.9	16	88
Mobile	32	4.3	42	76
Savannah	25	3.3	31	81
Wilmington	11	1.5	16	69
SPD	2	.3	6	33
Los Angeles	18	2.4	29	62
Sacramento	27	3.6	37	73
San Francisco	8	1.1	13	62
SWD	7	.9	8	88
Albaquerque	9	1.2	13	69
Ft. Worth	33	4.4	48	69
Galveston	11	1.5	16	69
Little Rock	9	1.2	15	60
Tulsa	16	2.1	19	84
MED	3	.4	26	19
MED REAR	2	.3	26	19
OCE	8	1.1	11	73
UNK Division	8	1.1		
UNK District	53	7.1		
TOTAL	749	100.0	979	76

Table B-2 Comparison by Grade Level

Grade	Sample	Pop	Total
5	3	63	66
7	16	216	232
9	38	376	414
11	203	1,379	1,582
12	293	1,884	2,177
13	129	985	1,114
14	46	279	325
15	8	88	96
Total	736	5,270	6,006

X^2 = 19.6, 7df
Significant

Table B-3 Comparison by Organizational Level

	Sample	Pop	Total
DISTRICT	625	4,192	4,817
DIVISION	109	867	976
OCE	8	54	62
Total	742	5,113	5,855

X^2 = 2.8, 3 df
Not Significant

FIGURE B-1

SAMPLE-POPULATION COMPARISON

BY GRADE LEVEL

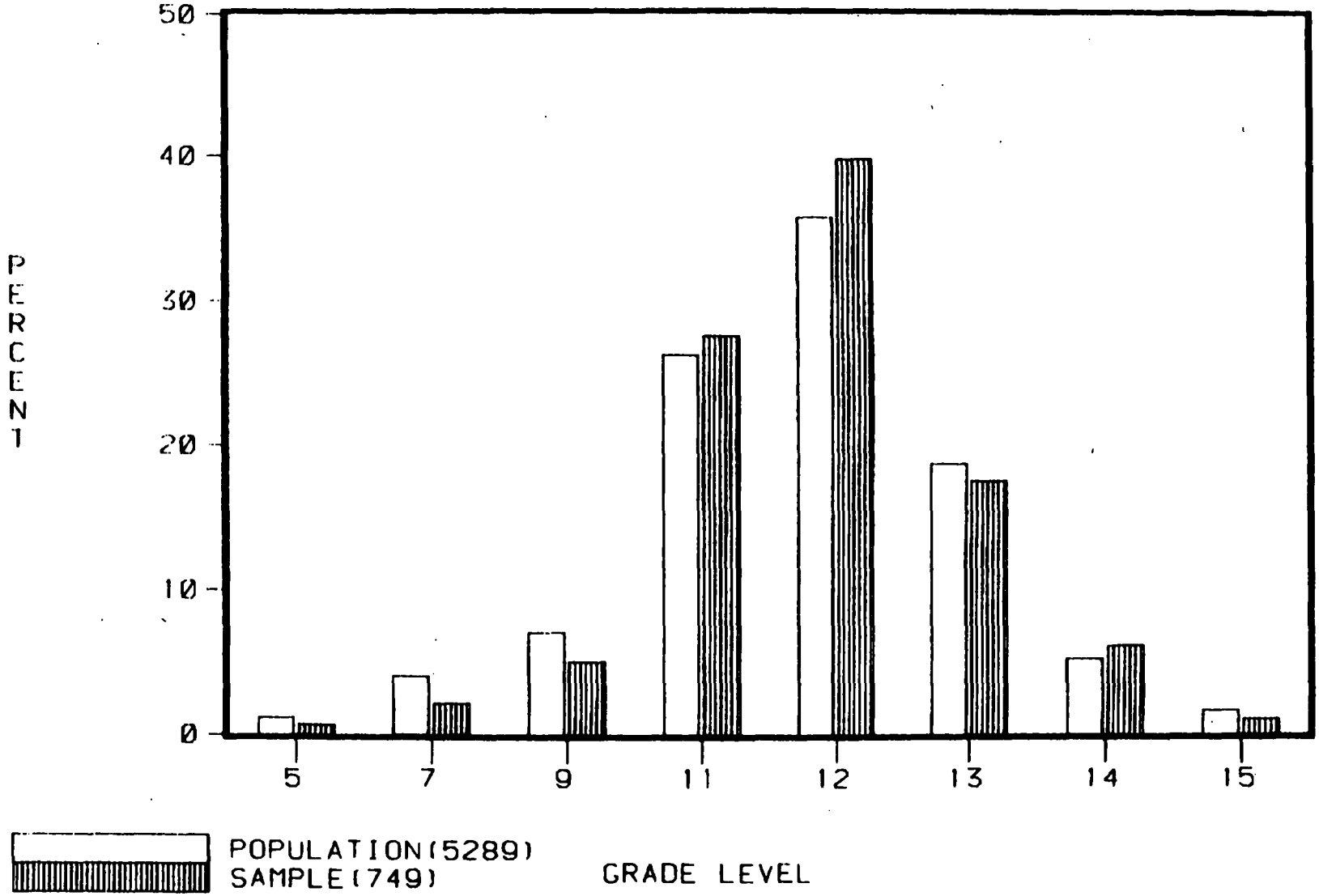

Table B-4 Comparison by Occupation

Occupation	Sample	Population	Total
Engineers	611	4,591	5,202
Scientists	138	698	836
Total	749	5,289	6,038

$X^2 = 14.8$, df = 1
Significant

Table B-5 Comparison by Engineering Discipline

Discipline	Sample	Population	Total
CEs	492	3,545	4,037
Mech.	45	330	375
Elec.	29	266	295
Other	45	450	495
Total	611	4,591	5,202

$X^2 = 5.2$, df = 3
Not Significant

APPENDIX II:

Private Industry and AE Contracting Policy

by

William N. McCormick, Jr.

and

Jack G. Starr

1. Introduction

1.1 Study Objectives

The purpose of this survey and analysis is to provide the Committee on Technical Capability Of The Engineering Function (hereafter referred to as"the Committee") reliable information in the following areas:

1. The opinion of the private Architectural and Engineering community as to the current status of the Corps' technical capability.

2. The views of typical, successful Architectual and Engineering firms concerning their efforts in maintaining technical capability.

3. The attitudes of private consulting firms toward the Corps' policies and practices in contracting out engineering services.

4. Current Corps policies and guidance concerning the use of in-house engineering forces versus contracting out, and their impacts on our ability to maintain a strong technical capability.

1.2 Background to the Study

1.2.1 Blue Ribbon Committee

The present survey and analysis is part of the work of the Committee references in 1.1 above and was accomplished by a two-person subcommittee consisting of Mr. Jack Starr, R.A., P.E., Chief of Engineering Division in the Norfolk District, and Mr. William N. McCormick, Jr., Chief of Engineering for the South Atlantic Division. Mr. McCormick served as chairman.

1.3 Plan of Action

Attached as Inclosure 1 is the Plan of Action initially adopted; however, during the course of the study, changes were necessary in order to accommodate the availability of the members and to more specifically meet the evolving requirements of the Committee. Addressing each element of the original plan, adjustments were made as follows:

(1) Subcommittee Membership - No change.

(2) Subcommittee Objectives - In addition to providing information on how the private sector is coping with the challenges of maintaining its technical capability, the subcommittee was also asked to contact the major professional societies as well as representative firms to discover how the Corps' technical capability is viewed from outside. In those same contacts, the Corps' philosophy on contracting out was to be explored.

(3) Strategy: No change.

(4) Plan of Study:

a. No change, except that the list of questions was amended to include additional items as noted in DAEN-SWE-BU letter dated 8 Jan 82 (Inclosure 2).

b. In the interest of economy and time it was decided to limit the field visits to four CONUS divisions, and contacts in the LMVD were deleted.

c. No change.

d. The St. Louis, Missouri, visit was cancelled and some others rescheduled.

e. No change in those contacted but visits were rescheduled.

f. Completion of the final report was rescheduled by the Committee to 4 June 1982.

1.4 Findings

1.4.1 Responses to Interview Questions

The specific comments and responses offered by the various societies and firms were recorded in approximate form, i.e., not verbatim and memoranda of those contacts are attached as Inclosures 3 through 9 for the record. However, in keeping with the strategy as outlined in the approved Plan of Action, Inclosure 10, it is not appropriate that these responses and comments be attributed to the originators in the final report. Accordingly, the findings are stated in summarized, narrative form in response to the questions which guided the discussions.

1. Q. Does your firm consider it difficult at this time to attract and retain good technical specialists?

Response: The segment of the private sector samples, i.e., the consulting Architect-Engineer community, appears to be having little difficulty in either attracting or retaining competent and capable engineers, architects, and other professionals. One firm indicated that in addition to the normal recruiting techniques, it uses a cash reward system. An employee who locates and refers a successful candidate is given a cash award, e.g., $500.00 for finding a good mechanical engineer. Although this survey did not include industrial, academic, or other governmental organizations, according to the professional societies, these segments may be having some difficulty. In terms of the total number of professionals employed, the consulting practice actually represents a small fraction. However, for the purposes of this study the experiences of the consulting community are perhaps most relevant.

2. Q. Based on the experiences of your firm in dealing with the Corps, how would you rate the Corps' technical expertise in comparison to that of your firm?

Architectural	Cost Engineering
Structural	Civil
Geotechnical	Landscape Architecture
Sanitary	Instrumentation
Mechanical	Specifications
Electrical	Project Management
Hydrology	Surveying and Mapping
Hydraulics	Hydraulic and Mathematical Modeling

Response: The Corps' engineering capability appears to enjoy a good reputation in most circles. It is viewed as one of the best Federal engineering organizations and is respected for its integrity and its competence. It was difficult and in some cases impossible to develop any meaningful rating by discipline for a variety of reasons, e.g., some firms have only limited contact with certain specialties, firms have varying experiences with different districts and with different projects, and quality judgments will vary according to the expertise of the rater, etc. With the above caveat, the following comments are offered:

Architectural - Not too strong and not quite as good as some other Federal agencies. Problem may be due to the way the Corps uses its architects and the fact that most of the Corps' architectural design is accomplished by contract.

Structural - Comparable to the private sector and quite good in some areas, e.g., mass concrete. Generally conservative.

Geotechnical - Very good in comparison with the private sector and better than most other Federal agencies.

Sanitary - Comparable in some areas, but not in all cases. Not as well qualified in specialized waste treatment and disposal.

Mechanical - Very good and certainly comparable in most districts.

Electrical - Very good and comparable to the private sector in most cases.

Hydrology & Hydraulics - Extremely well-qualified and better than many in the private sector.

Cost Engineering - Well qualified for the role in Federal service and for the most part comparable to the private sector. Lack of actual involvement in the contracting arena was cited as the difference, which is no reflection on the individuals.

Civil - Very well qualified and comparable in nearly all districts.

Landscape Architecture - Very little basis for comparison but apparently comparable in quality.

Instrumentation - Not comparable in most cases and perhaps this is appropriate, since most Corps work does not entail elaborate instrumentation.

Specifications - Quite comparable, and perhaps even superior in terms of meeting the Federal needs.

Project Management - Poor by commercial standards. Corps PMs are not allowed to operate with the degree of authority and freedom that is typically found in industry and neither are they held as accountable. Industry views the Corps' PM as more of a project coordinator. Most AEs interviewed feel that the Corps' PMs (and other technical people as well) lack understanding of the overall design/construction process and, as a result, have a difficult time appreciating time and effort involved, or the practical limitations of a particular circumstance.

Surveying and Mapping - Comparable in most areas, although the firms interviewed were not heavily engaged in either surveying or mapping.

Hydraulic and Mathematical Modeling - Very strong and perhaps stronger than available in most firms.

General Comment - The Corps has apparently not yet lost its reputation as a capable engineering organization, but it is now viewed as a competitor and to some extent a threat to private industry. The Corps has greatly expanded its contracting base but perhaps has not invested heavily enough in the quality of its project management.

3. & 4. Q. What is your corporate philosophy with regard to employment of technical specialists? For example, do you generally favor recruiting young graduates and provide the necessary training and development, or do you recruit at the journeyman level as needed?

Q. About how many or what percentage of your total organizational strength do you hire each year directly from colleges and universities?

Response: Responses to the question of recruiting philosophy varied according to the nature and size of the firms. The smaller firms favored recruiting at the journeyman level and avoiding attrition to the extent possible. Larger firms generally favored a mix of intake from the fresh graduate level and the journeyman level, with that mix ranging from 50/50 down to maybe one or two college level each year. For example, a 150-person firm might recruit 4 to 6 new grads per year. All firms viewed the matter in terms of economics, i.e., whatever strategy would yield the best productivity, favoring the near future more than the long term. None were interested in training young people per se - they employ for production and training and development is a by-product.

5. Q. What has been your success in retaining the better technical talents? To what do you attribute this performance?

Response: All firms interviewed claimed reasonable success in retaining good people, and almost without exception, attributed their success to corporate viability and a challenging workload. Most stated that their employees were interested in "opportunity," and that was interpreted as promotion or individual growth with the firm. Pay and other benefits were not

viewed so much as "attractors" as they were retainers, i.e., firms were quite interested in being competitive, all factors considered. Another reason given for success in recruiting and retention was selectivity. Most firms emphasized the extreme care exercised in hiring to insure that only the best risks are taken. Unsaid, but certainly a factor too is their ability to fire those who do not measure up!

6. Q. What factors do you consider important in attracting and retaining strong professional talent? What relative priority or value do you assign to each? e.g.

Pay
Fringe Benefits
Working Conditions
Challenge & Job Interest
Exposure to Professional Community
Training, Educational Opportunities
Promotion Opportunities

Response: The ratings in order of priority varied slightly, but only after number two or three. The general impression was as follows:

1. Challenge and Job Interest
2. Promotion Opportunities
3. Pay
4. Fringe Benefits
5. Working Conditions
6. Training, Educational Opportunities
7. Exposure to Professional Community

7. Q. In recruiting for technical specialists are you most influenced by academic achievement, experience, or by reputation among the professional community?

Response: Most firms indicated that for young graduates they were most influenced by the individual's attitude as well as academic achievement. The term "presentation" was used several times to describe that quality that defines a person's overall adaptability to the work situation. In recruiting at the journeyman level, the discriminating factor was experience. Most felt that good, relevant design experience in responsible positions was more important than academic achievement. Professional reputation seems to take care of itself, i.e., those with successful experience soon gain a good reputation and conversely!

8. Q. To what extent does your firm participate in the technical development of its people? Does it view individual expertise as being the responsibility of the individual?

Response: Responses as to corporate participation in individual technical development varied from little or none to a very systematic involvement. The smaller firms who tend to hire at the journeyman level appeared to invest very little in employee development, whereas those who employ trainees did provide some formal assistance. All expressed the view

that development was a personal responsibility, i.e., an individual must have the ambition and be willing to work at it. The firm will usually assist in some way.

9. Q. To what extent does your firm encourage and sponsor employee pursuit of advanced academic degrees?

Response: Most firms will reimburse employees for tuition for undergraduate and graduate level work. Some pay one-half initially and the other one-half upon satisfactory completion. Some only reimburse for successes. None appeared to openly encourage or promote employees to seek advanced degrees.

10. Q. What forms of training does your firm support or provide? Short courses, seminars, resident university programs, company programs, etc.

Response: Most firms offer internal update seminars for professionals, most will sponsor employee attendance at specialty conferences, and some will pay for short courses. Generally, the decision to reimburse will relate to the relevance of the training to the employee's job.

11. Q. Does your firm encourage its technical people to also develop project management skills?

Response: Most firms are alert for project manager potential and tend to invest only in those employees who have demonstrated interest and potential. The larger firms do provide training and encouragement, but they too are selective. Of the firms interviewed, all appear to draw their project managers from the design elements, insisting that to be a manager one must first be a producer.

As noted in the response to question 2 above, the "project manager" in the private sector is viewed as a far more critical and senior position. Assignments are very carefully made by top management, full latitude and authority to act for the firm are normally given and the PM is accorded to authorities needed to command internal resources. He is also held personally and directly accountable to top management for the success of his project.

12. Q. Do you cross-train any of your professional personnel? Please describe its success or outcome.

Response: Cross training is indorsed by some firms but not all. Where it is used, the meaning is restricted to the application of talents <u>within</u> a discipline. Industry does not find it useful to move people into positions outside of their basic fields. The most common types of cross training are in the assignment of design people to the field and the assignment of say a mechanical engineer who normally does pumping stations to a sanitary job. The impetus for cross training in industry appears to be business capability and not individual career development. Some firms have sufficient diversity in workload with a limited staff to warrant the investment in cross training.

13. Q. Do you have a published career plan for your engineers and scientists? Describe how it works.

Response: None of the firms interviewed had career plans. One large firm was in the throes of developing a career management program, but it had not yet been placed in operation. The consulting industry may not be representative of the total profession, and the large industrial firms, who employ great numbers of engineers, may have more formal career guidance schemes. However, the nature of the consulting practice is more akin to the Corps, and its experiences may be more pertinent. The basic philosophy expressed by the firms interviewed is that career development is an individual's responsibility, and if the individual can fulfill his development needs while a member of that firm's production staff that is fine; however, the firm is not particularly interested in "taking individuals to raise."

14. Q. Does your firm have a formal intern program and, if so, how does it operate?

Response: None of the firms interviewed had formal intern programs; however, all recognized the need to provide young graduates and junior engineers with the proper level of professional supervision. None employed a rotational program as does the Corps. They tend to hire for particular slots and expect the employee to remain in that general functional area.

15. Q. Does your firm offer separate career ladders for technical specialists or must an employee eventually become a manager to achieve senior corporate status?

Response: Most firms do offer separate ladders, at least up to a point. For instance in a typical medium-sized firm (with say 200 employees), a specialist could earn as much as a department head, but probably would never achieve a level comparable to an executive or partner. All agreed that a separate ladder was a good idea, but its application was limited to the larger firms which had enough workload volume in a particular specialty to justify retaining an exceptional level of expertise. In response to the second part of the question, yes, in all cases one must become a manager to achieve senior corporate status, i.e., partner or participating member.

16. Q. Does your firm encourage employee mobility and, if so, does it provide shelters to mitigate incidental employee personal economic losses and inconveniences?

Response: In those instances where firms are operating in more than one location they insist on mobility for certain positions and they generally provide varying forms of shelter ranging from salary adjustments to real estate subsidies. Some of the larger firms with widely dispersed operations are quite generous in their policies, offering essentially complete shelter from financial losses and very attractive incentives to encourage mobility. Personal inconveniences and family trauma are given careful consideration in the timing and conditions of transfer. They provide re-employment guarantees (within the framework of normal business risks, i.e., no work, no job) and in general make it attractive for their best employees to move. Although not found in the sample of firms interveiwed, it is known that some very large and

very successful firms do not attempt to provide financial shelter. In those instances it is likely that salary and other incentives are being used to offset the hardship.

17. Q. What is your firm's retention policy? Is it based solely on tenure or is any preference given for special talents?

Response: None of the respondees considered tenure as a primary retention factor. Performance records, special talents, and potential were cited as discriminating criteria. Few of those interviewed had a published retention policy and felt any obligation to adhere to any pre-set reduction in force procedures. All firms fully recognized the need for fairness in their hiring and firing practices and felt morally accountable to their employees for personnel actions. Most of the firms interviewed were "old" and had well-established practices with very little turbulence in the workforce. They tend to take the normal swings in expansion and contraction in the subprofessional and nonprofessional ranks where turnover rates are quite high.

18. Q. Are professional employees in your firm carried in separate salary classifications, i.e., offered higher salaries than others?

Response: Yes, in most cases professionals are afforded higher salaries and are given titles to recognize their status. It was noted, however, that in some instances "designers" - subprofessionals who do some computation and prepare layouts, etc., are paid at levels well above the lower graded professionals. In some areas of the U.S. (and in most overseas) there is intense competition for good designer/draftsmen. These individuals are the key to high production output and are worth paying at premium levels - a fact that Civil Service has never recognized.

19. Q. Who determines professional employee eligibility for promotion or reassignment to positions of greater responsibility?

Response: In all cases it is the supervisor who first determines promotion eligibility. In most cases his recommendation is accepted, however, in nearly every case there is some review at the corporate level. In the case of partnerships, one of the principals will review and approve, or there may be a board or executive committee, but in nearly all cases someone reviews and exercises ultimate approval authority. Promotions to positions of greater responsibility are viewed in most firms as very significant decisions and are taken quite seriously. It appears that for the most part employees are not rewarded simply for being "good ole boys" or friends of the management.

20. Q. Within your design organization, what would you consider the journeyman level? Using October 1981 GS/GM wage scales, what would be your equivalent grade for the journeyman?

GS-11 - $23,566
GS-12 - $28,245
GS-13 - $33,586
GS-14 - $39,689
GS-15 - $46,684
GS-16 - $54,755

Response: It was most difficult to correlate and compare salaries with government scales because no two firms offered the same package and none included retirement and other allowances that are a part of Federal salaries. Some variation was noted in different geographic locations, e.g., the San Francisco area salaries appeared to be a little above the Ft. Worth levels. In general, it appears that with all factors considered, the private sector is offering a slightly more attractive starting salary for the graduate and a comparable salary for journeyman GS-11/12 levels. At the higher levels the private sector is unlimited and at the GS-13 level becomes much more attractive, albeit there are relatively few of such positions in any one firm. Most firms employ professional audit firms on a continuing basis to conduct salary surveys and advise on adjustments needed to remain competitive in the area. Salaries are not used to attract people but rather to retain good employees. The philosophy is that in recruiting, the candidate should be able to accept employment with the firm, if offered, without financial loss and probably without a significant gain over what others would offer. An important point in equity of salaries was made by several firms, i.e., that adjustments must be made from year to year in the salaries of those who have been on board for a while, so that in no instance would a new hire be making more than a more senior coworker who has performed well but was hired in at a lower salary level.

21. Q. Describe how your firm maintains quality assurance of your design products. For example, do you have a requirement of a certain minimum number of years of experience to qualify as a design journeyman, and then as a design reviewer? Who oversees the work of junior and recently hired engineers?

Response: Responses concerning quality assurance were difficult to categorize. The larger firms had more formal internal procedures and the smaller organizations seemed to operate on a very informal basis. In all cases there was full agreement that quality assurance was necessary and that quality control was most important. Professional responsibility and accountability of the individual performing or overseeing the work was cited as an important element. The need for independent checking and review was recognized by all. As for minimum qualifications, most firms rely on their department heads and supervisors to assign the work properly. All firms require that the work be properly certified by registered professionals. Most firms carry malpractice insurance to protect their employees. Corporate executives, especially in the smaller firms, feel an obligation to personally review the products in the interest of the firm's reputation and financial exposure. In terms of accountability, the individual is accountable to the firm for his performance and, in the event of negligent action, would run the risk of being fired. Except in a very unusual circumstance, the employee would not be assessed for liability. Of the firms interviewed, none were maintaining separate quality assurance organizations or even separate checking departments, although some very large firms do. It appears that the consulting industry relies on (1) professionalism, (2) thorough and competent supervision, and (3) responsible oversight by top management.

22. Q. What internal indicators are used in your firm to monitor the quality of the product and the quality of the workforce?

Response: No novel ideas were revealed in response to this question. It seems that most firms are guided by the results of internal reviews, client reaction, nature of problems arising in construction, and comparison with community standards. None of the firms indicated that they had any internal reports, displays, or other systems that portrayed quality.

23. Q. How is your firm organized in the technical areas and how does it assure the appropriate level of competence?

Response: Each of the firms interviewed were organized differently to suit their particular needs and preferences. None were employing other than the traditional departmental structures, organized generally by function although in some cases the units were defined by the type of feature being designed. All employed some form of project management either in a separate element or as special assignments to individuals in the design elements. Most firms have carried on over a period of years with little change in structure - many with the same organization (and people) as founded. In discussions with the principals of these firms, there was little interest in changing organization and none in experimentation. Apparently, the more successful consulting firms have found stability and strength in the traditional design organization which tends to segregate like or related disciplines under departmental leadership of an expert in that field. Project managership is viewed as a separate and critical responsibility and is assigned only to those individuals who have demonstrated their loyalty to the firm, their comprehensive understanding of the business aspects as well as the engineering details of the work, and their willingness to put forth the required effort. People with these attributes will invariably be senior in the company and encounter little difficulty in commanding the needed resources from the design organization, regardless of where they are normally assigned. The smaller firms can ill afford to have individuals dedicated solely to project management and, therefore, tend to rely on dual assignments. Some of the larger firms do employ separate PM organizations, particularly where individual projects require more than the part-time of one individual. Addressing the second part of the question, i.e., how competence in the organization is assured, there is no simple response. In each of the firms interviewed top management was keenly aware of the fact that the firm's viability was dependent upon its competence, and without exception the quality of the workforce was of primary concern. It was clear that in each firm the professional judgments of the principals, department heads, and supervisors were relied upon to assure that the proper talents were available for each assignment. None of those interviewed expressed any reservation or hesitation to employ outside consultants where needed to fill a gap or bolster their in-house capability.

24. Q. How is responsibility assigned within the firm and to what extent is the individual performer held accountable?

Response: Assignment procedures vary according to the size of the firm. In all cases, however, top management exercises some degree of control as to who does what. In the small firms the principals personally assign the work and in some cases remain involved as partner or principal-in-charge. The larger firms operate in a somewhat more decentralized manner, but apparently even in those organizations the top managers share in the assignment process at

least to the extent that they are aware of where the work is being done and who is in charge. Individuals are held accountable and their tenure is at stake. (See also response to question 2 above).

25. Q. In measuring and assessing individual performance within the firm, what yardsticks are used? (e.g., profit, client satisfaction, excellence of output, personal/professional achievement, managerial skills).

Response: The "bottom line" in private practice is profit and all things are related to that common denominator. Client satisfaction is important as is product quality and recognition, but those all ultimately relate back to profit and the ability of the firm to remain viable in the business world. From the interviews, one would conclude that the consulting industry is highly professional, but it is also in business and its actions must be guided by a prudent balance of objectives.

26. Q. What, if any, control do your technical specialists have over the end product? How is that influence administered?

Response: The technical specialists have control over the features within their disciplines to the extent that they are compatible with the overall project requirements. When there is a conflict the matter is escalated to an appropriate level (sometimes the top) for a properly balanced decision considering investment and client needs. When compromises are made they are carefully tested to insure that the basics of sound engineering are not violated. Compromises are generally in the areas of designer choice and preferences. The key point from the interviews was that such compromises are made by management and not at the low levels in the organization.

27. Q. Does your firm have the requisite expertise to handle the routine workload or does it normally rely on consultants/associate firms for certain disciplines?

Response: Responses varied in terms of degree of reliance on outside assistance. Generally, there was no hesitancy to employ consultants or to associate if the task at hand exceeded the firm's capability. The view was expressed that it was generally preferable to use outsiders to cover specialties not normally needed and to use associations or joint ventures to handle large productions rather than attempt to staff up and later have to retrench.

28. Q. How is your firm organized in terms of project management versus design production? Have you considered or tried other schemes?

Response: The responses to the question of organization were surprisingly flat. Most firms indicated a preference for the traditional design organization (see item 23 above) and little interest in experimenting with any of the newer concepts such as the matrix form. Few of the firms had even tried other forms. One might glean from this that there is not a great pay-off in manipulating the structure of a design organization - or that the traditional set-up is still quite attractive in comparison to the more innovative schemes. Those interviewed seemed to be well aware of the range o the options and had either made a conscious decision not to change or had simply ignored the idea.

29. Q. Who within your firm conducts client briefings? What are the minimum qualification?

Response: Client briefings are generally handled by the principals and/or by the project managers, supported occasionally by technical specialists. The firms were all very careful in determining who handles external contracts.

30. Q. What forms of advanced technology/systems are employed by your firm? (e.g., Computer-aided design, computer graphics, electronic mail, video conferencing, inertial surveying, interactive management information systems, real-time accounting and reporting).

Response: Of the firms interviewed only one or two were really involved in using advanced systems. All used ADP accounting and computer-aided design, but few had even experimented with video conferencing, electronic mail, or computer graphics. Part of the explanation could be in the geographic spread of their operations. Most would have little need for video conferencing or electronic mail. Several firms had installed or procured computer drafting services and were quite optimistic that they would pay off. None had accumulated enough experience yet to indicate how profitable it would be. Several firms expressed reservations in purchasing hardware and indicated that they might entertain the services on a rental basis.

31. Q. Do you perform all of your design work in the home office or branch offices? Describe how your design office(s) is (are) organized. Do you have a design center? If so, describe the relative merits of how it is working.

Response: Most of the firms interviewed prefer to do the design in the office nearest the project, although in the cases of the larger firms they did rely on the home office for heavy production backup. None of the firms interviewed had design centers, other than their home offices. No particular problems or complaints with present operations were voiced.

32. Q. What, if any, system of incentives exists within the firm? Is recognition of the technical staff a part of your management concept?

Response: Incentives ranged from profit sharing, which applies to all employees, to motivational awards given to employees for exceptional contribution. Most firms have some form of profit sharing which is considered a substitute for a retirement fund. Some firms also pay merit bonuses to those, who in the judgment of management, have contributed most heavily during the year. Those are awarded by the company based on recommendations "from the floor" and approved by either the corporate board or as one firm termed it, "the God Committee." There is no paper work involved and determinations of merit are simply judgments by the supervisors and managers. No job standards or formal appraisal process is used. As in the case of promotions, reductions in force, and other personnel actions, fairness is of paramount concern.

33. Q. What is your pay system based on, i.e., once an employee is on board, how is advancement determined? Are salaries keyed to cost-of-living indices?

Response: Without exception the firms interviewed base their advancements on merit. Tenure is not a factor. In most cases the firms rely on periodic salary surveys to indicate the need for adjustments to maintain competitiveness and do not employ automatic cost-of-living adjustments. (See also the response to question 20.)

34. Q. How does your firm determine its future needs for technical people, i.e., do you maintain staff in anticipation of work or do you generally hire-up for projects in hand?

Response: Future needs are determined by judgments and predictions of market prospects. The firms interviewed, for the most part, attempt to find work to keep their staffs busy rather than the converse. They tend to seek only those projects that suit their capabilities and availability and do not operate in the highly speculative mode. Recruiting is done to replace attrition and to fill those voids that appear to represent long-term needs. It was pointed out that to survive in a low profit margin business, it is not possible to hire up to any significant degree in anticipation of future work. There are no doubt exceptions where the opportunities in a particular locale are so abundant that speculative build-up would be justified.

35. Q. Are you involved in construction management as well as design?

Response: All of the firms interviewed are involved in construction management to some degree, at least in providing advice to the owners. Most firms prefer to follow their designs through construction and prefer to have full control of the AE aspects during that phase. This enables them to detect errors and omissions and to correct for changed site conditions in the most timely manner. It also provides inherent feedback on the design for future reference.

36. Q. What are your firm's requirements for professional registration? Do you sponsor (pay) your employees' registration?

Response: All firms comply with the registration laws of the states in which they practice and require that senior engineers be registered. All engineers, architects and other professionals are encouraged to become registered. Some firms offer salary adjustments and others pay bonuses for attainment of professional status. Most firms pay for refresher training and some give time off for preparation for exams. Most pay fees for any licenses required beyond the employee's state of residence and some even pay those fees.

37. Q. Does your firm encourage and sponsor employee participation in the professional societies?

Response: All of the firms interviewed encourage participation and most will reimburse employees for dues and for expenses incidental to membership and routine meeting attendance, as well as attendance at conventions and seminars. Some firms indicated that their financial support was limited to those memberships that related to their business and their employees' business interest. They would not, for instance, sponsor a mechanical engineer's participation in the American Society of Landscape Architects.

1.4.2 Additional Comments Resulting from Interviews

The Corps' contracting policies and procedures as well as its philosophy concerning the performance of design with government forces were discussed with each of the firms and with the professional societies. The essence of the significant points from those discussions is reflected in the following random-ordered statements:

1. The Corps' administration of its AE source selection procedure is viewed as one of the best in the Federal Government. It is fairly administered and for the most part, handled by professionals in a professional manner. The fact that we are not politically influenced in our selections was particularly noted. Criticisms were levied against certain specific districts and divisions concerning peculiarities of their particular procedures, but overall the Corps was commended. Several general comments of a minor, but critical nature were noted:

(a) Too many firms are being asked to make presentations to the selection boards. Industry feels that except in unusual cases not more than three to five firms should be asked to appear before the selecting committees.

(b) Districts tend to withhold advice of nonselection and keep firms "on the string" too long. AEs would prefer prompt notification of nonselection (the complaint may be stemming from the time required for selection approval).

2. The Corps' philosophy concerning the performance of certain work in-house is neither well understood nor acceptable to the A-E community. The need for a modilization contracting capability is recognized, but the connection between that and our doing in-house design of civil works is not understood. The A-Es would suggest that we concentrate on contracting capabilities instead of trying to be able to perform design when the "balloon goes up." The AE community is firmly convinced that it could readily handle our entire engineering workload and be in an excellent position to respond in time of crisis. It is not so willing to concede that the Corps must also be in a position to review the A-E's work - either now or in an emergency! The A-Es are quite distressed over the Corps efforts to level workloads among districts and to use design centers. According to the AEs this is interfering with the "natural" regional distribution of work and denying the AE industry in the prosperous region the opportunity of performing the work. They say that it has always been understood that we would contract for work that we could not accomplish in-house - now we transfer it to another CE district. The A-Es are particularly disturbed over our involvement in overseas programs, claiming that they could and would provide those services directly. Some, however, understand and appreciate the Corps' role and the fact that if it were not for foreign military sales and other joint defense assistance programs there would be no A-E work set aside for U.S. firms. It is not likely that the consulting community will ever warmly endorse our performing any design in-house but as suggested by one of the societies, we might improve the acceptance of the idea by launching an information program to explain what we are up to and why.

3. Several A-E firms noted a perceived deterioration in the Corps' attitude toward the consulting community. It was suggested that perhaps there was a growing suspicion of the A-Es motives and integrity and a resulting decline in the level of professionalism evident in our dealing. Some believe that the A-E community is being tainted by the image that the construction contractor industry seems to have created by its attitude toward claims and contract compliance in general. A-Es do not consider themselves as displaying that kind of mercenary attitude and feel that we are justified in treating them as "professionals" first and "contractors" second. The primary basis for concluding that things were deteriorating seems to be the tone and content of correspondence and review comments being returned to A-Es and the apparent lack of Corps management sensitivity to the nature of remarks being made. Apparently, some districts are sharing with their A-Es a lot of sarcastic, caustic, and even demeaning comments made by the technical reviewers and not filtered out by the project managers. Of course, the fact that reviewers are even expressing such thoughts is the point of real concern.

4. Several firms expressed the view that our contracts often do not reflect requirements in keeping with expectations and, therefore, we have built-in disappointment and frustration. It is suggested that we rethink our scopes of work to make sure they are explicit in requiring exactly what is expected. The A-Es cited such things as life cycle cost studies and formal energy analyses as typically not specified, but ultimately demanded.

5. The A-E community is generally opposed to the Small Business Set Aside program as applied to consultants and is particularly disturbed over the $7.5 million fee threshold (which is being lowered!). Most A-Es would prefer no set asides based on fee volume if set asides are necessary and use of a project fee threshold instead.

6. Several A-Es complained that the Corps overreviews design work done by contract. Reviews are too frequent (i.e., too many points) and frequently the comments are late in being offered. They suggest that we reduce the number of reviews and that we try to offer our comments earlier in the process to reduce the amount of lost effort.

1.4.3 Architect Engineer Contracting

The Corps' present policy governing the use of Architect-Engineering contracts in lieu of performance with in-house forces allows considerable freedom of choice. There are no explicit requirements or instructions as to what may or may not be contracted, except requirements stemming from legal aspects, e.g., performance of governmental functions. There are, of course, many procedural requirements associated with the actual contracting process, but these apply only after the proposal to contract has been initiated.

The only guidance on contracting out of E&D work extant in the field today has to do with the proportions of work being contracted and general philosophy concerning the maintenance of "bedrock" skills. As a result of previous studies of contracting out, guidelines were promulgated by OCE which suggested that the total E&D workloads in each program be accomplished according to the following breakout:

Civil Works - 75 Percent In-House
25 Percent A-E

Military Construction - 25 Percent In-House
75 Percent A-E

These percentages were later used at all levels as a test of manpower adequacy and have gradually evolved from the originally intended "guidelines" to what many FOA's now consider "targets." District and division commanders tend to be graded on their conformance to these "targets" and manpower allocations seem to be heavily influenced by them. This has resulted in improper balance in a number of offices, i.e., those with very light workloads are perhaps contracting out too much (or trying to) and those with heavy loads being criticized for not being able to accomplish enough in-house. The idea in the original scheme was to suggest that some level of in-house activity was both necessary and desirable, yet to recognize that realistically we must rely heavily on the private sector.

Nonuniform geographical distribution of workloads has contributed to creating extremes in percentages of contracting out. There has been a tendency for districts and divisions to attempt local accomplishment of heavy workloads and contracting out as necessary, rather than referring portions of the work to other Corps offices. To some extent the formal designation in the past year or so of several design centers (e.g., NPD hydroelectric design and MRD for "Superfund") has helped to encourage intra-Corps transfers; however, there would appear to be other applications of the concept that would tend to level out the distribution, better support, strong design centers, and allow the Corps to be a bit more selective in what it performs in-house. As noted earlier in this report, the A-E community is not in agreement with intra-Corps transfers.

1.4.4 Miscellaneous

In addition to the basic investigations and analyses required in connection with its original charter, the subcommittee was asked to document several points that were developed in the course of Committee deliberations. These thoughts are presented in the following:

a. Control of Manpower Space Allocation

In keeping with its policy of decentralization, the Corps has traditionally allocated manpower spaces to the field in block form, i.e., total ceilings for each program (CW and Mil Con) and for each category (FTP, PTP, FTT, etc.). Along with these allocations, OCE, and in-turn, the divisions passed on to the field the functional breakdowns used as the basis for development of the totals. Division and district commanders were free to allocate according to their own perceptions of needs. In periods of adequate manpower ceilings, this procedure operated quite well, and there was no reason to consider a change. In recent years, however, with progressively diminishing manpower ceilings in all programs the impacts of suballocations have become more critical. We are now in a period when managers are faced with the tough decisions as to what functions to contract out or what activities should be terminated. In this environment the concept of decentralization can and in

our opinions has led to a "survival of the fittest" syndrome. In some FOA's the "fittest" has been other than the technical elements and in those districts (and perhaps divisions) the requisite technical capabilities are either being threatened or lost altogether. This is particularly true in the Engineering Division, where it appeared that by contracting out, spaces could be saved for allocation elsewhere.

If the Corps is serious about maintaining a strong technical capability, there must be some additional control imposed on the use of spaces at the field level. Specifically, for example, it appears we must institute some system to force a district (or division) with a declining workload in engineering to eliminate that organization (tailor the district) when it reaches some minimum size and can no longer remain viable.

b. Technical Capability, A Performance Indicator

In addition to the idea explored in "a" above, the Committee discussed the need for some formalized indicator of performance by field commanders and their staffs in the area of how well they are maintaining the organization's technical capability in comparison to assigned responsibilities. Tailored districts would naturally not be expected to perform in the functions provided by others. This, the Committee felt, would discourage attempts to sustain marginally viable organizations.

c. Fragmentation

The fact that certain engineering and design functions have been properly assigned to other elements outside of the Engineering Divisions was noted. The impacts of this practice are being discussed in other reports; however, it is mentioned here to suggest its relationship to the manpower allocation issue addresed in "a" above. Mandatory allocations by function would perhaps discourage fragmentation and eventually lead to restoration of proper functional segregation.

1.5 Conclusions

1.5.1 Reflecting on the responses by the A-E firms and the professional societies, the following thoughts appear to be representative of the view of private industry and are points that the Committee may wish to address in its report:

1. The private consulting engineers and architects are experiencing no particular difficulty in either attracting or retaining competent professionals. They are finding it difficult in some locales to maintain an adequate designer-draftsmen staff.

2. The experiences of consulting engineers and architects in recruiting and retaining professionals may not be reflective of what other private industries are encountering; however, for the purposes of this study the consulting business would appear to be more closely parallel to the Corps' engineering function.

3. The Corps still enjoys the respect of the private sector both as a Federal agency and as an engineering organization. It is viewed by most as one of the best in both categories. The Corps does apparently need to improve its attitude toward consultants and seek a more professional relationship in its day-to-day transactions.

4. The Corps is not as well understood (as opposed to "known") as it should be. There appears to be a need to explain our missions and organization to the public and, in particular, to the professional engineering and architectural community. Exactly what we do, how we do it, and why is not well understood. It is possible that if there was a more widespread knowledge of the Corps, we would encounter less opposition from the private sector to our continuing to perform some design in-house. It is also probable that our recruiting of professionals would be enhanced. The idea here is to promote understanding and not to enlist support or "sell" our services.

5. The keys to attracting and retaining good people appear to be challenge and opportunity coupled with a fair and reasonable employment contract package, i.e., competitive for the geographic area.

6. The lack of employee mobility in the Corps is apparently the result of a combination of undue financial burden associated with relocation and a lack of commensurate incentives, either in terms of job security or pay. The private sector is not experiencing particular difficulty with employee mobility, although it does represent an increasing overhead expense.

7. The existing CE policies, programs and practices relating to employee education and training are excellent in comparison with the private sector. They offer greater opportunity for development than is available in most private companies.

8. The concept of career management as practiced in the Corps is not found in the private sector and may not be worthwhile. Individual career development is viewed in the private sector as a personal responsibility. The employee is encouraged to develop and assist in his own initiatives, but typically the firm feels no obligation to accommodate advancement (except as earned through productivity and contribution to profitability) simply to satisfy career programs.

9. The more successful private engineering design firms are heavily committed to quality in their services. Assurance programs vary in form, but all include active involvement by key people. In the smaller firms, even the principals play active roles in the management of projects and in the technical review of designs. The need for internal, independent checking and multilevel review is well recognized and addressed in nearly every firm. None of the firms interviewed offered shortcuts or innovative approaches as alternatives to the traditional checking and review techniques. Engineering competence and mature judgment applied in a systematic fashion are the key elements in quality assurance in the private sector as they are in government.

10. The concepts of performance measurement and evaluation as embodied in merit pay and GPAS are not found in the private consulting sector and may not be meaningful for professional level positions. None of the firms

interviewed used any form of written performance standards, nor did they have a written appraisal. Employees are counseled periodically on performance expectations and details of assignments and at least annually an appraisal interview is held. Based on the supervisor's opinion of the employee's performance, appropriate pay raises, bonuses, etc., are recommended. Those recommendations are normally accepted, although monetary amounts are often adjusted by management to conform to overall corporate fiscal policies.

11. Project management as practiced in the private sector is quite different from that employed in the Corps. The differences lie in the scope and level of responsibility and accountability vested in the PM. The Corps' PM typically reports to a section or branch chief, has little operational control over resources in other departments, and is basically a coordinator/expeditor/reporter. He is expected to see to it that assigned projects are afforded proper priority, that needed information and resources are available, and that commitments are met. Accountability is limited by authority, i.e., the Corps' PM is not normally considered to be in charge of the work or the workforce. His role is to transfer information and to report status to those who are in charge. The grade levels of typical PM positions in the Corps tend to confirm the level of investment in that function. In most districts the typical PM is carried at the GS-12 level with a few at the GS-11 level. In some special purpose organizations the GS-13 and even GS-14 levels have been justified; however, these were indeed exceptions. In the private sector the PM is typically placed in charge of the work with full authority to direct the workforce. He reports directly to the corporate head(s) and is held fully accountable for the success or failure of that assigned business venture (project). The problems of organizational responsibilities and conflicts are controlled by top management and an understanding by all concerned that project success and resulting profit are paramount. PMs are carefully selected from among the firm's top people and are well paid. In selecting PMs, importance is placed on the individual's technical background and knowledge as well as his managerial skill. It is believed that to be an effective PM one must have a thorough knowledge of the processes involved and have sufficient experience and stature to command respect. This is certainly not the philosophy applied in most Corps offices.

12. The indicators being used throughout the Corps to manage quality and performance may be operating to some extent as disincentives. In the private sector the element of profitability is a key indicator of business success - the measure of which in government is difficult. Perhaps a review of our "business" performance indicators would be worthwhile to see if any are being used to our overall disadvantage. Those which relate costs of one function to a percentage of another (E&D, S&A, VE, etc.) are the most susceptible to misuse. Quality indicators are even more elusive and, in the private sector, little effort is devoted to formalized monitoring and reporting of quality aspects. Instead, there is a commitment at all levels to diligently, systematically and critically review and examine both processes and products and to judge their quality based on sound professional standards. There are no gimmicks and it would appear counterproductive to devote great efforts toward devising and operating elaborate quality monitoring information systems. A strengthening of the internal supervisory and review effort both in the quality of people involved and the level of effort invested might yield a greater return.

1.5.2 Architect Engineer Contracting Policy

1. The standing policy guidance concerning percentages for contracting out should be rescinded and in its place should be a general statement of objectives. FOAs should be encouraged to contract these functions/activities that least impact on our long-term technical capability and to refer to the full service districts or to design centers E&D work beyond the owning district's capability that should logically be accomplished in-house. The wording of any such policy statement must be carefully chosen, to avoid further alienation of the private sector. In addition, it may be advisable to precede issuance of such a policy with a series of meetings with the professional societies to better explain our motives and objectives.

2. To facilitate referral of engineering and design to other districts, the Corps might consider establishing its own internal "Commerce Business Daily," i.e., a published listing of work that owning districts are unable to accomplish in a timely manner or that exceed their technical capability to execute. This device would replace the rather informal practice presently in use whereby referrals are made within divisions and via OCE among divisions. The success of this concept will depend heavily on a change in attitude toward declaring/admitting to having available capability to undertake transferred work. In the present environment, most districts are reluctant to air the fact that they have any excess capacity for fear that spaces will be out or transferred.

1.5.3 Manpower Allocation

1. The present system for allocating spaces to the FOAs, although in keeping with a policy of decentralization, may be (and in the opinion of the Committee is) contributing to the long-term degradation of our technical capability. It would appear that the only positive way to assure protection of a viable in-house design capability and forcing tailoring in those districts which can no longer afford viable Engineering Divisions in the face of increasing pressures to contract and reduced manpower totals is to institute mandatory limits on manpower space allocations in certain functions, namely in engineering and perhaps in other technical functions. Recognizing that some latitude at the field level is practically essential, such restrictions should be judiciously applied.

2. As a measure of performance of district and division commanders in increasing or at least maintaining the organization's technical capability, we should consider establishing some type of standards and indicators. The Committee recognizes the difficulty in such an undertaking but feels that it might be worthwhile.

1.5.4 Fragmentation of the Engineering Function

The practice of condoning and even encouraging further fragmentation should be discontinued and positive steps considered to reverse the trend.

APPENDIX III:

Report of Subcommittee on Organizational Concepts

by

Paul Barber

and

A.E. Wanket

1. Purpose

Of primary importance in the current situation the Corps faces (declining civil works workload, reducing manpower strength, more functional responsibilities, etc.) is how to get the mission accomplished and still retain technical capability. This section provides an analysis of various organizational alternatives which should be considered, including their impacts on technical capability. Participants were A.E. Wanket and Paul Barber.

2. Constraints

There is no ability, nor indeed is there any desire, to assure that all possibilities are open for consideration. There are some obvious constraints. Those assumed by the Committee are:

a. There will be no district offices closed. Since such an evaluation was recently conducted, and a decision made to keep all current district offices open, the existing array of office locations is presumed to remain intact for the near term future. This assumed constraint does not, however, include within it a further caveat in regard to internal district functional relationships. It is apparent that some major considerations in the area of consolidating expertise must be undertaken. While it appears that interests outside the Corps of Engineers have been heavily involved in assuring that no "flag" is withdrawn, the extent to which specific functions are similarly included in this concern is unknown.

b. The Corps of Engineers is committed to continued reliance on the Architect/Engineering industry for some of its work. We have historically had a strong relationship with the A-E community and are the largest user of their expertise in our work. An option to accomplish all assigned work in-house on the basis that this is necessary in order to maintain capability is not practical.

c. The ability to support mobilization is a paramount consideration. The engineering and construction abilities of the Corps of Engineers are the primary foundation for the agency's ability to respond in a national emergency. An erosion of this ability can have an adverse impact on response at a time when the Nation needs it most. Response to mobilization involves more than building barracks and tent cities. The operation of hydropower and flood control facilities, transportation needs, and other work items related historically to civil works are essential elements to mobilization. The ability to respond to the major design and construction requirements in a long-term conflict is also essential. The responsibility to provide technical guidance to the massive A-E effort that will be required for design falls on the engineering element. We have the capability to provide this guidance, and must retain it. Our recent involvement in assisting some other Federal agencies points up the Corps of Engineers capability in this regard.

3. References

Information presented in the following documents has been utilized where applicable in this analysis:

a. Field Review of Corps Organization and Resources, prepared by Engineers Study Group, Office Chief of Engineers, July 1977.

b. A Field Structure Concept, prepared by NCDED, October 1980.

c. A SPD Organization and Realignment Study of the San Francisco District, July 1979.

d. Civil Works Realignment/Reduction Study of SPD, March 1981.

e. Organization and Staffin, US Department of the Interior, Bureau of Reclamation, October 1981.

f. Organization Bulletin, Tennessee Valley Authority, July 1979.

g. NAVFAC document "Acquisition Department Indoctrination" (as modified by Memorandum dated 9 February 1981), and Functional Statements for Acquisition Departments.

4. Minimum Workload - Full Service District

This paragraph analyzes the manning and funding levels necessary for a district office to retain capability in engineering and design. Both civil works only and combined CW/MC districts are discussed.

4.1 Civil Works Only

4.1.1 ESG Report

The ESG Report (Annex D) considered the workload level which a division engineer (commander) should consider in tailoring a district. ESG's recommended criteria were as follows:

a. When projections of E&D workload funded under the Construction, General Appropriation fall below $4 million per year.

b. When projections of total E&D workload fall below $6 million per year. (Values generated for E&D should not include work to be done for other Corps organizations.)

c. When projections for Construction, General Appropriation (less E&D) workload are less than $40 million per year.

d. When projections for the above workloads are at sustained low levels for 3 to 5 years, and when the longer range estimates confirm these low workload conditions.

e. When workload levels are so low that the district's ability to attract and retain qualified personnel in key functions is seriously impaired.

4.1.2 Minimum Technical Expertise

The ESG Report assumes by inference that the workload levels identified would be adequate to retain a technical engineering staff to accomplish all normally identified functions. A check on this approach is to subjectively evaluate the areas of expertise required and the minimum levels of manpower required in each. It is assumed that in order to qualify for a full service district, FOA's engineering function must be involved with effort in one or more of the following:

- Dam design (new or modification)
- Lock design (new or modification)
- Hydropower design (new or modification)
- Six to ten existing reservoir systems
- Flood control design (levees and channels)
- Navigation design (coastal or inland)

This basic assumption then results in engineering organization which should involve the following elements of expertise:

ENGINEERING DIVISION

H&H	Geotech	Design
Hydrology	Soils	Structural
Reservoir Regulation	Geology	Mechanical
Hydraulics	Materials	Electrical
Water Quality	Surveys	Architectural
Sedimentation		Estimates
Tech Evaluation of FPM		Specs
		Civil
		Drafting

This organizational breakout is displayed to demonstrate the expertise areas required for full service. Individual geographical area needs may involve a slightly different organizational requirement, but the areas of expertise involved should be as displayed. A judgment evaluation was made of the minimum manpower level which needs to be retained in order to maintain a minimum level of capability. Factors considered include:

a. In all areas, more than one professional is required. In most areas, more than two professionals are essential.

b. Actual in-house design experience is needed in order to develop expertise.

Based on the above, the minimum staffing levels are judged to be as follows:

ED Chief	- 4	to	5
H&H	- 22	to	28
Geotech	- 14	to	18
Design	- 51	to	56
	91	to	107

With a minimum range of personnel between 90 and 110 for an engineering function, a test of funding required to support this effort would be approximately as follows:

Average Cost/Space (incl DO O/H)	X Spaces =	Requirement
$48,000	X 90	= $4.32 Million
$48,000 X 100	= $4.80 Million	
$48,000	X 110	= $5.28 Million

The above assumes about $22/hr E&D chargeout for 1800 hr/yr, and 20 percent district office overhead charges.

4.1.3 SPD Evaluation

In its 1979 evaluation of the San Francisco District, SPD reanalyzed the ESG study and concluded the $6 million per year (CG & O&M) for E&D effort would be required in order to maintain a viable E&D force. This figure was reaffirmed in SPD's realignment/reduction study in March 1981. (USACE March 1981 minimum was noted in the SPD report as $8 million.)

4.1.4 Comparisons

An update of the 1977 ESG value of $4 million (CG) to 1982 (assuming 10 percent escalation) results in $6.5 million for 1982. However, the in-house effort in the above technical expertise evaluation is considered more realistic for a minimum organization. It is concluded that a minimum E&D workload lies somewhere between and that $6 to $7 million is probably needed to sustain a full service District effort in the engineering function.

4.2 Civil Works/Military Construction District

Greater flexibility exists in those districts with a CW/MC assignment to develop and retain expertise than in a CW only location. Manpower requirements are greater, and the ability to work in both areas gives an added dimension to the engineering workforce.

4.2.1 ESG Report

This report did not address the minimum funding levels required.

4.2.2 Minimum Technical Expertise

In addition to the organizational elements identified in the CW only district, the following element is required in a mixed district:

ENGINEERING DIVISION

H&H	Geotech	Design	Military
			Proj Mgrs Adv Plng Master Plng FE Support Programming

As in the civil works only evaluation, judgment on the manpower required for this added function is required. As a minimum, this is considered to be as follows:

ED Chief	-	4	to	5
H&H	-	22	to	28
Geotech	-	18	to	24
Design	-	70	to	80
Service	-	5	to	8
Military	-	30	to	40
		149	to	185

Based on this, a combined district needs, as a MINIMUM, 150 to 190 personnel assigned to the engineering function, or 60 to 80 more than a civil works only district. This added staff would require an annual military construction program of $100 to $120 million. This dollar volume program is based on the following considerations:

a. Supervisor, administration and review cost for A-E design of 2 percent.

b. Total design cost for in-house design of 6 percent.

c. Average cost per space, including District office overhead of $48,000.

d. A-E design effort equal to 80 percent of the total program.

e. In-house design effort equal to 20 percent of the total program.

4.2.3 Comparisons

This is a more difficult area to compare since the workload in the military area is less predictable than in the civil works arena. OCE, in the recent military realignment effort, considered that a $75 million annual program would support a military design mission. This dollar value differs somewhat from the $100 to $120 million shown above, and can be attributed to different mixes of assumptions on amount of A-E versus in-house design, design cost targets, and cost per manyear.

Currently, the added emphasis on defense spending is resulting in more design and construction for military work. The manpower levels required to do a good effort in this arena would seem to tend more to the higher than the lower number for the range. In other words, 170 to 180 minimum manpower levels are more realistic, assuming that a larger measure of in-house design effort is utilized than heretofore.

4.3 Conclusion

The analysis presented herein is an attempt to identify the minimum manpower, related to workload, which should be maintained in a district to retain engineering and design capability. It should not be construed as a goal to reduce manpower at locations where workload warrants greater manpower strengths. The analysis is intended to identify a milestone decision point, where a determination should be made, as a result of declining workload, to either consolidate the engineering function at another location or add workload to assure capability at the affected district.

5. Organization of Other Agencies

5.1 Bureau of Reclamation

Information on the Bureau of Reclamation was obtained through visits to the Engineering and Research Center in Denver, Colorado, and the Lower Colorado River Region in Boulder City, Nevada. The Bureau of Reclamation provides water resource development services to the Western states. The Bureau's geographical area is broken into seven regions, each of which has total responsibility for water resource development within its geographical area, operating under the guidance and direction of the Washington office. All planning, some engineering and design, and all construction operation and maintenance are under the direction of the region. The regions in turn have "project offices," staffed to handle the planning, construction, operation and maintenance of specific projects or groups of projects. Operating under the direction of the regional headquarters, project offices perform the basic planning, development of appropriate engineering and design criteria, accomplish the construction and in some cases, perform authorized operation and maintenance. The size of the project office varies, depending on the status of development of a project (heaviest during actual construction) and the residual operation and maintenance responsibilities after the project has been completed. Most projects are turned over to a local water district for operation and maintenance. All major engineering and design is accomplished by the ENGINEERING AND DESIGN RESEARCH CENTER (ERC) headquartered in Denver, Colorado. Some minor design and construction is accomplished by a small staff in the regional office.

ERC has a staff of about 900, and is organized essentially along functional lines. The Division of Design is the largest activity, with a strength of about 570. Its workload is about $650 million in new design, annually. Until recently, the ERC had both design and construction responsibility, including contracting officer function. Currently, construction responsibility is decentralized to the regional office, and, more specifically, to project offices. Contracting officer functions also have been decentralized to the regions within the procurement function. In addition to design, the ERC is

responsible for providing "consulting" engineering services for the regions during the planning processes. The regions, in turn, are responsible for furnishing all the necessary engineering and design criteria to the ERC, including hydrologic and hydraulic data, subsurface investigations, topographic survey information, and similar site related technical information. The role of the Division of Construction within the ERC, only recently changed from a line to a staff function, is somewhat cloudy, but appears to be that of providing technical construction advice to the regions in specialty areas.

The region has full responsibility for the development of water resource activities within its geographic area, subject only to the mandatory use of the ERC for engineering and design for the region. A Division of Design and Construction provides staff level overview for the activities of the several project offices. For example, the Division of Design and Construction for the Lower Colorado River Region is comprised of approximately 40 personnel, of whom approximately one-half are engineers or geologists. Its responsibilities consist of developing plans and specifications for relatively small projects and providing technical engineering advice during construction, not only for the small projects, but for the large projects designed by the ERC. The Chief of the Design and Construction Division at the regional office carries the title of "regional engineer."

The ERC is an outstanding example of a highly professional, motivated, workable design center. While the Lower Colorado River Region had some concerns over the level of the ERC's responsibilities, particularly regarding small projects, it was highly complimentary of its capabilities. It was also obvious that the design center was professionally challenged with little difficulty in recruitment and retention of engineers. It was not without concerns, however, particularly in the engineering-construction and the engineering-planning interface occasioned primarily by distance and functional responsibilities in different offices.

A major concern expressed by both ERC and the region engineering personnel dealt with the contracting officer role of the procurement activity. This concern was generally expressed in two areas: (1) The loss of a significant professional engineering responsibility in the contracting processes; (2) The day-to-day need to orient and train the contracting officer in the engineering and construction considerations, particularly for contract modifications. The Corps of Engineers practice of delegating contractor officer authority to district commanders or their deputies is a significant benefit in the retention of a professional engineering character in the eyes of the engineering and construction community.

While the region was strongly influenced by professional engineer needs and requirements, it appeared that engineering was placed in a subordinative role. The top engineering position is at the middle management level, reporting to an assistant regional Director (a nonengineer although engineers can qualify for the position; in fact, the Lower Colorado River regional director is an engineer).

5.2 Navy Facilities Engineering Command

Navy's Facilities Engineering Command is charged with all engineering, design and construction requirements for the US Navy and US Marine Corps, along with other selected Department of Defense activities, including real estate acquisition, advanced planning and facility engineering support. It is comprised of six geographically disbursed Divisions (reduced from 13 divisions as a result of a consolidation effort in the early 1970's). The Western Division of NAVFAC is organized at the top level along principal activity lines (departments). The key ones are: Acquisition Department - management of the military construction program; Facilities Management Department - facility engineering; and Facilities Planning and Real Estate Department - advance planning, including real estate acquisition. The Acquisition Department contains four functional areas: project management, contracting, design and construction. The head of the Acquisition Department has the resources available to plan, design, and construct a new military facility. The head of the department receives appropriate advisory and administrative support from other elements of the division in fulfilling his mission.

To accomplish facility engineering type work at their installations, the Navy has established Public Works Centers (PWC) at San Diego and San Francisco; their primary responsibilities are to do the actual facility engineering at all installations. The commanding officer of the PWC exercises his command through the Western Division commanding officer. Public Works Offices (PWO) and Public Works Departments (PWD) are established at activities not serviced by PWCs. The Facilities Management Department provides housing maintenance, utilities, and transportation overview for the PWC activities, and the Acquisition Department provides design and construction services for major repair and rehabilitation projects.

The Western Division's design workload is $350 million in FY 1982 and about $500 million in FY 83. The total strength of the Western Division is approximately 1,100 with the Acquisition Department strength at about 650 (230 in design and 340 in construction.)

The Western Division is comparable to a large district confined to a large military program, but with the added significant responsibilities of facility engineering which it handles through Public Works Centers. The Public Works Centers are in turn comparable to the facility engineer organizations at our Army installations. Furthermore, unlike our districts, The Western Division has primary responsibility for Navy military programming including the development of appropriate programming documents. In this sense, it is much more of an engineering design and construction "center" than any of our districts.

The Acquisition Department includes a Project Management Office which is responsible for overall project execution. This office coordinates the work efforts of the Contract, Design and Construction Divisions, and is responsible for execution of all projects from the feasibility study stage through design to construction and transfer to the "customer," emphasizing adherence to establish scope, schedule and funds. Its responsibilities include the initiation of the A-E contract effort, to include CBD

advertisements, handling of the SF 255 forms, participation in the selection processes (chairman for the A-E preselection and selection boards are drawn from the Design Division), and participation in negotiation of fee. Administration and execution of the A-E contract is turned over to the Design Division.

It was felt by those interviewed that the consolidation of NAVFAC offices in the early 1970's was much too severe. The feeling was expressed that the nine-state area under the direction of the Western Division contained a workload too large to permit effective design management. The consolidation combined former offices at San Diego, San Bruno, and Seattle in San Bruno. It was further felt that the location of the consolidated office in San Bruno was too far removed from the center of the work located in the San Diego area, resulting in extensive travel requirements for the San Bruno staff and consequential reductions in "customer" relationships as travel constraints and the pressures of production preclude necessary visits to the site. They also expressed that the extent of in-house work accomplished by the San Bruno staff was adversely impacted because of this distance problem. It was also felt that the location of the consolidated office at San Bruno, in a relatively high cost-of-living area, was significantly impacting on the Design Division's capability to recruit qualified engineering personnel. As a consequence of these concerns, the Design Division is considering the establishment of a small satellite in San Diego and Seattle as cost reduction measures and to better serve the customer. These satellite offices would be responsible for project accomplishment within specified areas, including consultation to local activities, support to the Resident Officer In Charge of Construction (RIOCC), local surveying, contract support, and local contact with activities. The San Bruno design center would then be headquarters support office providing technical support in specialty areas and overall management of the satellite offices. It was also judged that it took about 3 years for the consolidation of Western Division to become fully effective. The lesson for the Corps appears clear: design centers, if established, must carefully consider specific location, workload, impact on the customer, and ability to recruit necessary talents. It was urged by those interviewed that consolidation will not occur unless the efficiencies and benefits are certain.

The review processes for designs accomplished by the Western Division are somewhat different from those required by the Corps. The Western Division reports directly to the NAVFAC headquarters in Washington, DC. That headquarters apparently has a very limited ability for review, emphasizing support in the "specialty" areas. As a result, designs accomplished by the Design Division are reviewed by the Design Division, both A-E and in-house.

The Construction Division, like the Design Division, is organizationally located within the Acquisition Department. The field instruction management and inspection staffs are under the direction of a Resident Officer In Charge of Construction, always a military officer, who reports directly to the commanding officer of the Western Division, but under the technical direction of the Construction Division within the Acquisition Department.

This arrangement is very similar to the Corps' system, whereby the resident engineer or area engineer reports directly to the district commander, but receives technical direction from the chief of the Construction Division. The

contracting officer for the construction contracts is normally the commanding officer of the Western Division. He in turn relies heavily on the head of the Acquisition Department wherein both the Design and Construction Divisions are located. The field staff appears to have great latitude in interpreting designer's intent; however, no apparent difficulties were expressed in the design-construction interface. The Design Division becomes involved in solutions to any problems developed during construction, as might be requested.

5.3 Tennessee Valley Authority (TVA)

The TVA is a corporate agency of the Federal Government, created in 1933, and operates with considerable autonomy under the direction of a three-member board which is appointed by the President. Its basic purpose is to provide for the economic development of the Tennessee Valley, generally through the provisions for electrical power facilities. A considerable investment in hydro, fossil, and nuclear powerplants has been and is being made. The TVA is managed by a general manager who reports to the three-man board and is responsible for the overall administration and execution of programs, policies and decisions adopted by the Board. Responsibility for program development and execution is delegated to major organizational elements called "offices." The Office of Engineering Design and Construction (OEDC) supports the other principal offices in the development of TVA's capital facilities.

ODEC performs engineering services to the various planning elements within the TVA and, upon authorization of a project by the Board, designs and constructs the project. The single exception to this responsibility is in design and construction of switchyard and transmission facilities which are accomplished by the Office of Power. The project is then turned over to a user organization, primarily the Office of Power and the Office of Natural Resources, for operation and maintenance. The OEDC is comprised of two principal divisions, Engineering Design and Construction. The Engineering Design organization contains four major elements, two of which handle thermal power projects (both fossil and nuclear). A third handles hydropower development and its related facilities including locks and dams, and the fourth is a service organization. One of the thermal elements (850 people) concentrates on developing all the engineering criteria, requirements and needs of both fossil and nuclear powerplants. The second thermal power element is organized on a project basis and is responsible for design and preparation of plans and specifications for specific power projects, utilizing the criteria and requirements of the first element. This element operates under the project management principle, wherein all the necessary disciplines are available within each project unit. Review of the designs and plans and specifications are accomplished by the element which developed the criteria which also provides specialized technical assistance as may be needed. The element which is responsible for designs, plans and specifications for TVA facilities other than thermal powerplants is organized somewhat conventionally along discipline lines.

The OEDC expanded greatly in the 70's and has had an extremely large design and construction program until rather recently. Generally, their projects are extremely large ($1-2 billion), highly complex (nuclear powerplants, fossil fuel powerplants, hydropower developments), with extremely high demands for

personnel well versed in the state-of-the-art of several engineering disciplines particularly mechanical, electrical and associated disciplines common in the nuclear engineering area. To accomplish its mission, the OEDC has a total staff of approximately 27,000 of which approximately 3,000 are in the Engineering Design Division. It is important to note that virtually all engineering and construction is accomplished through in-house labor forces. While alluding to some past and upcoming manpower cuts, apparently the emphasis on contracting out has not reached the same intensity as it has with the Corps of Engineers. This policy has enabled an extremely effective control of the design and construction processes.

The OEDC has developed a somewhat informal program of cross training between the engineering and construction functions and within the engineering function itself. This initiative of the OEDC manager along with several others has also contributed to a highly effective working relationship between the engineering and construction functions. In the engineering function, the OEDC manager has established dual career ladders, i.e., management and technical. In several cases, key technical specialists are graded at the same rate as their immediate supervisors, resulting in a staff of highly competent and properly compensated engineer specialists. The TVA has their own personnel system and compensation schedule, outside the purview of OPM. The grade of the top managers of the organization are at Senior Executive Service level for general manager and office directors; division managers are generally ranked at about a GS-15 level, with their subordinate organizations at correspondingly lower levels.

OEDC supports both the planning and operation and maintenance (O&M) functions of other offices. In planning, OEDC is required to "sign off" on any feasibility planning document for engineering feasibility and project cost. Support for operation and maintenance activities is less finite. Each of the other offices have O&M responsibilities along with some engineering and construction capability, principally for thermal power facilities. The decision on which office performs the engineering design and construction of maintenance or repair or rehabilitation efforts is often reached only through negotiation between the top echelons of the two offices.

The Office of Natural Resources is responsible for the planning and operation of all hydroelectric power developments. This responsibility carries with it all hydrologic and hydraulic analysis including reservoir regulation and water quality, including basic sanitary engineering. The Division of Water Management has a total staff of approximately 230, of which 150 are engineers. It was pointed out that the traditional planning function which the division had over the years had pretty much ceased because of lack of opportunities. Emphasis is now placed on operation of the completed facilities, hence, the heavy proportion of engineering personnel.

OEDC is a highly competent engineering and construction organization, with exceptional technical engineering and construction capabilities in the nuclear, fossil and hydropower plants. About 25 percent of its engineering and design staff are involved in work similar to that performed by one of our large civil works districts. The OEDC has successfully utilized the "project manager" approach in the design of major thermal power facilities. These facilities particularly lend themselves to production engineering and design

because of their high dollar value ($1 billion or more) and their complexity. Construction by the "fast-track" method utilizing in-house labor forces significantly simplifies the engineering-construction relationship. It is noted that the "project manager" system is not used for the civil works type projects, i.e., hydropower and navigation, employing a more traditional Corps of Engineers functional approach. No specific reason was given by the TVA personnel for these differences.

The OEDC, like the Corps, is facing a declining workload. As the economic development of the area is being fulfilled, electrical power needs have remained stable and the anticipated growth rate over the next several years is substantially less than earlier projections. Several nuclear powerplants have recently been deferred. The impact on the OEDC due to this deferral will be significant. For hydropower development, most of the opportunities in the Tennessee Valley have already been developed, with the major effort now concentrating on improvements to existing systems. The net result of this workload decline is expected to be further consolidating of engineering design and construction responsibilities. It is also interesting to note that this 3,000-man engineering and design organization considers it necessary to consolidate mission responsibilities and talents in the face of the declining workload. A similar consolidation among the Corps' small Engineering Division, i.e., 50 to 150 strength, appears inescapable in the interest of retention of a true technical capability.

Discussions with OEDC on many aspects of professional development, i.e., training, professional registration, rotational assignments, EDC, indicates that the OEDC treats this area less intensely than the Corps, although they recognize the high value of such development. Only about 20 percent of the OEDC engineering staff are registered professional engineers; a structured intern program is not available, although there has been such in the past; cross-training between engineering and construction and then engineering appears to be accomplished more on a target of opportunity basis rather than on a programmed basis. The OEDC does appear to have a rather strong emphasis on in-house training for their personnel, particularly state-of-the-art improvements in technology and in specific disciplines, primarily nuclear.

The engineering/construction interface in the OEDC appeared exceptional. Two primary reasons seemed predominant. First, both functional activities were under the direction of one individual, who had no other area of responsibility for producing a quality engineered and constructed product for a "user." Virtually 100 percent of his attention could be directed toward that goal, unlike our district engineers who are compelled to be involved in a multiplicity of other functional and administrative responsibilities. Secondly, virtually all the work accomplished by the OEDC is through in-house, and is generally performed by fast-tracking design and construction. This fast-tracking mandates a close working relationship between the engineering and construction elements and in the absence of a construction contractor, a much more effective and meaningful interface between the construction and engineering functions.

The TVA recently reorganized to reduce the excessive span of control imposed upon the general manager. The heart of the TVA organization are activities identified as "offices" each of which are highly autonomous in their

operation. The general manager has a staff of assistant general managers each of whom provide staff level oversight of several of the offices. Through this restructuring, the span of control of the general manager has been reduced to give from about 20. Considering the size of the TVA, the organization charts appears rather simple, with clear lines of authority and responsibility.

Although not an engineering organization in the pure sense of the word, the engineering disciplines permeate the organization. The general manager is an engineer, although not required to be; two of the five assistant general managers are engineers; and six of the office managers are engineers.

6. Organizational Alternatives

6.1 Introduction

The Corps' highly decentralized, full-service, engineering and design districts are unquestionably the most effective, efficient and productive means of doing our business. The Corps' long history of achievements really attests to this fact. The single factor which causes possible departure from this decentralized organizational philosophy is workload, or rather, absence of workload. Every district in the country was established to accomplish a significant engineering, design and construction workload. As that workload declined (or said another way, as the original mission was completed) many districts nonetheless, retained their full-service character, with a resulting decline in professional capacity, particularly in engineering. We have already addressed the workload scope considered necessary to maintain a minimum full-service engineering function. The purpose of this section is to discuss the establishment of design centers as an alternative to strengthening our engineering organizations. Implicit in this alternative is the need to "tailor" some low workload districts by removing their engineering function.

6.2 Design Centers

A design center is defined as a centralized office which accomplishes design for a geographical area and/or specific functions. It may be:

a. Full Function where all design functions for a geographical area are performed either for itself, or for other less staffed or tailored Districts. The Engineering and Research Center (ERC) of the Bureau of Reclamation is probably the most significant full-service design center in the Federal Government. It provides virtually the entire engineering and design for the Bureau's geographically dispersed regions. The A-E industry frequently uses design centers (home office) to service their branches which are the primary contact with clients. The division offices of the Navy Facility Engineering Command are full-service military engineering design centers as are the majority of our Corps of Engineers districts.

b. Limited Function where a specific design function is performed as a service for other offices, either "tailored" or full-service district. A prime example of this organizational concept within the Corps is the Hydro-electric Design Branch in the North Pacific Division. The Sacramento District is a limited function design center for military facilities in the South Pacific Division; Kansas City and Omaha Districts recently were assigned

design responsibility for Superfund projects nationwide. Los Angeles is a limited function design center for coastal projects in SPD.

6.2.1 Advantages of Design Centers

a. Technical Capability. Design centers provide the opportunity to develop a highly competent, in-depth staff of engineer talents from trainee through journeyman to technical specialists. The functions or activities of a proposed design center will determine the particular disciplines required for each, however, particularly for low workload functions, concentration of engineering capability permits the retention of, or can enhance, critical engineering expertise.

b. Challenging Workload. Design centers can accomplish a relatively large and varied workload with corresponding engineering challenges to stimulate interest and innovativeness at all experience levels for architects, engineers, geologists and related disciplines. These professional challenges, along with accompanying personal recognition (both financial and professional) are key ingredients to retention of a technical capacity.

c. Location. A decision to establish a design center provides some latitude to selection of a geographical location which is most suited for continued attraction of engineering talent. The difficulties in recruitment being experienced by one district and divisions located in major urban areas, along with the similar problems reported by the Western Division of NAVFAC in the San Francisco Bay Area is contrasted with the comparative ease of recruitment reported by the Bureau's ERC in Denver. It is considered that the long-term benefits of a desirable location for family, community interests and professional involvement would more than offset the short-term relocation impacts of affected personnel.

6.2.2 Disadvantages of Design Centers

a. Loss of Control. A district which receives engineering and design support from a design center will lose some degree of control over the performance of its mission. The district would be required to use the design center rather than having the option of accomplishment in-house or by A-E. The extent of this loss of control varies with the scope of the design center, i.e., full function or limited function. The district will be concerned with the ability of the design center to perform within required schedules, and will be impacted, on occasion, when priorities of the design center change for whatever reason.

b. Design-Construction Interface. The physical and organizational separation of the engineering and construction responsibilities may cause a lessening of the interface between these two functions, with some reduction in the quality of the end product. Institutional arrangements between the two offices can be developed; however, response time, once an issue is identified, can be expected to be longer. This separation will require the establishment of a strong positive relationship between key, top-level managers of both functions to assure properly engineered solutions to design problems which most certainly can be expected to occur. The impact of this disadvantage is dependent on the level of design center involved, i.e., full function or limited function.

c. Engineering-Planning Interface. Like the engineering-construction interface, a decrease in the quality and certainty of the engineering feasibility of proposed projects must be guarded against. Institutional arrangements can be developed to minimize this concern; however, geographical separation will, nonetheless, impact on the present organizational concept of the planning processes. Further, this geographical separation could result in pressure to establish duplicative engineering capability at a district, which would contradict the primary purpose of engineering consolidation, i.e., retention of strong expertise.

d. Diminished Engineer Reputation. Where districts may lose their engineering and design function to design centers, a potential exists for the Corps to lose its national identity as an "engineering and construction organization." Taken to extreme, a relatively few design centers would act as "service organizations" to 35 decentralized districts. This lack of local engineering capability will impact adversely on our relationship with national, state, and local interests which, in the past, looked to the Corps for engineering advice on a myriad of topics. While this advice will still be available from design centers, the logistics involved will cause delays in response. Design centers, because of their concentration of expertise and workload, can be expected to provide an economy of operations over that which would be experienced by small operations at individual districts. This efficiency, however, would be offset somewhat by the increased cost of coordination inherent in operating a project out of two geographically dispersed locations.

6.2.3 Analysis of Design Centers

Design centers are a viable alternative in areas of the country where diminishing workload precludes the retention of a well-rounded staff in the basic engineering disciplines required for accomplishment of our mission in civil works, military construction, or any other involvement. Design centers now in existence amply demonstrate their success, not only in retaining, but improving our competence through concentration of talents and programs with resulting professional challenge in a variety of activities. Design centers, moreover, are not a panacea and extreme care must be exercised to assure that the advantages of design centers will, in fact, be realized. The disadvantages cited above are real, and although institutional arrangements can be developed to minimize these adverse impacts, the need for a design center, whatever its scope, must be clearly apparent before its establishment. Some consideration in evaluating the creation of design centers are as follows:

An existing full-service district is, by definition, a full-service design center. Reducing that district to something less should be undertaken only after it has been conclusively shown that an insufficient workload exists to support an engineering activity generally of the size and function described in para d. above. The strength of the Corps is in its decentralized full-service districts; retention of this strength should be maximized.

Notwithstanding, the obvious success of the Hydreologic Engineering Design Branch (HEDB) in NPD generally, a design center should be added to the mission

responsibilities of an existing district, with review being accomplished by the Division Office having jurisdiction over the project. Serious consideration should be given on the location of the design center to maximize recruitment and retention opportunities. (In order to minimize priority problems, it is preferable that full-function design centers serve only one division. Available workload will govern this consideration.)

A small liaison office should be established by a full-function design center in each of the districts that the design center serves. This liaison office would form the link between the center and the serviced district, assuring a two-way communication on status, funding, criteria, priority, etc.

For design centers handling civil works projects, program development responsibility should rest with the district office which will ultimately be responsible for operation and maintenance. For design centers handling military projects, the design center should be responsible for all activities including project advertisement. Design centers provide a much greater opportunity for implementing a program of dual career ladder. The workload and need for specialized expertise in the several engineering disciplines provide a strong basis for developing (and compensating) a cadre of technical specialists, serving both their "home" design center, and other engineering activities throughout the Corps.

6.3 Other Concepts

Other organizational concepts were considered, including matrix, differing functional alignments and objective-oriented. However, none appeared to offer any advantage to retaining or improving our technical capability, which is the primary purpose of this study effort.

6.4 A-E Organizations

The Subcommittee on Private Industry and A-E Contracting conducted in-depth interviews with six firms of varying size, and spot interviews with representatives of several other firms. These interviews revealed that, in the consulting business, most organizations correspond quite closely to those found in the typical design district. The larger firms employ greater variety in form and function from the strict project management concept to the use of project design units for various types of features. In the project manager (PM) scheme, highly qualified senior design engineers/architects who have displayed strong managerial skills are assigned major responsibility (to the corporate head) for overall project accomplishment. These PMs accomplish their objectives either by tapping specialists in technical production units (termed by some as a "matrix" setup) or by tasking the production units through their chiefs (typical PM arrangement).

The smaller firms which cannot afford separate PMs use dual assignments of department heads and even principals of the firm to orchestrate the accomplishment of particular projects. Some firms use separate production leaders in the various sections who report to an overall PM or director. None of the firms interviewed were employing (or had ever tried) any new or novel organizational scheme. It would appear that consulting work can be quite efficiently accomplished with traditional organizations and there is no real need to experiment.

One could conclude from this sample that the keys to selecting the right organizational scheme are (1) nature of workload, (2) geographic spread; (3) quality of people available; and, (4) individual preferences for degree of centralization. The concept of design centers is widely used, especially when many small branch offices exist or when strong specialization is desired.

A-E firms adjust to evolving workloads and open or close branch offices as needed, attempting to protect a home office design center. They do not keep nonproductive offices open for extended periods in hopes of landing future business, neither do they staff up in anticipation of a favorable future market.

In discussions with the principals of these firms, the one point that most commonly arose was that the key to the success of their firms was competent, aggressive management of a lean and technically competent workforce. None displayed much interest in trying new things except as they might enhance profitability. It seems that organizations are selected and adjusted to gain maximum productivity of available talents at least cost - not to build empires or protect grades of incumbents. Of the firms interviewed most had retained the same basic organization that they have had for many years - some spanning several decades.

Although this report presents little or no detail on the various A-E organizations, the Subcommittee believed sufficient to confirm that the Corps is currently employing the optimum types of organizations for engineering activities. It is also our conclusion that the concept of design centers is sound as is the premise that unproductive branch offices should not be maintained.

7. Engineering Fragmentation

There exists a number of situations where engineering and design effort is being accomplished within other Corps of Engineers elements. This has resulted in dilution of the scarce manpower, lower quality of work product, and is a factor contributing to degradation of engineering capability. A reconsolidation of engineering functions within that element will result in the following benefits:

a. Consistency of Application. Rather than two elements solving similar problems in potentially dissimilar ways, the ability to apply lessons learned experience to these situations should reduce overall effort and contribute to the experience factor so necessary to improving capability.

b. Quality Product. The ability to learn from mistakes and avert repetition of approaches that have not worked in the past is a major factor in improving the quality of the product. Continued exposure to problem solving is beneficial to all professions, but is especially beneficial in the Corps of Engineers where many situations have similar solutions in a geographical area.

c. Better Utilization of Manpower. With our declining manpower and the requirement to stretch the resource, it follows that consolidating expertise rather than performing similar functions in more than one location will assist the Corps of Engineers in dealing with this impact.

d. Improvement of Engineering Capability. The ability to develop expertise over a period of time through exposure to a variety of problems is essential to developing and retaining engineering capability. The opportunity to develop is hampered when more than one element is given or develops similar responsibilities.

The various interfaces involving engineering when fragmentation either is or may be a problem are discussed as follows:

a. Planning-Engineering. The purpose of the emphasis on separation of planning was to strengthen the planning process. Care now needs to be taken that engineering capability is not adversely affected by that decision. The area of expertise most susceptible to duplication or fragmentation between engineering and planning is in hydrology. Hydroanalysis is involved in some manner in nearly all our civil works effort, from preauthorization studies to reservoir regulation of operating projects. Other areas of potential problems are cost-estimating and determination of engineering feasibility of any particular alternative being studied.

b. Construction-Engineering. This is not so much a problem of fragmentation as it is one of close coordination needed to improve the quality of the product. On the one hand, engineering elements need to actively seek input on constructibility of the product being designed. On the other hand, field elements need to be constantly aware that design decisions cannot be made in the field. When problems arise, the designer needs to be alerted and then must respond with a solution in a timely manner. Cost estimating input by the engineering element into required construction modifications is another area where closer coordination between these elements is needed. Improvements of this process will have position results on both the quality of our products and the development of the designer's capability.

c. Operations-Engineering. As the operation of projects has grown over the years, there has been a growing tendency to accomplish the engineering and design effort to support that increased mission within the Operations Division, resulting in implication. In some cases, the increased staff have taken with them engineering and design decisionmaking and duplicated effort that engineering personnel should accomplish. Examples of duplication at some locations include: surveying, development of plans and specifications for maintenance dredging activities, and operation and maintenance repairs which involve design decisions. Perhaps some Operations Division elements have done this because the Engineering Divisions did not respond to this customer as quickly as needed. A reconsolidation where this has occurred is needed and engineering input to the funding decisions on the O&M account is essential.

APPENDIX IV:

Report on Improved Career Development for the Engineer and Scientist Workforce

by

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1. INTRODUCTION

1.1 Study Objectives

The purpose of this study is to assess the impact of the Corps of Engineers Career Development Program on attracting, developing and retaining technically capable personnel within the engineering function.

1.2 Background to the Study

1.2.1 Blue Ribbon Committee

A study of career development activities was prompted by a prevalent concern of the OCE Blue Ribbon Committee that the Corps is no longer attracting the top-quality technical graduate; that technically capable engineers and scientists are leaving the workforce and advancement opportunities for technical specialists are not comparable with opportunities for individuals who choose supervisory and managerial positions.

1.2.2 Subcommittee on Career Developments

Based upon its conclusion that an in-depth assessment of career development factors was needed, the Blue Ribbon Committee established a subcommittee to conduct a study of career development as part of a larger study on the status of technical capability of Engineering Divisions. The subcommittee was assigned responsibility for gathering and assessing data on educational and experience factors, developmental opportunities, retention factors, rotation, registration, pay, professional development, mobility, performance standards, hindrance to development and quality indicators.

1.2.3 Survey of Engineering Division, Engineer and Scientist Workforce

To determine whether its perceptions of current technical capabilities were shared by engineers and scientists in the field, the OCE Blue Ribbon Committee obtained a cross-section of views by use of a survey administered by the Institute for Water Resource (IWR). Results of the survey are presented elsewhere in the Committee's report. Segments of field survey deal with current perceptions of problems in career development and identifies possible solutions to issues related to maintaining a technically capable workforce in Engineering Divisions. The survey results contributed substantially to work of the Subcommitte on Career Development and provided confirmation that many perceptions and concerns of committee members are broadly shared by members of the workforce in field offices.

1.3 Career Development Factors Evaluated

Seven factors bearing on the career development of engineers and scientists are evaluated in this study. Any one factor, if not accorded top-management attention, can contribute to a further decline in technical capability of Engineering Divisions. The major areas of study are:

a. Career Ladder for Technical Specialists

b. Recruitment

c. Training

d. Pay and Benefits

e. Retention

f. Professional Development

g. Technological Innovation

1.3.1 Career Ladder for Technical Specialists

The Army Civilian Career Program for Engineers and Scientists (CPR 950-118) prescribes establishment of career goals for each engineer and scientist positions at the GS-13 through GS-15 levels. The career path inherent in the system deals predominately with supervisory and managerial qualifications and is oriented toward the future selection, training and placement of personnel into key managerial positions. This current emphasis on career development for supervisory personnel is confirmed by the field survey. Administrative skills are seen by 73 percent of the engineer and scientist workforce as important to extremely important for advancement to higher grades. At present, highly technically capable engineers and scientists have three basic career options -- choose advancement to supervisory jobs, be content with a long-term career at the GS-12 level as a technical specialist, or find employment outside the Corps of Engineers.

Section 2 of this study examines the problems of career progression of technical specialists and identifies a model career program to recognize, maintain and enhance superior technical capability within the engineering function.

1.3.2 Recruitment

Technical capability of the workforce is sustained by an intake of highly qualified engineer and scientist graduates. It is the Committee's perception that the Corps is attracting graduates of lower academic standing and is losing many of its best junior-level engineers and scientists from Engineering Divisions. The field survey indicates that 82 percent of the engineer and scientist workforce believes that failure to attract and recruit highly capable technical professionals will be a major problem facing Engineering Divisions in the next several years.

Section 3 of this study assesses the most important factors considered by technical graduates in choosing to join the Corps of Engineers and suggests areas of needed improvement.

1.3.3 Training

This subcommittee is concerned with the extent to which Corps training programs are effective in enhancing technical capabilities in such areas as design of structures, geology, soils and materials assessments, and the

production of technical engineering designs. The survey of the field workforce points out that significant improvements can be made in developing training needs and administering training programs to maintain and enhance technical capabilities of Engineering Divisions.

A discussion and assessment of training is provided in Section 4 of this study.

1.3.4 Pay and Benefits

Pay scales for engineers and scientists are a significant factor in recruiting highly capable professionals and in maintaining job satisfaction within the workforce. Pay compression, low starting salaries for technical specialists and Federal pay scales that are below those of the private sector contributes to the problem of retention of highly capable technical engineers and scientists.

In Section 5, the subcommittee assesses pay and benefits for engineers and scientists within the Corps' engineering function and contrasts those with salaries and compensation of technical experts outside the Corps of Engineers.

1.3.5 Retention

Is the Corps likely to loose its most technically capable workers? It is the perception of subcommittee members that the morale of Engineering Divisions is at a low ebb. Confirming this, the survey of the field workforce indicates that 80 percent of engineers and scientists in Engineering Divisions are inclined to seek a change of jobs if given an opportunity. In Section 6 of this study, the subcommittee examines factors influencing job satisfaction and identifies needed improvements to help retain and improve the technical capability of the engineering function.

1.3.6 Professional Development

Section 7 of this study provides an assessment of professional activities of the engineer and scientist workforce of the engineering function. While a higher proportion of highly technically capable individuals are professionally certified, the level of professional activity of 83 to 89 percent of the engineer and scientist workforce is very low. Eighty-six percent never have published a professional article and 82 percent do not participate in National Engineers Week activities. Yet, the IWR survey identifies professional activities as a key indicator of technical capability of the workforce. The subcommittee identifies several aspects of professional development that needs improving to enhance the technical capability of Engineering Divisions.

1.3.7 Technological Innovation

The subcommittee is concerned with whether the engineer and scientist workforce in Engineering Divisions of the Corps are provided and encouraged to utilize state-of-the-art methods and technology in engineering applications. For example, new graduates would expect to routinely utilize computer terminals and desk-top computers in engineering design applications.

Section 8 of this study assesses current field utilizations of a range of advanced technology. Also, it identifies areas in need of emphasis to maintain and enhance the technical capability of Engineering Divisions.

1.4 Conclusions and Recommendations

Pertinent conclusions stemming from studies of the seven career development factors are included in the respective sections of this report. Recommended actions, where applicable, are included in the main report of the OCE Blue Ribbon Committee.

2. CAREER LADDER FOR TECHNICAL SPECIALISTS

2.1 Purpose

One of the greatest challenges confronting the Corps of Engineers management concerns how to maintain essential technical capability in its workforce under prevailing constraints of declining workload, pay compression, lack of employee mobility and reduced manpower strength. This section provides an analysis of career planning and advancement opportunities for the highly technically capable engineers and scientists within the Corps' engineering function and assesses the impact of the present career management process on technical capability.

A specific career planning and management system for technical engineers and scientists is suggested in this section and a comparison is made with programs of private engineering firms and with other agencies including the Bureau of Reclamation and TVA.

2.2 Background of the Study

2.2.1 Subcommittee Evaluation

The Army career program for engineers and scientists was reviewed by the subcommittee to determine its adequacy in the following areas:

a. For career planning and advancement of highly qualified technical engineers and scientists based upon the individuals progressive development of their technical knowledge, skills and abilities.

b. The adaptability of the present career system to provide more specific career management for technical specialists.

c. The impact on technical capabilities of the engineering function of accepting the status quo, versus initiating efforts to define a separate career ladder for highly capable technical engineers and scientists.

2.2.2 Technical Careers in Private Engineering Firms

The professional standing of private consulting engineering organizations often depends upon the level of technical capability demonstrated in engineering analysis and design.

As part of the study, members of the OCE Blue Ribbon Committee visited several private engineering organizations to evaluate their policies and experiences in the area of career ladders for technical personnel. Private engineering firms almost exclusively employ separate career ladders for managers and for technical experts. Private firms typically provide advancement opportunities and salary levels in proportion to an individual's value and contribution to execution of the firm's technical engineering program. Accordingly, the salary of engineers and scientists in private engineering firms, who develop high technical ability, often exceed that of the head of administrative units to which they are assigned.

2.2.3 Survey of the Corps Engineer and Scientist Workforce

A survey of field perceptions of career development and its impact on technical capability was conducted by the OCE Blue Ribbon Committee. Following are several pertinent opinions of field engineer and scientist personnel within the engineering function:

a. Almost one-half of the engineers and scientists within the engineering function feel dissatisfied with the Corps career system and feel the system is ineffective for career planning purposes.

b. A majority (58%) does not believe the current promotion system is fair in the sense that the most qualified person is selected.

c. Seventy percent believe there is a lack of promotion opportunities within Engineering Divisions for technically capable engineers and scientists.

d. Administrative skill is seen by 73 percent of the workforce as important to extremely important for advancement to higher grades.

e. Eighty-two percent believe that technical specialists become supervisors because they have no other avenue for grade increases within the Corps. This is perceived, in many instances, as a misuse of valuable technical resources.

f. If promotion opportunities were available for nonsupervisory technical engineers and scientists, 68 percent of the workforce surveyed indicate they would establish career goals in a technical rather than managerial area.

g. A majority of the field engineer and scientist workforce (62 percent) agree that establishment of a separate career ladder for technical specialists would have highly positive results in enhancing the technical capability of Engineering Divisions.

2.4 Contribution of a Technical Career Ladder to Maintenance of Technical Capability

Establishment of a career system that would provide opportunity for setting specific goals for a technical career in the engineering function would produce the following positive effects on the Corps' technical capability:

a. A visible technical career ladder in the Corps would be a valuable aid for recruiting, developing and retaining highly qualified technical engineers and scientists.

b. A defined technical career program would enable individuals to examine career objectives and establish goals to advance to progressively higher levels of technical challenge as they enhance their individual technical knowledge, skill and ability.

c. An identified career management system for technical specialists will help both in establishing training needs and individual development plans for individuals to best equip them for achieving technical career goals and objectives.

d. A technical career management plan within the Corps engineering function would be strongly supported by Professional Engineers in Government, by the Committee on Civil Engineers in Government, by ASCE and by other professional organizations.

e. A Corps of Engineers technical career program would be a significant stride to more effective utilization of engineering talent in the organization and would provide a continuing cadre of technically capable engineers and scientists. This obviously is critical to support of the Army and to insure effective mobilization preparedness.

2.5 A Proposed Technical Career Program for Engineers and Scientists

A career management system for technical specialists is proposed in this section.

2.5.1 Career Program Objectives

A career program for technical engineers and scientists is intended to systematically develop a cadre of specialized experts in fields crucial to maintaining the Corps' capability for design and construction and its mobilization readiness. The program means that career opportunities would be broadened. These would not be limited to management to insure challenging work, stature and advancement, but also would single-out and distinguish those highly technically skilled engineers and scientists as well.

2.5.2 Separate Supervisory and Technical Career Paths

The proposed program would establish an alternative path for those whose objectives, motivation and abilities point toward technical specialization. Of course, some will want to develop both technical and management skills to optimize opportunities at the lower professional levels. As noted in Figure 1, an entry engineer could remain flexible in determining career goals to about the GS-12 level. At that point, an individual could, in a career planning setting, choose either to specialize in a technical discipline or to proceed to develop more interpersonal skills and advance along the supervisory and managerial path.

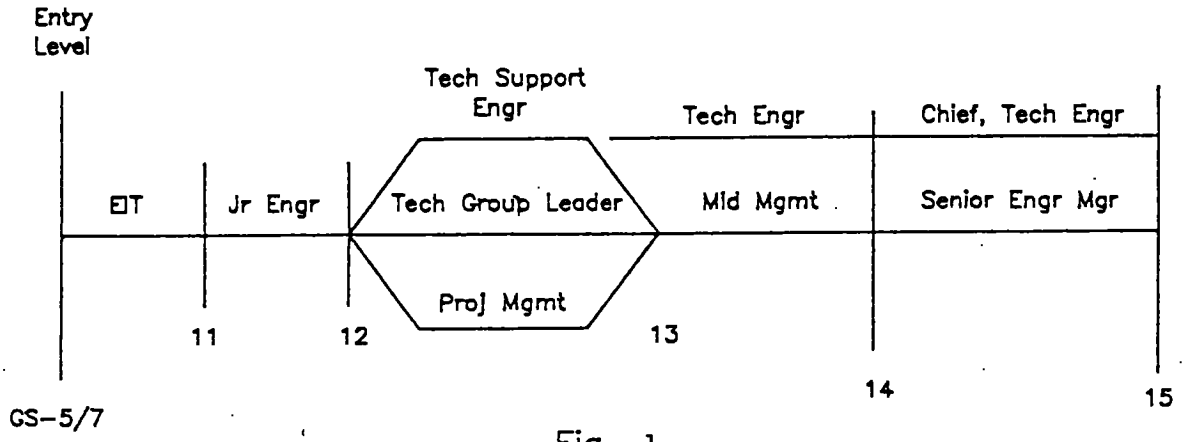

Fig. 1

Dual Career Ladder

Of course, because of organizational constraints and differences in individual capabilities, there would be no guarantee that every engineer will become an outstanding technical specialist or a top-level manager. The success of each individual in reaching career objectives will continue to depend on ability and opportunity.

2.5.3 Technical Specialty Areas

Specialty areas which would be deemed essential to technical activities in the Corps are varied and would include the fields of hydrology, hydraulics, geology, soils, materials, structural, mechanical, electrical engineering as well as scientific areas of economics, biology and other fields. Commanders and division heads would determine which specialty areas are needed in their program to fulfill the mission. The system would be flexible so that areas could be added, modified, or deleted from the program to reflect changing program needs and individual capabilities.

2.5.4 Technical Career Board

A technical career board would be formed to administer the operation of the technical career program. The board would consist of chiefs of Engineering, Construction, Operations and Planning functions and the Personnel Management Office.

2.5.5 Technical Specialist Designations

Referring to Figure 1, engineer and scientist positions in the program include technical support engineers and chief technical engineers.

2.5.5.1 Chief Technical Engineers

Chief technical engineers are the Corps' leading experts and consultants in their areas. Their titles (i.e., Chief, soils engineers, chief, hydroelectric engineer) reflects their stature. They are in staff positions reporting to division or branch chiefs. Since they have no managerial responsibilities, they are able to more freely apply their technical expertise wherever needed.

2.5.5.2 Technical Support Engineers

Technical support engineers would be at the GS-12 and GS-13 level in workload positions. They are competitively selected for the technical career program and must demonstrate outstanding potential for eventual selection as chief technical engineers. Technical support engineers are specialists in their discipline area and would retain their title as they are reassigned or promoted. Their title, therefore, under this concept is given to a person and is not attached to a position or organization. Since this engineer or scientist fills a workload position and the activities are added responsibilities, no additional positions are needed for this part of the program concept. The numbers and types would be determined by the board and approved by the commander.

2.5.6 Career Development for Technical Engineers and Scientists

To develop expertise, technical support engineers would be given priority consideration for attendance at professional meetings, working groups, and training would be included in the Army civilian career system for referral to expert positions throughout the Corps of Engineers, in both civil works and military engineering programs.

2.5.7 Position Classification Procedure

Position classification procedure for this program would be based upon indications of technical expertise requirements.

- The list of papers prepared for publication in technical journals or delivered before symposiums, etc.
- List of research and development projects completed or in progress.
- List of registrations, honors and awards.
- List of memberships and participation in professional engineering societies, study groups, etc.
- As illustrated through consultant assignments, correspondence, position papers, studies and analysis, the technical contributions to the state-of-the-art in the field of specialization.
- List of patents, or license attained or pending.

2.5.8 Career Panels for Determining Qualifications for Technical Career Positions

To be rated as qualified for these positions, individual applicants would prepare career documentation which would be reviewed by a peer panel appointed by the board. This panel would be convened biennially to review chief, technical engineering positions and to review the qualifications of the

technical support engineer registrants. Members of the panel would be qualified to evaluate the complexity of positions as well as the contributions and stature of the incumbents and applicants. This panel at a minimum would consist of:

- An engineering professor
- A renowned retired Corps senior engineer
- A senior specialist from a pertinent field from another agency or private engineering firm
- A branch or division chief from an organization which will have closest external interface with the chief technical engineer position or individual being evaluated.

The organization's senior classification specialist would advise and assist. Biennially the panel would review individuals to determine:

a. The manner and quality of performance as reflected through official reports from the supervisor.

b. Qualifications which the incumbent has added to those possessed upon original selection.

c. Whether the combination 1 and 2 above constitute sufficient additional capability and acceptance to warrant promotion to the next higher grade.

d. Whether the incumbent must improve his performance qualifications and acceptance to warrant advancement.

2.6 Summary of Experience of Other Federal Agencies in Establishing Career Ladders for Technical Personnel.

During the course of this study, the subcommittee interviewed several other Federal agencies to determine their practices and experiences with similar issues of career management for technical personnel. In this connection, contact was made with the Bureau of Reclamation, Tennessee Valley Authority and Bonneville Power Administration.

2.6.1 Bureau of Reclamation

U.S. Bureau of Reclamation senior managers in regional offices and in the Engineering and Design Research Center (ERC) indicate they recognize the need for a career program ladder for technical specialists. However, the Bureau's current career management system is similar to the Corps'. That is, technical specialists must transfer to higher headquarters to achieve career advancement. No specific career management is provided to insure the most technically capable engineers and scientists are identified early and developed so as to be available for future advancement to those top level expert positions. An informal technical career ladder has been established in the ERC whereby technical specialists have the opportunity to obtain grade levels commensurate with their expertise and value to the organization.

2.6.2 Tennessee Valley Authority (TVA)

While TVA has a formalized career program for technical engineers and scientists, it has established administrative policy that permits the advancement of experts to the equivalent grade of section and branch chiefs of the administrative salary scale. Under this administrative rule, several experts have been advanced to the equivalent grade of section, branch and division heads. However, the TVA policy does require that the actual salary of the technical specialist should not exceed that of the administrative chief. TVA expressed interest in coordinating with the Corps in developing a more specific career program for technical personnel.

2.6.3 Bonneville Power Administration, Department of Energy (BPA)

In June 1978, BPA implemented a technical career program for professional engineers. Their program has been reviewed by the Office of Personnel Management. The administration of BPA reported that the program has proven very successful in giving appropriate recognition and advancement opportunities to the highly capable technical engineers and scientists of his organization. The technical career program proposed in paragraph 2.5 above is patterned after the BPA system.

2.7 Study Findings

The subcommittee considers the separate career ladder option outlined in this study to be a significant step for career development and management of technical experts within the Corps of Engineers. Significant study findings are:

a. An identifiable career path for technically qualified engineers and scientists would prove highly beneficial in attracting, developing and retaining technical capabilities in the Corps of Engineers. Those individuals committed to achieving technical excellence as a career goal would be able to improve their expertise and to extend their service to support the Corps, civil works and military programs.

b. Taking positive steps to implement a technical career program would provide a significant management response to field engineers and scientists who share a widespread belief that such a program would greatly help attract, maintain and enhance technical capability in the Engineering Divisions.

c. Most professional engineering firms and agencies contacted by the subcommittee have an equal concern with this issue and are seeking to properly recognize and compensate technical capability comparable to the recognition of career development for engineering administrators and managers.

d. Bonneville Power Administration has implemented a significant technical career program with highly favorable results.

3. RECRUITMENT

3.1 Introduction

This section will explore the role of recruitment (both at the entry level and advanced technical specialist level) in maintaining the Corps' corporate engineering capability and assuring capability of the individual engineer within an Engineering Division. Of importance will be an evaluation of both quantity and quality of the supply of engineers and the impact of recruitment practices on success. The importance and criticality of the recruitment issues, at least in the minds of the respondents to the IWR survey, are reflected in replies to the following two statements:

a. 1-8. On balance, the Corps recruits and attracts the most highly competent engineers and scientists. Replies were -

Strongly agree	= 1 percent
Agree	= 14 percent
No opinion	= 16 percent
Disagree	= 53 percent
Strongly disagree	= 16 percent

2. 1-9. The failure to attract and recruit highly capable technical professionals is likely to be a major problem facing Engineering Divisions in the next several years. Replies were -

Strongly agree	= 27 percent
Agree	= 55 percent
No opinion	= 8 percent
Disagree	= 10 percent
Strongly disagree	= 1 percent

The overall reduction in civil works workload, with a concurrent reduction in staffing needs, has a dramatic impact on recruitment requirements. Recruitment must still, however, replace the shortage should attrition through retirement and employment mobility exceed the necessary reductions in staffing level. The demand will be for selective recruitment to replace the loss of critical skills and to fill vacancies with the highest quality recruitment possible. Recruitment must concentrate not only on the recent college graduate, but also on those entering the Corps from other sources. The IWR survey indicates that 34 percent of the respondents entered the Corps through college recruitment, 4 percent from the cooperative education program, 14 percent transferred from another government agency, but 47 percent were hired from an open announcement.

3.2 Impacts of Recruitment on Corps' Capability

As the Corps' engineering workforce matures and ultimately leaves either through retirement or movement to management or other employment, one of the most important factors influencing the maintenance of engineering capability will be the effective recuruitment, placement and retention of the proper numbers of engineers and technical support staff, with required ability, education and/or experience to perform the assigned missions. Thus, effective

recruitment and then retention are the bases for maintaining the Corps' corporate and individual engineering capabilities. Inherent in this statement is the assumption that the Corps will have a job (workload) to do. The recruitment of a supply of both new engineering graduates, experienced engineering specialists, and skilled technical support staff provides the needed ingredient (staff) to train, obtain experience, and perform in a capable and competent manner. Without the continued intake of engineers and technical support staff with high potential to take the place of those leaving through retirement or employment mobility, the capability of the Corps to accomplish its assigned workload will rapidly decline.

3.3 Internal Factors Influencing Recruitment Success

The following internal factors impact directly on recruiting success:

a. The quality of the recruitment effort must be examined. Are the advantages of a career in the Corps being effectively presented in the placement interview? Is advance publicity and effort attracting sufficient interviewees and applicants? Does the interview team include a young, articulate, enthusiastic and empathetic engineer? Are Corps-wide career opportunities effectively communicated? Is the Corps' career development program defined?

b. A declining Corps of Engineers' water resources workload has a dramatic impact. This factor can significantly influence the applicants' perception of the availability of challenging work and major projects, opportunities for advancement and job security. Declining workload has a pervasive and negative influence on recruitment success.

c. A noncompetitive compensation system, including both lower entry salaries and a relative decline in the fringe benefit package, eliminates any competitive edge the Corps' recruiter may have enjoyed in the past. This is consistent with results of the IWR survey in which 67 percent of those replying disagreed that benefits for a technically capable engineer or scientist within the Corps are as good as those in private industry.

d. The practice to place a substantial portion of water resources work in the hands of architect-engineer firms increases outside competition for the engineer or recent graduate looking for employment, reduces the in-house hands-on work challenge, and broadens to a wider choice of employers the opportunities for those interested in working in the water resources field thereby reducing the Corps' chance of success in recruitment. We, in effect, are creating a segment of our own competition. In the IWR survey, 31 percent of those replying were of the opinion that 26-50 percent of the Engineering Division technical work was being done by private A-E contracts and 22 percent thought the percentage was between 51-75 percent. Sixty-three percent indicated they thought the level of A-E contracting would increase during the next 2 to 3 years.

e. The creation of a challenging and comprehensive career development and training program with competitive, multiple-track career paths, rapid advancement, and effective delegation of responsibility will appeal to many job applicants interested in water resources career advancement even though

the overall salary/compensation package may not be highly competitive. Seventy percent of the respondents to the IWR survey agreed that there is a lack of upward mobility within Egnineering Divisions for technically capable engineers and scientists.

f. The Corps' engineer career intern program and cooperative education programs are positive influences in attracting new college graduates and should be effectively described during placement interviews.

3.4 External Factors Influencing Recruitment Success

The most important outside factor is the overall condition of the marketplace. If few private employers would be hiring, there would be no outside competition, jobs would be scarce, and the Corps could fill its needs with high quality candidates. Secondly, the location of the job is becoming increasingly important because of the high cost of living in certain regions of the country, desirability of climate, and decreased mobility of the work force. The attitudes of the job applicants toward Federal employment, in general, and their perception of the Corps, in particular, as a "good" place to work is paramount. This can only be influenced by an effective Corps' information program though the total recruitment process, in particular, and the media, in general, to positively display the overall image of the Corps as a challenging, professional, and responsive agency serving the Nation in the water resources, natural disaster and national defense areas. Results of the IWR survey revealed that 78 percent of those replying indicated that geographic location was important in making a choice to join the Corps, 75 percent said that opportunity for professional or career advancement was important, and 71 percent said technical challenge was important. Following these items were fringe benefits at 64 percent indicated importance, job security at 63 percent, and the level of pay at 60 percent. These same factors, with approximately comparable percentages, were listed as important factors in choosing to remain with the Corps.

3.5 Study by the Joint Logistics Command (JLC)

In November 1981, the Joint Logistics Commanders published a study on civilian engineer recruitment, retention, and use throughout the Joint Logistics Commands. Several observations of that study are pertinent to this evaluation. The first is the private sector offers new graduates a minimum of about $3,000 more in starting salaries than the Federal sector at the GS-7 level, but this does not reflect the added amount industry pays to the quality graduate (one with a high grade point average). The second relates to the effectiveness of recruiting practices. Interviews with college and university officials resulted in recommendations that Federal recruiters "need to keep in closer contact, improve (their) image, present more precise information about jobs, spend more money on their recruiting program, conduct a more effective advertising program, and do as good a job of selling their engineering opportunities as are private firms." The most frequently stated advice was "pay more money," "raise the salary structure," and "offer better salaries." The JLC study resulted in two recommendations. The first, to pay salary differentials to engineers GS-7 through GS-11 based on superior academic achievement. The second would credit engineering cooperative education or comparable experience as professional experience when determining entry

qualifications. Both recommendations are directed at providing increased entry pay in order to attract and retain high quality engineers. These recommendations, in themselves, would lead toward further pay compression within the overall inplace engineering staff and could contribute to a reduction in the credibility or perception of the engineering capability or competence at the GS-11 and perhaps GS-12 levels. It could also have an adverse impact on the perceived value of capability or competence achieved through in-house experience in the GS-5 to GS-11 levels. To be totally effective, these recommendations would have to be combined with the elevation of the journeyman engineer level to the GS-12 grade level, added qualifications credit for experience gained within the engineering organization, and flexibility in pay setting to avoid further salary compression. Crediting cooperative education as professional experience could, in fact, be counterproductive when viewed in the context of overall engineering capability.

3.6 Evaluation

To assure the proper level of recruitment of highly qualified engineers and technical support staff into the Corps' workforce, the following actions are necessary and are recommended:

a. Assure enthusiastic engineer involvement in the total recruitment effort. This effort should be both formal through participation on the recruitment team and informal in that each engineer in the Corps can be an effective recruiter through his/her outside contacts. The innovative use of special acts or other awards for success in recruiting initial skills may encourage effort by the in-house workforce.

b. The Corps' recruitment programs should be evaluated and enhanced to match those of the other Federal agencies and private industry with whom we must compete for both new college graduates and experienced specialists.

c. The Corps should work toward achieving comparability and competitiveness in entry level salaries through appropriate starting level salary adjustments, including salary differentials based on academic achievement. This program must be coupled with appropriate understanding of the adverse influence caused by salary compression. Thus, experience gained within the organization must also be rewarded.

d. An effective public information program is needed to publicize the major positive accomplishments of the Corps, the challenging professional nature of our work, the permanence of our organization, and that the Corps is a good place to make a career. This item focuses on the necessity for displaying our positive image to both the internal workforce and the public. This activity must be conducted with sensitivity to avoid the perception of being self-serving or pure promotional activity. A number of offices have sponsored student visits to project sites with a high degree of success.

4. TRAINING

4.1 Introduction

Of all the factors that influence individual and coprorate technical capability, training in its broadest sense is the one activity most directly under the control of first- and second-line supervisors or managers. Also, effective training within each section or branch will have the most immediate and direct impact on maintaining and improving both corporate and individual technical capability. Thus, the manager or supervisor has substantial control over the maintenance and development of technical capability within the engineering function. Supervisors and managers must, therefore, be directly involved in the training program for the work-force and accept this responsibility as one of their most important duties. Training in this context includes not only short- and long-term formal classroom situations, workshops, seminars, professional meetings and technical conferences but also informal on-the-job experience, the career intern rotational training program, and self-development activities.

This section will explore the impacts effective training has on technical engineering capability. Thus, the emphasis will be on technical and professional training rather than supervisory and managerial training. It is not the intent to down-play the importance of this latter type of training but to recognize the importance of the former. Many feel that, in recent years, supervisory and managerial training has been emphasized at the expense of technical and professional training. It is the technical training that has the most direct impact on engineering capability. The Committee does not mean to imply that the technical training provided is either ineffective or inadequate. However, the Institute for Water Resources survey of engineers and scientists within Engineering Divisions found that 51 percent of the respondents agreed that the Corps provided them with sufficient training opportunities to remain technically competent, but only 35 percent agreed that the Corps has enough training for technical specialists. The survey found that only 20 percent of the respondents agreed that the Corps has too much training for managers, and only 26 percent agreed that managers are sufficiently trained in how to give a performance appraisal. As a basis for comparison, interviews conducted in this study with a number of architect-engineer firms found that these firms placed less emphasis on formal technical training to maintain technical capability than do most Corps offices.

A number of indirect benefits accrue in the area of corporate engineering capability because of an effective and well-publicized training program within the Corps. These are the positive impacts training has on the image of the Corps' expertise within the broad engineering profession and amongst the public at large, the retention value of training as an incentive to the individual to remain and develop a long-term career in the Corps, and as an inducement to the young engineer during the recruiting process.

As training is tied directly to mission and technical demands of workload, an effective training program to maintain and develop technical capability is very dependent upon the level of workload within the Engineering Division, plus the technical complexity and challenge of the workload. If the workload

is small and with little technical challenge or demand, the need for training to maintain capability is substantially reduced. The following paragraphs will evaluate first, the less formal or on-the-job types of training; next, the formal classroom or conference activity; and finally, a number of impediments to effective training.

4.2 Engineer Intern (Rotational Training) Program

The engineer intern program is a 12- to 18-month series of rotational assignments throughout the district office in the areas of engineering, planning, construction and operations. Based on the needs of the individual and the office, assignments may also include the computer center and a number of laboratory and field activities. The objective is to provide a well-rounded orientation of Corps engineering activities but not to develop a high level of specialized technical knowledge. The assignments are on-the-job and provide the young engineer the hands-on opportunity to apply knowledge gained during his academic career. An important aspect of the rotational assignments is to provide insight into the interrelationship of the many engineering specialties necessary to plan, design, construct and manage a water resources or military project. To be effective, the rotational assignments must provide meaningful and challenging work, but must also be under the direction and guidance of senior, experienced engineers willing to share their experience and advice. The IWR survey found that rotational career intern training was perceived by 13 percent of the respondents as being highly effective in enhancing the Corps' technical capability. Of the respondents 32 percent found career interns effective, and 25 percent found career interns to be marginally effective in enhancing technical capability.

The rotational training program should be flexible to meet the changing needs of management and the workload, but also the desires of the young careerist. This is important when determining time to be spent in civil works, military programs and facility engineering activities. The formal and fixed criteria for the facility engineering field, in particular, needs flexibility to meet district needs.

Rotational experiences in a number of engineering fields will help young engineers determine where their interests lie and help them make a choice of specialization. This part of the rotational program is a valuable recruitment incentive and should be highlighted in the recruitment and placement interview.

4.3 Experience and On-the-Job Training

Experience is the adhesive that binds a comprehensive training program together and assures both individual and corporate capability. On-the-job experience does the following:

a. Develops capability to identify, define and solve problems using knowledge and capabilities gained in the past through formal and informal training.

b. Develops competence and confidence in applying procedures, techniques and using tools.

c. Develops confidence and understanding to apply state-of-the-art procedures.

d. Develops sound judgment and insight in problem resolution and application of technology.

The IWR survey revealed that 65 percent of the respondents felt that starting a major program of on-the-job training would have a positive impact on the Corps.

Either during the rotational training program or early in the engineer's career, experience in a soils or hydraulics laboratory; on a drilling crew or topographic survey party; in field economic data collection, stream gaging, flood intelligence work, flood fighting, periodic inspection program, or construction inspection is invaluable in developing background to become a highly capable engineer. Of those responding to the IWR survey, 66 percent agreed this field or laboratory work should be done in-house. As workload declines, work is given to architects-engineers or is consolidated either through formation of tailored districts or design centers, the opportunity for the engineer to gain field and laboratory experience declines and, thus, can reduce overall corporate capability. This can be offset by sending the young engineer to locations where this experience can be obtained. Mobility limitations and reduced travel funding targets have an adverse impact and can severely limit the opportunity. The value of laboratory and field experience as a hands-on training experience to develop technical capability and insight needs the constant attention of supervisors and managers.

Details to, cross-training, or developmental assignments between districts, offices or laboratories can be used to maintain capability in some specialties, broaden the experience base and perspective, or to develop and transfer new ideas between offices. Here again, lack of mobility and travel fund limits are impediments. A value of cross-training is to develop not only a primary specialty, but also a secondary capability. This is important when offices are faced with declining staff. The flexibility of the organization can also be maintained to accomplish different future missions. Cross-training to a military district is particularly important to a purely civil works district to gain capability in military design and construction and to be able to assume a mobilization mission.

Specialized cross-training within a broad technical area, such as water quality, reservoir regulation, and flood studies within hydrology for example, will provide the individual with a broadened background and experience in a number of different types of projects or narrower technical areas. To be effective, cross-training and other on-the-job training must provide meaningful tasks supervised by qualified managers, work must be reviewed by experienced specialists, and specific activities to be covered should be identified in advance. Thus, success can be measured against a predetermined set of expectations and criteria.

The training and experience value of technical review by technical specialists should not be overlooked. Therefore, at the district level, the relationship between the technical specialist and the working level production engineer should be developed to encourage transfer of knowledge and experience. An

inordinate emphasis on schedules and deadlines can reduce the value of this relationship as a training experience. The tutoring and mentor relationship between the senior and junior engineer should be fostered, but is also impacted by the emphasis on quantity at the expense of quality. Supervisors and managers must develop and encourage a positive atmosphere and attitude toward developing the capability of the young engineer and the importance of transferring knowledge from the senior, experienced engineer to others.

The development of design centers can be a positive factor in protecting and consolidating expertise, knowledge and experience, but the responsibility of these centers to pass on the knowledge and train others cannot be ignored. The centers can be used to develop and keep current on state-of-the-art and train and develop technical specialists.

4.4 Formal Short- and Long-Term Training

In addition to on-the-job training and experience, formal classroom training is necessary to keep current with emerging state-of-the-art technology, to obtain specialized training not now available in-house, and to gain the speed and efficiency of the classroom setting. This is also one of the few ways to gain the knowledge needed but not now available within the district or Corps. This type of training spans from the more or less formal seminars and workshops in a Corps office, technical and professional meetings and conferences by the engineering societies, formal training classes by the laboratories and specialized offices, up to and including the formal college or technical school classroom activity. The objective is technology transfer, the improvement of knowledge, and expansion of experience. Short- and long-term professional training was viewed by respondents to the IWR survey as being effective in enhancing Corps technical capability. The results are as follows:

	Highly Effective	Effective	Marginally Effective	No Effect	No Opinion
Long-Term Professional Training	14	41	24	5	10
Short-Term Professional Training	15	47	24	4	8

Thus, it would appear from the results of the IWR survey that the Corps' formal training program is effective. Current level of training in most Corps' offices is judged to be between 2-4 percent of the workhours available; that is, between 40-80 hours per person per year. Actual level should be determined by the training needs survey.

Short-term training (defined generally as a 1-day to 2-week course but including any training less than 120 days) should be tied to the short-term and immediate need to get the job done; whereas, long-term training (in excess of 120 days) can concentrate on the overall maintenance of capability, state-of-the-art technology and future missions. The training should consider not only the needs of the district, but the career development goals of the

individual. As part of the performance appraisal process, the individual and supervisor should, together, develop an Individual Development Plan (IDP) to include the training needs of the individual and also the mission and workload of the district.

Training should be a planned activity, based on a training needs survey with individual involvement, considering career development, evaluation of the needs of the district and Corps based on current and projected workload, the funds and time available, and an assessment of current capability. All levels of management need to be directly involved in the training needs survey and development of an annual training plan. The IWR survey showed that 34 percent of its respondents agreed that the Corps' training system is effective in recognizing training needs, whereas 53 percent disagreed.

To encourage long-term training, it may be necessary to increase central Corps funding. Budgets and funds need to be identified in advance of each fiscal year. Funds for training and travel should be allotted with a priority to formal technical courses and seminars of the technical and professional societies rather than the promotional and trade organizations. Meetings of the professional and technical societies should be recognized as valuable sources of training to enhance Corps capability. The formal training should take advantage of the in-house learning center concepts now available, including programmed instruction, multimedia (video tapes, etc.), and correspondence instruction. Formal courses developed by the Huntsville District can be valuable sources of training. These courses should be developed and offered based on identified training needs, should be of high quality using skills of both in-house and out-of-house instructors, and the scheduling of courses should be fixed well in advance early in the training or fiscal year.

Also, to enable engineers to see where they are going and where their future lies, it may be necessary to develop a separately identifiable technical career track or ladder leading to highly rewarding positions and salary. To be successful, the commitment and time spent on training must provide a return to the individual in advancement, increased responsibility, increased salary and added recognition, image and reputation.

4.5 Self-Development

When dealing with professional engineers, the concept of self-development must be an important factor in any training or career development program. The professional must take responsibility for his individual capability and the corporate capability of his employer. The responsibility cannot be left totally in the hands of others. Of importance to the Corps is the encouragement, incentive and positive opportunity for motivation that is furnished.

What is the payoff to the individual professional in terms of opportunity for challenge, reward and career advancement? Will the professional be rewarded by more than self-satisfaction for personal involvement in technical and professional engineering organizations or personally-motivated continuing education? Will the engineer be rewarded for obtaining an advanced degree or professional registration? Does the Corps encourage publishing papers in

technical or professional journals by providing time on the job to write the paper? Does the Corps' policy toward attendance at technical society meetings, payment for professional registration, or schooling for registration encourage this activity? Do these self-development activities have a positive impact on the engineering capability and image of the Corps? Positive steps should be taken to assure a positive answer to each of these questions.

4.6 Impediments to Effective Training

Following is a list of factors that reduce the effectiveness of training and the ability to maintain or improve the engineering capability of the Corps through training:

a. Low travel and training funding targets.

b. Course cancelling once scheduled.

c. Lack of individual mobility.

d. Policy restrictions on attending professional and technical society meetings.

e. An overemphasis on schedules and deadlines with a sacrifice in engineering quality.

f. Tailoring of districts as it influences broad mobilization response and military design capability.

4.7 Recommendations for Consideration

The following recommendations are offered to improve training as a means to maintain and improve individual and corporate technical capability:

a. Emphasize the career intern program as a valuable entry training experience. Each district should allot a minimum of about 50 percent of its annual recruitment needs to entry level engineers in the career intern program.

b. On-the-job training in soils or hydraulic laboratories, field surveys, construction inspection, and other technical field activities will provide young engineers the experience and insight in basic engineering functions. Details to consolidated design centers or retaining this capability in many Districts will promote this type of training.

c. Details and cross-training to offices with major projects, military programs, or specialized work will develop engineers with limited opportunities in their home office. Each engineer should be trained not only in a primary area, but also a secondary specialty to increase capability as the size of engineering staffs in reduced. Cross-training should be offered within each technical field to broaden capability.

d. Encourage the development at the district level of a positive relationship between senior engineers or technical specialists and the

inexperienced engineer to foster the passing on of experience. Emphasize the importance of developing the capability of the inexperienced engineer through in-house seminars and workshops.

e. Place a balanced emphasis on technical quality when managing schedules and deadlines. Project schedules should provide adequate time for technical review and technology transfer.

f. Training plans should be based not only on the needs of the Corps office to maintain capability, but also the needs of the individual for career development. Training plans should be based on a training needs survey, should have management review and input, and should result in an Individual Development Plan for each person.

g. Training should be programmed, budgeted and funded in advance each fiscal year. Once established, the plan for the year should not be reduced nor courses cancelled. Funding for long-term technical training should be expanded to include not only the OCE-sponsored long-term training, but also long-term training initiated at the District level. Overall technical and professional training should be funded at about 2-4 percent of the annual workhours. All funds for technical training (tuition and travel) should be identified separately when establishing overall targets.

h. Consider establishing separate technical career paths for the technical specialists to provide adequate reward, an identifiable future, incentive, recognition, salary, advancement, and increased responsibility. This feature would have a major positive impact on the retention of engineers once they gain capability and experience. Incentives and recognition should be provided for the completion of training.

i. Change policy to permit expanded opportunity for attendance at technical and professional society meetings, encourage writing papers on Corps time, reward and recognize advanced degrees, and reimburse for professional registration and for the schooling taken to prepare for registration. A clear policy statement is needed that identifies as training the attendance at technical and professional society meetings.

5. PAY AND BENEFITS

5.1 References

a. Total Compensation Comparability: Background, Method, Preliminary Results, Office of Personnel Management, July 1981.

b. The 1981 National Society of Professional Engineers (NSPE) Income and Salary Survey.

c. The 1981 Engineering News Record Salary Survey, Engineering News Record Magazine, May 28, 1981.

d. Survey of Engineering Division Engineer and Scientist Workforce: Institute for Water Resources, May 1982.

5.2 Benefits

5.2.1 General

The quantitative evaluation of benefits is a task which has eluded measurement until recently, when the Office of Personnel Management (OPM) released the results of a 7 year study to compare employee benefits for Federal and private employers (Reference 1). The results of this survey will be used in this comparison, with the exception that, in order to be conservative, in all cases where the data is more favorable to the Federal sector because of nonengineering personnel in the private sector, data from other sources will be used which will increase the Federal value of that benefit. All instances of variation from the OPM study will be noted.

5.2.2 Retirement

The OPM study compares favorably with other available data and indicates that, as expected, the Federal retirement plan has a higher value (28.2 percent of pay) than the private value (16.7 percent of pay). Most of this advantage is due to the fact that Federal employees can retire at age 55, with 30 years of service, without a reduction in benefits. Other reasons for this advantage are the fact that Federal annuities are fully indexed for inflation and some private employers provide no retirement benefits other than Social Security.

5.2.3 Health Insurance

Figures in the NSPE Salary Survey serve to reinforce the figures by the OPM. These figures indicate that Federal value is $760 per annum compared to a private value of $1,045 per annum. It should be noted, however, that since these studies were made Federal employees received increases in the cost of health insurance combined with a decrease in benefits.

5.2.4 Life Insurance

The OPM figures show the Federal value to be 0.3 percent of pay and the private value to be 0.5 percent of pay.

5.2.5 Secondary Benefits

These figures show the combined value of such benefits as profit sharing, stock purchase plans, bonuses, employee discounts on company products, employer-furnished automobiles, etc., are valued at 0.3 percent of pay for the Federal employee and 5.5 percent of pay for the private sector.

5.2.6 Scheduled Work

The OPM study indicates the private sector employee works 2,062 hours per year as opposed to 2,080 hours for the Federal employee. Since this is close to the same and is more conservative, this comparison assumes the same number of hours worked.

5.2.7 Leave

A value of 336 hours for a GS-12, step 5, for the Federal value and a value of 288 hours for the private sector was used in this comparison.

5.2.8 Summary of Benefits

A tabular summary of benefits is presented below. The salary values used for these comparisons is that of a GS-12, step 5, engineer ($30,543/annum) for the Federal value and the NSPE median income for civil engineers in general practice ($33,682/annum) for the private value. A 1981 base year was used in both cases.

Benefit	Federal Value	Yearly $ Value	Private Value	Yearly $ Value
Retirement	28.2% of pay	$ 8,601	16.7% of pay	$ 5,625
Health Benefits	$760/year	760	$1,045/year	1,045
Life Insurance	0.3% of pay	92	0.5% of pay	168
Secondary Benefits	0.3%of pay	92	5.5% of pay	1,853
Leave	336 hours/yr.	4,932	288 hours/yr.	4,663
		$14,489		$13,354

This would indicate that Federal employees enjoy an 8.5 percent advantage in benefits.

5.3 Salary

Engineering News Record states in their May 28, 1981 issue (Reference 3) that civil engineers in general practice have a median annual salary of $33,682. Based on Office of Personnel Management studies, a GS-12, step 5, is the average grade of the journeyman engineer working for the Federal Government. Using 1 January 1981 salaries for comparison with the ENR article, a GS-12, step 5, had an annual salary of $30,543. Therefore, on 1 January 1981, there was a difference of $3,139 between the salaries of engineers in government and the salaries of engineers in industry and private practice.

5.4 Total Compensation Comparison

By combining the above information, a comparison of the actual total compensation for the average engineer in the Federal Government, as compared to the average engineer in the private sector, can be obtained. The Federal engineer receives $30,543 per annum in salary and has benefits valued at $14,489 for a total compensation of $45,032. The private sector engineer receives $33,682 in salary and has benefits valued at $13,354 for a total compensation of $47,036. Thus, the Federal employee is compensated $2,004 less per annum than his private sector counterpart.

5.5 Employee Views Obtained from Questionnaire, Reference 4.

a. Seventy percent feel that pay scales are <u>not</u> competitive with private industry.

b. Sixty-seven percent feel that benefits are not as good as those in private industry.

c. Sixty-six percent favor instituting an Incentive Pay System.

d. Sixty percent do not believe the Corps merit pay system is effectively and fairly managed.

e. Sixty-five percent do not believe their pay is clearly related with job performance.

5.6 Recommendations

5.6.1 Pay and Benefits

Recommend that OCE continue to work with the ASCE Committee on Civil Engineers in Government, in cooperation with other Federal Agencies employing engineers, to establish a separate pay scale for engineers which brings total pay and benefits for Federal engineers into comparability with engineers in the private sector.

5.6.2 Retention of Engineers and Scientists

With the single exception of pay structure, all the factors which are perceived by employees to influence their decision to stay with or leave the Corps are presently within management control. It is recommended that Corps management at all levels strive: to improve job satisfaction by providing opportunities for individuals to acquire and use new skills and knowledge; provide feedback and recognition; provide opportunities for technically challenging work and provide opportunities to build professional reputations.

6. RETENTION OF ENGINEERS AND SCIENTISTS

6.1 Reference

Survey of Engineering Division Engineer and Scientist Workforce: Institute for Water Resources.

6.2 General

Retention of engineers and scientists presently in the Corps is central to the objective that this report addresses, Maintaining the Technical Capability of the Engineering Function. It is obvious the "Corps" itself has no technical capability, it is all vested with the engineers, scientists, and other professionals who make up the organization. If, for whatever reason, one of these individuals decides to leave the Corps, his or her expertise, ability and experience is lost to the organization. Therefore, the questionnaire results are extremely important in assessing why do people stay with or decide to leave the Corps. The questionnaire results are extensively analyzed in Sections 6 and 7 of reference 1. An extract of some of the most important factors are discussed below:

a. Job satisfaction. The Corps average in providing job satisfaction is similar to other Federal groups.

b. In general, management is more satisfied than are engineers and scientists.

c. Higher graded engineers and scientists are more satisfied than lower graded. The lower graded group comes into the Corps with high expectations concerning the professional development potential and technical challenge. This group is more inclined to feel that those expectations have not been met.

d. The most dissatisfied engineers and scientists tend to be less technically capable.

e. The ability of the job to allow the individual to grow and acquire new knowledge and skills; the ability of the job to make use of present knowledge and skills; to provide a good salary; the technical challenge provided by the job; and the opportunity to build a professional reputation are all rated as being at least fairly important by a majority of engineers and scientists.

f. Feedback and recognition. The majority of the Corps engineer and scientist workforce feels that it does not receive recognition for doing a good job.

g. Expectation of leaving the corps. Comparing the responses to a 1976 ASCE survey with the present survey indicates that no greater percentage of the Corps workforce is looking for other employment than the average for Federal employees in 1976. In the present survey, by far the strongest association between the major variables and the expectation of leaving the Corps is job satisfaction. Only 28 percent of those dissatisfied with their jobs plan to stay while 87 percent of those satisfied expect to remain with the Corps.

7. PROFESSIONAL DEVELOPMENT

7.1 Purpose

This section presents an analysis of professional development activities of the engineering function and relates professional factors to maintaining and enhancing technical capability.

7.2 Background for the Study

Professional activities of individual engineers and scientists was selected for special consideration by the OCE Blue Ribbon Committee.

Investigations by IWR, in connection with the survey of the field engineer and scientist workforce, determined that the amount of continuing professional development activities undertaken by an individual is a prominent indicator of technical capability. As technical fields advance, continued reading, interaction with professional societies, independent study, preparation of technical papers and related development grow in importance for maintaining

technical expertise. It is noteworthy that the Chief of Engineers has established professionalism and integrity as the highest command goal for 1982-83. The emphasis of the goal is on professional ethics and standards of conduct -- essential characteristics of the engineer or scientist seeking technical excellence or a career goal.

7.3 Measuring Professional Development

Professionalism generally is measured by the extent to which individuals evidence standards of ethical conduct and to which they engage themselves in contributing to the body of knowledge of the profession. The usual standards which measure "professionalism" include:

a. Achieving certification under the rules of a state which establish the level of technical capability expected of an individual to practice within the profession in that state.

b. Membership in professional societies offer an individual opportunity to associate with peers and to contribute to the body of knowledge, criteria and standards which form the basis of the profession.

c. Adaptability to new processes and methods, an extent to which this new knowledge is shared through publication of articles or by presentations within the profession.

d. Pursuit of self-development through continuing training and educational programs.

e. Achieving increased professional standing is usually reflected by the extent of recognition accorded to an individual for contributions to the profession.

7.4 Professional Development and Technical Capability

Each of the above attributes and activities contribute to the overall professionalism of an individual, and corporately to the Corps of Engineers as a whole. As an individual becomes distinguished among peers of the profession, that individual is recognized more and more as a leader of the profession--their expertise is sought and they are consulted on matters of innovation and practice in their fields.

Therefore, professional development and maintenance of technical capability of the Corps' engineer and scientist workforce are closely aligned. That is, a program to strengthen technical capability will improve professionalism and conversely, initiative to provide professional development will contribute to more technically capable personnel.

The overall result of increased emphasis on professional development, therefore, will be to enhance and maintain Corps technical capability for executing civil works and military engineering projects and for mobilization readiness.

7.5 Professional Development in the Corps of Engineers

Except for tracking professional registrations through personnel channels, the Corps has no systematic professional development program for its technical workforce. While the policy requiring registration for key technical positions is a positive step toward improving professionalism, there is significant lack of support in other areas. Based on the OCE Blue Ribbon Committee Survey of the field, the current level of professional activity is very low. For example:

a. Most members of the Corps' engineer and scientist workforce in Engineering Divisions (86 percent) have never published a technical article in a local, regional or national publication. Only 7 percent have published one article in the past 5 years.

b. Almost 89 percent have no contacts with, or do not support contacts with local schools, colleges, or serve in any capacity to improve the level of teaching of engineering related subjects or to share knowledge with students about the technical professions.

c. Eighty-two percent do not participate in National Engineers Week activities.

d. Travel funds are usually reduced for professional development activities during application of funding constraints and there typically is no on-the-job time provided to prepare technical papers for presentation or for publication in professional journals.

7.6 Comparison with Private Engineering Organizations

Interviews with private engineering organizations by members of the OCE Blue Ribbon Committee determined that professionalism is considered essential in private engineering organizations. It establishes credibility, attracts work and produces a safe, quality product. Therefore, private engineering organizations view professional development as an essential part of doing business and provides liberal support in the following areas:

1. Require senior designers to be registered engineers.

2. Encourage membership in professional societies and sponsor attendance at meetings and conventions.

3. Some firms interviewed pay professional registration fees and EIT training.

4. Some firms pay bonuses for registration.

5. Accord recognition and status to their ranking professional employees and pay salaries commensurate with the value of their contributions to the organization.

7.7 Committee Findings

Strengthening professional development activities in the Corps of Engineers will result in maintaining and enhancing the technical capability of Engineering Divisions. The following measures would produce a significant professional development program for the Corps of Engineers:

a. To enhance professional registration, the field needs clear authority to grant administrative leave for individuals to take examinations, to pay for related technical courses, provide incentive awards, bonuses, or quality step increases to recognize attaining registration which reflects and enhances technical capability, and to advocate use of P.E. after registered engineers names.

b. Establish an objective for increasing the number of Corps professional staff who hold offices in professional societies or head committees of society organizations.

c. Provide a high priority for retaining travel funds to support professional activities and give credit or training for attendance at technical and specialty conferences sponsored by professional societies.

d. Establish a goal to increase preparation and publication of Corps of Engineers design and technical innovations. In this regard, clear authority is needed for field offices to grant duty time in which technical engineers and scientists can prepare documentation on new innovations and to submit papers to professional journals for publications.

e. Provide opportunities for exceptionally qualified technical engineers and scientists to conduct research and study leading to new criteria and methods of design and engineering procedure.

f. More recognition of professional engineering achievements is needed. For example, the annual Engineer Week ceremony should be utilized to honor new professional registrants and EIT's. Utilize incentive or on-the-spot cash awards to recognize published articles and require that lead design specialists and heads of engineering functions be present when Chief of Engineers design awards are presented to division and district commanders. Require that lead design engineers be present and officially recognized at such ceremonies or project dedications and other occasions when major design or construction accomplishments are given recognition.

8. Technology

An objective determination of the level of technology within the Corps was determined to be outside the scope of this report. Technology as used in this report refers to the usage and application of up-to-date technical tools to accomplish our engineering mission. In the opinion of the panel, the Corps' usage of the following important methods and techniques is excellent:

Mathematical Modeling
Computer-aided Design
Interactive Graphics
Computerized Drafting
Satellite Gauging

The subjective opinion of the panel that the Corps is in the forefront of technology usage was substantiated by the A-E visits made by panel members in two ways; observation of technology usage in the A-E field; and by the feedback from the A-Es that in their opinion, the Corps was up-to-date and perhaps ahead of the private sector in this area.

APPENDIX V:

Federal Engineer Concept-Decision Memorandum

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:
DAEN-CWE-BU

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

SUBJECT: Federal Engineer Concept - DECISION MEMORANDUM

PURPOSE. This is to outline requirements and strategy necessary for the Corps to become "Federal Engineer". First will be a summary of recent actions pursued and how they apply to current conditions.

DISCUSSION.

1. Background.

a. Inventory of Agencies.

You may be aware that the Carter Administration, in 1977, studied alternative missions and emphases for the Corps of Engineers. This study was performed in a spirit of "getting the Corps of Engineers out of dam building." The White House surveyed the Federal agencies (Tab A). A summary of agency responses is included as Table 1 and Table 2 (Tab B).

b. Analysis of Agency Responses.

(1) Fifty-five agencies responded to the request, with 30 providing suggestions or information. The other agencies are not involved in relevant activities. The survey provided a reasonable assessment of the construction and engineering activities of Federal agencies.

(2) The largest direct Federal construction program surveyed was that of the Department of Energy. The type of facilities involved range from low-head hydro development to very complex research and demonstration projects. The program also involves unusual Federal/non-Federal partnerships. The Corps has the capability to participate in many of these projects.

(3) There are a number of Federal agencies involved in the construction of somewhat standard buildings and facilities. These range from the small isolated facilities of the U.S. Information Agency to the hospital construction program of the Veterans Administration at a $400-500 million per year funding level. The skills and experience required for accomplishment of these construction programs are available within the Corps, although the agencies generally do not see opportunities for Corps

assistance. In some cases, GSA is providing the engineering and construction services to the agencies. The survey also identified special Federal construction activities where Corps involvement could be appropriate.

(4) The Federal grant programs represent the category with the largest Federal construction expenditures. The Federal overview responsibility for the grant programs varies. Indeed, there is growing concern that the lack of engineering capability at various steps in program execution is adversely affecting these programs. There is an apparent need for a revised Federal role to assure that the final product appropriately reflects the Federal investment. The Corps involvement in EPA's programs reflects this concern. There is general agreement that Corps support of the wastewater management program was a strong contribution to protection of the taxpayer's interest.

(5) The survey identified a number of technical assistance activities that the Corps could provide if its manpower and mission assignments permit.

Included in these were:

Cooperation with the Department of State in the preparation of environmental impact statements for international bridges and pipelines

Technical assistance for the Flood Insurance Program of FEMA

Technical assistance to accomplish dam safety activities for other Federal agencies

Other suggestions for Corps activities included:

The Corps as the agency for land acquisition for all Federal programs and projects

Planning and analysis of regional and local water supply needs in an efficient and timely manner

Expanded program of floodplain mapping

Environmental rehabilitation and mitigation program for existing projects

(6) The Corps presently has formal agreements with several Federal agencies. These include real estate services for elements of the Department of Energy, the National Park Service, the National Science Foundation and NASA. These services are not, in the case of any of these agencies, complete in their coverage. Design and construction management

activities include a long-standing relationship with NASA and the agreements with EPA, mentioned earlier. Again, the services are hardly complete.

c. Agency Attitudes.

Agencies with stable, on-going design and construction programs were generally not receptive to Corps involvement. These agencies would prefer to retain in-house capability to accomplish their planning and engineering programs. However, Corps involvement was viewed favorably in new activities, large one-time Federal roles, and activities outside the normal purview of agencies.

d. Changes Since 1977.

(1) The Corps Civil Works (on water resources) program is diminishing. Corps projections in 1977 were overly optimistic, showing a stable workload. There has not been an omnibus authorization since 1976. There have been few new AE&D and construction starts in the last several years. Current budget activities, despite efforts to find new cost-sharing initiatives, are likely to continue in further reductions in the Corps' workload.

(2) The Corps is losing engineering and construction competence. A stable and challenging workload is necessary to retain the Corps as a premier engineering organization.

(3) The Federal Government is undergoing a basic consolidation. Agencies undergoing consolidation may be more receptive now to unloading engineering and construction activities if they believe corresponding manpower reductions are not attendant, and that the Corps would be an efficient, responsive agent.

2. Opportunities.

a. The Administration's views of the scope and missions of the various domestic agencies are in a state of flux. Significant changes and realignments are under consideration or ongoing now. The Administration will likely execute the structural changes and realignments it proposes this year or next. It will settle in soon and live with what it has as the practical and political incentive for change diminishes with time.

b. If the "Federal Engineer" concept is successfully pursued, bold initiatives should be proposed soon. Many past attempts for change fell victim to bureaucratic inertia and excessive study, which delayed decisions past the time they could be effected.

c. The pending Corps/EPA Superfund Interagency Agreement is evidence of this Administration's receptiveness to change. However, the Carter Administration's effort demonstrates the changes we envision to become "Federal Engineer" would be very difficult to achieve.

3. Recommended Strategy.

a. I suggest we follow a building block strategy in pursuing the goal of becoming "Federal Engineer."

b. We have a very good foundation. We are now, in effect, "Defense Engineer" (excluding Navy), the "State Department Engineer" (through our Foreign Programs activities), and EPA's Engineer. There remain loose ends and areas still to nail down, but these areas are already recognized as part of the Corps' responsibility, if "federal engineering" talent is needed.

c. The next steps are to move quickly to seek work from agencies being restructured. The Department of Energy is being dismembered. A significant "target-of-opportunity" appears evident for activities involving engineering and construction that will be continued. Other agencies with potential significant Corps work include:

*National Weather Service --- Selected Flood Forecasting Activities that now overlap onto Corps activities
*Nuclear Regulatory Commission - Quality Assurance Assistance in Nuclear powerplant construction
*FEMA --- Flood Insurance Stu~~dies~~; Technical Assistance Program (FEMA seeking to reduce "in-house" operational staff)
*HHS --- Design and Construction of Facilities
*Veterans Administration -- Design and Construction of Facilities
*GSA — All engineering support amenable (design, construct, O&M, real estate); the Corps has in essence taken on (in 1980) the GSA's role in supporting DOD recruiting efforts

d. Agencies that should be avoided include:

* DOI --- Avoid confrontation with Bureau of Reclamation (but see 4g, below)
* Commerce --- Program small and not amenable (that department may get part of DOE)
* Agriculture --- Avoid confrontation with Soil Conservation Service (but see 4g, below)
* TVA --- Avoid Confrontation (but see 4g, below)

e. The Carter Admininstration experience demonstrates that a meaningful role expansion toward "Federal Engineer" will not occur by other agencies volunteering the role to us. It would have to be dictated. Specific administration directions or a policy statement to the selected agencies to conduct their engineering and construction activities through Corps support should be sought, especially for new

activities. The directions could come from the White House or through OMB to the agencies in their budget pass-back instructions. The impetus logically should come from the concern over having multiple federal design/construct offices.

4. Case for a Corps Civil Works Role Expansion.

a. A basic reason a Corps Civil Works Program was established and has been continued is that its capability is a vital national asset. An existing nationwide organization is in place to quickly respond to the nation's needs, military or civil.

b. The Corps basic engineering design and construction management capability is vital for a national defense mobilization and for natural disaster emergencies. We mobilized Civil Works forces for the Mt. Saint Helens' disaster and for many other domestic natural disaster activities nationwide. Other examples of the Corps being tasked to meet national needs include surveying the transcontinental railroad routes, protecting national parks, constructing government buildings, and supporting the space program. Further, the Corps was mobilized to meet requirements in World War II, to construct the ICBM complexes in the early 1960's, to participate in the ABM program in the early 1970's, the ongoing Sinai airfield relocations, the nation building program in Saudi Arabia, and now in a "be prepared" role for the pending MX program. The Civil Works manpower base has facilitated our build ups for these special tasks.

c. Should a national defense mobilization occur, we estimate the Corps would increase military construction 10 to 50 fold. Civil Works employees would be available for direct and immediate transfer to perform military programs functions.

d. Civil Works is a strategic reserve and a "no-cost" peacetime defense asset. It is a Federal technical center of competence responsive and "on call" to the President and the Military. We provide an additional dimension to the defense base as our civil works design and construction exercises the same private industry components that would be called upon during mobilization and sustained war in expanding our industrial base.

e. If budget, authorization, and policy constraints diminish the Corps water resources activities, an expanded domestic civil works activities role is necessary to preserve the Corps engineering and construction capability. We should not apologize for seeking logical missions to keep our emergency/mobilization construction capacity warmed up.

f. The Corps record and reputation for efficiency and responsiveness in executing large and varied engineering and construction activities are outstanding.

g. We have avoided to date taking on the "turf" issue of the roles of DOI (BuRec), DOA (SCS), and TVA. Yet we should, with this examination, forthrightly address the overlap in water resources between our four agencies. If the Aministration continues into 1982/83 seeking major savings, there is logic in assessing the savings and efficiencies of consolidating the design/construction activities of BuRec, SCS, and TVA under the Corps. Policy and budget activities could remain with the agencies, while the Corps could conceivably assume the engineering activities, as it does with EPA. Yet the emotional and political reaction must be carefully assessed ... it may not be worth the fuss.

5. Expected Views of Others.

a. Congress. Committees having Corps Civil Works jurisdiction have instructed us to use restraint in engaging Civil Works forces in foreign and "work for others" activities. They have been concerned that our water resources activities were being delayed and given low priority. Accordingly, they would need to be consulted and educated to the view that the new role expansions are necessary if the Corps resource base is to be preserved. The resources would then be available for traditional Civil Works activities should new authorizations and new starts occur in the future. In short, the Army should understand its obligation to show the affected Committees that readjustments to strengthen the Corps are in their interest.

b. Private Industry. Private industry AE's might oppose a role expansion. AE's could oppose either from a lack of understanding that their work would not diminish, or as an effort to capture new work now done in Federal agencies. The primary issue is in-house vs. private industry design. AE's might push for zero in-house design based on recent Superfund agreements. Those AE's would have to be convinced they would receive more work or they would oppose. The construction industry would probably be neutral or supportive. Large management consultants engaged in engineering activities are likely to oppose any Corps role. Yet, with the ongoing cutback of Corps employees (CW) to 25,000, new activities could be assumed with a Corps commitment (or restriction) to a vastly adjusted "in-house" percentage.

6. Chief of Engineers' Position. New work is needed to maintain our capabilities and to preserve the Corps of Engineers as a premier engineering organization. Accordingly, the Chief of Engineers' position is to adopt the recommended strategy.

SECRETARY OF THE ARMY'S OPTIONS:

a. Do Nothing. The Corps of Engineers Civil Works vitality would continue to decline. The opportunity for change and agency realignment is now, early in the Administration's tenure. A substantial effort later would probably be unproductive. We would, however, under this option, continue seeking obvious opportunities as they became evident.

b. Adopt Recommended Strategy. Risks include focusing Administration attention on the Corps. That could lead to events beyond our control. However, the possible opportunities now evident for Civil Works long term health and capability seem to override the risks.

c. Adopt a More Aggressive Strategy. Going for Agriculture, Interior, and TVA, in addition to the recommended work, could be more than we could practically or politically take on. It would likely doom all potential work outside our present base. Only under immense Administration wide manpower pressures with a strong commitment on the part of the Secretary of the Army (likely with OMB support), could a more aggressive strategy work. The Corps should not be expected to "lead the charge" in this controversial area.

RECOMMENDATION.

Adopt the strategy recommended in paragraph 3, above, but not pursuing (on Army initiative) the expansions discussed in paragraph 4g. Key to that strategy is ASA(CW) initiatives within the Administration securing the specific directives (or policy statements) to selected agencies. If you elect to pursue the recommended strategy, we will develop a brief executive report (suitable for use within the Administration) outlining the Corps capabilities, rationale for the Corps as "Federal Engineer," and specific agency activities suitable for consolidation.

FOR THE CHIEF OF ENGINEERS:

2 Incl
TAB A- White House Survey
TAB B- Summary of Agency Responses

E. R. HEIBERG III
Major General, USA
Director of Civil Works

BALLIF/20216
Typed by B. Lewis